1-1-1 Purpose

June 2005

GENERAL

This Manual contains policy, guidelines and procedures related to traffic engineering and related functions as practiced within the Wisconsin Department of Transportation, more specifically the region field and bureau office forces of the Division of Transportation Systems Development, the staff of the Bureau of Traffic Operations, and other agencies of the Department which *may* be involved in traffic engineering at some point. Traffic engineering functions include the installation and maintenance of traffic control devices, highway lighting facilities, traffic regulations, safety analyses, and support for the improvement program.

APPLICATION

The content of the Manual is applicable only to the state trunk highway system. Good practices contained herein *may* by implication be desirable on other systems of highways. However any requirements for other systems are beyond the scope of the Manual, and are appropriately addressed in the Manual on Uniform Traffic Control Devices and the Wisconsin Supplement to the MUTCD, together called the Wisconsin Manual on Uniform Traffic Control Devices.

Conscientious usage and adherence to the manual *should* provide several benefits, chief among which would be:

- Uniformity of treatment of traffic control devices on the state trunk highway system;
- Readily available and adoptable methods and procedures;
- Source of information for interpretations of policies.

DEFINITION OF GUIDELINES

When used in this Manual, the text headings **shall** be defined as follows:

1. A statement of policy is required, mandatory, or specifically prohibitive practice regarding a traffic control device. The verb **shall** is typically used and in bold type.
2. A statement of guidance is recommended, but not mandatory, practice in typical situations, with deviations allowed if engineering judgment or engineering study indicates the deviation to be appropriate. The verb *should* is typically used and italicized.
3. A statement of optional practice is a permissive condition and carries no requirement or recommendation. The verb *may* is typically used and italicized.

RESPONSIBILITY FOR TEOPS

Policies, guidelines and procedures are most frequently developed by the Traffic Engineering standing committees and approved by the Director of BTO. BTO posts and distributes updates and new issuances) and maintains a distribution list.

Contributions of ideas, suggestions for changes, new concepts, and entire drafts of subjects, etc, are welcome and *should* be addressed to the BTO Program Leads or Supervisors and routed to the appropriate statewide Standing Committee.

Updates to the manual are normally issued quarterly or when there is a sufficient amount or content of policies that need to be published.

1-5-1 Subject Numbering System — June 2005

DEFINITIONS

Chapter: A main divisional unit of this manual, addressing one of the major functions of traffic engineering or supporting functions.

Section: A grouping of related subjects within a chapter.

Subject: A specific guideline, policy or procedure.

SUBJECT NUMBERING

The manual is divided into topical chapters with each chapter having one or more sections that are divided into specific treatments of material, called subjects.

Chapters, sections and subjects are all numbered.

Chapter numbers are numbered consecutively, generally without gaps. Sections and subjects are numbered consecutively or sometimes with gaps--5, 10, 15, 20--to allow for future insertions of material at the most appropriate locations within the chapter or to follow the MUTCD numbering system.

Chapters 2 through 10 are allotted to subjects related to traffic control devices covered in the corresponding Parts 2 through 10 of the MUTCD.

1-5-5 Table of Contents — April 2025

1-10-5 MUTCD and Wisconsin Supplement Approval Dates — June 2011

Wisconsin State Statutes 84.02(4)(e) require that standards for traffic control devices be prescribed by the Wisconsin Department of Transportation. The Department, in fulfilling this requirement, has for many years adopted the latest edition of the Federal Highway Administration's publication "Manual on Uniform Traffic Control Devices", and has added a Supplement to make the standards applicable to Wisconsin.

The December 2009 edition of the MUTCD and the Wisconsin supplement was made effective May 25, 2011 by the Director of the Bureau of Traffic Operations on behalf of the Department.

The latest edition of the MUTCD can be found on the website mutcd.fhwa.dot.gov and can also be obtained in hard copy from several sources noted. The Wisconsin Supplement is available on the DOT website and a limited amount of hard copies will be provided free of charge to individuals without Internet access. Periodic revisions will be made to the Supplement as changes are made in the MUTCD. For this reason, you are encouraged to obtain the Supplement from the DOT website.

1-10-25 Federal Aid Policy Guide — June 2005

Refer to the Federal-Aid Policy Guide located at http://www.fhwa.dot.gov/legsregs/directives/cfr23toc.htm 23CFR 25 "Design Standards for Highways" for material related to traffic operations matters. Topics include design speed, design exceptions; vertical clearance, and accessibility standards. Also, Section 23 CFR 655 "Traffic Operations" for FHWA policy on uniformity of traffic control devices (including requirements for MUTCD).

1-11-1 Highway Numbering — August 2012

INTRODUCTION

Historically the Secretary's Office has designated the State Traffic Engineer to approve assignments of highway numbers on the State Trunk Highway system with input from the Regions and locals. This does not include approval of the beginning and end and alignment of the highway, but merely the approval of the number itself. In some cases the State Traffic Engineer *may* be asked to select a number, or a rearrangement of numbers. Since the State Traffic Engineer's authority transcends region lines, all proposals for additions, deletions, or revisions to the state's route marking system **shall** be submitted to the State Traffic Engineer in the Bureau of Traffic Operations.

To allow sufficient lead time to establish or modify route numbering for new or reconstructed highways, the evaluation for the route assignment *should* begin during the highway planning stage. The State Traffic Engineer will inform and coordinate with the Division of Transportation Investment Management Bureau of Planning and other Divisions to determine appropriate highway route numbering. Any impacts to the National Highway System (NHS) if reconstructed **shall** be addressed with FHWA at the beginning of the numbering process to address NHS continuity.

NHS is a federal designation for funding eligibility, by changing the number on an NHS route the NHS designation is not changed. This would be an issue if, for example, a new bypass is built and now the NHS designation moves to the bypass. It does not move just because a bypass is given the state route number. Refer to FDM 4-1-20, Federal Aid System, for more information on the National Highway System route designation.

The official information on numbering, beginnings and terminations, as well as connecting highway limits is contained in the booklet, Official State Trunk Highway System Maps, which can be found on the WisDOT website.

STATE NUMBERED HIGHWAY NUMBERING PROCESS

Proposal to change a state highway designation is initiated by the Region, typically the Planning Section. This could constitute adding a STH route, dropping a portion of a STH route or changing the route name. It is unnecessary to submit an application for changes of a state highway to AASHTO. The following steps *should* be considered when changing a State Trunk Highway Number (this process can also be used to determine US Highway route numbering for submittal to AASHTO):

1. Proposed changes to the State Highway numbering system *should* be discussed with local government agencies representing the communities through which the proposed route change traverses prior to implementation. Others affected *should* also have their comments considered, such as trucking and farm implement operators. The Regional Traffic Engineer *should* canvass local government jurisdictions to determine their reaction, views and comments to the proposed numbering changes. However, this is strictly a courtesy procedure and final authority for making the ultimate decision still remains with the Department (i.e., local government does not have veto power over route establishment on the State Highway System). For most significant changes to the SHS, there *should* be public involvement in the decision process. This includes any implications due to mile marker and exit number changes. Often a public informational meeting or hearing at which the proposed changes are discussed and the public is allowed to comment on them is valuable.
    a. It is necessary, however, to have approval by the county board of each county in which part of the proposed change is situated when the change is more than 2 ½ miles of the system, according to Wisconsin State Statute 84.02 (3).
2. Any impacts to the National Highway System (NHS) if reconstructed **shall** be addressed with FHWA at this time to address NHS continuity.
3. If a new STH route is being proposed, the Region *should* propose a number to discuss with BTO Traffic. Some guidelines to consider when requesting a new number:
    a. Number cannot be used elsewhere on the STH (includes STH and USH) system unless it is an extension of an existing route.

b. Typically, the route number chosen is the next consecutive highway number unless the number is already used or a sufficient “tied” number can be used.

c. “Tied” numbers *should* be considered to relate to the main route (ex. Highway 251 connects back to Highway 51).

i. Tied “300" series routes *should* be used if the route connects to a state route on **one** end (spur route). Additional routes *should* use the next odd numbered series (ex. 500, 700, etc.)

ii. Tied “200" series *should* be used if the route connects back to the STH on **both** ends of the same route making a loop. Additional routes *should* use the next even numbered series (ex. 400, 600, etc.)

4. The State Traffic Engineer *should* seek consensus with the Region on the route number that makes the most sense, based on the reasoning above.
5. The Region prepares a formal letter explaining the reason why the route change is needed, the benefits of a route change and the timetable when it will take effect.
6. The Region submits a formal letter along with map locations to the State Traffic Engineer for approval.
7. Upon the State Traffic Engineer’s approval, notification is made by Central Office Traffic to the following units:
   a. Central Office DTIM Bureau of State Highway Programs Highway Data Management Section.
   b. Central Office DTSD Surveying and Mapping Section. In addition to updating the State Highway Map, the Surveying and Mapping Section will also notify private sector mapping and atlas companies like MapQuest, DeLorme, etc.
   c. Central Office DTSD Highway Development for updating the official state trunk highway list.
   d. Regional Office(s) affected by the route numbering change.
8. The Region **shall** make the public aware of the changes and the time period for the changes. This includes:
   a. Fire, EMS, State Patrol and Local Police.
   b. Businesses along the route (individual mailings)
   c. Media (TV, radio, newspapers)
   d. Chamber of Commerce
   e. Elected Officials and government officials
9. Once a number is established, the State Traffic Engineer will also coordinate with the Office of General Counsel in order for them to make the appropriate changes on official truck operator routing lists and maps (i.e., Trans 276).
10. Utilize PCMS as the changes take place for at least the first month.
11. Installation of independent Type II reassurance marker signs that state "Formerly" on the cardinal header. It has been WisDOT practice to keep these signs installed for two years, then removed.

If needed, the Department *may* request a legal opinion and/or interpretation from Office of General Counsel on legal matters concerning the proposed State Highway Numbering System revision.

US NUMBERED HIGHWAY NUMBERING PROCESS

Any proposed alteration of the US Numbered System *should* be extremely meritorious and thoroughly, though concisely, explained in order that the Special Committee on US Route Numbering and the Standing Committee on Highways of the American Association of State Highway and Transportation Officials (AASHTO) *may* give prompt and proper consideration to each and every request made by a member department. The application for US Route Number, Interstate and Bicycle Routes can be found at www.aashto.org. Refer to TEOpS 1-11-5, U.S. Route Renumbering Process for further instructions regarding the application process and responsible parties.

Bureau of Traffic Operations, Bureau of Planning and the Regional office(s) affected **shall** be involved in the route numbering process prior to being submitted to AASHTO.

According to the AASHTO Transportation Policy Book, January 2000, Establishment and Development of United States Numbered Highways:

1. *The Standing Committee on Highways of the American Association of State Highway and Transportation Officials **shall** have full authority to review the U.S. numbered road system and the numbering and marking thereof, to make additions, changes, extensions, revisions or reductions in said road system and to revise the numbering or marking thereof.*
2. *Before approving any addition, change, extension, revision or reduction in the U.S. numbered road system or the numbering or marking of any U.S. numbered road, the Standing Committee on Highways **shall** consult the State Highway Department of the State or States through or within which such addition, change, extension, revision or reduction is located.*

INTERSTATE HIGHWAY NUMBERING PROCESS

Any proposed route alteration or additional route of an Interstate Highway requires the Department to work closely with FHWA to determine an appropriate route number and submission of the US Route Number, Interstate and Bicycle Routes application to the AASHTO Special Committee on US Route Numbering. The State Numbered Highway Numbering Process can be followed for the preliminary steps of the Interstate Highway Numbering Process. However, the Department **shall** coordinate with FHWA at the beginning of the process. Refer to “Federal-Aid Policy Guide Subchapter E, Part 470” for information on the policy for the signing and numbering of future Interstate corridors. The State Traffic Engineer **shall** coordinate with the Division Administrator and the Secretary’s Office when proposing Interstate Highway numbers.

BUSINESS ROUTE MARKING

For information on business route markers, refer to TEOpS 2-4-19.1. If a business route is proposed related to a U.S. Highway designation the route has to have the approval of AASHTO. Refer to the US Numbered Highway Numbering process stated previously.

1-11-5 US Route Renumbering Process — August 2012

BACKGROUND

The purpose of the U.S. route numbering and U.S. bicycle routes system is to facilitate travel on the main interstate lines, over the shortest routes and the best roads. To serve that purpose a system of main interstate routes was designated, and a uniform system of guide and warning signs was adopted for use in all the States, on such designated routes.

Applications are submitted twice a year to AASHTO Special Committee on US Route Numbering at the AASHTO Spring Meeting and the AASHTO Annual Meeting on the day before the Subcommittee on Highways (SCOH) Business Meetings. Application request is an open solicitation but states are asked to submit their applications twice a year. BTO Traffic Engineering Section leads the effort in coordinating responses for the entire Department.

The following steps in the process of U.S. Route Numbering applications must be completed in order for new changes become official.

1. The committee reviews applications and makes recommendations to approve or disapprove the request.
2. The committee **shall** report all recommendations and decisions to the Standing Committee on Highways and will ask for its approval. This will take place at SCOH's spring and annual meetings.
3. In the case of interstate route requests, both FHWA and SCOH must approve.
4. These decisions will be presented to the AASHTO Board of Directors in the SCOH report at the Board's business meeting.

It is WisDOT’s responsibility to submit all proposed changes to the Special Committee for approval and implementation on maps and the GIS network.

PROCESS

The process for reporting route number changes to AASHTO is shown below:

1. Secretary’s Office receives a letter twice a year from AASHTO to add or make changes to existing routes

2. Secretary's Office send request to DTSD Administrator Office for response
3. DTSD Administrator Office sends to BTO Director
4. BTO Director sends to State Traffic Engineer
5. State Traffic Engineer sends to BTO Traffic Operations Engineer for response
6. BTO Traffic Operations Engineer sends out request to Planning Chiefs and Operations Chiefs two months prior to AASHTO's meeting to collect changes to US Routes needed in Wisconsin. All requests are sent to BTO Traffic Operations Engineer for compilation. Note: If route numbering changes come up throughout the year, the Regions can submit applications to BTO at anytime.
7. BTO Traffic Operations Engineer sends out same request to DTIM Bike/Pedestrian Coordinator for changes needed to the US Bicycle Route numbering. All requests are sent to BTO Traffic Operations Engineer for compilation
8. BTO Traffic Operations Engineer reviews all submittals for accuracy and compliance and sends along with a letter to AASHTO from the DTSD Administrators Office to Secretary's Office, then to AASHTO. The BTO Traffic Operations Engineer is identified as the main contact person for WisDOT. The AASHTO Special Committee needs 30 days to review each application and vote.

EXAMPLE SUBMITTAL

American Association of State Highway and Transportation Officials

Please save and send as a word file. You can attach a map in PDF or JPG with the application to

usroutes@aashto.org (M.Vitale)

An Application from the State Highway or Transportation Department of Wisconsin for:

- ☐ Elimination of a U.S. (Interstate) Route
- ☐ Establishment of a U.S. (Interstate) Route
- ☐ Extension of a U.S. (Interstate)Route
- ☒ Relocation of a U.S. (Interstate) Route
- ☐ Establishment of a U.S. Alternate Route
- ☐ Establishment of a Temporary U.S. Route
- ☐ **Recognition of a Business Route on U.S. (Interstate) Route
- ☐ **Recognition of a By-Pass Route on U.S. Route

USH 18

AASHTO Use Only

Date received:

Date to Special Committee on U.S. Route Number:

Date Presented to Standing Committee on Highways (SCOH):

Action taken by SCOH:

Member Department Notified:

Between Wisconsin Street and La Pointe Street

The following states or states are involved:

City of Prairie du Chien

State of Wisconsin

- ****"Recognition of…"**A local vicinity map needed on page 3. On page 6 a short statement to the effect that there are no deficiencies on proposed routing, if true, will suffice.
- If there are deficiencies, they should be indicated in accordance with page 5 instructions.
- **All applications requesting Interstate establishment or changes are subject to concurrence and approval by the FHWA**

DATE SUBMITTED: February 24, 2011

SUBMIT APPLICATION ELECTRONICALLY TO usroutes@aashto.org

*__U.S. Bicycle Route System__: this form is not applicable for US Bicycle Route System see new form.

1

The purpose of the **United States** (U.S.) **Numbered Highway System** is to facilitate travel on the main interstate highways, over the shortest routes and the best available roads. A route should form continuity of available facilities through two or more states that accommodate the most important and heaviest motor traffic flow in the area.

The routes comprising the **National System of Interstate and Defense Highways** will be marked with its own distinctive route marker shield and will have a numbering system that is separate and apart from the U.S. Numbered Highway System. For the convenience of the motorist, there must be continuity and a uniform pattern of marking and numbering these Interstate routes without regard to state lines.

The U.S. Numbered System was established in 1926 and the Interstate Numbered System was established in 1956. Both have reached the period of review, revision, and consolidation. They now need perfecting rather than expansion. Therefore, any proposed alteration in the established systems should be extremely meritorious and thoroughly, though concisely, explained in order that the Special Committee on U.S. Route Numbering and the Standing Committee on Highways of the Association may give prompt and proper consideration to each and every request made by a member department.

Explanation and Reasons for the Request (US and Interstates Only): (Keep concise and pertinent.) USH 18 is designated as part of the National Highway System and is also a State designated Long Truck Route. The existing and projected traffic volumes on the roadway are causing and will continue to cause traffic congestion and unsafe traveling conditions. Access points have decreased the mobility and efficiency of the roadway. Re-routing USH 18 from Main Street to La Pointe Street will improve safety and mobility in the area.

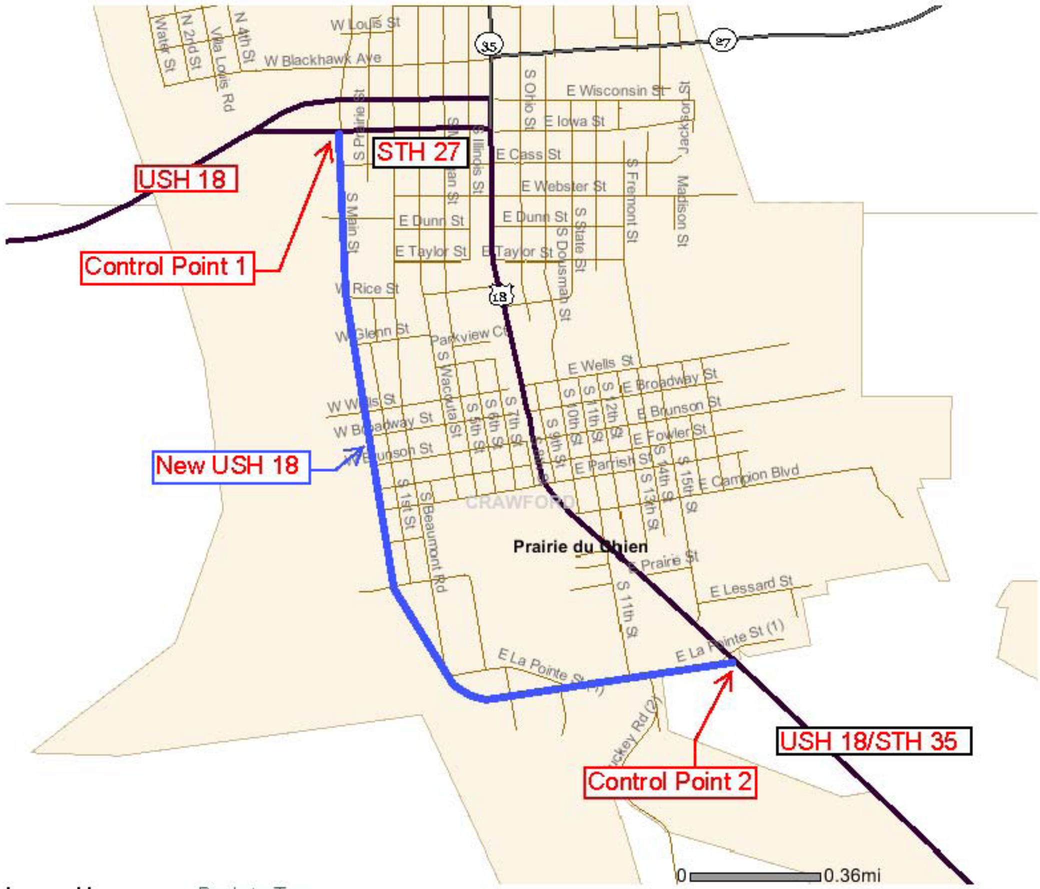
Date facility available to traffic: 08/2011

Does the petition propose a new routing over a portion of an existing U.S. Route? No
If so, where?

Does the petition propose a new routing over a portion of an existing Interstate Route? No
If so, where?

Map of state, or portion thereof, indicating proposed addition or change in the (This includes US and Interstates) U.S. Numbered or Interstate Numbered System:

There are two ways to do this follow the instructions below or convert your map in PDF format and submit as a separate document along with this application to usroutes@aashto.org. It is your preference, however all files are converted to PDF once received by AASHTO.



Control Point 1: Intersection with State Highway 27
Control Point 2: Intersection with State Highway 35

3

The State agrees and pledges its good faith that it will not erect, remove, or change any U.S. or Interstate Route Markers on any road without the authorization, consent, or approval of the Standing Committee on Highways of the American Association of State Highway and Transportation Officials, not withstanding the fact that the changes proposed are entirely within this State.

The weighted average daily traffic volume along the proposed route, as shown on the map on page 3, is 7,300 as compared to 9000 for the year 2009 for all other U.S. Numbered Routes in the State.

The *Purpose and Policy in the Establishment and Development of the United States Numbered Highways,* as *Retained from October* 3, 1991 or the *Purpose and Policy in the Establishment of* a *Marking System of the Routes Comprising the National System of Interstate and Defense Highways* as *Retained from August 10,* 1973 has been read and is accepted.

In our opinion, this petition complies with the above applicable policy.

(Signature Required – see note below)

Chief Executive Officer

(Member Department)

This petition is authorized by official action of

under date of as follows: (Copy excerpt from minutes.)

(This includes US, Interstates)

A **letter** from your Chief Executive Officer with the **CEO's signature** is sufficient when submitting your application, if you choose not to include the signature on this form.

4

(US and Interstates Only)

Instructions for Preparation of Page 6

Column 1: **Control Points and Mileage**. Top of column is one terminus of road. Indicate control points by identical number as shown on map on page 3. Show mileage between control points in miles and tenths.

Column 2:

Pavement Type.	**Code**
High type, heavy duty	H
Intermediate type	I
Low type, dustless	L (show in red)
Not paved	N (show in red)

Column 3:

Pavement Condition	**Code**
Excellent	E
Good	G
Fair	F (show in red)
Poor	P (show in red)

NOTE: In columns 2 and 3, where pavements types and conditions change, the location of the change shall be indicated by a short horizontal line at the proper place opposite the mileage log and the proper code letter (shown above) shall be entered in the respective column between the locations so indicated.

Column 4: **Traffic**. Indicate average daily traffic volumes in this column. Points of changes in these data to be indicated by short horizontal lines opposite the appropriate mileage point on the mileage log. Any existing main line rail crossing that is not separated shall be indicated at the appropriate mileage point by RXR - black if signalized - red if not protected by signals.

Columns 5 & 6 **Pavement Width and Shoulder Width**. These columns to be completed by comparing standards of highway involved with applicable AASHTO standards. Entries that fall to the right of the tolerance lines (dashed) should be shaded in red. If there are no deficiencies indicate by use of the word NONE.

Columns 7 & 8 **Major Structures**. Show in these columns those structures that do not meet AASHTO standards. Show by horizontal line sufficiently long to indicate percentage of deficiency. Portion on right of tolerance line shall be shown in red. Indicate length of structure in feet immediately under the line. Any sub-standard highway underpass structure shall be shown opposite the appropriate mileage point by the designation LP with the vertical clearance in feet following and shown in red. If there are no deficiencies indicate by the use of the word NONE.

Column 9: **Vertical Sight Distance**. Items to be shown in this column as a horizontal line, the length of which will indicate the deficiency as determined in accordance with comparisons with comparable AASHTO standards. Portions of the line past the tolerance line shall be shown in red.

Column 10: **Horizontal Curvature**. Curves in excess of AASHTO applicable standards to be shown in this column by a short horizontal line with degree of curve shown immediately above the line. To be shown in red.

Column 11 **Percent Grades.** Show by horizontal lines opposite proper mileage point on mileage log. Show percent of grade above the line and length of grade in feet immediately below. To be shown in red.

What follows is an Excel worksheet that you can open by right clicking your mouse and select "Worksheet Object" – you can then Edit, Open or Convert but you must first unlock the form as show when inserting maps.

.

5

Double click inside frame to release excel worksheet. Click outside frame to re-lock. (US and Interstates Only)

	1	2	3	4	5	6	7	8	9	10	
					Comparison to Applicable AASHTO Design Standards						
Mileage	Control Points and Mileage	Pavement Type	Pavement Condition	Traffic ADT	Pavement Width Deficiency	Shoulder Width Deficiency	Major Structures: Roadway Width Deficiency	Major Structures: H - Loading Deficiency	Vertical Sight Distance Deficiency	Show Wher Excess of Star: Horizontal Curvature	Pe Gı
					Percent	Percent	Percent	Percent	Percent		
					10 20 30 40	20 40 60 80	10 20 30 40	20 40 60 80	20 40 60 80	Degree	Le
0	1										
		H	E	7,300				NONE			
	2										
10											
20											
30											
40											
50											
60											

6

(Contact person regarding this application:

Name: Joseph Langeberg PE

Address: 3550 Mormon Coulee Road, La Crosse, WI 54601

Telephone Number: 608-785-9961

Fax Number: 608-246-3819

Email Address: joseph.langeberg@dot.state.wi

Description to be provided to the AASHTO Highways Special Committee on US Route Number (USRN) when they review this application:

- Where does the route begin? (Intersection or Mile Marker) Wisconsin Street
- Describe where it is going? To the west of the existing US 18
- What type of facility is it traveling over? (New alignment or over an existing pathway) Existing pathway and new alignment
- Give the direction of travel(north, east, south, and west) South and east
- Name the focal point city or cities Prairie du Chien
- Length of route in miles. 2.62
- Where does it end? (Terminal intersection or mile marker) Marquette Street

Table 1. Example of Log Data File for submittal

Log Data for USH 18

US Route Number	State	Type	Intersection	Point to Point	Accumulated	Remarks
18	Wisconsin	Regular	Milwaukee	0	0	Route begins
18	Wisconsin	Regular	Milwaukee	1	1	Crosses I-43
18	Wisconsin	Regular	Milwaukee	3	4	Crosses U.S. 41
18	Wisconsin	Regular	Milwaukee	3	7	Crosses U.S. 45
18	Wisconsin	Regular	Jct. E. Waukesha	7	14	Crosses I-94
18	Wisconsin	Regular	Jefferson	35	49	NONE
18	Wisconsin	Regular	Cambridge	11	60	Joins U.S. 12
18	Wisconsin	Regular	Jct. E. Madison	14	74	Crosses I-90
18	Wisconsin	Regular	Madison	2	76	Crosses U.S. 51
18	Wisconsin	Regular	Madison	5	81	Joins U.S. 14, U.S. 151
18	Wisconsin	Regular	Jct. S. W. Madison	3	84	Leaves U.S. 12, U.S. 14
18	Wisconsin	Regular	Mt. Horeb	15	99	NONE
18	Wisconsin	Regular	Dodgeville	23	122	Leaves U.S. 151
18	Wisconsin	Regular	Fennimore	28	150	Crosses U.S. 61
18	Wisconsin	Regular	Prairie du Chien	28	178	NONE
18	Wisconsin	Regular	State Line	2	180	NONE

1-16-1 Standing Committees and Policy Development June 2010

INTRODUCTION

The development of guidelines, standards, policies and procedures related to traffic engineering functions in the Division has been undertaken in several ways:

- Memos and letters answering inquiries, the answers then becoming guidelines;
- Recorded decisions from discussions at meetings such as traffic conferences, coordinators meetings, traffic standing committee meetings, and special conferences;
- Assignments and activities by BTO staff;
- Formalization of the above by publication in traffic operations manual.

Standing Committees are a means of addressing needs for policy development and revisions. These groups are established so adequate time and attention *may* be given to setting policy and guidelines that meet the needs of practitioners. This attention in turn streamlines operations in the future, thereby increasing efficiency and improving the quality of products and services.

BTO relies on the active involvement of regional staff and other resources with special insights into policy issues. BTO takes the policy lead and coordinates the work of others, as outlined in the Structure and Procedures section below.

PURPOSE

The basic purpose for Traffic Engineering Standing Committees is to provide a means of concentrating additional time, experience, knowledge, and expertise on specific issues in order to offer better guidelines, policies and standards.

This results in:

- Enhancing cooperation and developing consensus,
- Providing leadership, incentive and professional growth opportunity.
- Promoting uniformity in regulations, devices, and field practices,
- Enhancing communication, information service, and technology transfer,
- Gathering advice and best practices from other agencies,
- Enhancing the decision-making process, and
- Improving the professional image of the Traffic Engineering community.

STRUCTURE AND PROCEDURES

There are seven Standing Committees for the following technical areas:

- Lighting
- Electrical Standards
- Signing & Marking
- Traffic Signals
- Work Zones
- Traffic Safety Engineering
- Traffic Incident Management (TIME)

Additional work groups *may* be established for emerging technical and program areas.

Responsibilities of the Standing Committees are to:

- Identify issues and draft a potential policy document for appropriate manual;
- Follow policy development practices of the Bureau including actively involving the Operations Managers through the BTO State Traffic Engineer in these efforts to assure buy in and alignment with Bureau direction;
- Clarify any questions and concerns on issues approved for action;
- Prepare a work plan and make assignments,
- Follow deadlines established by the Standing Committee;
- Bring the study to a conclusion and recommend final action in a policy document;

- Develop implementation plans for proposed actions when appropriate, including documentation, education or training needs, performance measures, and budget impacts.
- Make progress reports at Traffic Conferences.
- Respond to requests for information on the status of issues, especially to complete quarterly and annual reports.
- Give due consideration to traffic safety in all issues.

Each Standing Committee **shall** consist of one BTO Traffic Engineering Section member, at least two and preferably more Region members, and a management sponsor from a Region. Each Standing Committee will appoint its own membership and keep the Traffic Engineering Section informed of activities by keeping meeting minutes and providing updates at Section meetings. Each Standing Committee meeting *should* be scheduled as a Microsoft Outlook appointment including the BTO Unit Supervisor and the State Traffic Engineer as optional attendees.

Each Standing Committee *may* elect its own Chairperson. Alternatively, the State Traffic Engineer *may* at their discretion designate the Chairperson. The BTO representative *may* serve as Chairperson, although it is suggested that he/she be more in the role of facilitator and resource person. The chairperson *should* maintain close contact with the committee management representative to discuss policy proposals.

Each Standing Committee will have one regional management representative assigned to the committee. The roles of the management representative are as follows:

- Provide the regional management viewpoint and guidance to the Standing Committee.
- Serve as communication link between Highway Operations Managers, Operations Supervisors and the Standing Committee.
- Inform other regional managers and supervisors of major policy initiatives being discussed or proposed that *may* have resource impacts.
- Attend Standing Committee meetings when major policy changes are being proposed. If not able to attend meetings regularly, the management representative *should* provide regional management perspective to the Standing Committee Chairperson prior to the Standing Committee meeting.
- Coordinate with Standing Committee Chairperson to brief BTO Director when a policy has other impacts on other bureaus, and as necessary, assist BTO Director in relaying information to other bureaus and DTSD management.

Each Standing Committee *may* establish ad hoc and/or sub-committees for efficiently and effectively conducting certain tasks.

The Director of the Bureau of Traffic Operations has the authority to:

- Establish Standing Committees
- Generally oversee and guide activities as necessary
- Assign issues for action
- Suggest methods of study, alternatives, modifications, resources, etc.
- Assign priorities and deadlines
- Review recommendations from the Standing Committees,
- Give final approval to each recommendation although he *may* elect to defer approval to an administrative level on specific issues.

The Standing Committee Chairperson will provide a briefing on any proposed policy being presented to the Executive Group. The executive group will provide a consensus recommendation to the BTO Director. Any policy action needed between quarterly meetings will be considered interim policy.

POLICY COMMUNICATIONS PROTOCOL

Any Regional policy inquiries requiring BTO involvement, as well as legislative and sensitive media contacts, **shall** involve the relevant Regional and BTO Traffic Engineering Supervisors. It *should* be noted that legislative and sensitive media contacts also require the completion of a Public Communications Record (PCR).

POLICY AND GUIDELINE DEVELOPMENT PROCESS

The Policy and Guideline Development Process *should* be followed whenever a policy for this manual is being developed.

1. Department staff identifies need for policy
2. BTO develops proposed concepts of the policy or guideline. \
3. Preliminary policy concepts are shared with regional staff via Standing Committee.
4. BTO collects comments and drafts policy for review by Traffic Supervisors.

5. Preliminary review and comment period of 2-4 weeks by Regional Traffic staff via email along with a copy to Operations Chiefs and FHWA.
6. If creating a new policy or making major changes to a policy, it may be necessary for the Standing committee to review the policy for the second time and make necessary changes to document upon receipt of comments.
    a. If making minor changes to a policy, BTO can make the necessary changes after reviewed by the Regions.
    b. An overview of the final draft should be reviewed by the Operations Managers, especially when policies have political or resource impacts.
7. Once issues have been resolved BTO makes final changes to the document presented to the Director of the Bureau of Traffic Operations for final review and approval. When policies have political or resource impacts, it *may* be necessary to present the issues to the DTSD management or other Bureaus that *may* be impacted for input.
8. Post and distribute new document in next transmittal unless prompt distribution is necessary. The document is then effective statewide.

INTERIM GUIDANCE PROCESS

In special or urgent circumstances when a policy needs to be implemented quickly, interim guidance *may* be appropriate.

1. Initial drafting of the interim policy or guideline by BTO with assistance from Standing Committee or Traffic Supervisors and possibly OGC.
2. Operations Chiefs review interim guidance and present the issues to their Regional staff. Subject to the urgency of the topic, this task can be completed by email (informational copy to FHWA) or presented at Operations Managers meetings.
3. Operations Chiefs report back to the BTO once the Region has concurred.
4. Bureau Director reviews and approves the interim guidance.
5. BTO posts and/or distributes the interim guidance to the key stakeholders for implementation.
6. Post and distribute new document in next transmittal unless prompt distribution is necessary. The document is then effective statewide.

INFORMATION MANAGEMENT RESPONSIBILITIES

BTO **shall** perform support services for the Standing Committees including:

- Suggest, define and transmit candidate issues as needed.
- Set priorities and deadlines if requested.
- Perform background or resource work for the Standing Committees as necessary.
- Prepare and distribute quarterly and annual reports.
- Provide updates at traffic conferences.
- Receive Standing Committee recommendations and provide the initial screening.
- Circulate Standing Committee recommendations to any other Office for review if desirable.
- Submit final recommendation to Bureau director and act on results.
- Follow up on any further business involving issues.
- Monitor implementation of approved/adopted actions, when appropriate.
- Edit, publish and distribute all issues that become part of the TGM.
- Keep full and updated records of all transactions, available upon request.

1-16-2 FHWA Approvals — September 2008

INTRODUCTION

According to FDM 5-2-1.1 Federal-Aid Oversight Agreement (Appendix A), the Wisconsin Division of FHWA requires certain policies and procedures to be submitted for review and/or approval before publication.

APPROVAL PROCEDURE

For all items listed below, WisDOT will timely submit changes to FHWA for approval, and will not proceed with execution or publication until FHWA has provided formal approval of changes. For those items that are sent for review purposes only, WisDOT *should* submit changes at least two weeks prior to execution; if comments are not received within two weeks, WisDOT *may* proceed with execution or publication. Requests to FHWA **shall** be directed through the BTO Traffic Supervisor and State Traffic Engineer.

Table 1. FHWA Oversight Agreement List

Item	FHWA Requirement
Traffic Operations Manual	Submit to FHWA for review only
FDM Standard Detail Drawings	Submit to FHWA all changes
Standard/Additional Special Provisions	Submit to FHWA all changes
Standard Specifications	Submit to FHWA all changes
Public Interest Findings	Submit to FHWA all requests
Federal Workplans	Submit to FHWA all requests
Experimental Traffic Controls	Submit to FHWA all requests

FORMAT FOR SUBMITTAL

All requests **shall** be in a professional electronic format (no hand drawings) and submitted via email to FHWA describing the changes or request.

1-16-3 Traffic Engineering Materials & Technology Standards — December 2008

INTRODUCTION

When requests are received from the Regions, vendors and contractors for use of new traffic engineering materials and technologies, it is necessary to follow the steps shown in the flowchart to consider the technology for possible use. If the technology is evaluated and found successful, results of the evaluation *may* lead to development of standards and specifications for use of such products and technologies in Wisconsin.

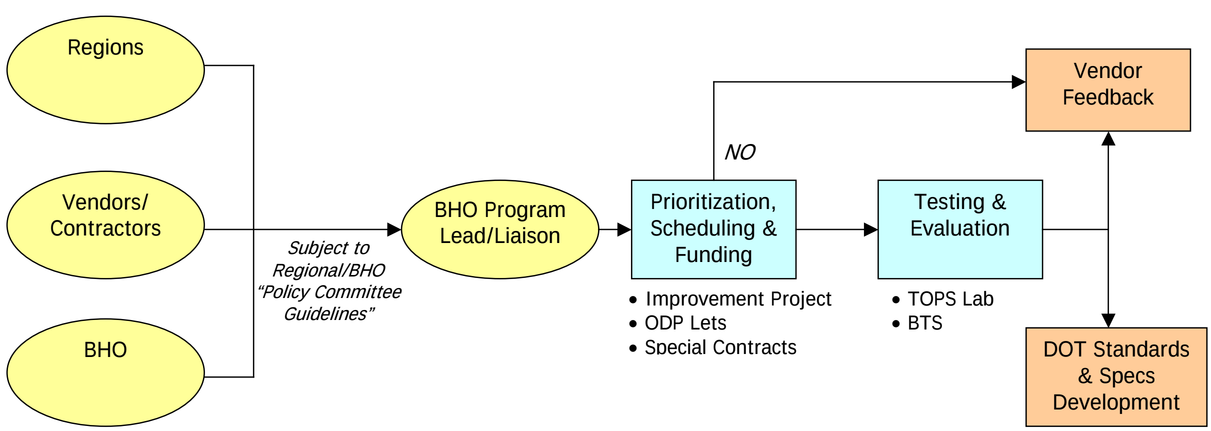
PROCEDURE

Typically, Regional staff, vendors or contractors suggest the use of a new material or technology for use in the WisDOT projects. Before a product can be used in the field, its expected benefits must be considered and an evaluation plan developed.

The appropriate standing committee or BTO Program lead must first consider the feasibility of the product (i.e., cost, benefits, disadvantages, life expectancy, etc.) in order to make a decision in pursuing the use of this product. If it is a proprietary product or is not in compliance with the MUTCD an experimental work plan must be submitted to FHWA for their review and approval before any further progress is made with the product. Refer to TEOpS 1-16-2, FHWA approvals for a list of items that require Federal approval.

The BTO Program lead prioritizes the use of the product depending on scheduling of pilot projects and funding for the use of the product. This product *may* be piloted in an improvement project, ODP project or set up in a special contract. If the BTO Program lead cannot effectively find a project or funding for use of the material or technology, he/she will provide feedback to the vendor for the reason not choosing the product. If the product is approved for a pilot test, the UW TOPS Lab or the Bureau of Technical Services Quality Assurance Unit *may* provide or assist with the testing and evaluation of the product.

If the product is successful in the testing and evaluation process and WisDOT chooses to standardize its use, standards and specifications must be developed in order to implement statewide. BTO staff will work with BPD and/or BTS staff to develop and publish language allowing the use of the material or technology in statewide projects. If the product is not successful or WisDOT chooses not to use the product, the BTO program lead *should* provide feedback to the vendor.



1-20-1 Liabilities of Tort

November 1992

The following was specially prepared by Risk Management for inclusion in this manual

GENERAL

Because traffic engineering functions are one of the most visible elements of the Wisconsin transportation system, the department's traffic engineers are convenient targets for litigation and are often named as defendants in tort liability actions arising from traffic accidents on/along the State Trunk Highway System. Experience has proven the following to be generally valid across a broad range of circumstances:

1. If it becomes apparent that a problem exists on/along the State Trunk Highway System, due to an accident having occurred or for other reason, do whatever is necessary to rectify the situation as soon as possible/practical. Correcting a problem situation that has been brought to your attention (by whatever means) does not establish a condition of guilt. Moreover, responding in a timely manner can prevent accidents from occurring or recurring and is in concert with the department's overall mission of providing a safe wand efficient transportation system. Implement remedial actions, as soon as possible and document actions accordingly.
2. If you are named as a defendant in a civil action, it is recommended that you immediately inform your supervisor, the Risk and safety Management Section of the Bureau of Management Services. *Should* you decide to consult with your own attorney, it is highly recommended that he/she discuss your case with representatives of the Risk Management and Safety Section before advising you in the matter. Consultations with your own attorney are at your expense.
3. As a representative of the department and as a named defendant, you're entitled to be represented in your defense by the Attorney General's office. As an employee of the State of Wisconsin, this representation is provided at not cost to you. Even if judgment is rendered against you, as long as you were acting of s. 895.45, Wis. Stats. And the State of Wisconsin will pay all judgments rendered against you. If you refuse representation by the Attorney General's office (which is your right) and hire your own attorney, you waive the right to be represented by the Attorney General's office if further actions are brought in the matter, and you will be responsible for your attorney's fees in any and all such actions. Your protection as a state employee under s. 895.45, Wis. Stats. Remain, however, as long as you were acting within the scope of your employment.

The prospect of being named in a tort action is unpleasant at best, and one which unfortunately confronts the department's traffic engineering professionals all too frequently. One can deal with this situation most effectively by:

1. Applying the traffic engineering principles and standards of practice in a consistent and uniform manner, to create wherever possible the sense of expectation in the driver, that will in turn ensure that his/her driving actions/responses are as close to "second nature" as possible (eliminate the choices or reduce them to a minimum at any decision point along the highway).
2. Develop a methodology for identifying areas of (or practices related to) high accident occurrence in order to determine what, if any, mitigative measures can be taken of any engineering nature.
3. Document your actions. Keep diary. Record complaints and investigations. Your records are your best means of defending your actions, decisions and professionals conduct.
4. Remember that being named in a tort action, and even having a judgment rendered against you, does not impugn you as a conscientious, capable professional. Because the State of Wisconsin is a "deep pocket," you are a tempting target for litigation.

BASIS FOR LEGAL ACTION

Several considerations enter into the filing of a valid action against a state officer, employee, or agent.

1. Notice has to be served within 120 days of the date of the accident. (Certain exceptions apply.)
2. The named defendant/s must have owed the plaintiff a specific duty and have breached that duty causing the injury complained of.

The legal duties that accrue to department staff are divided into two categories:

1. Ministerial Duties. These are duties, which by their very nature are absolute, imperative and certain as to the time, mode, occasion, and performance that nothing is left for judgment and discretion. Typically, they are duties required by rules, regulations, standards, practice or law. For example, the duty to maintain certain signs or to properly install them.
2. Discretionary Duties. These are duties that require the exercise of judgment. Typically, these duties are exercised by upper levels of management. However, it is possible to establish discretion at any level. The true test involves the exercise of judgment, by a qualified and trained professional, over valid alternatives and based upon acceptable standards of the profession. For example, the decision to place a supplemental sign is generally considered to be a discretionary act.
3. Negligence. Negligence is the failure to exercise that degree of care expected of any reasonably prudent person in the same or similar circumstances. However, the comparison is based upon what other reasonably prudent traffic engineers would do under the same circumstances. In other words, your actions must be appropriate in terms of the practice of the industry or your profession at the time and not what *may* have been the practice in the past.
4. Comparative Negligence. This is a doctrine that assigns negligence to all the parties of a lawsuit in terms of percentages the total of which does not exceed 1005. Then any judgment is reduced by the percent assigned to the plaintiff and if any of the remaining defendants are assigned a percentage greater than that of the plaintiff, those defendants will pay the remaining judgment.
5. Joint and Several Liability. This doctrine requires the payment of the entire judgment by any one of the defendants in an action whose negligence is greater than the plaintiff's. That means that if a state employee defendant is assigned 1% more negligence than the plaintiff and some other defendant who *may* be grossly more negligent than the state employee, the state could still be required to pay. This generally happens when the other defendants are not solvent. This doctrine is often referred to as the "deep pocket theory."

LIABILITY REDUCTION

Adverse exposure can and *should* be reduced in the following ways:

Pre-accident Actions

While the efforts of traffic engineers are usually focused upon improving efficiency of operation, reducing accidents is usually a prime consideration. Because the best method of limiting liability is to reduce the potential for accidents, an accident reduction program is an integral part of the overall traffic effort. The following aspects are typically involved:

- A system of regular inspection *should* be established and maintained on a continuing basis.
- Design and operational reviews *should* be conducted before and after installation of traffic control elements.
- A procedure for handling citizen complaints *should* be established and records made and kept.
- Claims and judgments can be a major financial drain, and *should* be a consideration in expanding funds to improve highway systems.
- Engineering countermeasures to accident problems *should* be sought.
- Careful prioritization of needed improvements (as in the Traffic Operations Improvement Program) is an appropriate means of documenting why a specific improvement was not implemented earlier.
- Project and program evaluations should be undertaken regularly. A project is site specific, lending itself to a before-and-after engineering analysis. Program evaluation is a managerial function, and is particularly relevant to accident reduction and tort liability mitigation.
- Utilize positive guidance principles in the operation and the development of improvements to the highway system.
- Evaluate all feasible alternatives.
- Keep the highway system as simple, consistent and forgiving as possible.
- Maintain a system of documentation.

Post-accident Actions

Adequate instructing and training of personnel in on-site actions, accident investigations and use of accident data can go a long way toward preventing further unwarranted accidents close behind the initial incident, thereby reducing liability exposure. While the traffic engineer is not typically involved in site control, he/she is typically involved in analysis of "problem" locations. These investigations enable the cause of accidents to be identified, and where feasible engineering countermeasures to be implemented.

1-20-4 Indemnification April 1995

Standard indemnification provisions occur mostly in two areas in the Division of Highway's policies. One is in Standard Spec 107 covering construction activities. The basic premise there is that the contractor insures us while the construction activity is occurring. It also covers actions resulting from faulty materials or construction. The second indemnification in use is the standard provision for utility-type facilities administered by the Maintenance Office. This provision is part of every utility permit and is referenced therein to policy 96.03 of the Utility Accommodation Policy. This indemnification is tailored to cover the liability occurring while an object, most commonly a utility pole, is being installed, and also to cover liability during the time the object remains on the ROW.

The Office of Traffic has found on several occasions that Regional offices have attached the above indemnification to various traffic related permits issued by the Regions. These permits include closure of highway, banners, snowmobile crossings, and highway lighting. The Office of Traffic does not endorse the use of indemnification provisions. The perceived need for and use of provisions is left up to the Region. The following advisory comments about the usage *may* be helpful, however.

The Maintenance indemnification is tailored to cover utility-type situations. The provision first covers the period of installation, with the implication that the applicant *may* damage someone else's utility, and secondly, the period while the object is in place, which of course would be many years. The primary concern during that time could be inferred to be mainly crashes with the poles. The Maintenance indemnification applies to situations very similar to that covered by lighting permits, permits for flashing beacons and banners over highways, where new poles or supports are set. From that standpoint the Regions *may*, if they so choose, make use of or make reference to the Maintenance indemnification, using the full name.

On the other hand the Maintenance policy does not appear to fit the situations involved in highway closures, snowmobile crossings or routes, or painting crosswalks, etc. In these cases the anticipated major problem would likely be vehicle crashes resulting from alleged inadequate signing, marking or barricading; in other words, something which can be described as a traffic control device misuse or inadequacy. While this guideline makes no recommendation as to the need for indemnification statements in permits issued by the Regions related to traffic operations activities, caution is urged that unless the indemnification is tailored to the nature of the activity or situation the indemnification *may* have little or no substance.

In the case of small communities especially, the inclusion of an indemnification requirement *may* cause their insurance carrier to re-assess their coverage situation.

Indemnification related to work performed for us by others which is not being done under contract administered by the Construction Office *may* be referenced to Standard Spec 107. Again, this is not a recommendation that the activity be covered, but simply an appropriate and approved indemnification clause that can be used if the Region so chooses.

1-20-5 Avoiding Utility Damage June 2005

LOCATING PRIOR TO DIGGING

It is the policy of the Department that all WisDOT employees comply with the provisions of s. 182.0175 (1m)(a), prior to any digging or excavating of earth either on or off the highway right-of-way whether manually or with powered equipment except in those cased where such digging or excavating is necessary for the immediate protection of highway users.

In all cases except emergencies as discussed below, WisDOT employees whose work requires digging or excavating **shall** investigate what utility companies and others *may* have underground transmission lines in the area where the digging or excavating is required. Diggers Hotline (1800-242-8511) **shall** be contacted prior to digging or excavating. No digging or excavating *may* be done until after the locate by Diggers Hotline.

Emergencies in which the practice of contacting the owners *may* be omitted include, in the traffic area, replacement of knocked down, missing, and severely damaged Stop signs, traffic control signals, Stop Ahead signs, Large Arrow signs, and Curve and Turn signs. The installation of new signs (including detour signs) and the routine maintenance of posts are not of an emergency nature.

DIGGERS HOTLINE MEMBERSHIP

Wisconsin law, s. 182.0175 (1m) (b) requires WisDOT to be a participating member of the one call service known as Diggers Hotline system. As a member, WisDOT needs to provide the one call service with information regarding the location of state-owned electrical facilities and WisDOT will receive tickets that require WisDOT to locate and mark its facilities when work is to be performed in the vicinity of those facilities.

In order to incorporate WisDOT electrical facilities into the Diggers Hotline database, the Regional offices submit location maps to Diggers. Typical electrical installations to include on the Diggers Hotline service are: signal systems, lighting systems, flashing beacons, ramp meters, changeable message signs, rest areas, and weigh scales.

Following receipt of a Diggers Hotline ticket, WisDOT electrical installations are field-located by Electrical personnel or a designated contractor. To ensure valid tickets are received, electrical installation location maps *should* be verified and updated routinely.

1-20-10 Response to Damage — June 2005

BACKGROUND

The Department has a 24/7 obligation to respond to failures or damage that *may* jeopardize traffic safety or mobility. Given the extent of the system and the role of the Department, it is most often the case that law enforcement or local government employees will become aware of these situations first. A protocol for dealing with those situations will benefit the entity that first becomes involved, as well as serving the public needs for safety and mobility.

NOTIFICATION TO OTHERS

In conjunction with and addition to the “Highway Facilities Damage Claim Program” coordinated by Risk Management, each region **shall** develop an on-going program of establishing and maintaining contacts with appropriate enforcement agencies, for the purpose of distributing information on whom to contact for emergency sign repair.

This notification *should* include the types of signs which are critical in nature and the telephone number and agency of whom the enforcement people are to contact at any given hour of the week -- day, night, weekday, weekends.

The notification *should* also include the appropriate contact regarding traffic signals, highway lighting and other appurtenances. Instructions *should* go on to cover reporting of routine damage or malfunction of a non-emergency nature.

The same notifications *should* be distributed to state maintenance people and others who *may* be in a position to see and report problems.

A suggested letter to be used for this purpose is included as part of this guideline.

CRITICAL SIGNS

Critical signs are stop signs and yield signs, and *may* include large arrows in critical locations, keep right signs on important transition sections, and similar applications.

> Date
>
> Addressee
>
> Subject: Reporting Damage to Signs and Signals On State Trunk Highways
>
> We are contacting you to reconfirm and/or update information on whom to contact regarding the repair of damaged highway signs and traffic signals which are owned and operated by the State Department of Transportation.
>
> We have assumed that you have enforcement officers and/or maintenance workers who will come upon damage and will be obliged to initiate action to have repairs made. The list on the next page will serve to expedite obtaining the proper phone number and the circumstances necessitating a call. You *should* make copies of this list available to each person.
>
> We suggest that the officer or employee keep a record of the time and circumstances when contact was made with the person on the list.

We thank you for your cooperation and welcome your comments or questions regarding notification of damage to traffic control devices.

Regional Chief Traffic Engineer or Supervisor

Contact Persons Below to Report Damage to Signals and Signs on State Highways

Agency-Person/Telephone Number

Emergency Damage	Working Hours	Week Nights	Weekend
Electrical			
Examples:	____________	____________	____________
Traffic signal down	____________	____________	____________
Signals on flash	____________	____________	____________
(call top name first	____________	____________	____________
then next, etc.)	____________	____________	____________
	____________	____________	____________
Signing:			
Critical sign down or	____________	____________	____________
missing, such as stop,	____________	____________	____________
yield, large arrow, keep	____________	____________	____________
right sign, etc.	____________	____________	____________
	____________	____________	____________

In most cases a sign can be re-erected temporarily until the next working day.

Non-Emergency Damage	Work Hours Only
Electrical	________________
Example: lamp burned out	________________
	________________
Signs	________________
Example: Less important sign damaged or missing	
	________________
	________________

1-25-6 Charging for Signs **March 2023**

For signing, the cost of which is to be billed to another party, a professional and technical project *should* be set up to receive charges.

Refer to Program Management Manual 06-10-90 for more information on Professional & Technical Project setup, authorization and billing.

1-30-1 Traffic Role in Improvement Program — November 2022

INTRODUCTION

The following tables summarize the standard role for Traffic Operations in developing and delivering improvement projects in order to promote increased consistency of how traffic-related items are incorporated into projects, and to increase the consistency of work assignments played by Traffic Operations staff in the regional offices.

DEFINITIONS

'Acceptance Review' is defined as a field review of the completed project/item with the PDS Project Engineer for purposes of developing a punch-list of activities to be accomplished within a specific Traffic Engineering function before the contractor moves off the project and/or payment to the contractor is made for the items in each work category. As a general rule, this is accepted as the minimal role regional Traffic Operations would provide for all Traffic Engineering functions on projects.

'Needs identification' includes the project definition and project delivery stages.

ROLES & RESPONSIBILITIES

Signing

Refer to Table 1 for Traffic Operations and PDS roles in the signing function. Traffic Operations is directly responsible for producing signing plans for all improvement projects. Traffic Operations *may* accomplish this in a variety of ways, including in-house design by Operations staff; consultant design under a traffic master contract; or consultant staff under a (PDS managed) design contract. If the latter method is utilized, it is critical that the Traffic Operations staff person in responsible charge of the signing plan remain in the communication chain with PDS staff and the consultant so effective work reviews (preliminary plan, DSR plan, Pre-PS&E) can occur. During construction inspection by PDS, Traffic Operation's role is to provide technical guidance to PDS inspectors and be involved in acceptance review with the project engineer. The acceptance review *should* be completed shortly after signs are installed so the contractor can fix any signing that needs to be addressed before the contractors finish construction operations.

Table 1. Signing Roles

NEEDS IDENTIFICATION		DESIGN		CONSTRUCTION			
Identify need for replacement or new installation	Present need in project scoping or project initiation	Directly manage consultant in design & drafting (Consultant Mgmt for Delivery)	Complete design (In-House Delivery)	Provide technical guidance to PDS staff or PDS consultant in construction inspection	Complete construction inspection	Acceptance Review	Field Review for Compliance WZTC
Operations	Operations	Operations	Operations	Operations	PDS	Operations	PDS

Pavement Marking

Refer to Table 2 for Traffic Operations and PDS roles in the pavement marking function. Pavement marking plan production remains the responsibility of the PDS section. Traffic Operation's role is to provide technical guidance and design review when requested by PDS during design. Traffic Operation's role is to provide technical guidance to PDS inspectors and be involved in acceptance review with the project engineer during construction inspection conducted by PDS. The acceptance review *should* be completed shortly after the pavement marking is placed so the contractor can fix any marking that needs to be addressed before the contractors finish construction operations.

Table 2. Pavement Marking Roles

NEEDS IDENTIFICATION		DESIGN			CONSTRUCTION			
Identify need for replacement or new installation	Present need in project scoping or project initiation	Provide technical guidance to PDS staff or PDS consultant in design	Directly manage consultant in design & drafting (Consultant Mgmt for Delivery)	Complete design (In-House Delivery)	Provide technical guidance to PDS staff or PDS consultant in construction inspection	Complete construction inspection	Acceptance Review	Field Review for Compliance WZTC
Operations	Operations	Operations	PDS	PDS	Operations	PDS	Operations	PDS

Intersection Control

Traffic Operation's role is to identify the need for replacement, upgrade, or new installation of intersection control and present the need within the Project Initiation or Project Definition phases. Regional traffic operations complete the Intersection Control Evaluation (ICE) process to evaluate traffic control change alternatives for reasonableness. FDM 11-25-3 provides additional details on the ICE process. Refer to Table 3 for Traffic Operations and PDS roles in the various intersection control functions.

Intersection Geometrics

Traffic Operation's role is to provide technical guidance on geometric and operational issues as necessary.

Traffic Signal/Electrical Plans

Traffic Operations staff is directly responsible for producing signal/electrical plans (separate from geometrics). Traffic Operations *may* do this in a variety of ways including via in-house staff; via a traffic master contract; or via the design contract used for the project. If the latter method is used, it is critical that the Traffic Operations staff person in responsible charge of the signal/electrical signing plan remain in the communication chain with PDS staff and the consultant so effective work reviews (preliminary plan, DSR plan, Pre-PS&E) can occur.

Traffic Operations electrical staff are to serve as first-line inspectors on signal installations and are involved in acceptance review with the project engineer during construction inspection. The PDS project engineer is the lead on contract administrative duties. Operations staff and the PDS project staff agree prior to construction on proper level of inspection for electrical installations.

Operations Analysis

Regional Traffic Operations staff *should* provide technical guidance to PDS staff or PDS consultant staff by completing needs analyses for alternative intersection control during the Project Initiation phase, by analyzing intersection crash data, and comparing and evaluating the alternatives relative to intersection control guidelines and warrants. TEOpS 16-15 and TEOpS 16-20 provide details on how to conduct traffic operations analyses following the Highway Capacity Manual (HCM) methodologies and microscopic simulation traffic analysis methodologies, respectively.

Table 3. Intersection Control Roles

	DESIGN			CONSTRUCTION		
	Provide technical guidance to PDS staff or PDS consultant in design	Directly manage consultant in design & drafting (Consultant Mgmt for Delivery)	Complete design (In-House Delivery)	Complete construction inspection	Acceptance Review	Field Review for Compliance WZTC
Intersection Geometrics	Operations	PDS	PDS	PDS	PDS	PDS
Traffic Signal/ Electrical Plans		Operations	Operations	Operations	Operations	PDS
Operations Analysis	Operations	PDS	PDS			

Intelligent Transportation Systems

Intelligent Transportation Systems (ITS) includes items such as closed-circuit television (CCTV), cameras, ramp meters, detector stations, count stations, permanent message boards, etc.

Refer to Table 4 for Operations and PDS roles in the ITS functional area. Traffic Operations staff is directly responsible for producing ITS component plans. Traffic Operations *may* do this in a variety of ways including via in-house staff; via a traffic master contract; or via the design contract used for the project. If the latter method is used, it is critical that the Traffic Operations staff person in responsible charge of the ITS component plan remain in the communication chain with PDS staff and the consultant so effective work reviews (preliminary plan, DSR plan, Pre-PS&E) can occur.

Traffic Operations/electrical staff are first-line inspectors on ITS construction installations, plus they are involved in acceptance review with project engineer.

Table 4. ITS Roles

NEEDS IDENTIFICATION		DESIGN		CONSTRUCTION		
Identify need for replacement or new installation	Present need in project scoping or project initiation	Directly manage consultant in design & drafting (Consultant Mgmt for Delivery)	Complete design (In-House Delivery)	Complete construction inspection	Acceptance Review	Field Review for Compliance WZTC
Operations/PDS	Operations/PDS	Operations	Operations	Operations	Operations	PDS

State-owned Highway Lighting

Refer to Table 5 for Operations and PDS roles in the state-owned highway lighting function. Traffic Operations staff is directly responsible for producing state-owned highway lighting plans. Traffic Operations *may* do this in a variety of ways including via in-house staff; via a traffic master contract; or via the design contract used for the project. If the latter method is used, it is critical that the Traffic Operations staff person in responsible charge of the lighting plan remain in the communication chain with PDS staff and the consultant so effective work reviews (preliminary plan, DSR plan, Pre-PS&E) can occur.

Traffic Operations/Electrical staff are first-line inspectors on state owned lighting installations and involved in acceptance review with the project engineer.

Table 5. Highway Lighting Roles

NEEDS IDENTIFICATION		DESIGN		CONSTRUCTION		
Identify need for replacement or new installation	Present need in project scoping or project initiation	Directly manage consultant in design & drafting (Consultant Mgmt for Delivery)	Complete design (In-House Delivery)	Complete construction inspection	Acceptance Review	Field Review for Compliance WZTC
Operations	Operations	Operations	Operations	Operations	Operations	PDS

Work Zone Transportation Management Plan

Refer to Table 6 for Operations and PDS roles in the work zone transportation management plan (TMP) task. Traffic Operations role during the work zone TMP process is to provide technical guidance to PDS on:

- assessing work zone impacts
- determining mitigation strategies
- developing TMP documents, and
- reviewing work zone traffic operations during construction

Additional details on roles and responsibilities of Traffic Operations and PDS in the TMP process are discussed in TEOpS 6-1-1.

Table 6. Work Zone TMP Roles

NEEDS IDENTIFICATION		DESIGN			CONSTRUCTION			
Identify work zone management needs & issues	Present need in project scoping or project initiation	Provide technical guidance to PDS staff or PDS consultant in design	Directly manage consultant in design & drafting (Consultant Mgmt for Delivery)	Complete design (In-House Delivery)	Provide technical guidance to PDS staff or PDS consultant in construction inspection	Complete construction inspection	Acceptance Review	Field Review for Compliance WZTC
Operations/PDS	Operations	Operations	PDS	PDS	Operations	PDS	PDS	PDS

Safety and Operational Review

The Safety Certification Process (SCP) is defined in FDM 11-38 and is required for state highway projects meeting the improvement concept codes in FDM 11-1-10 Attachment 10.1. Traffic Operations or preliminary design engineers are responsible for completing and documenting this process. The SCP uses network screening tools to identify safety sites of promise which are locations that experience more crashes than similar sites; therefore, having a higher potential for safety improvement. These locations are investigated for reasonable alternatives which help define the purpose and need of a project. Regions are responsible for completion of the SCP, while the Bureau of Traffic Operations (BTO) approves documents in which an economic appraisal is completed.

The Highway Safety Improvement Program (HSIP) process is a separate, independent process from the SCP. This program aims to reduce serious and fatal crashes on all streets and highways. Information on the HSIP process can be found on the WisDOT webpage. A HSIP project *may* occur within an existing state highway improvement project, or as a standalone safety project.

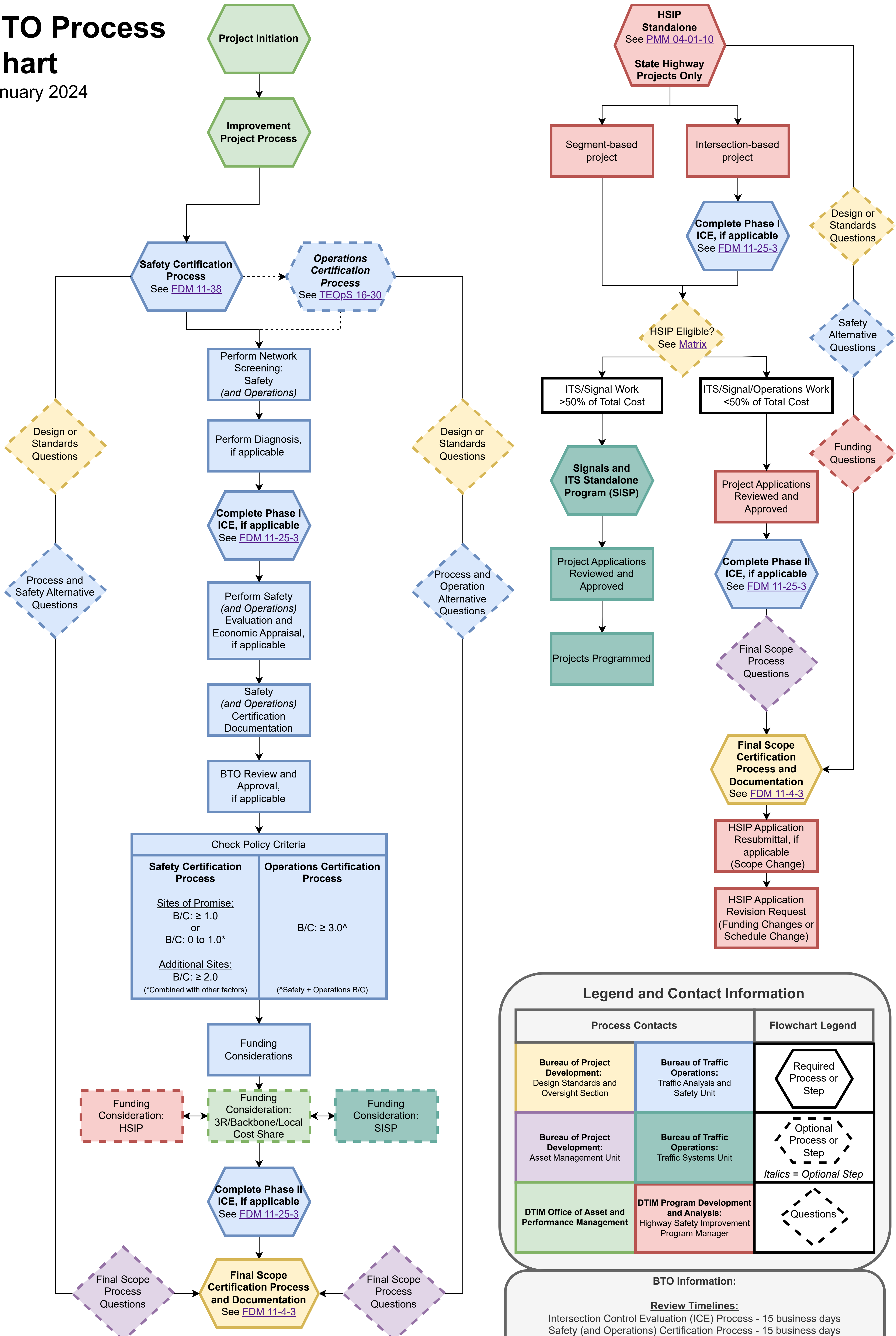
The Operations Certification Process (OCP) for intersections is currently defined in FDM 11-52-15 and TEOpS 16-30. The OCP is an optional process that Traffic Operations or preliminary design engineers *may* consider for operational improvements. The OCP identifies and investigates operational sites of promise to identify reasonable operational improvements which help meet the purpose and need of a project. Regions are responsible for completion of the OCP, while the BTO approves the documentation.

The Intersection Control Evaluation (ICE) process is defined in FDM 11-25-3 and is required for all intersections on the State Trunk Network (STN), including those along connecting highways, regardless of the funding mechanism, where consideration is being given to an alternative form of traffic control or type of intersection/ interchange. Regions are responsible for completion of the ICE, while BTO approves the documentation.

Figure 1 helps illustrate how these processes interact and how they could be completed within the life of an improvement project. For the improvement project process, beginning with Project Initiation phase, this flowchart illustrates an example in which all processes were completed. This example illustrates a linear outline, however, many of these steps can be completed concurrently. Not all projects will complete all the steps. For a full-page flowchart with accessible links, click the image.

BTO Process Chart

January 2024



BTO Information:

Review Timelines:

Intersection Control Evaluation (ICE) Process - 15 business days
Safety (and Operations) Certification Process - 15 business days

Process Contacts:

Operations Certification - DOTTrafficAnalysisModeling@dot.wi.gov
Safety Certification - DOTBTOSafetyEngineering@dot.wi.gov
Highway Safety Improvement Program (HSIP) - HSIP webpage
Signals and ITS Standalone Program (SISP) - SISP webpage

Note: This process chart provides an example project completing all possible steps of the Safety Certification and Operations Certification Process. Not all projects will complete all steps.

2-1-1 Introduction September 1992

Beginning with Chapter 2 and extending through Chapter 9, Bicycle Facilities, the TEOpS entry heading and numbering system will follow the corresponding system in the MUTCD. The SECTION designation will be numerical instead of alphabetic as in the MUTCD partly in order to differentiate between the two.

2-1-3 Standardization December 2005

Although the Department exercises no control over the usage of non-conforming signs on other systems, except on sections being built under state contracts, the Department can and *should* be looked to for direction in preserving the uniformity of all traffic control devices. Signs are of special concern because they can be designed in almost endless variation.

Part 1 of the MUTCD gives specific positive purposes for the use of standardized traffic control devices. If these were closely followed by all agencies there would be no need for further discussion. Unfortunately, there are some who believe that non-uniform signs are more effective, generally because of their uniqueness. The following discussion is intended to counter this attitude and service as a resource in replying on the subject of uniformity or objecting to the use of non-conforming signs.

While it *should* be quite clear as to the purposes of signing for the benefit of the motoring public, there are other purposes for signing which *may* be installed on streets and highways, some of which have no benefit to motorists at all. These side purposes *may* include efforts to:

- Attract
- Notify, inform
- Advertise
- Educate
- Influence
- Propagandize
- Memorialize
- Placate
- Landmark
- Reinforce

The consequences of displaying non-conforming signs would be expected to mainly affect the motorist, but sometimes *may* affect others, such as pedestrians. These consequences *may* include:

- Misinterpretation
- Incorrect message
- Message contrary to law
- Distracting from driving task
- Distracting from important signs
- Incomprehensive message
- Generation of humor rather than seriousness
- False trust by others (pedestrians)
- Wasted money
- Bad precedent
- Loss of respect
- Poor materials (deterioration)
- Poor aesthetics
- Liability

EXAMPLES

Some specific examples follow which are intended to explain why the usage is undesirable.

Slow Children

The use of this sign is probably the most common non-standard to be found on local streets. It is typically a black on yellow rectangular sign, with a running child figure. A variation *may* add the phrase “at play.” It is often shown in sign catalogs.

The purpose of this sign is largely to placate the residents. While their concern for the safety of their children is understandable, the real issue is not being addressed, which the hazard is caused by children either playing in the street or entering the street without exercising care. Both actions are illegal. The sign therefore tends to endorse illegal actions, and that is why it *should* not be used.

Motorist Stop/Yield to Pedestrians

This sign is commonly a red and white rectangle, but could have several variations. It is usually erected at the crosswalk. A variation seen in other states refers to children and is probably used at crossings of neighborhood school routes. The departure from shape, color and message tends to diminish the impact of conforming signing. It *should* be expected that the public is slightly confused as to what is expected at these "special" places. The most serious reason why they *should* not be used would be if the pedestrians themselves observed the signs and reacted differently, thereby not exercising their normal caution. In Wisconsin, pedestrians have the right of way only if they do not cause the motorist to have difficulty in stopping.

Black Spot

This sign is used in foreign countries and perhaps in this country to indicate the scene of one or more fatal accidents. It is intended to warn motorists of a perceived dangerous location as well as to memorialize the location. In Wisconsin crosses have been erected by private persons to do the same thing. The negative aspects of this activity are the possibility that motorists will be distracted, that the location is only randomly the scene of a fatality, that the sign itself *may* be an obstruction to sight or otherwise an obstacle; that the sign is not informative as to what the hazard might be if there was one; and the prospect that the memorial will be unpleasant to local people if the victim was local.

Directional Signs to Generators

In a recent contract funded with federal aid, provisions were made to install directional signs on a downtown street. The design of the signs was non-conforming regarding the MUTCD Sections 1A.02 and 2D.02 through 2D.08. The signs had two-color backgrounds, had arrows set in circles, which were black and white and raised above the sign surface and extended out beyond the edge of the sign, and had letter fonts and sized which would have made the signs illegible to the motoring public. The signs were removed from the project.

This was admittedly an extreme case of non-conformance. However, it is our obligation to advise that there are definite standards on all features of guide signs. To the extent that signs depart from any of these standards, the motoring public is not served, but rather some other interest is being addressed, some of which are listed above, along with the consequences.

2-1-7 Dynamic Speed Display Signs — December 2022

PURPOSE

The MUTCD section 2A.07 allows usage of Dynamic Speed Display Signs to measure and display individual speeds at a specific location. These signs are commonly referred to as "speed display signs," "driver feedback signs" or "your speed is" signs. The signs are activated by radar to detect and display individual vehicle speeds to the vehicle driver. The expectation is that the driver will compare his speed with the legal posted speed and adjust accordingly. These sign installations may be portable installations that are installed on a temporary basis or may be permanent installations attached to new or existing signing. Local units of government have requested to install this signing. This policy provides guidance on the usage of these signs on state-maintained roadways.

DEFINITIONS

Freeways are defined as divided highways with fully controlled access at interchanges only. Interstate Highways are freeways with the interstate route designation.

Expressways are defined as divided highways with partially controlled access by a combination of interchanges, at-grade intersections and driveways.

Conventional Highways are defined as streets or roads other than freeways or expressways. They may be divided or undivided, two-lane or multi-lane, and access is available at intersections and driveways.

POLICY

Requests to install and maintain dynamic speed display signs on DOT-maintained roadways **shall** be made in writing by a local unit of government. Each request **shall** include a map showing the proposed location of the dynamic speed display sign(s). Upon Region review, approval or denial **shall** be made by a letter to the local unit of government. If approval is granted, the letter **shall** confirm that all provisions of this policy are met by the request. If approval is given, the Region *should* also provide a copy of the R2-1C standard sign plate with the approval letter so consistency is maintained in the design and manufacture of the signs.

QUALIFYING CRITERIA

The following criteria **shall** be used by the Region to determine whether a roadway would qualify for dynamic speed display signs.

1. Dynamic Speed Display Signs *may* be allowed in the following locations on the state highway system:
    a. School Speed Limit Zones
    b. Reductions in Speed Zones within a community
    c. Work Zone speed limit areas.
2. Portably mounted dynamic speed display signs *may* be permitted at locations where they can safely be deployed for a time not to exceed eight days.
3. Dynamic speed display signs for work zones *may* be allowed for the duration of the project. The decision to utilize dynamic speed display signs for construction work zones is determined through the work zone transportation management plan process.
4. Except for work zone areas, dynamic speed display signs **shall not** be allowed on freeways and expressways, including ramps.
5. The usage of dynamic speed display signs is limited to one sign per approach of speed transition zones such as at city limits, school zones or speed reduction transition. Transition points from expressways to conventional highways may be permitted.
6. Dynamic Speed Display sign installations **shall** comply with all NCHRP 350 crashworthy requirements.
7. When permanent mounted dynamic speed display signs are used, they **shall** be placed next to or downstream (typically 100'-200') of the regulatory speed limit sign (R2-1) or school speed assembly sign (S4-51) sign. The signs **shall** be at the same mounting height.
8. Dynamic speed display signs that do not conform to this policy **shall** be removed. Notification to communities **shall** be made by written letter. If existing non-permitted signs are not removed, WisDOT will remove the sign(s) at the owner's expense.
9. The local unit of government **shall** be responsible for manufacture, liability, installation and maintenance costs.
10. The local unit of government **shall** affix an identification label to the back of each sign, per Wisconsin State Statute 86.19(5).
11. WisDOT reserves the right to remove or move dynamic speed display signs in the event of a speed zone change, maintenance work or improvement project. WisDOT will notify the local unit of government, in writing, of the work and all costs associated with moving or removing the dynamic message speed signs. All costs for such moves **shall** be paid by the local unit of government.
12. The size lettering used on dynamic speed display signs **shall**, at a minimum, match the adjacent speed limit sign (see R2-1C sign plate).

USAGE CRITERIA

1. Dynamic speed display signs installed in permanent speed zones *should* operate 24 hours a day, 7 days a week.
2. Dynamic speed display signs installed on a temporary speed zone *should* operate for the time that the speed zone is in effect (e.g. school zones or work zones).
3. For work zones, the dynamic speed display signs *should not* be overused.

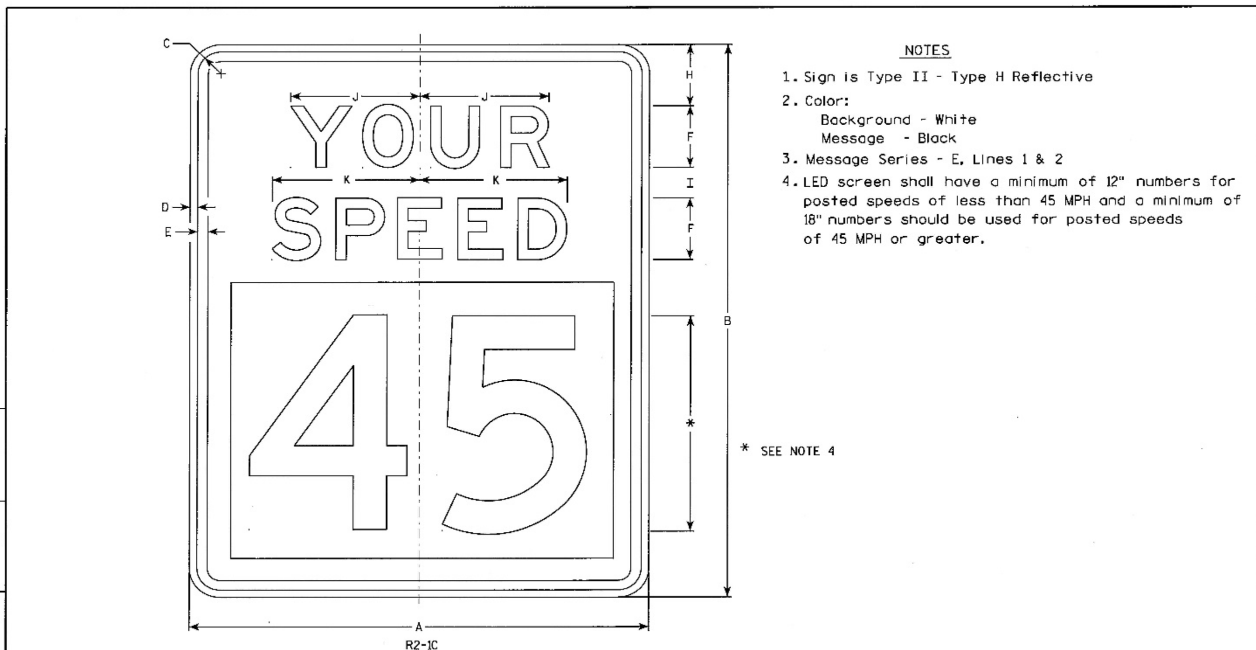
SIGN DESIGN CRITERIA

1. The R2-1C sign (See Figure 1) **shall** be used for permanent applications.
2. The changeable portion of the dynamic speed display sign **shall** have a black background with an amber (yellow) legend. On devices equipped with flip discs, the legend color *may* be yellow or green. Only one sign, in each direction of a two-way street approach or back-to-back signs, will be allowed for

each crosswalk approach.

3. The changeable message portion of the sign **shall** display the speed of the approaching vehicle as “XX” in miles per hour. The following standards apply to the changeable message portion of the sign:
    a. The sign **shall** flash at drivers traveling over the posted speed limit.
    b. The flash rate *should* be between 50 and 60 cycles per minute.
    c. Threshold speed setting *should* be set at 20mp below and above the posted speed.
    d. For speeds measured over the speed threshold setting, the dynamic speed display sign **shall** go blank.
    e. The dynamic speed display sign **shall** be either blank or display zeros when no vehicles are present.

Figure 1. Dynamic Speed Display Sign R2-1C



SIZE	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	Area sq. ft.
1																											
2S	VARIES	VARIES	1 1/8	3/8	1/2	4		3	2 1/4	8 1/2	9 5/8																VARIES
2M	VARIES	VARIES	1 1/8	3/8	1/2	4		3	2 1/4	8 1/2	9 5/8																VARIES
3	VARIES	VARIES	1 3/8	1/2	5/8	6		6	5	13	15 1/2																VARIES
4	VARIES	VARIES	1 3/8	1/2	5/8	6		6	5	13	15 1/2																VARIES
5																											

STANDARD SIGN R2-1C
WISCONSIN DEPT OF TRANSPORTATION
APPROVED Matthew R Rauch For State Traffic Engineer
DATE 2/13/14 PLATE NO. R2-1C.3
PROJECT NO: HWY: COUNTY: SHEET NO: E

2-1-8 LEDs (Blinker Signs) July 2018

PURPOSE

The MUTCD section 2A.07 provides standards and options for the usage of Light Emitting Diode (LED) units within the face of a sign and in the border of a sign to improve conspicuity and increase the legibility of sign legends and borders. This policy provides requirements and guidance on the proper use of the LED (commonly referred to as blinker) signs on state-maintained highways. Per the MUTCD, these blinker signs *may* be used on STOP signs, Warning signs and other regulatory signs such as speed limit sign or school signs. This policy provides guidance and requirements for usage on state-maintained highways. Refer to TEOpS 4-5-1 for warning sign flasher enhancement device options for pedestrians.

BACKGROUND

The MUTCD includes language in 2A.07 which provides guidelines for the proper use of these devices. They are considered similar to flashing beacons in section 4L of the MUTCD. The limiting guidelines under which they are considered in the Wisconsin Supplement are:

- Guideline 1: Demonstrated crash problem
- Guideline 2: Visibility restrictions

- Guideline 3: Unusual geometrics
- Guideline 4: Poor conspicuity—sign blending in with the environment

These four guidelines apply to all public highways and streets, including those not under state jurisdiction. The policy statements below pertain specifically to state-maintained highways.

DEFINITIONS AND MUTCD REQUIREMENTS (IF LEDS USED)

1. LEDs **shall** have a maximum diameter of ¼ inch and **shall** be the following colors based on the type of sign:
    a. White or red, if used with STOP or YIELD signs.
    b. White, if used with regulatory signs other than STOP or YIELD signs.
    c. White or yellow, if used with warning signs.
2. If flashed, the LED units **shall** flash simultaneously at a rate of more than 50 and less than 60 times per minute.
3. The uniformity of the sign design **shall** be maintained without any decrease in visibility, legibility, or driver comprehension during either daytime or nighttime conditions.
4. A module of multiple LED units used as a closely-spaced, single light source **shall** only be used within the sign face for legends or symbols.

POLICY

The usage of any illumination methods for traffic signs, including LEDs, is strictly limited to situations with documented safety concerns.

1. Local authorities **shall not** be allowed to installed units on state-maintained highways.
2. Blinker signs **shall** only be considered at existing locations. A conversion from a two to four-way stop is also considered an existing location. New locations **shall not** be considered until a minimum of one-year crash data, volume data and other traffic data is available for a traffic evaluation safety **shall** be submitted to the State Safety Engineer for review.
3. For blinker STOP and STOP AHEAD signs, at a minimum, consider at intersections that meet both of the following criteria:
    a. Crashes due to failure to stop (i.e. running the stop sign), not failure to yield the right of way (i.e. stopping and then proceeding)
    b. At least two documented failures (crash reports) to stop in the most recent 12-month period, or three documented failures to stop within the past five years.
4. Other countermeasures *should* be considered first, prior to installation of blinker STOP and STOP AHEAD signs, to address safety concerns such as:
    a. Clearing vegetation
    b. Double-marking STOP or STOP AHEAD signs
    c. Flags on signs
    d. Rumble strips
    e. Increasing sign sizes
    f. Flashing beacons
    g. Others.
5. Side-by-side ramps are common at partial cloverleaf interchanges where entrance and exit ramps operate directly adjacent to one another rat the interchange ramp terminal. Geometric design techniques to discourage wrong way maneuvers *should* be considered at side-by-side ramps. Where design constraints exist, blinker WRONG WAY signs *may* be utilized at side-by-side interchange ramps, provided there are documented wrong way movements noted by law enforcement or the Department. Blinker WRONG WAY signs **shall** not be used at locations other than side-by-side interchange ramps. WRONG WAY blinker signs shall only be used downstream of the ramp termini.
6. To maximize the effectiveness of the blinker WRONG WAY signs, vehicle actuated and time-of-day usage **shall** be considered by the Region. Some examples of time-of day usage would include:
    a. Operation during periods when wrong way drivers are prevalent.
    b. Operation during periods of low visibility or darkness, which may include a photocell operation.
7. Blinker signs **shall** only be used for STOP, STOP AHEAD, and WRONG WAY signs (at side-by-side

ramps). These are considered the more important of the regulatory and warning sign series. Enhancements or blinkers on warning signs are allowed on pedestrian and school crossing warning signs, refer to TEOpS 4-5-1. There is the longstanding concern that overuse of the blinker signs will diminish their effectiveness.

Any requests for additional blinker sign evaluations **shall** be approved by the Bureau of Traffic Operations.

8. Blinker STOP AHEAD signs **shall** be furnished and installed by WisDOT on state highways based on the criteria noted above.
9. Do not install blinker STOP signs and STOP AHEAD signs on the same approach. If used where there is a curve or hill approaching a STOP sign, use blinker on STOP AHEAD sign rather than STOP sign.
10. Do not mix beacons and blinker signs with STOP and STOP AHEAD signs on the same approach.

A cost comparison analysis *should* be done to determine where beacons or blinker sign is more appropriate. Studies have not been performed to determine if one device is more appropriate than the other.

2-1-30 Sign Numbering — January 2007

Section 86.19(5) Wis. Stat. provides that all maintaining agencies in the state must affix a unique code number to each of their signs for identifying the owner of the sign if it *should* be found elsewhere. Whereas the vandalism sticker is prescribed by law to be applied to the face of the sign, there is no provision about sign numbers in 86.19 (5) to that effect, and therefor the number *may* be placed on the back of the sign, although it could be incorporated unobtrusively into the stenciling.

The format of the sign number *should* follow the example below for the Town of Big Flats in Adams County:

1-02

The numerals *should* be one inch in height and made of durable materials such as stencil paste on adhesive-backed vinyl film. Felt pen ink will not last. Paint applied directly to aluminum *may* come of if the aluminum is not specifically treated.

The numbers to be used are on the following pages.

2 ASHLAND

Townships		Cities & Villages	
02	Agenda	201	Ashland (C)
04	Ashland	106	Butternut (V)
06	Chippewa	251	Mellen (C)
08	Gingles		
10	Gordon		**Unincorporated Villages**
12	Jacobs	09	Cayuga
14	La Pointe	05	Clam Lake
16	Marengo	06	Glidden
18	Morse	02	High Bridge
20	Peeksville	13	Marengo
22	Sanborn	05	Morse
24	Shanagolden	11	Odanah
26	White River	13	Sanborn

1 ADAMS

Townships		Cities & Villages	
02	Adams	201	Adams (C)
04	Big Flats	291	Friendship (V)
06	Colburn		
08	Dell Prairie		**Unincorporated Villages**
10	Easton	17	Arkdale
12	Jackson	10	Brooks
14	Leola	17	Dellwood
16	Lincoln	10	Grand Marsh
18	Monroe	15	New Rome
20	New Chester	04	Plainville
22	New Haven	05	White Creek
24	Preston		
26	Quincy		
28	Richfield		
30	Rome		
32	Springville		
34	Strongs Prairie		

3 BARRON

Townships		Cities & Villages	
02	Almena	101	Almena (V)
04	Arland	206	Barron (C)
06	Barron	111	Cameron (V)
08	Bear Lake	211	Chetek (C)
10	Cedar Lake	212	Cumberland (C)
12	Chetek	116	Dallas (V)
14	Clinton	136	Haugen (V)
16	Crystal Lake	171	Prairie Farm (V)
18	Cumberland	276	Rice Lake (C)
20	Dallas	186	Turtle Lake (V)
22	Dovre	151	New Auburn (V)
24	Doyle		Also in Chippewa
26	Lakeland		
28	Maple Grove		**Unincorporated Villages**
30	Maple Plain	05	Angus
32	Oak Grove	13	Barronett
34	Prairie Farm	16	Brill
36	Prairie Lake	19	Campia
38	Rice Lake	23	Canton
40	Sioux Creek	08	Comstock
42	Stanfold	14	Hillsdale
44	Stanley	23	Lehigh

46	Sumner	05	Mikana
48	Turtle Lake	07	Poskin
50	Vance Creek		

4 BAYFIELD

	Townships		Cities & Villages
02	Barksdale	206	Bayfield (C)
04	Barnes	201	Ashland (C)
06	Bayfield	151	Mason (V)
08	Bay View	291	Washburn (C)
10	Bell		
12	Cable		Unincorporated Villages
14	Clover	07	Barkpoint
16	Delta	14	Benoit
18	Drummond	02	Bingo
20	Eileen	05	Cornucopia
21	Hughes	08	Delta
22	Iron River	02	Fresh Air
24	Kelly	22	Grandview
26	Keystone	07	Herbster
28	Lincoln	20	Moquah
30	Mason		
32	Namekegon		
34	Orients		
36	Oulu		
38	Piben		
40	Port Wing		
42	Grandview		
46	Russell		
48	Tripp		
50	Washburn		

5 BROWN

	Townships		Cities & Villages
10	Eaton	102	Allouez (V)
12	Glenmore	104	Ashwaubenon (V)
14	Green Bay	106	Bellevue (V)
18	Holland	126	Hobart (V)
22	Humboldt	116	Denmark (V)
24	Lawrence	216	De Pere (C)
25	Ledgeview	231	Green Bay (C)
26	Morrison	136	Howard (V)
28	New Denmark	171	Pulaski (V)
30	Pittsfield	178	Suamico (V)
34	Rockland	191	Wrightstown (V)
36	Scott		
40	Wrightstown		Unincorporated Villages
		15	Anston
		19	Big Suamico
		20	Greenleaf
		12	Little Rapids
		11	New Franken
		13	Wayside
		20	W. Wrightstown

6 BUFFALO WSP-6

	Townships		Cities & Villages
02	Alma	201	Alma (C)
04	Belvidere	206	Buffalo (C)
06	Buffalo	111	Cochrane (V)
08	Canton	226	Fountain City (C)
10	Cross	251	Mondovi (C)
12	Dover	154	Nelson (V)
14	Gilmanton		
16	Glencoe		
18	Lincoln		
20	Maxville		
22	Milton		
24	Modena		
26	Mondovi		
28	Montana		
30	Naples		
32	Nelson		
34	Waumandee		

7 BURNETT

	Townships		Cities & Villages
02	Anderson	131	Grantsburg (V)
04	Blaine	181	Siren (V)
06	Daniels	191	Webster (V)
08	Dewey		
10	Grantsburg		Unincorporated Villages
12	Jackson	16	Danbury
14	La Follette	14	Ferron Park
16	Lincoln	12	Gaslyn
18	Meenon	07	Hertel
20	Oakland	01	Randall
22	Roosevelt	10	Yellowlake
24	Rusk		
26	Sand Lake		
28	Scott		
30	Siren		
32	Swiss		
34	Trade Lake		
36	Union		
38	Webb Lake		
40	West Marshland		
42	Wood River		

8 CALUMET

	Townships		Cities & Villages
02	Brillion	206	Brillion (C)
04	Brothertown	211	Chilton (C)
06	Charlestown	136	Hilbert (V)
08	Chilton	261	New Holstein (C)
10	Harrison	179	Sherwood (V)
12	New Holstein	181	Stockbridge (V)
14	Rantoul	201	Appleton (C)
16	Stockbridge	160	Potter
18	Woodville	241	Kiel
		251	Menasha
			Unincorporated Villages
		05	Darboy
		09	Dundas
		01	Forest Junction
		03	Hayton
		05	Highcliff

9 CHIPPEWA

	Townships		Cities & Villages
02	Anson	206	Bloomer (C)
04	Arthur	106	Boyd (V)
06	Auburn	111	Cadott (V)
08	Birch Creek	211	Chippewa Falls (C)
10	Bloomer	213	Cornell (C)
12	Cleveland	161	New Auburn (V)
14	Colburn		also in Barron Co.
16	Cooks Valley	281	Stanley (C)
18	Delmar	128	Lake Hallie (V)
20	Eagle Point		
22	Edson		Unincorporated Villages
24	Estella	16	Albertville
26	Goetz	18	Arnold

28	Hallie	02	Cobban
32	Howard	10	Eagleton
34	Lafayette	01	Jim Falls
35	Lake Holcombe		
36	Ruby		
38	Sampson		
40	Sigel		
42	Tilden		
44	Wheaton		
46	Woodmohr		

10 CLARK

	Townships		Cities & Villages
02	Beaver	201	Abbotsford (C)
04	Butler	211	Colby (C)
06	Colby	111	Curtiss (V)
08	Dewhurst	116	Dorchester (V)
10	Eaton	131	Granton (V)
12	Foster	231	Greenwood (C)
14	Fremont	246	Loyal (C)
16	Grant	261	Neillsville (C)
18	Green Grove	265	Owen (C)
20	Hendren	286	Thorp (C)
22	Hewett	191	Withee (V)
24	Hixon	186	Unity (V)
26	Hoard		
28	Levis		Unincorporated Villages
30	Loyal	07	Chili
32	Longwood	20	Humbird
3	Lynn	27	Riplinger
36	Mayville	23	Tioga
38	Mead	10	Willard
40	Mentor		
42	Pine Valley		
44	Reseberg		
46	Seif		
48	Sherman		
50	Sherwood		
52	Thorp		
54	Unity		
56	Warner		
58	Washburn		
60	Weston		
62	Withee		
64	Worden		
66	York		

11 COLUMBIA

	Townships		Cities & Villages
02	Arlington	101	Arlington (V)
04	Caledonia	111	Cambria (V)
06	Columbus	211	Columbus (C)
08	Courtland	116	Doylestown (V)
10	Dekorra	126	Fall River (V)
12	Ft. Winnebago	127	Friesland (V)
14	Fountain Prairie	246	Lodi (C)
16	Hampden	171	Pardeeville (V)
18	Leeds	271	Portage (C)
20	Lewiston	172	Poynette (V)
22	Lodi	176	Randolph (V)
24	Lowville	177	Rio (V)
26	Marcellon	291	Wisconsin Dells (C)
28	Newport	191	Wyocena (V)
30	Otsego		
32	Pacific		Unincorporated Villages
34	Randolph	119	Okee
36	Scott		
38	Springville		
40	West Point		
42	Wyocena		

12 CRAWFORD

	Townships		Cities & Villages
02	Bridgeport	106	Bell Center
04	Clayton	116	De Soto (V)
06	Eastman	121	Eastman (V)
08	Freeman	126	Ferryville (V)
10	Haney	131	Gays Mills (V)
12	Marietta	146	Lynxville (V)
14	Prairie du Chien	151	Mt. Sterling (V)
16	Scott	271	Prairie du Chien (C)
18	Seneca	181	Soldiers Grove (V)
20	Utica	182	Steuben (V)
22	Wauzeka	191	Wauzeka (V)
			Unincorporated Villages
		05	Barnum
		05	Petersburg

13 DANE

	Townships		Cities & Villages
02	Albion	106	Belleville (V)
04	Berry	107	Black Earth (V)
06	Black Earth	108	Blue Mounds (V)
		109	Brooklyn (V)
08	Blooming Grove	111	Cambridge (V)
10	Blue Mounds	112	Cottage Grove (V)
12	Bristol	113	Cross Plains (V)
14	Burke	116	Dane (V)
16	Christiana	117	Deerfield (V)
18	Cottage Grove	118	De Forest (V)
20	Cross Plains	221	Edgerton (V)
22	Dane	251	Madison (C)
24	Deerfield	151	Maple Bluff (V)
26	Dunkirk	154	McFarland (V)
28	Dunn	152	Marshall (V)
32	Madison	153	Mazomanie (V)
34	Mazomanie	255	Middleton (C)
36	Medina	258	Monona (C)
38	Middleton	157	Mt. Horeb (V)
40	Montrose	165	Oregon (V)
42	Oregon	176	Rockdale (V)
44	Perry	181	Shorewood Hills (V)
46	Pleasant Springs	281	Stoughton (C)
48	Primrose	282	Sun Prairie (C)
50	Roxbury	286	Verona (C)
52	Rutland	191	Waunakee (V)
54	Springdale		
56	Springfield		Unincorporated Villages
58	Sun Prairie	20	Basco
60	Vermont	27	Klevenville
62	Verona	12	London
64	Vienna	34	Morrisonville
66	Westport	27	Mt. Vernon
68	Windsor	20	Paoli
70	York	27	Riley

14 DODGE

Townships		Cities & Villages	
02	Ashippun	206	Beaver Dam (C)
04	Beaver Dam	106	Brownsville (V)
06	Burnett	111	Clyman (V)
08	Calamus	211	Columbus (C)
10	Chester	226	Fox Lake (C)
12	Clyman	230	Hartford (C)
14	Elba	236	Horicon (C)
16	Emmet	136	Hustisford (V)
18	Fox Lake	141	Iron Ridge (V)
20	Herman	241	Juneau (C)
22	Hubbard	143	Kekoskee (V)
24	Hustisford	146	Lomira (V)
26	Lebanon	147	Lowell (V)
28	Le Roy	251	Mayville (C)
30	Lomira	161	Neosho (V)
32	Lowell	176	Randolph (V)
34	Oak Grove	177	Reeseville (V)
36	Portland	186	Theresa (V)
38	Rubicon	291	Watertown (C)
40	Shields	292	Waupun (C)
42	Theresa		
44	Trenton		Unincorporated Villages
46	Westford	07	Astico
48	Williamstown	05	Atwater
		15	Knowles
		21	Marshville
		17	Minnesota Jct
		20	Richwood
		17	Rolling Prairie
		10	Woodland

15 DOOR

Townships		Cities & Villages	
02	Baileys Harbor	121	Ephraim (V)
04	Brussels	127	Forestville (V)
06	Clay Banks	181	Sister Bay (V)
08	Egg Harbor	281	Sturgeon Bay (C)
10	Forestville	118	Egg Harbor (V)
12	Gardner		
14	Gibraltar		Unincorporated Villages
16	Jacksonport	14	Detroit Harbor
18	Liberty Grove	09	Ellison Bay
20	Nasewaupee	07	Fish Creek
22	Sevastopol	08	Jacksonport-Sturgeon Bay
24	Sturgeon Bay	05	Mapelwood
26	Union	53	Sawyer-Sturgeon Bay
28	Washington	14	Washington Island
		04	Carlsville

16 DOUGLAS

Townships		Cities & Villages	
02	Amnicon	146	Lake Nebagamon (V)
04	Bennett	165	Oliver (V)
06	Brule	171	Poplar (V)
08	Cloverland	181	Solon Springs (V)
10	Dairyland	281	Superior (C)
12	Gordon	182	Superior Village (V)
14	Hawthorne		
16	Highland		Unincorporated Villages
18	Lakeside	55	Allouez
20	Maple	14	Amnicon Lake
22	Oakland	55	Billings Park
24	Parkland	10	Blueberry
26	Solon Springs	55	East End
28	Summit	14	Foxboro
30	Superior	07	Hines
32	Wascott	55	Itesca
		05	Dairyland
		14	Patzau
		12	South Range
		01	Wentworth

17 DUNN

Townships		Cities & Villages	
02	Colfax	106	Boyceville (V)
04	Dunn	111	Colfax (V)
06	Eau Galle	116	Downing (V)
08	Elk Mound	121	Elk Mound (V)
10	Grant	141	Knapp (V)
12	Hay River	251	Menomonie (C)
14	Lucas	176	Ridgeland (V)
16	Menomoniee	191	Wheeler (V)
18	New Haven		
20	Otter Creek		Unincorporated Villages
22	Peru	13	Caryville
24	Red Cedar	02	Downsville
26	Rock Creek	11	Meridean
28	Sand Creek	12	Rusk
30	Sheridan	13	Rock Falls
32	Sherman		
34	Spring Brook		
36	Stanton		
38	Tainter		
40	Tiffany		
42	Weston		
44	Wilson		

18 EAU CLAIRE

Townships		Cities & Villages	
02	Bridge Creek	201	Altoona (C)
04	Brunswick	202	Augusta (C)
06	Clear Creek	221	Eau Claire (C)
08	Drammen	126	Fairchild (V)
10	Fairchild	127	Fall Creek (V)
12	Lincoln		
14	Ludington		Unincorporated Villages
16	Otter Creek	03	Allen
18	Pleasant Valley	03	Foster
20	Seymour		
22	Union		
24	Washington		
26	Wilson		

19 FLORENCE

Townships		Unincorporated Villages	
02	Aurora	05	Spread Eagle
04	Commonwealth		
06	Fence		
08	Fern		
10	Florence		
12	Homestead		
14	Long Lake		
16	Tipler		

20 FOND DU LAC

Townships		Cities & Villages	
02	Alto	106	Brandon (V)
04	Ashford	111	Campbellsport (V)
06	Auburn	121	Eden (V)
08	Byron	126	Fair Water (V)
10	Calumet	226	Fond du Lac (C)
12	Eden	151	Mt. Calvary
14	Eldorado	161	N. Fond du Lac (V)
16	Empire	165	Oakfield (V)
18	Fond du Lac	276	Ripon (C)
20	Forest	176	Rosendale (V)
22	Friendship	181	St. Cloud (V)
24	Lamartine	142	Kewauskum (V)
26	Marshfield	292	Waupun (C)
28	Metomen		
30	Oakfield		**Unincorporated Villages**
32	Osceola	13	Calvary
34	Ripon	04	Hamilton
36	Rosendale	20	Malone
38	Springvale	15	Oak Center
40	Taycheedah	20	Peebles
42	Waupun	04	S. Byron
		11	Van Dyne

21 FOREST

Townships		Cities & Villages	
02	Alvin	211	Crandon (C)
04	Argonne		
06	Armstrong Creek		**Unincorporated Villages**
08	Blackwell	02	Argonne
10	Caswell	14	Carter
12	Crandon	05	Cavour
14	Freedom	08	Hiles
16	Hiles	11	Jones Spur
18	Laona	11	Mole Lake
20	Lincoln	11	Nashville
22	Nashville	01	Nelma
24	Popple River	13	Newald
26	Ross	14	Padus
28	Wabeno	10	Planets
		14	Soperton
		10	Keith

22 GRANT

Townships		Cities & Villages	
02	Beetown	106	Bagley (V)
04	Bloomington	107	Bloomington (V)
06	Boscobel	108	Blue River (V)
08	Cassville	206	Boscobel (C)
10	Castle Rock	111	Cassville (V)
12	Clifton	211	Cuba City (C)
14	Ellenboro	116	Dickeyville (V)
16	Fennimore	226	Fennimore (C)
18	Glen Haven	136	Hazel Green (V)
20	Harrison	246	Lancaster (C)
22	Hazel Green	147	Livingston (V)
24	Hickory Grove	151	Montfort (V)
26	Jamestown	152	Mt. Hope (V)
28	Liberty	153	Muscoda (V)
30	Lima	171	Patch Grove (V)
32	Little Grant	271	Platteville (C)
34	Marion	172	Potosi (V)
36	Millville	186	Tennyson (V)
38	Mt. Hope	191	Woodman (V)
40	Mt. Ida		
42	Muscoda		**Unincorporated Villages**
44	North Lancaster	27	Georgetown
46	Paris	13	Kieler
48	Patch Grove	13	Louisburg
50	Platteville	11	Sinsinawa
52	Potosi	14	Stitzer
54	Smelser	20	Werley
56	South Lancaster		
58	Waterloo		
60	Watterstown		
62	Wingville		
64	Woodman		
66	Wyalusing		

23 GREEN

Townships		Cities & Villages	
02	Adams	101	Albany (V)
04	Albany	206	Brodhead (C)
06	Brooklyn	106	Brooklyn (V)
08	Cadiz	110	Browntown (V)
10	Clarno	251	Monroe (C)
12	Decatur	151	Monticello (V)
14	Exeter	161	New Glarus (V)
16	Jefferson		
18	Jordan		**Unincorporated Villages**
20	Monroe	05	Clarno
22	Mt. Pleasant	08	Juda
24	New Glarus	04	Martintown
26	Spring Grove		
28	Sylvester		
30	Washington		
32	York		

24 GREEN LAKE

Townships		Cities & Villages	
02	Berlin	206	Berlin (C)
04	Brooklyn	231	Green Lake (C)
06	Green Lake	141	Kingston (V)
08	Kingston	251	Markesan (C)
10	Mackford	154	Marquette (V)
12	Manchester	271	Princeton (C)
14	Marquette		
16	Princeton		**Unincorporated Villages**
18	St. Marie	04	Dalton
20	Seneca		

25 IOWA

Townships		Cities & Villages	
02	Arena	101	Arena (V)
04	Brigham	102	Avoca (V)
06	Clyde	106	Barnevald (V)
08	Dodgeville	108	Blanchardville (V)
10	Eden	111	Cobb (V)
12	Highland	216	Dodgeville (C)
14	Landen	136	Highland (V)
16	Mifflin	137	Hollandale (V)
18	Mineral Point	146	Linden (V)
20	Moscow	147	Livingston (V) Also in Grant Co.
22	Pulaski		
24	Ridgeway	251	Mineral Point (C)
26	Waldwick	151	Montfort
28	Wyoming	176	Rewey (V)
		177	Ridgeway (V)
		153	Muscoda (V) Also in Grant Co.
			Unincorporated Villages
		07	Edmund
		13	Jonesdale

26 IRON

Townships		Cities & Villages	
02	Anderson	236	Hurley (C)
04	Carey	251	Montreal (C)
06	Gurney		
08	Kimball		
10	Knight		
12	Mercer		
14	Oma		
16	Pence		
18	Saxon		
20	Sherman		

Unincorporated Villages	
03	Cedar
04	Defer
08	Gile
05	Iron Belt
06	Manitowish
10	Powell
07	Sandrock
10	Springstead
01	Upson
07	Van Buskirk

27 JACKSON

Townships		Cities & Villages	
02	Adams	101	Alma Center (V)
04	Albion	206	Black River Falls (C)
06	Alma	136	Hixton (V)
08	Bear Bluff	151	Melrose (V)
10	Brockway	152	Merrillan (V)
12	City Point	186	Taylor (V)
14	Cleveland		
16	Curran		
18	Franklin		
20	Garden Valley		
22	Garfield		
24	Garfield		
26	Irving		
28	Knapp		
30	Komensky		
32	Manchester		
34	Melrose		
36	Millston		
38	North Bend		
40	Northfield		
42	Springfield		

Unincorporated Villages	
01	Disco
05	Pray
11	Sechlerville

28 JEFFERSON

Townships		Cities & Villages	
02	Aztalan	111	Cambridge (V)
04	Cold Spring	226	Ft. Atkinson (C)
06	Concord	241	Jefferson (C)
08	Farmington	141	Johnson Creek (V)
10	Hebron	146	Lac LaBelle (V)
12	Ixonia	246	Lake Mills (C)
14	Jefferson	171	Palmyra (V)
16	Koshkonong	181	Sullivan (V)
18	Lake Mills	290	Waterloo (C)
20	Milford	291	Watertown (C)
22	Oakland	292	Whitewater (C)
24	Palmyra		
26	Sullivan		
28	Sumner		
30	Waterloo		
32	Watertown		

Unincorporated Villages	
07	Helenville
10	Hubbleton
01	Jefferson Jct
13	Oak Hill
13	Rome

29 JUNEAU

Townships		Cities & Villages	
02	Armenia	111	Camp Douglas (V)
04	Clearfield	221	Elroy (C)
06	Cutler	136	Hustler (V)
08	Finley	146	Lyndon Station (V)
10	Fountain	251	Mauston (C)
12	Germantown	161	Necedah (V)
14	Kildare	261	New Lisbon (C)
16	Kingston	186	Union Center (V)
18	Lemonweir	291	Wisconsin Dells (C)
20	Lindina	191	Wonewoc (V)
22	Lisbon		
24	Lyndon		
26	Marion		
28	Necedah		
30	Orange		
32	Plymouth		
34	Seven Mile Creek		
36	Summit		
38	Wonewoc		

Unincorporated Villages	
14	Cloverdale
04	Finley
08	Mather
08	Meadow Valley
14	Sprague

30 KENOSHA

Townships		Cities & Villages	
02	Brighton	241	Kenosha (C)
04	Bristol	131	Genoa City (V)
06	Paris	171	Paddock Lake (V)
10	Pleasant Prairie	174	Pleasant Prairie (V)
12	Randall	181	Silver Lake (V)
14	Salem	186	Twin Lakes (V)
16	Somers		

Unincorporated Villages	
05	Bassett
06	Benet Lake
06	Camp Lake
05	Cross Lake
05	Crow Lake
06	Fox River
08	New Munster
05	Powers Lake
05	Richmond, Ill
08	Slades Corners
06	Trevor
04	Truesdell
06	Wilmot
02	Woodworth

31 KEWAUNEE

Townships		Cities & Villages	
02	Ahnapee	111	Casco (V)
04	Carlton	146	Luxemburg (V)
06	Casco	201	Algoma (C)
10	Franklin	241	Kewaunee (C)
12	Lincoln		
14	Luxemburg		
16	Montpelier		
18	Pierce		
20	Red River		

32 LA CROSSE

Townships		Cities & Villages	
02	Bangor	106	Bangor (V)
04	Barre	136	Holmen (V)
06	Burns	246	La Crosse (C)
08	Campbell	265	Onalaska (C)
10	Farmington	176	Rockland (V)
12	Greenfield	191	West Salem (V)
14	Hamilton		
16	Holland		
18	Medary		

Unincorporated Villages	
09	Midway

20	Onalaska	05	Mindoro
22	Shelby		
24	Washington		

33 LAFAYETTE

Townships		Cities & Villages	
02	Argyle	101	Argyle (V)
04	Belmont	106	Belmont (V)
06	Benton	107	Benton (V)
08	Blanchard	108	Blanchardville (V)
10	Darlington	211	Cuba City (C)
12	Elk Grove	216	Darlington (C)
14	Fayette	131	Gratiot (V)
16	Gratiot	281	Shullsburg (C)
18	Kendall	181	South Wayne (V)
20	Lamont	136	Hazel Green (C)
22	Monticello		
24	New Diggings	Unincorporated Villages	
26	Seymour	17	Calamine
28	Shullsburg	14	Dunbarton
30	Wayne	12	Leadmine
32	White Oak Springs	02	Leslie
34	Willow Springs	18	Woodford
36	Wiota		

34 LANGLADE

Townships		Cities & Villages	
02	Ackley	201	Antigo (C)
04	Ainsworth	191	White Lake (V)
06	Antigo		
08	Elcho	Unincorporated Villages	
10	Evergreen	12	Bryant
12	Langlade	07	Deerbrook
14	Neva	05	Elton
16	Norwood	17	Hollister
18	Parrish	07	Kempster
20	Peck	06	Lily
22	Polar	17	Markton
24	Price	02	Pearson
26	Rolling	08	Phlox
28	Summit	06	Pickerel
30	Upham	15	Summit Lake
32	Vilas		
34	Wolf River		

35 LINCOLN

Townships		Cities & Villages	
02	Birch	251	Merrill (C)
04	Bradley	286	Tomahawk (C)
06	Corning		
08	Harding	Unincorporated Villages	
10	Harrison	10	119 Bloomville
12	King	11	Doering
14	Merrill	10	Gleason
16	Pine River	01	Irma
18	Rock Falls	05	Jeffris
20	Russell	15	Spirit Falls
22	Schley	02	Heafford Jct
24	Scott		
26	Skanawan		
28	Somo		
30	Tomahawk		
32	Wilson		

36 MANITOWOC

Townships		Cities & Villages	
02	Cato	112	Cleveland (V)
04	Centerville	126	Francis Creek (V)
06	Cooperstown	241	Kiel (C)
08	Eaton	251	Manitowoc (C)
10	Franklin	151	Mishicot (V)
12	Gibson	176	Reedsville (V)
14	Kossuth	181	St. Nazianz (V)
16	Liberty	286	Two Rivers (C)
18	Manitowoc	186	Valders (V)
20	Manitowoc Rapids	191	Whitelaw (V)
22	Maple Grove	147	Maribel (V)
24	Meeme	132	Kellnersville (V)
26	Mishicot		
28	Newton	Unincorporated Villages	
30	Rockland	10	Branch
32	Schleswig	15	Collins
34	Two Creeks	01	Grimms
36	Two Rivers	02	Hika
		15	Quarry
		13	Tisch Mills

37 MARATHON

Townships		Cities & Villages	
02	Bergen	201	Abbotsford (C)
04	Berlin	102	Athens (V)
06	Bern	104	Birnamwood (V)
08	Bevent	106	Brokaw (V)
10	Frighton	211	Colby (C)
12	Cassel	116	Dorchester (V)
14	Cleveland	121	Edgar (V)
16	Day	122	Elderon (V)
18	Easton	126	Fenwood (V)
20	Eau Pleine	136	Hatley (V)
22	Elderon	145	Kronewetter (V)
24	Emmett	151	Marathon City (V)
26	Frankfort	250	Marshfield (C)
28	Franzen	251	Mosinee (C)
30	Green Valley	176	Rothschild (V)
32	Guenther	281	Schofield (C)
34	Halsey	181	Spencer (V)
36	Hamburg	182	Stratford (V)
38	Harrison	186	Unity (V)
40	Hewitt	291	Wausau (C)
42	Holton	192	Weston (V)
44	Hull		
46	Johnson	Unincorporated Villages	
48	Knowlton	23	Corinth
52	Maine	24	Dancy
54	Marathon	14	Galloway
56	Mc Millan	39	Granite Heights
58	Mosinee	23	Milan
60	Norrie	12	Moon
62	Plover	02	Naugart
64	Reid	08	Rozellville
66	Rib Falls		
68	Rib Mountain		
70	Rietbrock		
72	Ringle		
74	Spencer		
76	Stettin		
78	Texas		
80	Wausau		
82	Weston		
84	Wien		

38 MARINETTE

Townships		Cities & Villages	
02	Amberg	111	Coleman (V)
04	Athelstane	251	Marinette (C)
06	Beaver	261	Niagara (V)
08	Beecher	271	Peshtigo (C)
10	Dunbar	171	Pound (V)
12	Goodman	191	Wausaukee (V)
14	Grover	121	Crivitz (V)
16	Lake		
18	Middle Inlet		Unincorporated Villages
20	Niagara	01	189 Cedarville
22	Pembine	02	Intervale
24	Peshtigo	08	Loomis
26	Porterfield	17	Mc Allister
28	Pound	01	Marek
30	Silver Cliff	13	Walsh
32	Stephenson		
34	Wagner		
36	Wausaukee		

39 MARQUETTE

Townships		Cities & Villages	
02	Buffalo	121	Endeavor (V)
04	Crystal Lake	251	Montello (C)
06	Douglas	161	Neshkoro (V)
08	Harris	165	Oxford (V)
10	Mecan	191	Westfield (V)
12	Montello		
14	Moundville		Unincorporated Villages
16	Neshkoro	03	Briggsville
18	Newton	06	Glen Oak
20	Oxford		
22	Packwaukee		
24	Shields		
26	Springfield		
28	Westfield		

73 MENOMONEE

01	Indian Reservation Township of Menomonee County of Menomonee

Unincorporated Villages w/Post Offices	
01	Keshena
01	Neopit

40 MILWAUKEE

Unincorp.Villages		Cities & Villages	
57	Alois	106	Bayside (V)
57	Bay View	107	Brown Deer (V)
67	Carrollville	211	Cudahy (C)
57	Granville	126	Fox Point (V)
57	North Milwaukee	226	Franklin (C)
67	Oakwood	231	Glendale (C)
68	Saint Martins	131	Greendale (V)
56	Silverdale	236	Greenfield (C)
57	Tippecanoe	136	Hales Corners (V)
57	Wood	251	Milwaukee (C)
		265	Oak Creek (C)
		176	River Hills (V)
		281	Saint Francis (C)
		181	Shorewood (V)
		281	South Milwaukee (C)
		291	Wauwatosa (C)
		292	West Allis (C)
		191	West Milwaukee (V)
		192	Whitefish Bay (V)

41 MONROE

Townships		Cities & Villages	
02	Adrian	111	Cashton (V)
04	Angelo	141	Kendall (V)
06	Byron	151	Melvina (V)
08	Clifton	161	Norwalk (V)
10	Glendale	165	Oakdale (V)
12	Grant	281	Sparta (C)
14	Greenfield	286	Tomah (C)
16	Jefferson	191	Wilton (V)
18	La Fayette	192	Wyeville (V)
20	La Grange	185	Warrens (V)
22	Leon		
24	Lincoln		Unincorporated Villages
26	Little Falls	02	Camp Mc Coy
28	New Lyme	13	Cataract
30	Oakdale	03	Shennington
32	Portland	02	Sparta Military
34	Ridgeville	07	Tunnel City
36	Scott	03	Valley Jct
38	Sheldon		
40	Sparta		
42	Tomah		
44	Wellington		
46	Wells		
48	Wilton		

42 OCONTO

Townships		Cities & Villages	
02	Abrams	231	Gillett (C)
06	Armstruck	146	Lena (V)
08	Bagley	265	Oconto (C)
10	Brazeau	266	Oconto Falls (C)
12	Breed	171	Pulaski (V)
14	Chase	181	Suring (V)
16	Doty		
18	Gillett		Unincorporated Villages
19	How	23	Lakewood
20	Lakewood	08	229 Mosling
22	Lena	02	Mountain
24	Little River	12	Sobieski
26	Little Suamico		
28	Maple Valley		
29	Morgan		
30	Oconto		
32	Oconto Falls		
34	Pensaukee		
36	Riverview		
38	Spruce		
40	Stiles		
42	Townsend		
44	Underhill		

43 ONEIDA

Townships		Cities & Villages	
02	Cassian	276	Rhinelander (C)
04	Crescent		
06	Enterprise		Unincorporated Villages
08	Hazelhurst	17	Clearwater Lake
10	Lake Tomahawk	12	Gagen
12	Little Rice	01	Harshaw
14	Lynne	10	McNaughton
16	Minocqua	14	Pelican Lake
18	Monico	16	Robbins
20	Newbold	15	Roosevelt
22	Nokomis	15	Starks

24	Pelican	07	Tripoli
26	Piehl		
28	Pine Lake		
30	Schoepke		
32	Stella		
34	Sugar Camp		
36	Three Lakes		
38	Woodboro		
40	Woodruff		

44 OUTAGAMIE

Townships		Cities & Villages	
02	Black Creek	201	Appleton (C)
04	Bovina	106	Bear Creek (V)
06	Buchanan	107	Black Creek (V)
08	Center	111	Combined Locks (V)
10	Cicero	136	Hortonville (V)
12	Dale	137	Howard (V)
14	Deer Creek	241	Kaukauna (C)
16	Ellington	141	Kimberly (V)
18	Freedom	146	Little Chute (V)
20	Grand Chute	261	New London (C)
22	Grenville	155	Nichols (V)
24	Hortonia	281	Seymour (C)
26	Kaukauna	181	Shiocton (V)
28	Liberty	191	Wrightstown (V)
30	Maine		
32	Maple Creek		Unincorporated Villages
34	Oneida	06	Medina
36	Osborne	16	Sugar Bush
38	Seymour		
40	Vandenbrock		

45 OZAUKEE

Townships		Cities & Villages	
02	Belgium	105	Bayside (V)
04	Cedarburg	106	Belgium (V)
06	Fredonia	211	Cedarburg (C)
08	Grafton	126	Fredonia (V)
12	Pt. Washington	131	Grafton (V)
14	Saukville	255	Mequon (C)
		271	Pt. Washington (C)
Unincorp. Villages		181	Saukville (V)
03	Waubeka	186	Thiensville (V)
		161	Newburg (V)

46 PEPIN

Townships		Cities & Villages	
02	Albany	216	Durand (C)
04	Durand	171	Pepin (V)
06	Frankfort	181	Stockholm (V)
08	Lima		
10	Pepin		Unincorporated Villages
12	Stockholm	07	Arkansaw
14	Waterville		
16	Waubeek		

47 PIERCE

Townships		Cities & Villages	
02	Clifton	106	Bay City (V)
04	Diamond Bluff	121	Ellsworth (V)
06	Ellsworth	122	Elmwood (V)
08	El Paso	151	Maiden Rock (V)
10	Gilman	171	Plum City (V)
12	Hartland	271	Prescott (C)
14	Isabelle	276	River Falls (C)
16	Maiden Rock	181	Spring Valley (V)
18	Martell		
20	Oak Grove		Unincorporated Villages
22	River Falls	16	Beldenville
24	Rock Elm	02	Diamond Bluff
26	Salem	15	Hager City
28	Spring Lake	09	Martell
30	Trenton		
32	Trimbelle		
34	Union		

48 POLK

Townships		Cities & Villages	
02	Alden	201	Amery (C)
04	Apple River	106	Balsam Lake (V)
06	Balsam Lake	111	Centura (C)
08	Beaver	112	Clayton (V)
10	Black Brook	113	Clear Lake (V)
12	Bone Lake	116	Dresser (V)
14	Clam Falls	126	Frederic (V)
16	Clayton	146	Luck (V)
18	Clear Lake	151	Milltown (V)
20	Eureka	165	Osceola (V)
22	Farmington	281	St. Croix Falls (C)
24	Garfield	168	Turtle Lake (V)
26	Georgetown		Also in Barron Co.
28	Johnstown		Unincorporated Villages
30	Laketown	14	Andrus
32	Lincoln	23	Cushing
34	Lorain	16	Deronda
36	Luck	23	Evergreen
38	Mc Kinley	08	Joel
40	Milltown	07	Lewis
42	Osceola	19	Lorain
44	St. Croix Falls	21	Nye
46	Sterling	12	Wanderoos
48	West Sweden	10	Wolfcreek

49 PORTAGE

Townships		Cities & Villages	
02	Alban	101	Almond (V)
04	Almond	102	Amherst (V)
06	Amherst	103	Amherst Jct (V)
08	Belmont	141	Junction City (V)
10	Buena Vista	151	Milladore (V)
12	Carson	161	Nelsonville (V)
14	Dewey	171	Park Ridge (V)
16	Eau Pleine	176	Rosholt (V)
18	Grant	281	Stevens Point (C)
20	Hull	191	Whiting (V)
22	Lanark	173	Plover (V)
24	Linwood		
26	New Hope		Unincorporated Villages
28	Pine Grove	17	Arnott
30	Plover	14	Bancroft
32	Sharon	05	Coddington
34	Stockton	17	Custer
		16	Polonia

50 PRICE

Townships		Cities & Villages	
02	Catawba	111	Catawba (V)
04	Eisenstein	141	Kennan (V)
06	Elk	271	Park Falls (C)
08	Emery	272	Phillips (C)
10	Fifield	171	Prentice (V)
12	Flambeau		
14	Georgetown		Unincorporated Villages

16	Hackett	12	Brantwood
18	Harmony	04	Dover
20	Hill	13	Kaiser
22	Kennan	13	Kennedy
24	Knox	06	Lugerville
26	Lake		
28	Ogema		
30	Prentice		
32	Spirit		
34	Worcester		

51 RACINE

Townships		Cities & Villages	
02	Burlington	206	Burlington (C)
04	Caledonia	104	Caledonia (V)
06	Dover	121	Elmwood Park (V)
08	Mt. Pleasant	151	Mt Pleasant (V)
10	Norway	161	North Bay (V)
12	Raymond	276	Racine (C)
14	Rochester	176	Rochester (V)
16	Waterford	181	Sturtevant (V)
18	Yorkville	186	Union Grove (V)
		191	Waterford (V)
Unincorp. Villages		192	Wind Point (V)
02	Franksville		
03	Kansasville		
05	Wind Lake		

52 RICHLAND

Townships		Cities & Villages	
02	Akan	106	Boaz (V)
04	Bloom	11	Cazenovia (V)
06	Buena Vista	146	Lone Rock (V)
08	Dayton	276	Richland Center (C)
10	Eagle	186	Viola (V)
12	Forest	196	Yuba (V)
14	Henrietta		
16	Ithaca	**Unincorporated Villages**	
18	Marshall	02	Bloom City
20	Orion	12	Excelsior
22	Richland	09	Gillingham
24	Richwood	03	Gotham
26	Rockbridge	03	Sextonville
28	Sylvan	12	Tavera
30	Westford	10	Twin Bluffs
32	Willow	02	West Lima

53 ROCK

Townships		Cities & Villages	
02	Avon	206	Beloit (C)
04	Beloit	210	Brodhead (C)
06	Bradford	111	Clinton (V)
08	Center	221	Edgerton (C)
10	Clinton	222	Evansville (C)
12	Fulton	126	Footville (V)
14	Harmony	241	Janesville (C)
16	Janesville	257	Milton (V)
18	Johnstown	165	Orfordville (V)
20	La Prairie		
22	Lima	**Unincorporated Villages**	
24	Magnolia	17	Afton
26	Milton	03	Avalon
28	Newark	15	Hanover
30	Plymouth	11	Lima Center
32	Porter	19	Shopiere
34	Rock	19	Tiffany
36	Spring Valley	03	Emerald Grove

38	Turtle	12	Cainville
40	Union		

54 RUSK

Townships		Cities & Villages	
02	Atlanta	106	Bruce (V)
04	Big Bend	111	Conrath (V)
06	Big Falls	131	Glen Flora (V)
08	Cedar Rapids	136	Hawkins (V)
10	Dewey	141	Ingram (V)
12	Flambeau	246	Ladysmith (C)
14	Grant	181	Sheldon (V)
16	Grow	186	Tony (V)
18	Hawkins	191	Weyerhaueer (V)
20	Hubbard		
22	Lawrence	**Unincorporated Villages**	
24	Marshall	02	Apollonia
26	Murry	10	Crane
28	Richland	17	Horseman
30	Rusk	02	Island Lake
32	South Forks	17	Kalish
34	Strickland	11	Walrath
36	Stubbs		
38	Thornapple		
40	True		
42	Washington		
44	Wilkinson		
46	Willard		
48	Wilson		

55 ST. CROIX

Townships		Cities & Villages	
02	Baldwin	106	Baldwin (V)
04	Cady	116	Deer Park (V)
06	Cylon	231	Glenwood City (C)
08	Eau Galle	136	Hammond (V)
10	Emerald	236	Hudson (C)
12	Erin Prairie	261	New Richmond (C)
14	Forest	161	North Hudson (V)
16	Glenwood	276	River Falls (C)
18	Hammond	176	Roberts (V)
20	Hudson	181	Somerset (V)
22	Kinnickinnic	182	Star Prairie (V)
24	Pleasant Valley	184	Spring Valley (V)
26	Richmond	191	Wilson (V)
28	Rush River	192	Woodville (V)
30	St. Joseph		
32	Somerset	**Unincorporated Villages**	
34	Springfield	13	Boardman
36	Stanton	15	Burkhardt
38	Star Prairie	17	Hersey
40	Troy	15	Houlton
42	Warren	06	Jewett

56 SAUK

Townships		Cities & Villages	
02	Baraboo	206	Baraboo (C)
04	Bear Creek	111	Cazenovia (V)
06	Dellona	141	Ironton (V)
08	Delton	146	Lake Delton (V)
10	Excelsior	147	La Valle (V)
12	Fairfield	148	Lime Ridge (V)
14	Franklin	149	Loganville (V)
16	Freedom	151	Merrimac (V)
18	Greenfield	161	North Freedom (V)
20	Honey Creek	171	Plain (V)
22	Ironton	172	Prairie du Sac

24	La Valle	276	Reedsburg (C)
26	Merrimac	176	Rock Springs (V)
28	Prairie du Sac	181	Sauk City (V)
30	Reedsburg	182	Spring Green (V)
32	Spring Green	191	West Baraboo (V)
34	Sumpter	291	Wis Dells (C)
36	Troy		
38	Washington		**Unincorporated Villages**
40	Westfield	17	Badger
42	Winfield	01	Devils Lake
44	Woodland	19	Hillpoint
		04	Mirror Lake

57 SAWYER

	Townships		Cities & Villages
02	Bass Lake	111	Corderay (V)
04	Couderay	121	Exeland (V)
06	Draper	236	Hayward (C)
08	Edgewater	176	Radisson (V)
10	Hayward	190	Winter (V)
12	Hunter		
14	Lenroot		**Unincorporated Villages**
16	Meadow Rock	14	Hauer
18	Meteor	02	Lemington
20	Ojibwa	03	Loretta
22	Radisson	03	Oxbow
24	Round Lake	14	Reserve
26	Sand Lake	14	Stone Lake
28	Spider Lake	16	Weirgor
30	Weirgor	04	Wooddale
32	Winter	04	Yarnell

58 SHAWANO

	Townships		Cities & Villages
02	Almon	101	Aniwa (V)
04	Angelica	106	Birnamwood (V)
06	Aniwa	107	Bonduel (V)
08	Bartelme	108	Bowler (V)
10	Belle Plaine	111	Cecil (V)
12	Birnamwood	121	Eland (V)
14	Fairbanks	131	Gresham (V)
16	Germania	282	Marion (C)
18	Grant	151	Mattoon (V)
20	Green Valley	171	Pulaski (V)
22	Hartland	281	Shawano (C)
24	Herman	186	Tigerton (V)
26	Hutchins	191	Wittenberg (V)
28	Lessor		
30	Maple Grove		**Unincorporated Villages**
32	Morris	09	Caroline
34	Navarino	09	Hunting
36	Pella	02	Krakow
38	Red Springs	12	Leopolis
40	Richmond	12	Lyndhurst
42	Seneca	10	Pulcifer
44	Washington	20	Red River
46	Waukechon	01	Shepley
48	Wescott	07	Split Rock
50	Wittenberg	20	Thornton
52	Stockbridge	21	Tilleda
		02	Zachow

59 SHEBOYGAN

	Townships		Cities & Villages
02	Greenbush	101	Adell (V)
04	Herman	111	Cascade (V)
06	Holland	112	Cedar Grove (V)
08	Lima	121	Elkhart Lake (V)
10	Lyndon	131	Glenbeulah (V)
12	Mitchell	135	Howards Grove (V)
14	Mosel	141	Kohler (V)
16	Plymouth	165	Oostburg (V)
18	Rhine	271	Plymouth (C)
20	Russell	176	Random Lake (V)
22	Scott	281	Sheboygan (C)
24	Sheboygan	282	Sheboygan Falls (C)
26	Sheboygan Falls	191	Waldo (V)
28	Sherman		
30	Wilson		**Unincorporated Villages**
		07	Haven
		04	Hingham

60 TAYLOR

	Townships		Cities & Villages
02	Aurora	131	Gilman (V)
04	Browning	146	Lublin (V)
06	Chelsea	251	Medford (C)
08	Cleveland	176	Rib Lake (V)
10	Deer Creek	181	Stetsonville (V)
12	Ford		
14	Goodrich		**Unincorporated Villages**
16	Greenwood	18	Donald
18	Hammel	04	Hannibal
20	Holway	08	Interwald
22	Jump River	09	Perkinstown
24	Little Black	06	Polley
26	Mc Kinley	03	Whittlesey
28	Maplehurst		
30	McKinley		
32	Medford		
34	Molitor		
36	Pershing		
38	Rib Lake		
40	Roosevelt		
42	Taft		
44	Westboro		

61 TREMPEALEAU

	Townships		Cities & Villages
02	Albion	201	Arcadia (C)
04	Arcadia	206	Blair (C)
06	Burnside	121	Eleva (V)
08	Caledonia	122	Ettrick (V)
10	Chimney Rock	231	Galesville (C)
12	Dodge	241	Independence (C)
14	Ettrick	265	Osseo (C)
16	Gale	173	Pigeon Falls (V)
18	Hale	181	Strum (V)
20	Lincoln	186	Trempealeau (V)
22	Pigeon	291	Whitehall (C)
24	Preston		
26	Sumner		**Unincorporated Villages**
28	Trempealeau	14	Centerville
30	Unity		

62 VERNON

Townships		Cities & Villages	
02	Bergen	111	Chaseburg (V)
04	Christiana	112	Coon Valley (V)
06	Clinton	116	De Soto (V)
08	Coon	131	Genoa (V)
10	Forest	236	Hillsboro (C)
12	Franklin	146	La Farge (V)
14	Genoa	165	Ontario (V)
16	Greenwood	176	Readstown (V)
18	Hamburg	181	Stoddard (V)
20	Harmony	186	Viola (V)
22	Hillsboro	286	Viroqua (C)
24	Jefferson	291	Westby (C)
26	Kickapoo		
28	Liberty	Unincorporated Villages	
30	Stark	05	Mt. Tabor
32	Sterling	21	Rockton
34	Union	05	Valley
36	Viroqua	20	Victory
38	Webster	16	West Prairie
40	Wheatland		
42	Whitestown		

63 VILAS

Townships		Cities & Villages	
02	Arbor Vitae	221	Eagle River (C)
04	Boulder Junction		
06	Cloverland	Unincorporated Villages	
08	Conover	12	Knudson
10	Lac Du Flambeau	05	Lac Du Flambeau
12	Lincoln	12	Land O'Lakes
14	Phelps	14	Mishike
16	Plum Lake	09	Presque Lake
18	Presque Isle	05	Rest lake
20	St. Germain	10	St. Germain
22	Manitowish Waters	08	Sayner
24	Land O'Lakes	08	Starlake
26	Washington	01	Trout Lake
28	Winchester	09	Winegar

64 WALWORTH

Townships		Cities & Villages	
02	Bloomfield	206	Burlington (C)
		116	Darien (V)
04	Darien	216	Delavan (C)
06	Delavan	121	East Troy (V)
08	East Troy	221	Elkhorn (C)
10	Geneva	126	Fontana (V)
12	La Fayette	131	Genoa City (V)
14	La Grange	246	Lake Geneva (C)
16	Linn	153	Mukwonago (V)
18	Lyons	181	Sharon (V)
20	Richmond	191	Walworth (V)
22	Sharon	291	Whitewater (C)
24	Spring Prairie	192	Williams Bay (V)
26	Sugar Creek		
28	Troy	Unincorporated Villages	
30	Walworth	02	119 Allen Grove
32	Whitewater	15	College Camp
		12	Honey Creek
		04	Lake Beulah
		01	Pell Lake
		09	Springfield
		14	Troy Center
		08	Zenda

65 WASHBURN

Townships		Cities & Villages	
02	Barronett	106	Birchwood (V)
04	Bashaw	151	Minong (V)
06	Bass Lake	282	Shell Lake (C)
08	Beaver Brook	281	Spooner (C)
10	Birchwood		
12	Brooklyn	Unincorporated Villages	
14	Casey	18	Earl
16	Chicog	06	Lampson
18	Crystal		
20	Evergreen		
22	Frog Creek		
24	Gull Lake		
26	Long Lake		
28	Madge		
30	Minong		
32	Sarona		
34	Spooner		
36	Spring Brook		
38	Stinnett		
40	Stone Lake		
42	Trego		

66 WASHINGTON

Townships		Cities & Villages	
02	Addison	131	Germantown (V)
04	Barton	236	Hartford (C)
06	Erin	141	Jackson (V)
08	Farmington	142	Kewaskum (V)
10	Germantown	251	Milwaukee (C)
12	Hartford	181	Slinger (V)
14	Jackson	291	West Bend (C)
16	Kewaskum	161	Newburg (V)
18	Polk		
20	Richfield	Unincorporated Villages	
22	Trenton	01	Aurora
24	Wayne	01	Allenton
26	West Bend	10	Colgate
		10	Hubertus
		05	Rockfield

67 WAUKESHA

Townships		Cities & Villages	
02	Brookfield	106	Big Bend (V)
04	Delafield	206	Brookfield (C)
06	Eagle	107	Butler (V)
08	Genesee	111	Chenequa (V)
10	Lisbon	216	Delafield (C)
14	Merton	116	Dousman (V)
16	Mukwonago	121	Eagle (V)
22	Oconomowoc	122	Elm Grove (V)
24	Ottawa	136	Hartland (V)
28	Summit	146	Lac La Belle (V)
30	Vernon	147	Lannon (V)
32	Waukesha	151	Menomonee Falls (V)
		152	Merton (V)
Unincorp. Villages		250	Milwaukee (C)
13	Duplainville	251	Muskego (C)
04	Genesee Depot	153	Mukwonago (V)
07	North Lake	158	Nashotah (V)
11	Okauchee	261	New Berlin (C)
02	Statesan	161	North Prairie (V)
05	Templeton	265	Oconomowoc (C)
		166	Oconomowoc Lake (V)
		171	Pewaukee (V)
		270	Pewaukee (C)

181	Sussex (V)
191	Wales (V)
291	Waukesha (C)

68 WAUPACA

Townships		Cities & Villages	
02	Bear Creek	106	Big Falls (V)
04	Caledonia	211	Clintonville (C)
06	Dayton	121	Embarrass (V)
08	Dupont	126	Fremont (V)
10	Farmington	141	Iola (V)
12	Fremont	251	Manawa (C)
14	Harrison	252	Marion (C)
16	Helvetia	261	New London (C)
18	Iola	165	Ogdensburg (V)
20	Larrabee	181	Scandinavia (V)
22	Lebanon	291	Waupaca (C)
24	Lind	292	Weyauwega (C)
26	Little Wolf		
28	Matteson	**Unincorporated Villages**	
30	Mukwa	05	King
32	Royalton	07	Northland
36	Scandinavia	15	Northport
38	Union	02	Readfield
40	Waupaca	05	Sheridan
42	Weyauwega	19	Symco
44	Wyoming		

69 WAUSHARA

Townships		Cities & Villages	
02	Aurora	111	Coloma (V)
04	Bloomfield	136	Hancock (V)
06	Coloma	146	Lohrville (V)
08	Dakota	171	Plainfield (V)
10	Deerfield	191	Redgranite (V)
12	Hancock	291	Wautoma (C)
14	Leon	191	Wild Rose (V)
16	Marion		
18	Mt. Morris	**Unincorporated Villages**	
20	Oasis	01	Auroraville
22	Plainfield	07	Pine River
24	Poy Sippi	02	W. Bloomfield
26	Richford		
28	Rose		
30	Saxeville		
32	Springwater		
34	Warren		
36	Wautoma		

70 WINNEBAGO

Townships		Cities & Villages	
02	Algoma	201	Appleton (C)
04	Black Wolf	251	Menasha (C)
06	Clayton	261	Neenah (C)
08	Menasha	265	Omro (C)
10	Neenah	266	Oshkosh (C)
12	Nekimi	191	Winneconne (V)
14	Nepeuskun		
16	Omro	**Unincorporated Villages**	
18	Oshkosh	13	Allenville
20	Poygan	15	Butte Des Morts
22	Rushford	11	Eureka
24	Utica	12	Fisk
26	Vinland	03	Larsen
28	Winchester	12	Pickett
30	Winneconne	07	Rush Lake
32	Wolf River	11	Waukau
		09	Winnebago

71 WOOD

Townships		Cities & Villages	
02	Arpin	101	Auburndale (V)
04	Auburndale	106	Biron (V)
06	Cameron	271	Pittsville (C)
08	Cary	171	Port Edwards (V)
10	Cranmoor	251	Marshfield (C)
12	Dexter	151	Milladore (V)
14	Grand Rapids	261	Nekoosa (C)
16	Hansen	178	Rudolph (V)
18	Hiles	186	Vesper (V)
20	Lincoln	291	Wisconsin Rapids (C)
22	Marshfield	122	Hewitt (V)
24	Milladore	100	Arpin (V)
26	Port Edwards		
28	Remington	**Unincorporated Villages**	
30	Richfield	14	Babcock
32	Rock	12	Blenker
34	Rudolph	06	Dexterville
36	Saratoga	16	Lindsey
38	Seneca		
40	Sherry		
42	Sigel		
44	Wood		

PURPOSE

This subject provides general guidance on the sizes of signs to be used based on certain highway characteristics. **This guideline does not apply to sizes for STOP signs. There is a separate guideline pertaining to the required sizes for STOP signs for roadways (TEOpS 2-2-5).**

DEFINITIONS

For the purposes of this guideline, highways are grouped by certain characteristics into a defined highway facility:

Freeways are divided arterial highway facilities that have full control of access by means of grade separation at interchanges only.

Expressways are divided arterial highway facilities that have partial control of access, generally with grade separations at major intersections.

Conventional highways are either divided or undivided roadway facilities that have no control of access and no grade separations at intersections.

2S is the sign size designation of conventional highway signs for single-lane conventional highways or multi-lane conventional highways with a posted speed of 35mph or less.

2M is the sign size designation of regulatory and warning signs for multi-lane conventional highways with a posted speed of 40mph.

POLICY

This guideline establishes the standard sign size to be used for each defined highway facility. Signs larger than the standard size *may* be used selectively and with documentation of the specific situational reason for use of a sign larger than the standard. Whenever a sign smaller than the standard is used, the conditions such as space or visibility constraints *should* be documented and approved by the Regional traffic engineer. The designer **shall** work with the Region Traffic Section to determine the proper sign sizes:

1. Freeways and interstate highways, size 5 signs, regardless of the posted speed limit.
2. Expressways with posted speed limits of 65 mph, use size 5 signs. Expressways with posted speed limits of 60, 55, or 50 mph, use size 4 signs. Use size 2S signs for side road approaches or that when approaching a highway facility would require a larger sign size under this guideline, use the larger size.
3. On and off ramps for service interchanges, use size 2S signs. System interchange ramps, use size 5 signs.
4. Conventional highways with single lanes (all speeds) and multi-lane conventional highways with a posted speed of 35 mph or less, use size 2S signs. Size 2M signs *may* also be used, at the discretion of the Region, to upsize sign sizes on single lane conventional highways or multi-lane conventional highways with a posted speed of 35 mph or less.
5. Conventional multilane roadways, with a posted speed of 40 mph, use size 2M regulatory and warning signs.
6. Conventional multi-lane roadways, with a posted speed of 45 mph or greater, us size 3 signs. As an option, size 2M *may* be used for urban conventional multi-lane roadways with posted speeds of 45 mph if there are limiting physical factors that would not make size 3 signs feasible. Some of these limiting physical factors would include: narrow terrace or median widths, close driveway spacing and close intersection spacing.
7. Size 1 signs *may* be used on streets and highways which are neither state trunk highways, nor connecting highways when there is no more than one lane of traffic in each direction, and the posted speed limit is 30 mph or less.
8. Additional sign size criteria for bypasses are contained in TEOpS 2-15-53 (bypass Signing).

2-1-41 Jurisdictional Boundary Signs January 2024

GENERAL

Communities *may* request informational signing to either identify their municipal boundaries or to promote/advertise their community. These types of signs are considered to be Jurisdictional Boundary signs and *may* take the form of three different types of signs:

- Welcome signs
- Enhanced political boundary signs
- Community population signs.

The community population signs and enhanced political boundary signs are considered a traffic sign and are allowed on the highway right-of-way. Per Wis. Stat. s. 86.19 (1n) and (1p), municipal and tribal nation welcome signs are not traffic control devices and are not subject to the provisions of the WisMUTCD. A municipality or tribal nation *may* erect and maintain within the right-of-way of any highway, a welcome sign as defined in s.84.30(2)(hm), within the boundaries of the municipality or Indian reservation or other land held in trust for the tribe or band. This policy provides guidance for working with these types of signing requests.

AUTHORITY

Wis. Stat. s. 86.19 prohibits signs within the limits of any highway except as are necessary for the guidance or warning of traffic and certain other exceptions as provided in that section. This statute also requires the Department to prescribe regulations with respect to erection of signs on public highways.

The MUTCD Section 1A.01 states that advertising messages **shall not** appear on traffic control devices and Section 1A.10 states that the design, application and placement of traffic control devices, other than those adopted in the MUTCD are prohibited.

Therefore, the 2009 MUTCD and Wisconsin State Statute 86.19 have specific standards regarding the design and installation of such signing:

POLICY FOR COMMUNITY WELCOME SIGNS

Welcome signs are defined as an official sign that is erected and maintained by or for a local government within the boundaries of the municipality or tribal land to inform motorists of the territorial boundaries of the community.

The Highway Maintenance Manual 09-20-30 contains the formal detailed policy governing the permitting of Municipal or Tribal Nation Welcome Signs.

In summary, HMM 09-20-30 states:

1. Welcome signs along state highways *may* be permitted when located on or off the highway right-of-way. When off the right-of-way, the sign is considered an outdoor advertising sign and a permit is required under s. 84.30 and Trans 201.05.
2. Unpermitted welcome signs **should** be removed if conditions warrant that the sign cannot be permitted as is. Prior to removal, the Department will work with the community to determine if the sign may be moved to a different location, rebuilt with yielding features/materials, shielded, etc. to allow issuance of a DT1812 permit.
3. Welcome signs installed within the highway right-of-way shall require a work on right-of-way permit (DT 1812 form).
4. Welcome signs that are within the clear zone or clear recovery area on the right-of-way **should** be constructed with breakaway or yielding features/materials. If not, then WisDOT approved shielding **shall** be provided for the sign.
5. No welcome sign will be allowed to remain if it is a safety hazard. The permittee **shall** be responsible for any costs incurred by the Department to correct or eliminate hazards related to the welcome sign.
6. Welcome signs **shall not** have auxiliary plaques, as these are considered advertising, and not allowed per s. 86.19.
7. Welcome signs are not allowed to be placed within the right-of-way of interstate highways but *may* be allowed on freeways.
8. Welcome signs are not owned or installed by the Department.
9. Welcome signs **shall not** be installed where vision corners may be blocked, such as at intersections or median breaks.

10. Care shall be taken to ensure that vision of existing or planned traffic signs is not blocked.

POLICY FOR ENHANCED POLITICAL BOUNDARY SIGNS

Enhanced political boundary signs are more of an informational sign as they do not directly provide a guidance function for the motorist. These signs are traffic signs that are installed on conventional highways, in the highway right-of-way, at the municipal limits by permit. The signs serve the functions of conveying the municipal limits of a community and *may* tie into the theme of the community by utilizing different colors and/or a pictograph on the sign.

GENERAL POLICY CRITERIA

1. If off-right-of-way location efforts fail for a welcome sign, then a community could apply for a permit to install and maintain an “enhanced political boundary sign.” Enhanced political boundary signs **shall not** be allowed if there is an off-right-of-way welcome sign in place.
2. If an enhanced political boundary sign is installed, then WisDOT would remove the standard population sign.
3. Enhanced political boundary signs *should* be ground-mounted on the right side of the roadway. Ground-mounted median signs *may* be installed if right-side installation opportunities are not available. No overhead sign installations are allowed.
4. Supplemental signs (tree city USA, 1979 baseball champs, lions clubs, etc.) **shall not** be allowed on the enhanced political boundary signs or supports.
5. Enhanced political boundary signs **shall** only be allowed on conventional highways for incorporated cities and villages, located at the municipality border. Enhanced political boundary signs **shall not** be allowed for townships or unincorporated communities.
6. All enhanced political boundary sign requests, including CSS projects, **shall** be approved by the Region Traffic Engineer. Requestor **shall** furnish proposed locations, sign and pictograph design and type of supports used.
7. The community population number *may* be included on the enhanced political boundary sign.
8. The community **shall** be responsible for all costs associated with the manufacture, installation and maintenance of the permitted enhanced political boundary signs.

SIGN DESIGN STANDARDS

1. Destinations, arrows or specific traffic generators **shall not** be allowed on the signs.
2. The pictograph (logo) height **shall not** exceed two times the height of the upper case letters and **shall** be located at the top or left side of the sign. The pictograph **shall** be the official designation adopted by the jurisdiction. The pictograph *may* contain wording, provided it is not a commercial advertising message. Only one pictograph is allowed per sign.
3. Enhanced political boundary signs **shall not** be lighted or contain any animated or moving parts, flashing lights or disks.
4. At minimum, enhanced political boundary signs **shall** utilize Type H—High Intensity sheeting.
5. Minimum letter size **shall** be 4 ½” lowercase, 6: uppercase letters. Maximum sign size **shall** be 72: width by 48: height.
6. Sign base material **shall** be in accordance with [Section 637 of the WisDOT Standard Construction Specifications]().
7. The sign shape **shall** be rectangular. Aluminum signs **shall** have rounded corners.
8. Border is required on the signs and **shall** be retroreflective, and of the same color as the text.
9. Colors **shall** meet the standards for highway colors specified by the Federal Highway Administration.

Two color combinations *may* be used which are:

- White or yellow on blue, green or brown
- Blue, green, black or brown on white

- Red or orange on white, but not the reverse
- The background colors of orange, red, yellow, purple, or the fluorescent versions thereof, fluorescent yellow green and fluorescent pink **shall not** be allowed. One background color only allowed. Lettering and border (if used) **shall** be of the same color.

SIGN INSTALLATION STANDARDS

1. The standard WisDOT posts (4” x 6” wood or 2” x 2” tube steel) *may* be used. The community also *may* be allowed to utilize other types of sign posts. Non-standard sign posts **shall** conform to TEOpS 2-15-52.
2. Sign installation and placement **shall** be per WisDOT standards.
3. Sign mounting height **shall** be five feet to bottom of sign.
4. Sign locations **shall** be approved by WisDOT. Signs **shall** be located outside of the influence area of an intersection (typically 200’ minimum distance from the intersection).
5. WisDOT **shall** approve any proposed landscaping plans. Any landscaping items **shall** meet breakaway standards or be shielded with FHWA approved shielding. For example, there is a 20” high decorative curb that meets FHWA standards.

POLICY FOR COMMUNITY POPULATION SIGNS

1. City or village limit signs *may* be installed on freeways or expressways at or near where the highway enters the municipality, unless the city or village is identified on the primary guide signs or a supplemental guide sign.
2. City or village population signs **shall** be installed on conventional highways at or near where the highway enters the municipal limits. WisDOT will install and maintain the standard signs with the official current decennial census figures. No other signs **shall** share the supports.
3. If the city or village requests a population update, the Regional Traffic Engineer *may* authorize the municipality to modify the numbers with a white on green Type H adhesive overlay, using the same size and font as the original sign.
4. Signing for unincorporated communities is covered in TEOpS 2-4-48.

APPLICATION AND PERMIT

1. Permit **shall** be approved by the WisDOT Regional Traffic Engineer.
2. The application from the requesting community **shall** contain a plan showing the sign location9s) and sign fabrication detail (including colors and heights of letters and pictograph).

2-1-42 State Entrance Signing — December 2022

PURPOSE

In the past, several different signs have been installed along Department-maintained roadways at state entrances. In some cases, several signs have been installed on the same support. At some state entrances, blue and green signs cut out partially in the shape of Wisconsin have been installed. Based on an interpretation received from FHWA in 2013, the shape of these signs is not in conformance with the 2009 MUTCD. This policy will define the appropriate sequence of signs when entering the state along a Department-maintained roadway.

DEFINITIONS

Freeways are defined as divided arterial highway facilities that have full controlled access, by means of grade separation at interchanges only.

Expressways are defined as divided arterial highway facilities that have partial control of access and generally with grade separations at major intersections.

Conventional Highways are defined as either divided or undivided roadway facilities that have no control of access with grade separations at intersections. These highways can be two lane or multilane facilities.

POLICY

Freeways and Expressways

The standard order of sign installations along a freeway or expressway, beginning at the state line, is shown below. 200’ minimum spacing *should* be maintained between each sign installation. Note that this order may need to be adjusted based on field conditions.

1. I2-1 (Wisconsin) with I2-2 (County name) directly below.
2. J4-series (Reassurance Assembly)
3. R2-1 (Speed Limit)
4. R5-60 (Move Over or Slow Down)
5. D12-5 (Travel Info Call 511)

In addition to this on-right-of-way signing, for freeway and expressway entrances to the state, a large timber “Wisconsin Welcomes You” sign is typically installed in an off-right-of-way location that is visible to traffic.

Conventional Highways

The standard order of sign installations along a conventional highway, beginning at the state line, is shown below. 200’ minimum spacing *should* be maintained between each sign installation in rural areas. 100’ minimum spacing *should* be maintained between each sign in urban areas. Note that this order *may* need to be adjusted based on field conditions.

1. If a large timber sign is not present, the I2-1B *should* be used instead of the I2-1 with I2-2 (County name) directly below.
2. I2-3 (Community population sign) – only if entering municipal limits
3. J4-series (Reassurance Assembly)
4. R2-1 (Speed Limit)
5. D2-series – not used if entering municipal limits

In addition to this on-right-of-way signing, for conventional highway entrances to the state that are part of the National Highway System, a large timber “Wisconsin Welcomes You” sign is typically installed in an off-right-of-way location that is visible to traffic. If a large timber sign is present, I2-1 *should* be used instead of the I2-1B

IMPLEMENTATION

There is no formal phase-in period for installation of this signing. Existing non-conforming state entrance signs will be allowed to remain in place until the end of their useful life. Useful life ends when the sign message no longer meets legibility or condition standards. Existing non-conforming state entrance signs *may* be replaced prior to the end of their useful life when opportunities arise such as knockdown or damage, when other work is occurring nearby, or when projects make replacement practical.

2-1-45 Usage of Fluorescent Sheeting on Signs — August 2013

PURPOSE

Fluorescent colored sheeting cab be advantageous to use on certain traffic signs. In addition to enhanced nighttime retroreflectivity, the fluorescent color allows for greater daytime conspicuity of signs as well. This is especially important for enhancing traffic safety of the motorist and addressing the fact that a greater percentage of people in our population are becoming older and their eyesight requires a brighter sheeting material.

There are three colors of fluorescent sheeting that are commercially available: orange, yellow and yellow-green. The Federal Highway Administration allows the use of fluorescent yellow-green sheeting on some warning signs for pedestrian, bicycle, playground and school applications. The following guidelines limit the usage of the three fluorescent sheeting colors to certain specific signs in order to retain the unique quality of the sheeting.

POLICY

Fluorescent Yellow Sheeting

Beginning in 2010, WisDOT has been in the process of converting yellow warning signs from ASTM D4956 Type IV (prismatic high intensity yellow) to ASTM D4956 Type XI fluorescent yellow, starting with the most critical of warning signs. Phase 1 (June 2010) included signs such as Stop Ahead, No Passing Zone, Pedestrian Crossing, Chevrons and Large Arrows. Phase 2 (June 2012) included Curve and Turn signs, Intersection Warning signs, advisory speed signs and bridge object markers. The final phase for implementation (Phase 3) will be for the remainder of the warning signs. This change will be completed by December 1, 2013. Beginning with the December 2013 letting, all warning signs on WisDOT projects will be converted to ASTM D4956 Type XI fluorescent yellow. Replace existing conventional yellow signs with fluorescent yellow as they wear out, through improvement projects or sign damage/knockdowns.

All chevrons in a curve or turn **shall** match sheeting color (either fluorescent yellow or conventional yellow). If warning signs are doubled up on an approach, the sheeting **shall** match (either fluorescent yellow or conventional yellow). Supplemental warning plaques **shall** match the main signs that they supplement. No mixing of colors.

<u>Fluorescent Yellow-Green Sheeting</u>

S1-1 School Crossing Signs, S4-51 School Speed Limit Assemblies, S4-52 School In-Street Pedestrian Crossing Signs, S4-5 School Reduced Speed Limit Warning Signs on the WisDOT highway system **shall** use fluorescent yellow-green sheeting. The usage of fluorescent yellow-green sheeting **shall** also be used on the Ahead plaque (WF16-9P) for the School Advance Sign location, and Diagonal Down Arrow Signs (WF16-7L and WF16-7R) for the School Crossing Sign location. No other signs **shall** use the fluorescent yellow=green sheeting.

<u>S3-1 School Bus Stop Ahead and S3-51 School Bus Traffic Signs</u>

Replace existing conventional yellow signs with fluorescent yellow signs as they wear out, through improvement projects or damage claim knockdowns. All School Bus Stop Ahead signs and School Bus Traffic signs **shall** be replaced with the fluorescent yellow-green symbol sign no later than January 1, 2016.

Any signs with fluorescent yellow=green sheeting other than the School Crossing signs that were installed before the date this policy became effective *may* remain in place. Once these signs have reached their useful life, the Region **shall** replace them with regular yellow sheeting signs.

<u>Fluorescent Orange Sheeting</u>

Fluorescent orange sheeting **shall** be used on all work zone warning signs.

Fluorescent orange sheeting **shall** be used for all construction detour route assemblies (M4-5 TO, M5 and M6 series arrows and M4-8 detour plaques) and traffic control fixed message signs.

2-1-50 Snowmobile Trail Signing — August 1995

At some locations on state trunk highway right-of-ways, local agencies *may* erect signing for the purpose of directing and controlling snowmobile operations. This is permissible unless there is some problem generated by the existence of snowmobiles at specific locations. Signing for the snowmobile trails is described in Administrative Code NR 50, and also described with typical applications illustrated in DNR's "Trail Signing Handbook", 1994. A copy of this book *should* be kept in each traffic section.

In interpreting this book the following is offered:

1. All responsibility for signing along the trail is local, including installation and maintenance.
2. The Department's responsibility includes only signs which *may* be requested directing to trail head parking lots, and such warning signs directed to motorists advising of snowmobile crossings where these warnings are warranted.
3. Regarding illustrations in the book (figures on pages 19-22 and page 28):
    a. Warning signs on the trail when visible from the highway *should* be the minimum size specified.
    b. Orange markers on the right-of-way would usually be unnecessary except to mark a turn.
    c. STOP signs are shown too close to the highway. They *should* be back of the snowplowing range, at least 20' from the pavement and desirably more.
    d. STOP signs *should* be parallel to the highway, and the trail approaching the highway *should* be aligned to be as near to a right angle as possible.
    e. Warning signs on the highway are shown routinely in the illustrations. On state trunk highways,

they are only to be installed where warranted, usually due to sight conditions.

4. On page 12 of the handbook: "If requested, the Department will install and maintain guide signs for trail head parking lots. The signs *should* contain the word 'Parking.'"

   The term "snowmobile route" is defined to mean snowmobile travel on an unplowed roadway. Consequently, "routes" are not to be signed on state trunk highways or connecting highways.

5. Sign posts on the right-of-way installed by local agencies **shall** meet the same small support safety standards as those erected by the Department.

6. Trail signs **shall not** be attached to any of the Department's signposts.

2-1-55 Alternate Roadway Signing — April 2001

PURPOSE

In some areas of the state, there are sections of roadways that are frequently closed to traffic for brief periods of time. As a result, motorists are directed to use an alternate route, usually by law enforcement officials. Many of these alternate route locations are used frequently enough that they could be permanently signed as alternate roadways.

There are several benefits of alternate roadway signing. Alternate signing can direct traffic onto an alternate roadway in case the mainline roadway is closed, due to bad weather, crashes, or other incidents. A permanently signed alternate route can assist State Patrol Troopers and other personnel because less manpower will be required to direct motorists on an alternate route.

INSTALLATION GUIDELINES

The following criteria *should* be considered by each Regional Traffic Section in the design/implementation of permanent signing for an alternate roadway. It *should* be noted that this type of alternate route signing is optional in each Region and the Region will have the final say on whether to approve or deny this signing. Example details are also provided as part of this policy. This policy applies to the signing of alternate routes for mainline roadways that re on the WisDOT system.

1. During the design of alternate roadway signing, the Regional Traffic Section *should* contact the State Patrol and local highway officials for comment. Some existing county trunk highways and local roads *may* not be suitable as alternate traffic routes. The Region *should* check to see if the alternate route being considered has been previously designated a long truck route. Per Wisconsin Administrative Code 276.08, once a route is permanently signed as an alternate, it will legally be considered a long truck route. The Region *should* be aware that there is a potential problem of truckers legally using the alternate route even if the main route is open.

2. The alternate marker (M4-1 sign) **shall** be used in conjunction with the appropriate route marker shield. For interstate applications, the alternate marker (MB4-1 sign) **shall** be used with the interstate marker shield. The MB4-1 sign has white lettering on a blue background.

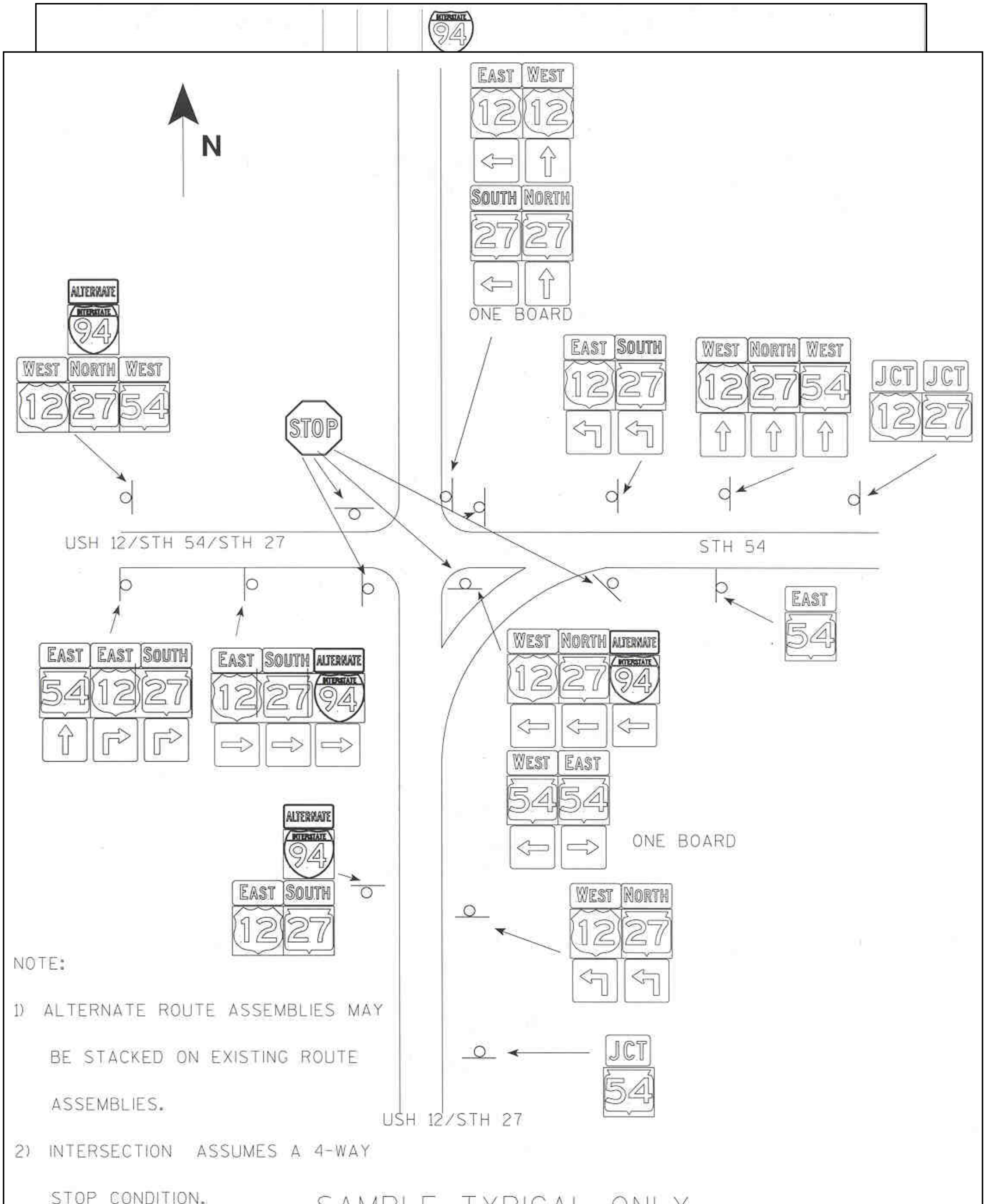
3. Figure 1 shows the use of a horizontal-cut aluminum folding alternate roadway sign. The folding alternate roadway sign is mounted below the EXIT gore sign. The State Patrol or other law enforcement officials could flip this sign open in times of roadway closure. Once traffic is directed off the mainline roadway, there would be alternate signing all along the alternate route that would direct motorists. **Usage of this sign has been determined to be optional. It is recommended that the Regional Traffic Section contact their State Patrol Regional office for input on the usage of this sign.**

4. No cardinal direction signs *should* be placed on the alternate route sign assemblies unless a specific direction is required.

5. The use of a vertical route panel is encouraged wherever possible (as shown on the examples). The placement of alternate route assemblies in urban areas *may* be difficult due to space restrictions. Alternate route assemblies *may* be stacked on existing route assemblies. Normally, 24" and 36" marker heads are used. For extreme space constraints, 18" marker heads can be specially ordered. For roadways that have multiple route assemblies (i.e. Interstate 39-90-94 in Southwest Region), one of the numbers can be used for the alternate route assembly on the alternate route.

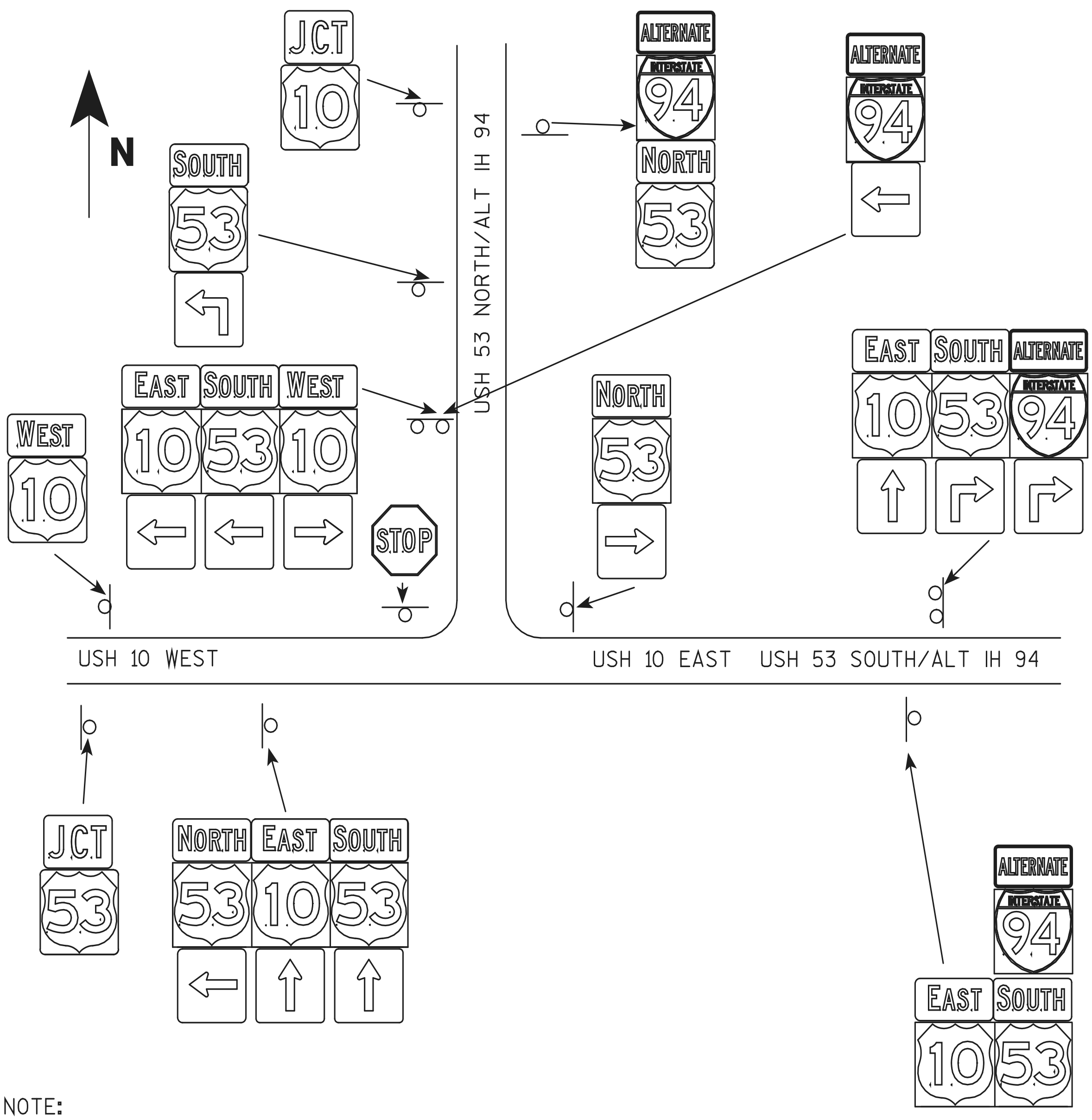
6. The horizontal size of the alternate route marker sign *should* be the same as the horizontal size of the roadway marker signs already on the roadway.

7. The placement of reassurance markers will differ on each route, but in general they *should* be placed every (+/-) 5 miles, or as needed. The alternate reassurance markers *should* be stacked whenever possible and *may* be placed with every reassurance marker on the roadway.
8. Generally, for a stop condition or right turn no stop condition, alternate route assemblies with advanced turn arrows would not be used, as shown on Figure 2. However, conditions such as unusual intersection geometrics and/or multi-lanes *may* require the addition of alternate assemblies with advanced turn arrows.
9. For a no stop condition, as shown on Figure 3, alternate route assemblies with advanced turn arrows *should* be used.
10. It is recommended that the Regions send their completed alternate roadway signing layouts to Central Office Traffic Operations for review prior to installation.



SAMPLE TYPICAL ONLY

- FIG 2 -



NOTE:

1) ALTERNATE ROUTE ASSEMBLIES MAY BE STACKED ON EXISTING ROUTE ASSEMBLIES.

2) INTERSECTION ASSUMES A "NO STOP" CONDITION FOR USH 10 TRAFFIC.

SAMPLE TYPICAL ONLY

- FIG 3 -

PURPOSE

Community Sensitive Design for signing is the incorporation of a sign or logo to blend in architecturally with a structure. There are many requests to utilize community Sensitive Designs (CSD) for signing along state-maintained highways. This type of signing can be very popular because they add an aesthetic community value to the roadway. However, there are several policies and guidelines that must be followed in this approach. MUTCD section 1A.01 states that Traffic Control Devices or their supports **shall not** bear any advertising message or any other message that is not related to traffic control. Advertising is only allowed on signs off of the highway right-of-way. Wisconsin State Statute 86.19(1) states that no sign **shall** be placed within the limits of any street except such as necessary for the guidance or warning of traffic.

DEFINITIONS

Freeways are defined as divided arterial highway facilities that have full controlled access, by means of grade separation at interchanges only.

Expressways are defined as divided arterial highway facilities that have partial control of access and generally with grade separations at major intersections.

Conventional highways are defined as divided or undivided roadway facilities that have limited access with no grade separations at intersections. These highways *may* be two lane or multi-lane facilities.

POLICY

Any Community Sensitive Design for signing *should* ensure that the message or logo does not compete with the essential message of any official traffic signs, nor create a distraction from conveying essential traffic information. In addition, any Community Sensitive Design for signing needs to ensure that there is no advertising of any kind. Welcome signs as part of the design aspect of a structure **shall not** be allowed. Stand-alone welcome signs are covered in TEOpS 2-1-41.

GUIDELINES

Community Sensitive Designs for signing will be allowed on state-maintained roadways provided the following criteria are met:

1. Except for street name identifications (covered in items 2, 3 and 4 below), other word messages **shall not** be used, including wording within logos.
2. Street name identifications *may* be formed into the concrete as part of the structure. They **shall** be independent and not included as part of a logo.
3. On freeways and expressways, street name identifications **shall** be a minimum of 6” lowercase or 8” uppercase letters, with a minimum letter stroke width equivalent to FHWA Series E.
4. On conventional highways, street name identifications **shall** be a minimum of 4 ½” lowercase or 6” uppercase letters, with a minimum letter stroke width equivalent to FHWA Series E.
5. Logos or designs **shall not** bear any resemblance to official logos already in place on official guidance or motorist Specific Information Signs (SIS signs).
6. Logos or designs **shall not** bear any resemblance to official advertising, correspondence or municipal logos.
7. Logo and designs, including designs for street name identifications, **shall** be submitted to WisDOT Central Office, Bureau of Highway Operations for review and approval.
8. Any existing non-conforming Community Sensitive Design signing already in place **shall** be allowed to remain until the end of its service life. Once the design has reached the end of its service life, it **shall** be removed and not be replaced.
9. Some architecturally acceptable logos would include logos of:
   a. Wildlife
   b. State Capitol
   c. State outline
   d. Floral patterns
   e. Outlines of city buildings
   f. Animals
   g. Ships/boats.

10. Internally or externally illuminated logos **shall not** be allowed.
11. Portraits of people **shall not** be allowed.
12. Logos or designs *should* be uniquely related to the community in which the structure is located.
13. Bridge painting is not allowed to resemble a sign or message.

2-1-65 Pedestrian Crossing Flags — January 2018

GENERAL

There are currently efforts by communities to enhance the visibility of pedestrians within crosswalks. Typically, these are crosswalks that are not at a stop or signalized location. Communities have adopted a pedestrian flag program where flags are provided at the pedestrian crossing to assist with increasing visibility of pedestrians crossing the street. This flag concept is like the concept of placing retroreflective material on clothing. Based on an April 27, 2005 Interpretation Letter from FHWA, it has been determined that these flags are not traffic control devices and therefore, no direct guidance is given in the 2009 MUTCD on the design and application of pedestrian flags. The 2009 MUTCD, Section 6E.03 does provide standards and guidance for hand signalizing devices, including flags, for work zones.

This policy is developed to provide specific guidelines for handling requests for the installation of pedestrian crossing flags for crossings on the state highway system.

POLICY

1. All requests to install pedestrian flag devices **shall** be made by the municipality.
2. Flag holder devices **shall not** be attached to WisDOT maintained sign posts.
3. The municipality **shall** be responsible for all installation and maintenance costs of the flag devices.
4. Pedestrian Crossing flags **shall** only be allowed at WisDOT permitted crosswalks.
5. For maximum visibility, flags **shall** be red or fluorescent orange-red in color. Flags **shall** be made of a retroreflective material or have a retroreflective strip attached to them.
6. Flags **shall** be a minimum of 18” x 18” in size, with a minimum 30” staff.

2-2-4 STOP and YIELD Signs for Separated Turn Lanes — August 2013

PURPOSE

The MUTCD, Section 2B.04 provides general guidance for the determination of STOP or YIELD sign usage to determine the right-of-way at intersections. The MUTCD also states that for signalized intersections, a STOP or YIELD sign **shall** only be used if there is a separated turn lane that is not controlled by the traffic signal.

In addition to separate, unsignalized turn lanes at signalized intersections, WisDOT has also installed roundabouts with separated turn lanes where the approaching, right-turning traffic can utilize a “bypass” lane to avoid going through the roundabout circle altogether.

Questions about whether to use a STOP or YIELD sign or no control for these applications has led to an inconsistent practice throughout the State. The purpose of this policy is to provide guidance on the signing treatments that are available and when they *should* be used, to help achieve a better consistency of practice statewide.

POLICY AND GUIDELINES

Signalized Intersections with Separated (Unsignalized) Turn Lane

1. Right turn lane with dedicated, long parallel receptor lane on the receiving roadway; typically, a STOP or YIELD sign would not be used. An added lane warning sign (W4-6) *should* be used in these cases. If traffic or crash problems persist, a YIELD sign *may* be used.
2. If there are two or more receptor lanes on the receiving roadway, a YIELD sign *should* be used. If traffic or crash problems persist, a STOP sign *may* be used in lieu of the YIELD sign.
3. If there is only one receptor lane on the receiving roadway, a STOP sign *should* be used. A YIELD sign *may* be used in lieu of a STOP sign where there is wider pavement and an available recovery area.
4. If double separated right turn lanes are used at a signalized intersection, traffic signal control **shall** be utilized.
5. If traffic or crash problems persist with any YIELD sign control, STOP signs or signal control *should* be considered.

Roundabouts with Separated Right Turn Lanes

1. YIELD signs *should* be used for both single and double separated right turn lanes at roundabouts.
2. If traffic or crash problems persist with any YIELD sign control, STOP signs *should* be considered.

SIGNING IMPLEMENTATION

1. The guidelines listed in Part B *should* be followed for newly installed intersections.
2. For existing intersections with signing not meeting these guidelines, there is no compliance date for making these changes. However, opportunities *should* be utilized through improvement projects, knockdowns or routine sign replacements to bring the signing up to the current guidelines.

2-2-4.5 STOP and YIELD Signs on Driveways and Private Roads — April 2008

GENERAL

The Department uses regulatory and warning signs conservatively, as recommended in the Manual on Uniform Traffic Control Devices (Section 2A.04). This conservative use is important to retain the effective impact of signs on driver behaviors; used in excess, regulatory and warning signs tend to lose their effectiveness. There is the concern that a proliferation of unnecessary STOP or YIELD signs at driveways and private roads will lead to their disregard and could cause potential safety issues at locations where STOP or YIELD signs are necessary.

Oftentimes the Department is requested to install and/or maintain STOP or YIELD signs for driveways and private roads. The Department is not obligated to provide STOP or YIELD signs for many of these locations, by basis of Wisconsin Statutes and the 2009 MUTCD.

AUTHORITY

The following Wisconsin State Statutes establish relevant rules of the road that drivers must obey without requiring a sign to be posted and describe the authority to place signs, and the MUTCD Sections provide standards and guidance for installations of these signs.

Chapter 346, Rules of the Road

s. 346.02 (7) Applicability of Provisions Requiring Signposting.

> …Whenever a particular section does not state that signs are required, such section is effective even though no signs are erected or in place.

s. 346.18 (4) Entering Highway from Alley or Non-highway Access.

> The operator of a vehicle entering a highway from an alley or from a point of access other than another highway **shall** yield the right-of-way to all vehicles approaching…

s. 346.18 (7) (b) Entering Alley or Driveway from Highway

> The operator of any vehicle crossing a sidewalk…**shall** yield the right-of-way to any pedestrian…on the sidewalk.

s.346.41 (1) Display of Unauthorized Signs and Signals Prohibited

> No person **shall** place, maintain or display upon or in view of any highway...any unauthorized sign…which: (a) purports to be…an official traffic sign…

MUTCD, 1A.08, Authority for Placement of Traffic Control Devices.

> Traffic control devices… **shall** be placed only as authorized by a public authority or the official having jurisdiction…
>
> Any unauthorized sign placed on the highway right-of-way by a private organization or individual constitutes a public nuisance. All unofficial and nonessential traffic control devices, signs, or messages *should* be removed.
>
> All regulatory traffic control devices **shall** be supported by laws, ordinances, or regulations.

These statutory provisions clarify that signs are not required to affect a requirement to comply with rules of the road, and it is apparent that a motorist is not required to comply with rules of the road, and it is apparent that a motorist is not required to stop before entering a street or highway from a driveway. STOP signs are not required in these situations. The following policy is established consistent with the stated objective of conservatively using regulatory signs to retain their effectiveness.

POLICY

1. STOP signs or YIELD signs **shall not** be erected on state highway right-of-way at driveways, except as noted below:
    a. STOP or YIELD signs **shall** be installed and maintained by WisDOT at driveways to state, county or municipal parks, and state forest, driveways on school grounds, and driveways to county institutions. These intersections often appear to be driveways, but are defined as highways under s.340.01(22).
    b. If a private driveway operates and functions like a public street, the Regions *may* provide a temporary exception to allow a STOP or YIELD sign while working to encourage the local government to make the intersecting road a public roadway.
    c. When there are demonstrated operational or safety issues resulting from a lack of a STOP or YIELD sign, and best efforts of the region to locate the STOP or YIELD sign off the state highway right-of-way do not work, a permit *may* be granted by the Region to allow the STOP sign in the highway right-of-way. The permit *should* be documented using the standard application/permit to work on highway right-of-way (DT 1812 form). The owner of the STOP or YIELD sign **shall** be responsible for the installation and long-term maintenance of the sign.
2. For pre-existing STOP or YIELD signs installed at driveway connections to state highways, not consistent with this policy and located in the right-of-way of the state highway, the Region *should* remove the sign from the right-of-way. Before removal, make every effort to work with the driveway owner, as opportunities permit, to relocate privately owned STOP or YIELD signs off the state highway

right-of-way. An ideal time for working with property owners for relocation of STOP or YIELD signs would be during an improvement project or if any other work is being performed on the right-of-way.

3. STOP or YIELD signs for private driveways connecting to state highways *should* be located off the state highway right-of-way in a location that is reasonably close to the ideal starting point. The 2009 MUTCD, Section 2A.16 states that a STOP sign *may* be located a maximum of 50 feet from the mainline roadway edgeline.
4. When privately owned STOP or YIELD signs are allowed in the highway right-of-way, the proper size STOP or YIELD sign for that particular state trunk highway **shall** be used, in accordance with TEOpS 2-2-5. In addition, the owner of the private road or driveway **shall** install STOP or YIELD in accordance with the MUTCD, Sections 2B.04, 2B.05, 2B.06, 2A.18, 2A.19 and 6F.05.

2-2-5 Size of STOP Signs on Roadways — September 2010

PURPOSE

The intent of this policy is to establish minimum STOP sign sizes on WisDOT roadway. These guidelines are applicable for intersections with single-lane conventional State Trunk Highways, intersections with multi-lane conventional State Trunk Highways and intersections with Expressways.

DEFINITIONS

Freeways are defined as divided highways with fully controlled access at interchanges only. Interstate highways are freeways with the interstate route designation.

Expressways are divided arterial highway facilities that have partial control of access, generally with grade separations at major intersections.

Conventional highways are defined as streets or roads other than freeways or expressways. They *may* be divided or undivided, two-lane or multi-lane, and access is available at intersections and driveways.

INSTALLATION GUIDELINES

The following minimum sizes **shall** be used for the installation of STOP signs on WisDOT system roadways.

1. A 36” STOP sign size **shall** be used for all STH/STH intersections, regardless of the number of approach lanes on each STH.
2. A 36” STOP sign size **shall** be used for all roadways intersecting multi-lane conventional state trunk highways and expressways.
3. A 36” STOP sign size **shall** be used for multi-lane conventional roadways intersecting single-lane conventional state trunk highways.
4. A 30” STOP sign size **shall** be used for single-lane conventional roadways intersecting single-lane conventional state trunk highways.
5. Additional STOP sign size criteria for bypasses are contained in TGM 2-15-53 (Bypass Signing).

If there are demonstrated or perceived problems at these intersections, the Regions have the option of increasing the STOP sign size. A traffic engineering study can be used to identify problems at intersections. Justification *may* be based on unusual roadway geometrics, crash problems, or sight restrictions.

2-2-12 In-Street Pedestrian Crossing Signs — June 2005

PURPOSE

The MUTCD section 2B.12 allows usage of in-street pedestrian crossing signs to remind motorists of laws regarding pedestrian right-of-way at an unsignalized location. While these signs *may* be useful to remind motorists of traffic/pedestrian right-of-way laws, it is important to develop and use additional application standards to promote consistency, safety and efficiency of the roadway. Local units of government have requested to install this signing. This policy provides guidance on the usage of these signs on state maintained roadways.

POLICY

Local units of government **shall** request, in writing, permission to install and maintain in-street pedestrian crossing signs on DOT permitted crosswalks. A map **shall** be provided to the District by the local unity of government showing the proposed locations of the in-street pedestrian crossing signs. Upon District review, approval or denial *should* be made by a letter to the local unit of government. If approval is given, the District *should* also provide a copy of the R1-6 standard sign plate with the approval letter so consistency is maintained in the design and manufacture of the signs.

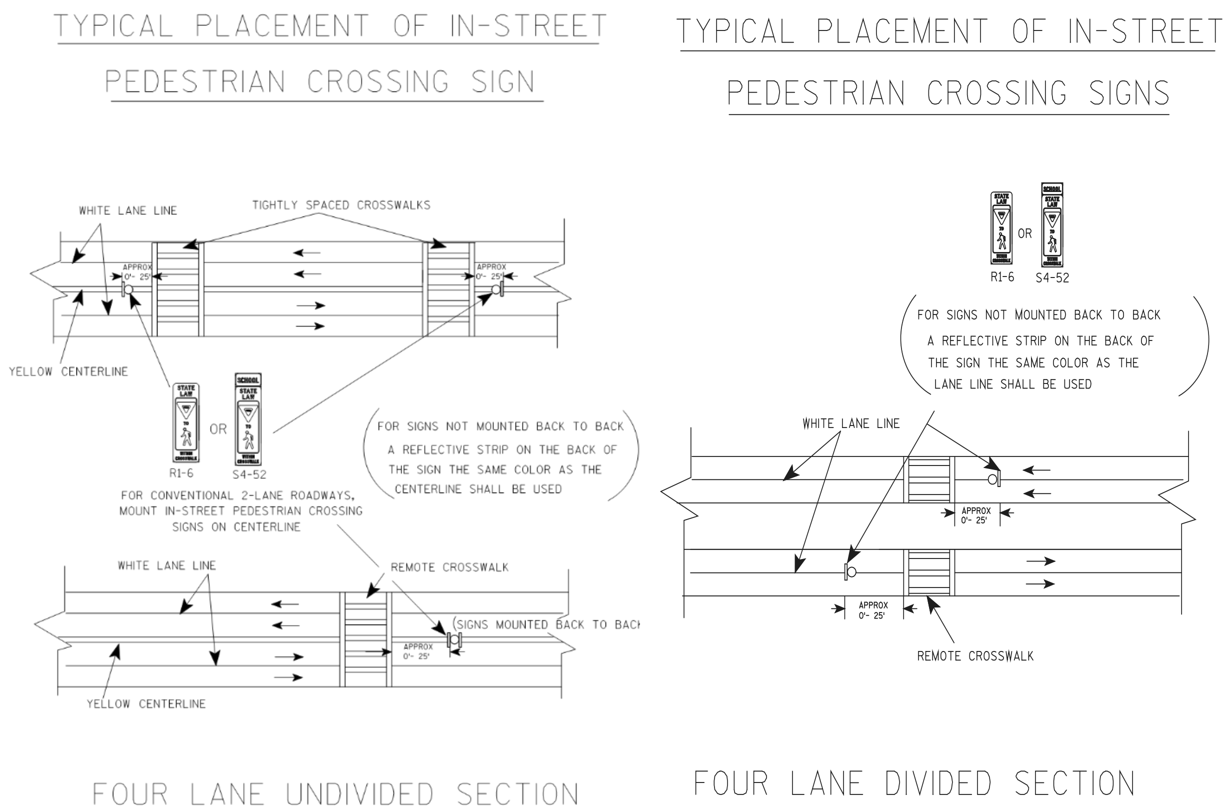
The following guidelines **shall** be used by the District to determine whether a roadway crossing would qualify for in-street pedestrian crossing signs.

GUIDELINES

1. The local unit of government **shall** be responsible for all liability costs.
2. Only the R1-6, in-street YIELD TO PEDESTRIANS WITHIN CROSSWALK sign **shall** be allowed only on roadways with posted speeds of 40 mph or less.
3. The R1-6, in=street YIELD TO PEDESTRIANS WITHIN CROSSWALK sign message shall only be used in Wisconsin since State Statute 346.24 requires drivers must yield to a pedestrian in a crosswalk. The R106a, STOP FOR PEDESTRIANS WITHIN CROSSWALK, sign should not be used.
4. Existing in-street pedestrian crossing signs that do not conform to this policy **shall** be removed. Notification to communities **shall** be made by written letter. *Should* existing non-permitted signing not be removed, WisDOT will remove the sign(s).
5. The in-street YIELD TO PEDESTRIAN sign **shall** only be used as a supplement to the standard pedestrian crossing sign (W11-2) with diagonal down arrow (WF16-7L/R) or standard school warning sign (S1-1) with diagonal down arrow (W16-7L/R). As an exception, the in-street YIELD TO PEDESTRIAN WITHIN CROSSWALK sign *may* be used alone provided there are no sight restrictions.
6. The in-street YIELD TO PEDESTRIAN sign **shall** only be used as an in-street sign, not on the outside shoulder or parking lane.
7. The in-street YIELD TO PEDESTRIAN sign **shall** only be used at marked and maintained crosswalk approaches that are not controlled by a STOP sign or traffic signal. Signs *should* be restricted to key locations, such as high-volume pedestrian crosswalks, to avoid overuse. The minimum spacing of signs **shall** be every other block, where there are several consecutive marked and maintained pedestrian crossings.
8. The sign locations **shall not** impede traffic movements (through or turning). Signs *may* have to be temporarily removed due to maintenance operations or oversized loads. WisDOT is not responsible for sign removal or reinstallation costs.
9. Only one sign, in each direction of a two-way street approach or back-to-back signs, will be allowed for each crosswalk approach.
10. For pedestrian crossing applications, the signs **shall** have a black legend on yellow background the design on the R1-6 sign plate **shall** be used.
11. For school crossing applications, the signs **shall** include the SCHOOL plaque and **shall** have black legend on fluorescent yellow-green background. The design on the S4-52 sign plate **shall** be used.
12. The reduced size in-street school warning sign (S1-1) with reduced size AHEAD sign (WF16-9P) or reduced size diagonal down arrow sign (WF16-7L/R) *may* be used in lieu of in-street pedestrian crossing signs for school applications as shown in the MUTCD, sections 7B.08 and 7B.09.
13. Supports **shall** be freestanding (maximum 2" square or 2" round post), meeting National Cooperative Highway Research Program (NCHRP) 350 breakaway standards. The maximum mounting height **shall** be 2 feet to the bottom of the sign. The sign **shall** be securely attached to the pavement if left in place for more than 24 hours. Sign support bases **shall not** be bolted or cored into the pavement.
14. Communities *may* use the following mounting devices. Mounting devices not included in this list **shall** be a proved by the District Traffic section, prior to use:
    a. *Impact Recovery Systems* Mount or Portable models (portable model #103QR or fixed model #101NS).
    b. *Safe-Hit* Surface Mount or Potable models (portable model #ST948PCD44WX or fixed model #ST948SMP44WX).
15. For signs not mounted back-to-back, a reflective strip the same color as the centerline or lane line **shall**

be used to warn traffic approaching from the opposite direction.

16. The local unit of government **shall** be responsible for manufacture, liability, installation and maintenance costs, which includes removal prior to snowfall and re-installation in the spring. If signs are not removed prior to November 1, WisDOT will remove and charge the local unit of government for all costs associated with removal. The in-street pedestrian crossing signs **shall not** be installed prior to April 1.
17. The local unit of government **shall** affix an identification label to the back of each sign, per Wisconsin State Statute 86.19(5).



2-2-13 Location of Speed Limit Signs — June 2015

PURPOSE

The following is to provide policy guidelines for distance between and proper location of speed limit signs. The policy pertains to signing on freeways, expressways, and conventional highways.

BACKGROUND (AUTHORITY)

The Wisconsin Statutes in Section 346.57 discusses Speed Restrictions. The statutes require certain statutory limits to be posted. Refer to this statute for locations that require Speed Limit signs to be posted.

TEOpS 13-5-1 discusses the statutory and approval process and setting limits. Refer to this section for information on these issues.

The MUTCD Section 2B-13 discusses location of Speed Limit signs.

Note: Reduce speed ahead sign requirements and placement is covered under a separate TEOpS 2-3-30, “Reduced Speed Ahead” signing.

POLICY

Based on the requirements in the MUTCD Section 2B-13, the following **shall** be the location where speed limit signs **shall** be placed:

1. Speed limit signs **shall** be placed at points of change from one speed limit to another and when leaving a zoned area such as a town, village, city, or municipality to return to rural speed.

2. After a school zone, where speed limit was reduced.

The following chart or table indicates MINIMUM criteria for each specific speed limit:

70/65/60/55/50 mph (Freeways)

1. After each interchange
2. Beginning and end of freeway segment
3. Changes in speed zone (double mark—outside and inside shoulder for reductions from 70 or 65 to 65/60/55/50 mph)

65/60/55/50 mph (Expressways)

1. After each interchange
2. At state or county highways
3. Changes in speed zone (consider double marking outside and inside shoulder)
4. Beginning and end of expressway section

Note: An expressway is defined as a divided arterial highway facility that has partial control of access and generally with grade separations at major intersections.

55 mph (Conventional Highways)

1. Leaving a zoned area less than 55 mph such as a town, village, city or municipality
2. After every state highway in a rural area
3. Typically, after major intersections with higher volumes
4. Reminder signs *should* be spaced approximately every 15 miles, when signs under criteria 1, 2, or 3 do not provide a reminder within 15 miles

50/45 mph (Conventional Highways)

1. At points of change from one speed limit to another
2. After major intersections with higher volumes
3. Every ½ mile (maximum distance between reminder signs)

Note: Engineering judgment *should* be used when placing every ½ mile to coordinate with other criteria above such as after major intersections to avoid unnecessary duplication.

40 mph and BELOW (Conventional Highways)

1. After major intersections with higher volumes
2. **Maximum** distance between reminder signs
   a. 40 mph = 2000 feet
   b. 35 mph = 1500 feet
   c. 30 mph = 1000 feet
   d. 25 mph = 1000 feet

Note: Field conditions *may* require varying from these criteria for these speed and highway categories.

SIZE OF SIGNS

See TEOpS 2-1-35 for optimum size of signs.

DOUBLE MARKING

Double marking (right and left side) for the first set of signs **shall** be employed for any reduction from 70 or 65 mph and *should* be employed for other speed limit reductions on divided highways.

PHASE IN PERIOD

As signs are replaced due to wear or where there are problem areas with spacing, maximum of five years from the effective date of this policy.

WORK ZONE TRAFFIC CONTROL SPEED LIMIT SIGNS

The spacing shown in this policy does not apply to work zone traffic control speed limit changes. See work zone standard detail drawings for applicable requirements.

2-2-15 NO TURNS (R3-3) Signs—Freeways November 1992

In the early 1970s there was some special concern expressed about wrong-way movements on the freeway system. Some of the concern was being generated by the Federal Highway Administration, and some of it was local in nature. As a result, standardized signing practices were developed and implemented throughout the state on the freeway system. Along with some other extensive signing, NO TURNS signs were installed in the areas between the merging roadways at on-ramps on all freeways. These signs were intended to discourage illegal U-turns, whether made purposefully or by accident. There was subsequently some feedback from the State Patrol that the signing improvements were effective in reducing wrong-way movements.

Unfortunately, the NO TURNS signs in the merging area are in a rather vulnerable location and have no doubt suffered more than their share of knockdowns, thus incurring maintenance costs, and costs and damages to the public. Over the years, the public has come to understand and accept the restrictive nature of the freeway roadways, which make U-turns difficult.

Consequently, it has been determined that there is no longer a need for the sign, and it can be eliminated.

There *may* be some specific locations where the geometrics or condition peculiar to the locations, or where an awareness of unusual driving habits, would seem to make the retention of these signs desirable. In these cases, the R3-3 sign *may* still be used. Consultation with the State Patrol or other enforcement agencies *may* be desirable in these instances.

2-2-19 No U-Turn Sign (Freeway/Expressway median Crossover Sign Placement) January 2013

GENERAL

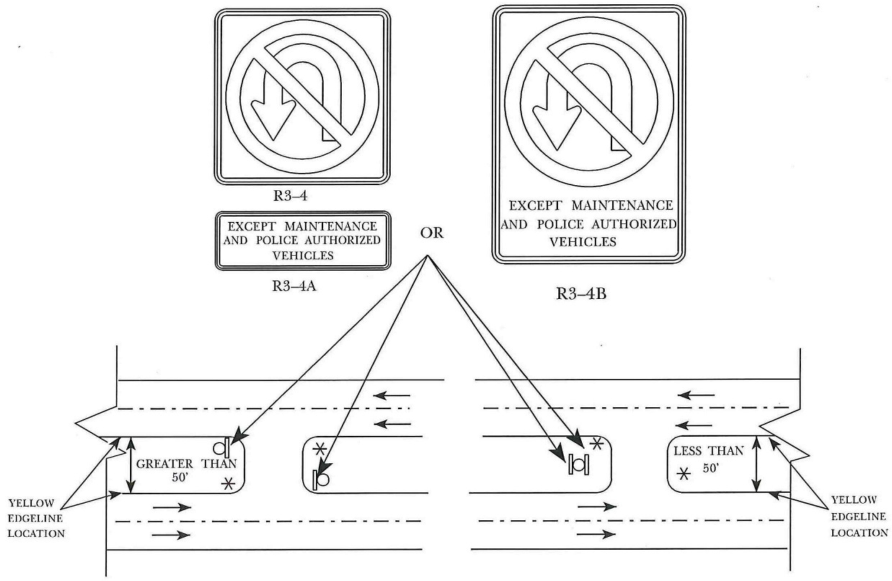
The MUTCD Section 2B.18 gives some guidance and options for the placement of No U Turn Signs (R3-4 sign with R3-4a plaque, or R3-4B sign). However, the 2009 MUTCD is lacking on guidance for the placement of these signs in median crossovers. Guidance as to the proper number and placement of these signs in the median is important. The median width plays a role in the effective placement of the signs.

GUIDANCE/POLICY

The following guidelines/policy apply to these signs:

1. The Region has the option of using the R3-4 sign with R3-4A supplemental plaque or the combination R3-4B sign for these applications.
2. If used for freeway and expressway median crossovers with a width of 50 feet or greater (distance from yellow edgeline to yellow edgeline), separate No U-Turn signs **shall** be installed on the far side of the median crossover facing traffic.
3. If used for freeway and expressway median crossovers with a width of less than 50 feet (distance from yellow edgeline to yellow edgeline), the No U-Turn signs *may* be mounted back-to-back in the center of the median. Vegetation or other sight obstructions *should* be considered to ensure visibility of the signs all year.
4. A yellow delineator *should* be placed on the left side of the through roadway on the near side of the crossover for each roadway (see Figure 1).
5. Any existing median crossover No U-Turn signs not conforming to this policy will be allowed to remain in place until the end of their useful life. Useful life ends when the sign message no longer meets legibility or condition standards. Existing signs *may* be removed prior to the end of their useful life when opportunities arise such as knockdown or damage, when other work is occurring nearby, or when projects make removal practical.

Figure 1. Median Crossover Signing and Delineation



2-2-19.1 No U-Turn Signs (Controlled Intersection Placement) April 2010

BACKGROUND

Historically, Wisconsin State Law has not allowed U-turns at intersections controlled by traffic control signals or intersections controlled by an officer. Effective January 1, 2010, the State law was changed to make U-turns legal at intersections that do not have signs prohibiting the maneuver. Traffic engineering experience has shown that the permitting of U-turns at controlled intersections can be a safe and beneficial traffic maneuver. From an economic standpoint, the permitting of U-turns can reduce costs and issues connected with access control where highway projects result in median closings because reasonable access to the businesses can be possible via U-turns. It is noteworthy to point out that all other states allow U-turns at intersections to one degree or another.

For dual left turn applications, Wisconsin State Statute 346 states that U-turns would be made from the innermost left turn lane in the same fashion as a left turn. Vehicles on the intersecting streets turning right on red will need to yield to the U-turning vehicle. Statute 346 also states that backing is not permitted as part of a U-turn maneuver, therefore a motorist will need to have knowledge of the turning radius of their vehicle. A U-turn is also prohibited on undivided highways for crest and vertical curve locations where the sight distance is less than 500 feet.

Usage of turn prohibition signs, specifically No U-turn Signs, is covered in MUTCD Section 2B.19. However, the MUTCD does not get into specific engineering criteria as to when signs *should* be used. Motorists are not necessarily familiar with state statute language and signing *may* be appropriate at certain intersections to prohibit U-turns, due to motorist safety issues or to help enforce the state statute. Wisconsin State Statute 346 gives maintaining governments the authority to prohibit U-turns at specific intersections. Intersections where U-turns are prohibited **shall** be signed.

DEFINITIONS

Freeways are defined as divided highways with fully controlled access at interchanges only. Interstate highways are freeways with the interstate route designation.

Expressways are defined as divided highways with partially controlled access by a combination of interchanges, at-grade intersections and driveways.

Conventional highways are defined as streets or roads other than freeways or expressways. They *may* be divided or undivided, two-lane or multi-lane, and access is available at intersections and driveways.

QUALIFYING CRITERIA FOR SIGNING

1. No U-Turn (R3-4 signs) **shall** be installed at the following signal and stop controlled intersections where U-turns are prohibited:

   a. Intersections where there are existing no left turn signs: The no U-turn (R3-4) sign **shall** be installed at these locations in conjunction with the no left turn (R3-2) sign. The combination no left turn/no U-turn (R3-18) sign *may* be utilized for these locations instead.
   b. Intersections where there are signalized right turns that operate simultaneously with protected left turn movements. The no U-turn (R3-4) sign *may* be utilized for these locations instead.
   c. Signalized intersections that are interconnected to a railroad crossing and operate with advance (not simultaneous) pre-emption. The no U-turn (R304) sign **shall** be installed on any divided highway approach that crosses the railroad tracks.

2. No U-turn (R3-4) signs *may* be installed at other signal and stop controlled intersections that have demonstrated the following operational issues:
   a. Intersections with less than 500 feet of sight distance and demonstrated crashes attributed to U-turns that are above the statewide average for that type of intersection.
   b. Intersections with dual left turn lanes and demonstrated problems with motorists making U-turns from the outside left turn lane. For this issue, the lane control sign (R3-8 UU) *should* be used to emphasize that U-turns *may* only be made from the inside left lane. For overhead signing applications, the R3-5U (with 6" black border) *may* be installed in place of the R3-5L or R3-50L.
   c. Intersections with a deficient truck turning radius that present repeated problems with trucks backing up to complete a U-turn, signs and/or signals being damaged or other safety or operational issues cause by the deficient truck turning radii. Intersections *may* have signing to just restrict trucks in making U-turns. For these applications, the standard no U-turn (R3-4) sign with supplemental truck plaque (M4-4) sign would be used.
   d. Temporary signalized intersections during improvement projects where left turns *may* be restricted or eliminated.
   e. Intersections that have poor geometrics and there are demonstrated crashes attributed to U-turns that are above the statewide average for that type of intersection. Examples would be skewed intersections or nearby railroad crossings.
3. Eliminations of signs. In the past, many signalized intersections were signed mainly from requests by law enforcement due to repeated problems with illegal U-turns at intersections and the signs aided in enforcement of the law. The Region *should* make efforts to review these intersections, based on the criteria outlined in items 1 and 2 above, and adjust or remove signs as necessary.

GUIDANCE FOR FIELD PLACEMENT OF SIGNS

1. Installation of no U-turn signs at controlled intersections can be challenging due to lack of space to install signs and the presence of many other signs. A minimum of on no U-turn sign **shall** be installed at each intersection approach where the U-turn move is prohibited. Below is a hierarchy of where the sign *should* be installed:
   a. <u>Primary choice</u> is mounting of the no U-turn (R3-4) sign on the far side median signal pole if it does not conflict with any other signs (keep right, etc.).
   b. Secondary choice is to install the no U-turn (R3-4) sign side-by-side with the keep right sign on the far side median signal pole. This *may* be accomplished by a separate post or bracket system. If a bracket system is used, the no U-turn sign *should* be mounted to the left of the keep right sign.
   c. <u>Third choice</u> is to install the no U-turn (R3-4) sign on a nearside median signal pole.
   d. Fourth choice is to install the no U-turn (R3-4) sign underneath the keep right on the far side median signal pole. This option is the last desirable because the no U-turn sign will be lower than the minimum 5-foot mounting height as specified by the MUTCD.
2. A second no U-turn (R3-4) sign *may* be installed in advance of the intersection approach for areas where compliance is still a problem that is resulting in safety issues or if visibility of the mandatory no U-turn sign is compromised due to intersection geometrics or the presence of other signs.
3. Placement of the ground mounted R3-8UU sign mentioned in 2B above *should* be in advance of the near median signal head in the median at a minimum distance of 150 feet back from the signal.

2-2-20 Intersection Lane Control Sign May 2011

PURPOSE

The MUTCD sections 2B.19, 2B.20, 2B.21, and 2B.22 provide standards and guidance for the usage of intersection lane control signs, mandatory movement lane control signs, optional movement lane control signs, and advanced intersection lane control signs. This policy provides requirements and guidance to the proper use of the signs on state maintained highways.

DEFINITIONS

1. Intersection lane control signs (R3-5 through R3-8 and R3-20L or LL and R3-20R or RR) include mandatory movement lane control signs, optional movement lane control signs, and advanced intersections lane control signs.
2. Mandatory movement lane control signs are as follows:
    a. R3-5, R3-5A, R3-5XL and R3-50 series contain an arrow and word ONLY
    b. R3-7 series indicate RIGHT (CENTER or LEFT) LANE MUST TURN RIGHT (CENTER or LEFT).
3. Optional movement lane control signs (R3-6 series) indicate a combination arrow.
4. Advanced intersection lane control signs (R3-8 series) indicates the configuration of all lanes ahead. The R3-20 series signs indicate the start of a turn lane with the text LEFT (RIGHT) TURN LANE (tilting down arrow).

POLICY

1. Mandatory movement lane control signs (Figures 1, 2 and 3)

   R3-5, R3-5A, R3-5XL and R3-50 series are generally used as overhead signs directly over the lane to which they apply. The R3-5, R3-5A, R3-5XL and R3-6 **shall not** be used as a ground mounted sign on a multi lane approach.

   R3-7 series signs **shall** only be used as ground mounted signs. The RIGHT (LEFT) LANE MUST TURN RIGHT (LEFT) **shall** be installed whenever there is a mandatory turn lane and **shall** be accompanied by pavement marking arrows/only per 3B.20 of the MUTCD. A mandatory turn lane is one where a through lane becomes a mandatory turn lane and the driver must change lanes to continue straight. An R3-7 series sign *should* be placed in advance of the intersection and repeated at the intersection depending on space availability for signs and the speed limit of the roadway. For higher speed roadways, 45 MPH or higher place the sign a minimum of 400’ prior to the intersection and repeat the sign at the intersection. For lower speed roadways, 40 MPH and below, place the sign a minimum of 300’ prior to the intersection and repeat the sign if necessary. An option to the R3-7 series ground mounted sign is an overhead R3-5 series sign (ONLY, ARROW). NOTE: The R3-8 series sign *may* be used in lieu of the R3-7 series sign when there is only one lane approaching an intersection and the roadway widens into separate turn lane(s).

2. Optional movement lane control signs

   R3-6 series signs indicate a combination arrow and are installed overhead. The word OK **shall not** be used on the sign per 2B.19 of the Wisconsin supplement to the 2009 MUTCD.

3. Advanced intersection lane control signs (Figures 4, 5, 6, 7, 8, 9 and 10)
   R3-8 signs show the configuration of all lanes ahead. This sign *should* be placed in advance of the tapers for the turn lanes to allow for drivers to read the sign and change lanes accordingly. This sign is required for complex intersections where it *may not* be apparent to the driver what each lane movement is. Examples where it is not apparent include horizontal and vertical curves approaching an intersection or lack of physical barrier channelization. Examples of complex intersections include dual rights and dual lefts. At other locations, it is an optional sign.
   R3-20L or LL and R3-20R or RR signs which indicate LEFT (RIGHT) TURN LANE and tilted down arrow are intended to be placed at the start of the taper for the turn lane. This sign is required:
    a. For dual left turns where there is a median physical separation.
    b. At single or dual turn lanes where there is a physical separation between the left turn lane and through lane. Note: If the R3-20 sign is used between the through lane and turn lane per Figure 7, the advanced sign is optional.

   The R3-20 series sign is not necessary at other locations unless there is a horizontal curve where the driver cannot distinguish the turn lane taper from the through lane.

4. Mandatory turn lane downstream of an intersection (Figure 3)
   An R3-7 series sign, RIGHT (LEFT) LANE MUST TURN RIGHT (LEFT) **shall** be used where a lane becomes a mandatory turn lane after an intersection. Option—overhead sign R3-5 series sign is recommended for higher speed facilities in lieu of the ground mounted R3-7 series sign.

Figure 1. Mandatory Movement Lane Control Signs

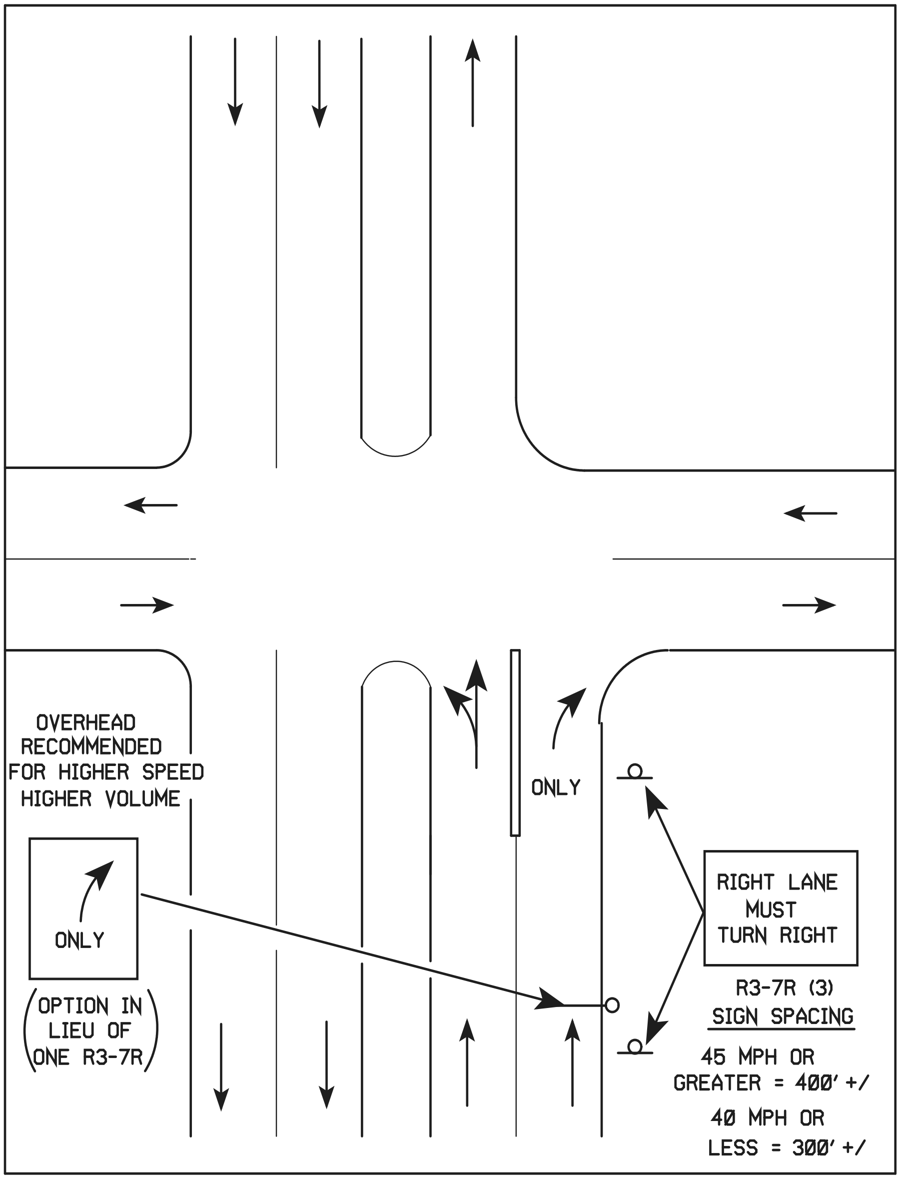


Figure 2. Mandatory Movement Lane Control Signs

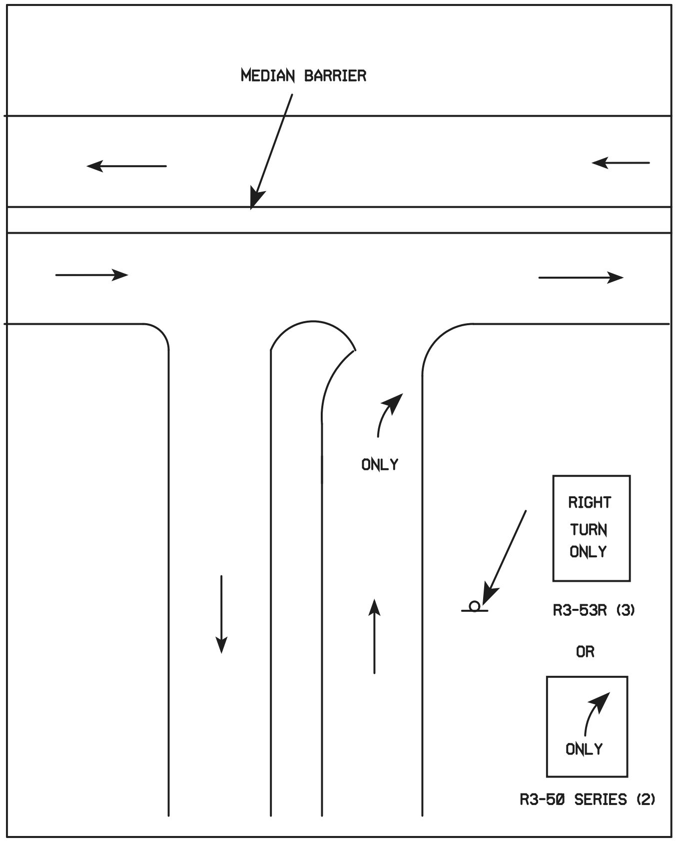


Figure 3. Mandatory Turn Lane After Intersection

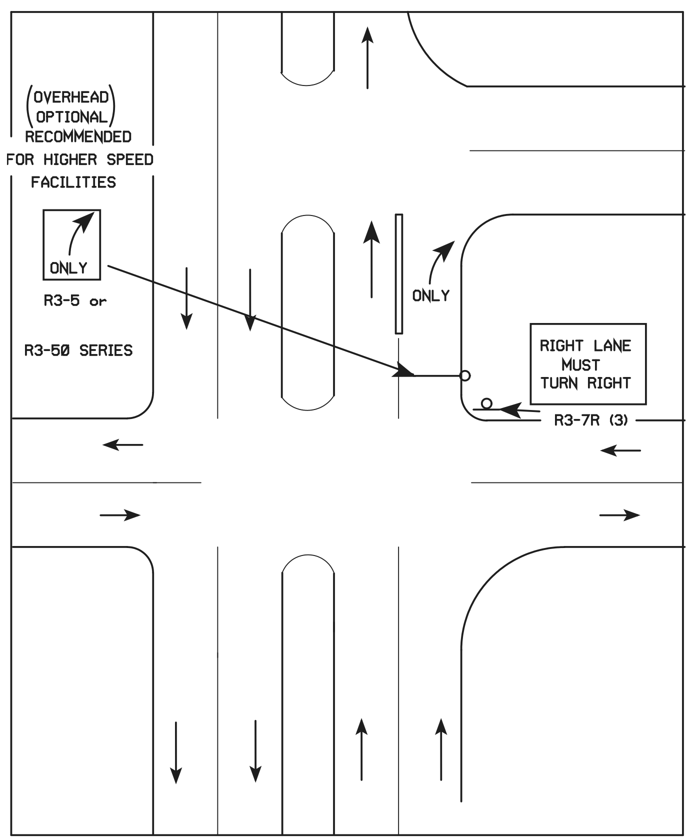


Figure 4. Advanced Intersection Lane Control Signs

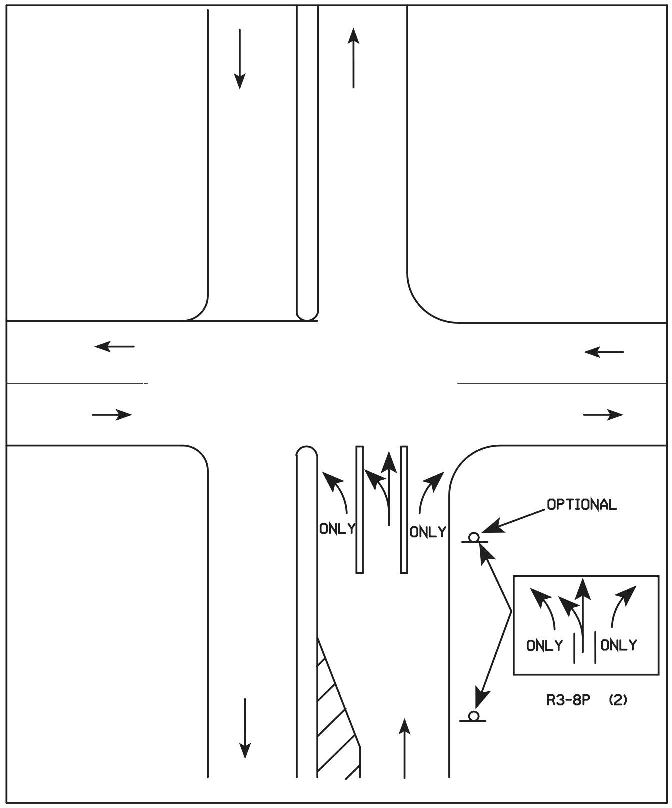


Figure 5. Advanced Intersection Lane Control Signs

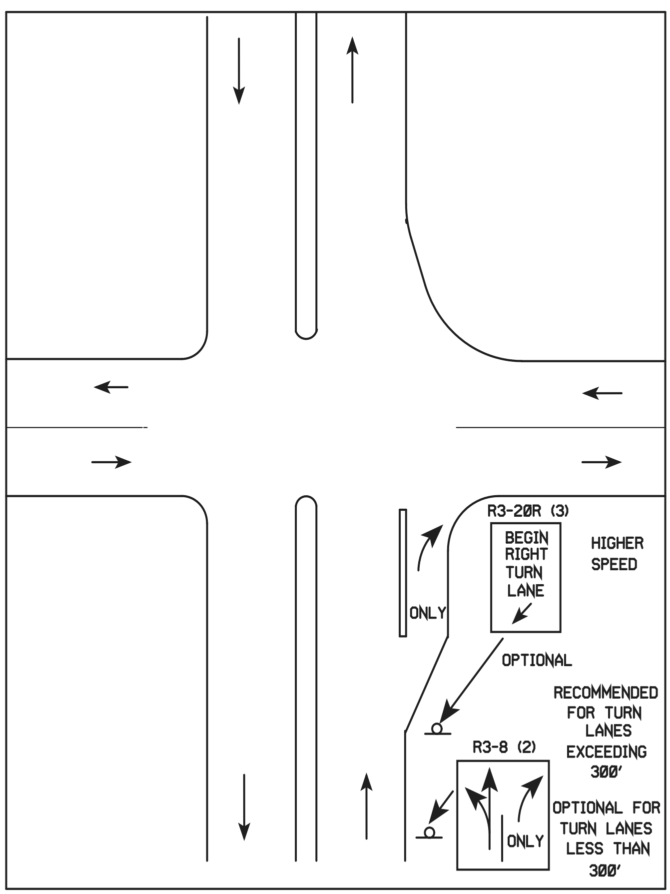


Figure 6. Advanced Intersection Lane Control Signs (Overhead Lane Control Signs)

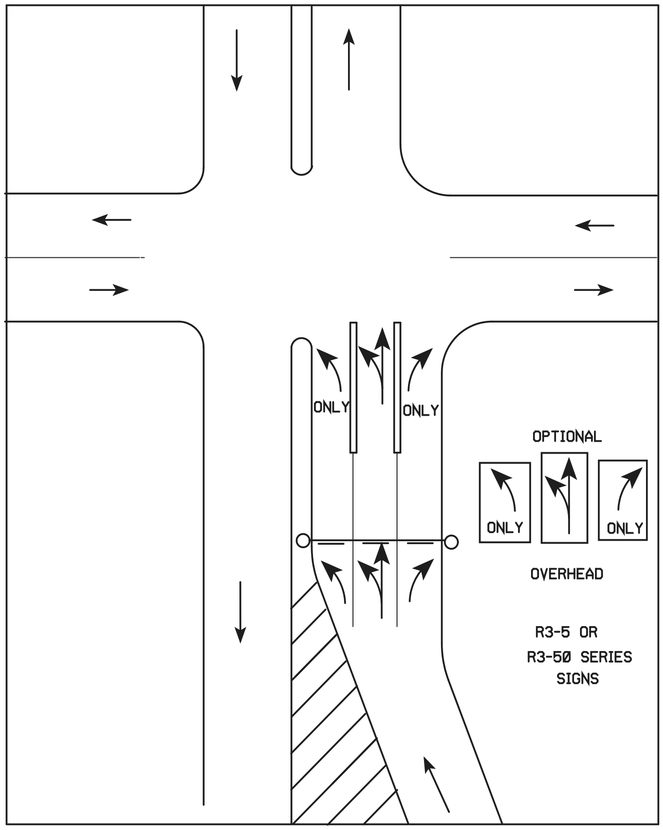


Figure 7. Advanced Intersection Lane Control Signs

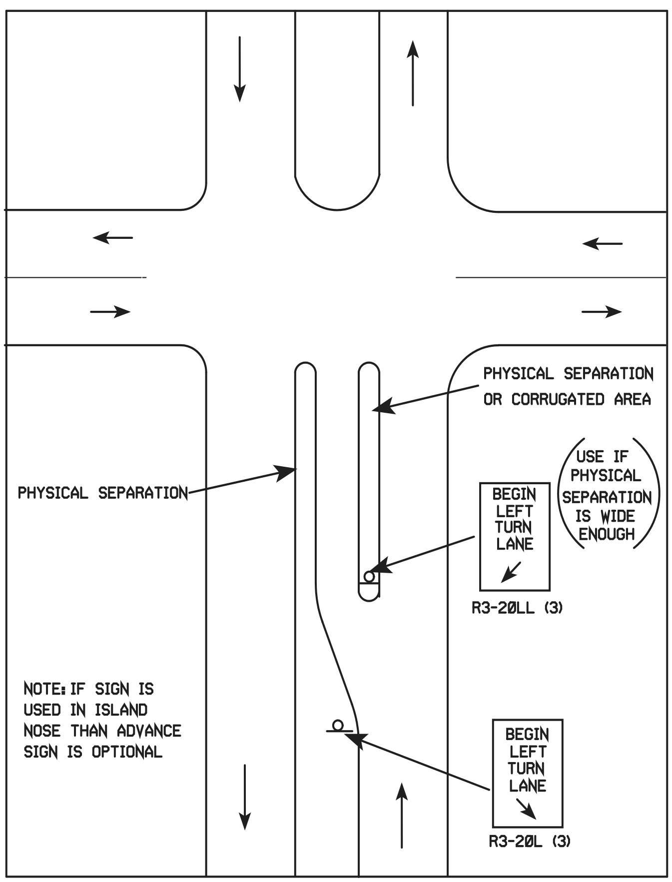


Figure 8. Advanced Intersection Lane Control Signs

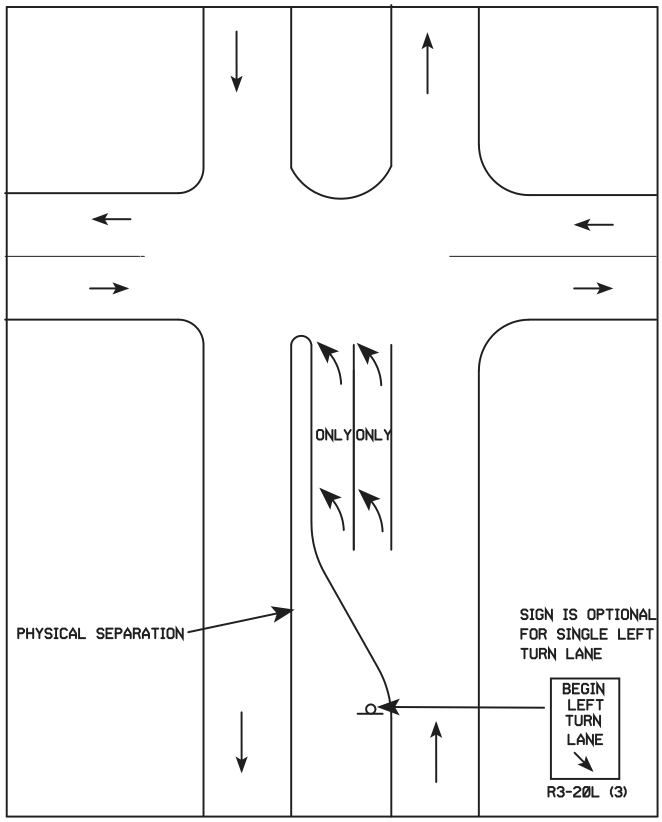


Figure 9. Advanced Intersection Lane Control Signs (Left Turn Lane on Curve)

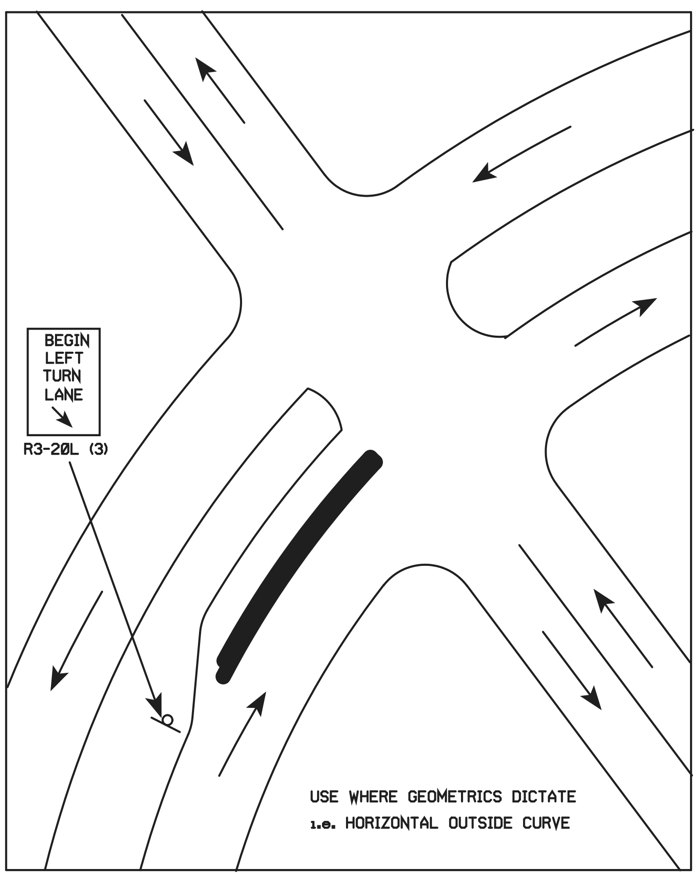
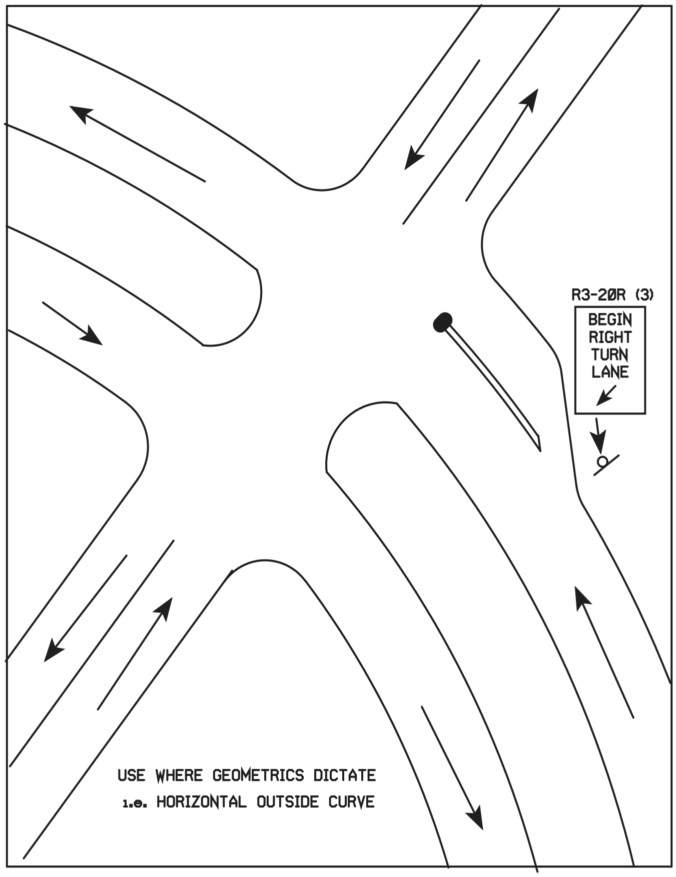


Figure 10. Advanced Intersection Lane Control Signs (Right Turn Lane on Curve)



2-2-28 Restricting Pedestrians and Non-Motorized Vehicles on Expressways and Freeways August 2013

PURPOSE

The operation of non-motorized vehicles or pedestrians on high-speed multi-lane facilities are incompatible uses that create hazards. The Department *may* prohibit certain traffic on freeways or expressways. To apply these restrictions on traffic, the Department is required to erect and maintain official signs giving notice of the prohibition.

This subject provides guidance on the official signs that *may* be used to give notice of restrictions on the use of controlled access highways, expressways and freeways.

AUTHORITY

State Statute 349.105 provides the authority to prohibit certain traffic on expressways and freeways. The authority in charge of maintenance of an expressway or freeway *may*, by order, ordinance or resolution, prohibit the use of such expressway or freeway by pedestrians, persons riding bicycles or other non-motorized traffic or by persons operating mopeds or motor bicycles. The state or local authority adopting any such prohibitory regulation **shall** erect and maintain official signs giving notice thereof on the expressway or freeway to which such prohibition applies.

DEFINITIONS

State Statute 990.01 (9a) Freeway means a highway with full control of access and with all crossroads separated in grade from the pavements for through traffic.

State Statute 990.01 (7a) Express highway or expressway is a divided arterial highway for through traffic with "full" or "partial" control of access and generally with grade separations at intersections. "Full" control of access means that the authority to control access is exercised to give preference to through traffic by providing access connections with selected public roads only and by prohibiting crossings at grade or direct private driveway connections. “Partial” control of access means that the authority to control access is exercised to give preference to through traffic to a degree that, in addition to access connections with selected public roads, there *may* be some crossings at grade and some private driveway connections.

Listings of declared freeways and expressways are available from the Region Planning Section.

POLICY FOR HIGHWAYS CLOSED TO CERTAIN TRAFFIC

Freeways

Freeways **shall** be closed to use by pedestrians, by persons riding bicycles or other non-motorized traffic and by persons operating mopeds or motor bicycles. Any exceptions to open freeway segments to use by pedestrians, by persons riding bicycles or other non-motorized traffic and by persons operating mopeds or motor bicycles *may* only be approved by the Director of the Bureau of Traffic Operations and listed in this policy.

Freeway exceptions (approved by Director, Bureau of Traffic Operations): none, as of October 1, 2007.

Expressways

Expressways *should* be open to use by pedestrians, by persons riding bicycles or other non-motorized traffic and by persons operating mopeds or motor bicycles. A general exception to open use of expressways is for those expressways with a parallel trail for pedestrians, persons riding bicycles or other non-motorized traffic and by persons operating mopeds or motor bicycles. In those cases, the Department **shall** prohibit that traffic from using the expressway and erect and maintain signs giving notice of the prohibition. Any other exceptions to close expressway segments to use by pedestrians, by persons riding bicycles or other non-motorized traffic and by persons operating mopeds or motor bicycles *may* only be approved by the Director of the Bureau of Traffic Operations and listed in this policy.

Expressway exceptions (approved by Director, Bureau of Traffic Operations): USH 10, Wood County, from CTH BB to CTH N

SIGN INSTALLATION POLICY

The R5-57 sign (see Figure 1) **shall** be erected on each ramp leading from a crossroad or frontage road to a restricted freeways or expressway within approximately 100 feet of the point where the ramp leaves the crossroad, and at other locations where pedestrian entrance has occurred or *may* reasonably be anticipated.

Transition from expressway to freeway

For areas that transition from a non-restricted expressway to a restricted freeway, the R5-57 sign *should* be placed after the last at-grade intersection and the R5057B sign (see Figure 2) BEYOND NEXT EXIT *may* be used to supplement the R5-7 sign. The R5-57 sign *should* be placed on all freeway on-ramps after this point.

Figure 1

Figure 2

2-2-30 Engine Brake Signing — January 2018

PURPOSE

One method of slowing the motion of a vehicle is to use the compression of the engine as part of vehicle braking. This method is often referred to as compression braking or exhaust braking. Engine braking can produce excessive, undesirable noise when muffler systems are not functioning as designed or are otherwise inadequate.

Noise from engine braking in vehicles with inadequate muffler systems has led some communities to take actions to restrict the noise. Compression braking is typically an unavoidable result of operating a vehicle that the driver cannot prevent or fully disengage. However, for some vehicles there are driver choices as to whether or when engine compression braking is used. Objectionable noise levels *may* be produced by any car or truck when using compression braking and often are related to equipment failure or aftermarket modifications.

There are several advantages to compression braking on vehicles and especially on large trucks. In addition to assisting deceleration, when a truck engine brake system is engaged, it helps prevent the conventional truck air brakes from overheating, thus saving on the normal wearing life of the truck air brakes. This is especially true on roadways with steep downgrades with long distances, where the safety of the truck can be enhanced using engine brakes.

Communities have installed or requested signing on state highways to address noise concerns associated with use of compression braking. The Department controls traffic signs on highways maintained by the state. Local governments do not have the authority to erect signs on those highways except when written permission is provided by the Department.

The Department supports efforts to deal with excessive noise from all vehicles and encourages enforcement of laws requiring effective mufflers (for example, State Statute Section 347.39). The use of signs specific to engine or compression braking has become popular among many communities, although it is unclear whether those signs are effective or necessary. Generally, the Department does not allow installation of traffic signs on state highways that have not been shown to be necessary or effective. In the case of engine braking, the Department has chosen to work with communities and allow limited use of these signs on state highways under certain conditions, despite the lack of evidence that they are effective in reducing noise problems.

POLICY

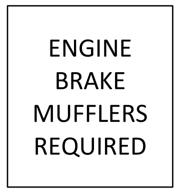
The Department *may* permit local governments to place signs on highways under WisDOT jurisdiction subject to the requirements included here:

1. Requests for a permit to allow these signs must be in writing to the WisDOT Regional Office and *should* contain the following information
   a. Locations where signs are to be installed, including state highway route number and distance to the nearest public roadway intersection
   b. Sign offset (distance from edge of travel lane) and type of post to be used
   c. Assurance that sign will be free standing (not attached to other signs)
2. The local government **shall** be responsible for supplying, installing, and maintaining the signs in conformance with the permit. The local government **shall** furnish their identification sticker on the sign.
3. The local government must be committed to actively enforce the requirements of the signs with local law enforcement personnel.
4. Only the standard ENGINE BRAKE MUFFLERS REQUIRED sign (R10-64) *may* be used on highways under state maintenance responsibility and those signs *may* be installed only on conventional highways at or near the corporate limits of the community (see Figure 1). This sign **shall not** be used on freeways, expressways, interchange ramps, or site-specific locations on conventional highways.
   a. For freeway locations going through communities, engine brake signs *may* be permitted on conventional state highways after the entry point to the conventional highway from the freeway, provided signs are already approved at the city/village limits.
   b. Engine brake signs *may* be allowed for urbanized townships provided they have the means to enforce it. Documentation **shall** be provided by the local law enforcement indicating that the ordinance will be enforced throughout the township. Urbanized townships are defined by having at least <u>two</u> of the following features:
      i. Urban cross section
      ii. Residential development abutting the highway that meets the definition of “semi urban district” as defined in Wisconsin State Statutes 346.57(1)(b)
      iii. Reduced speed zone
      iv. Qualify for an unincorporated community sign.

For qualifying urban townships, only 1 sign is allowed in each direction on any given state highway. The signs **shall** be installed at the township limits.

c. The local government must obtain the approval of the appropriate Regional office for the location of the sign. The sign language **shall** meet the requirements of the WisDOT R10-64 sign plate as described in item 4.
d. Any other signs related to use of engine braking installed on highways under WisDOT jurisdiction within or for the local government that do not meet the requirements of this policy *should* be replaced by the local government, as opportunities arise (knockdowns, improvement projects or replacement due to age) to comply with this policy.

Figure 1. R10-64 Sign



2-2-35 Littering Signs — September 2000

PURPOSE

The intent of this guideline is to eliminate signs that inform the public about fines for littering since the signs are not necessary for the guidance or warning of traffic.

Signs with the message $500 FINE FOR THROWING LITTER OR TRASH ON HIGHWAYS KEEP WISCONSIN CLEAN (R5-56) have been installed on state highways in the past. The purpose of these signs was to discourage littering and to reinforce to motorists the maximum statutory fine for littering on highways. While littering has the potential to create safety hazards as well as diminishing the quality of state highways, there is reason to believe that usage of these signs has a minimal effect on curbing littering problems. The State Patrol has mentioned that these signs have little effect on the motoring public, the law is very difficult to enforce, and citations have very rarely been given out. The State Patrol does not object to removing these signs. Due to previous cutbacks in resources and funding, these signs had previously been declared nonessential. Given the limited effectiveness of the signs, it has been determined these signs are not necessary.

POLICY

Littering signs (R5-56) are declared nonessential on state highways. As a result, the following actions are expected:

1. No new littering signs **shall** be erected on state highways.
2. Littering signs that have been installed on state highways will be allowed to remain in place until the end of their useful life, when they are to be removed and not replaced. Useful life ends when the sign message no longer meets legibility or condition standards. Littering signs *may* be removed prior to the end of the signs' useful life when opportunities arise such as knockdown or damage, when other work is occurring nearby, or projects make removal practical.

2-2-40 Seatbelt Signs — January 2018

PURPOSE

Over the years seatbelt signs have been installed to reinforce to motorists the importance of fastening safety belts and to remind motorists that there are penalties for people not fastening safety belts. These signs were placed at various locations on state highways and in rest areas, waysides, and weigh stations. It is typically expected that many motorists now know the importance of buckling up by means of media advertisements and safety campaigns. Consequently, it has been determined that these signs are no longer necessary.

DEFINITIONS

<u>Freeways</u> are defined as divided arterial highway facilities that have full controlled access, by means of grade separation at interchanges only.

<u>Expressways</u> are defined as divided arterial highway facilities that have partial control of access and generally with grade separations at major intersections.

Conventional highways are defined as either divided or undivided roadway facilities that have no control of access with grade separations at intersections. These highways can be two-lane or multilane facilities.

POLICY

1. No new seatbelt signs **shall** be erected.
2. Seatbelt signs that have been installed will be allowed to remain in place until the end of their useful life, when they *should* be removed and not replaced. Useful life ends when the sign message no longer meets legibility or condition standards. Seatbelt signs *may* be removed prior to the end of the signs' useful life when opportunities arise such as knockdown or damage, when other work is occurring nearby, or projects make removal practical.

2-2-41 Community Parking Restriction Signs — December 2008

PURPOSE

Oftentimes, municipalities will adopt ordinances for the prohibition or restriction of parking on certain roadways during certain periods of time. Wisconsin State Statutes 349.13(1e)(c)(2) gives municipalities the authority to enact ordinances and post signs at or reasonably near the corporate limits of the municipality on all state and county trunk highways and connecting highways.

The intent of posting signs is to inform motorists that 24-hour parking limitations, night parking regulations or snow emergency regulations are in effect in the municipality. It is the responsibility of the motorist to contact the governing body to determine the specifics of the actual ordinance. Posting of signs allows law enforcement to effectively enforce the municipal parking ordinances.

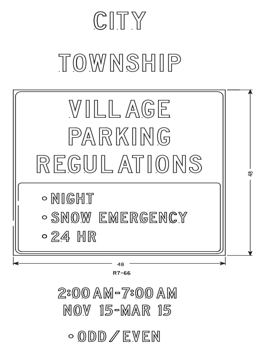
POLICY

The following rules **shall** apply for local governments requesting community parking restriction signs on highways under WisDOT jurisdiction:

1. The local government must pass a parking ordinance prior to requesting the sign(s).
2. The local government **shall** submit a written request to the WisDOT Regional Office for a permit to install and maintain the signs. The permit may be in the form of a letter.
   This request for a permit from the local government *should* contain the following items:
   a. Sign message in accordance with items 4 and 8 of this policy
   b. Sign offset (distance from edge of travel lane)
   c. Where sign is proposed to be located
   d. Type of post used
   e. Assurance that sign will be freestanding (not attached to other signs)
   f. Copy of local government parking ordinance.
   Once the permit is granted, the local government is responsible for supplying, installing and maintaining these signs in conformance with the permit.
3. It **shall** be the responsibility of the local law enforcement personnel to enforce the ordinance or the sign(s).
4. The sign message shall meet the requirements of the WisDOT R7-66 municipal parking sign plate (see Figure 1). See item 8 for approved supplemental messages. The local government must obtain the approval of the appropriate WisDOT Regional Office for the location(s) of the sign(s).
5. The R7-66 sign shall only be used on conventional highways at or near the corporate limits of the community. This sign shall not be used at site-specific locations on conventional roadways, freeways, expressways or interchange ramps.
6. Municipal parking signs not meeting the layouts outlined in this policy will be allowed to remain in their place until the end of their useful life. At that time, they should be removed and replaced with signs conforming to this policy. Useful life ends when the sign message no longer meets legibility or condition standards. Municipal parking signs may be removed prior to the end of the signs' useful life when opportunities arise such as knockdown or damage, when other work is occurring nearby, or projects make removal practical.
7. For townships, the signs should be placed at the boundary of built-up areas where the ordinance applies.
8. A maximum of three supplemental message **shall** be used on a sign. The six approved supplemental messages are:
   a. NIGHT
   b. SNOW EMERGENCY

c. 24 HR
d. X:XX AM – X:XX AM (example: 2:00 AM – 7:00 AM)
e. DATE – DATE (example: NOV 15 – MAR 15)
f. ODD / EVEN

Figure 1



2-2-45 Move Over or Slow Down Signs — January 2018

PURPOSE

The intent of this guideline is to restrict the usage of signs that inform the public about Moving Over or Slowing Down for Stopped Emergency Vehicles to locations that are most helpful to motorists.

Signs with the message "MOVE OVER OR SLOW DOWN FOR STOPPED VEHICLES WITH FLASHING LIGHTS" (R5-60) are installed on state highways as a reminder to motorists to slow down or move over for emergency/law enforcement vehicles that are on the roadway. These signs were installed in a partnership between Bureau of Traffic Operations and Bureau of Transportation Safety to educate motorists of this law. While signs can be a useful tool to help re-enforce a law, education and enforcement are also effective and essential tools that must be used with highway signing. These signs are primarily focused to motorists entering the state and *may* be unfamiliar with the Move Over or Slow Down Law. As for a reminder tool, other, more effective educational efforts have been employed in lieu of signs. These educational efforts often consist of public service announcements through the media, reminders included in DMV vehicle registration notices and driver education. However, due to budgetary concerns and the concern about over signage, signs *should* only be installed in locations that are the most effective for motorists.

DEFINITIONS

Freeways are defined as divided arterial highway facilities that have <u>full</u> controlled access, by means of grade separation at interchanges only.

Expressways are defined as divided arterial highway facilities that have <u>partial</u> control of access and generally with grade separations at major intersections.

Conventional Highways are defined as either divided or undivided roadway facilities that have <u>no</u> control of access with grade separations at intersections. These highways can be two lane or multilane facilities.

POLICY

1. Any requests to install "MOVE OVER OR SLOW DOWN FOR STOPPED VEHICLES WITH FLASHING LIGHTS" (R5-60) signs **shall** be reviewed by the statewide Traffic Incident Management Committee and approved by the State Traffic Engineer prior to installation.
2. "MOVE OVER OR SLOW DOWN FOR STOPPED VEHICLES WITH FLASHING LIGHTS" (R5-60) signs **shall** be installed in all rest areas and weigh stations serving freeways and expressways.
3. The following mainline locations have been approved for installation of "MOVE OVER OR SLOW DOWN FOR STOPPED VEHICLES WITH FLASHING LIGHTS" (R5-60). Signs **shall** be installed at these locations:

   SW Region:
   - IH 39 northbound in Rock County north of the state line
   - IH 39 northbound in Dane County north of USH 51 in Madison

- IH 39 northbound in Columbia County north of IH 90-94
- IH 39 southbound in Columbia County south of IH 90-94
- IH 39 southbound in Dane County south of USH 12-18
- IH 90 eastbound in La Crosse County east of the state line
- IH 90 eastbound in Monroe County east of IH 94
- IH 90 westbound in Columbia County west of IH 39
- IH 90 westbound in Monroe County west of IH 94
- IH 94 eastbound in Dane County east of IH 39-90
- IH 94 westbound in Monroe County west of IH 90
- USH 18 westbound in Dane County west of Dairy Ridge Rd
- USH 151 northbound in Grant County north of the state line
- USH 151 northbound in Dane County north of IH 39-90-94

SE Region:

- IH 41 northbound in Washington County north of USH 45
- IH 43 northbound in Milwaukee County at Holt Ave
- IH 43 northbound in Ozaukee County north of STH 60
- IH 94 eastbound in Milwaukee County east of 84th St
- IH 94 westbound in Kenosha County west of the state line
- IH 94 westbound in Waukesha County west of the Milwaukee County line
- USH 12 westbound in Walworth County west of the state line
- STH 119 westbound in Milwaukee County east of IH 94

NE Region

- IH 41 southbound in Outagamie County south of the Brown County line
- IH 43 southbound in Brown County south of STH 172
- USH 10 westbound in Winnebago County west of IH 41
- USH 41 northbound in Brown County north of CTH B
- USH 41 southbound in Marinette County south of Marinette
- USH 41 southbound in Brown County south of CTH B
- STH 29 westbound in Brown County west of IH 41

NC Region

- IH 39 northbound in Portage County at Stevens Point
- IH 39 southbound in Marathon County south of Business 51
- IH 39 southbound in Portage County at Stevens Point
- USH 51 northbound in Marathon County north of STH 29
- USH 45 southbound in Vilas County south of the state line
- STH 29 eastbound in Marathon County east of USH 51
- STH 29 westbound in Marathon County west of USH 51
- STH 153 westbound in Marathon County east of IH 39

NW Region

- IH 94 eastbound in Saint Croix County east of the state line
- IH 94 eastbound in Eau Claire County east of USH 53
- IH 94 westbound in Dunn County west of STH 29
- USH 2 eastbound in Douglas County south of Superior
- USH 53 northbound in Chippewa County north of STH 29
- STH 29 eastbound in Chippewa County east of USH 53

2-2-50 Spacing of Reminder Signs January 2007

EMERGENCY STOPPING ONLY

The R8-7 EMERGENCY STOPPING ONLY sign **shall** be used on expressways and freeways only. The R8-7 sign *should* be placed at random intervals of about 15 miles, generally being located just beyond the signing required after an interchange.

SLOWER TRAFFIC KEEP RIGHT

The R4-3 SLOWER TRAFFIC KEEP RIGHT sign *may* be used on multiple-lane roadways to reduce unnecessary weaving. If used on conventional highways, it *should* be erected just beyond the beginning of a multiple-lane pavement and selected locations where there is a tendency on the part of the motorist to drive in the left-hand lane (or lanes) below the normal speed of traffic. If used on freeways and expressways, the sign **shall** be erected at random intervals of about 7 ½ miles, generally just beyond the signing required after an interchange. It *should* not be used on the approach to an interchange or through an interchange area. Successive signs **shall** be alternated between the median and the right-hand side of the roadway.

2-2-51 Except Right Turn Signals — March 2011

PURPOSE AND BACKGROUND

The RIGHT TURN NO STOP sign is occasionally used below a STOP sign for intersections where an engineering study indicates that right turns do not have to stop. Many of these intersections are in urban areas with high right turning traffic volumes and oftentimes have a lack of space to construct a pork chop island with a separated free flow right turn lane. FHWA has previously discouraged the usage of the RIGHT TURN NO STOP sign, and as a result the Department used it very sparingly after exhausting all other traffic control strategies.

The MUTCD now allows the usage of a supplemental plaque below a STOP sign at intersections that allow a right turn to free flow.

POLICY

The EXCEPT RIGHT TURN (R1-10P sign) is approved for usage on WisDOT maintained roadways, provided the following policy criteria are met:

1. An engineering study of the intersection is performed and it is determined that the geometrics and traffic volumes make it possible for free-flowing right turns.
2. Existing locations should be reviewed periodically to see if geometric conditions can be changed (upcoming improvement project) or if the traffic volumes are still applicable. Discussion with local officials may result in developing other control strategies. At some locations, it may be possible to install right-turn channelization.
3. RIGHT TURN NO STOP (R1-51) signs should be replaced with the EXCEPT RIGHT TURN (R1-10P) signs as opportunities permit (improvement projects, knockdown replacement and replacement due to age).

2-2-53 Signing for Flashing Yellow Arrow Traffic Signals — May 2021

PURPOSE AND BACKGROUND

The MUTCD allows the usage of a flashing yellow left turn arrow that is intended to provide a safer, more efficient left turn for motorists. National studies have indicated that drivers have fewer crashes with the flashing yellow left-turn arrow than with the traditional yielding left-turn indication.

FHWA has indicated that flashing yellow arrow educational signing for motorists is normally not needed, since the obvious intent of the flashing yellow arrow is to yield to oncoming motorists. This is the reason why no signing for flashing yellow arrows is included in the MUTCD. Previously, WisDOT has utilized signing for intersections because flashing yellow arrows were new to Wisconsin, and the signs aided in motorist education efforts. However, with continued expansion of the usage of flashing yellow arrow signals, the need for signs has been mitigated to the point where they are now only needed for locations with demonstrated operational and safety issues. This policy will address the installation of signing for flashing yellow arrow signals to address any problem areas.

QUALIFYING CRITERIA FOR SIGNING

The LEFT TURN YIELD ON FLASHING YELLOW ARROW (R10-50) sign has been designed for usage on WisDOT maintained roadways, provided the following policy criteria are met:

1. The LEFT TURN YIELD ON FLASHING YELLOW ARROW (R10-50) sign, **shall** only be used for intersection locations with demonstrated operational or safety issues, per approval of the Region Traffic and Safety Engineer.
2. The LEFT TURN YIELD ON FLASHING YELLOW ARROW (R10-50) signs located at intersections that do not have operational or safety issues *should* be removed is opportunities permit (traffic signal work by electricians, corridor signing projects, knockdowns, etc.

GUIDELINES FOR FIELD INSTALLATION OF SIGNS

If signs are warranted at an intersection, the following guidelines *should* be utilized for installation:

1. Primary choice for mounting of the LEFT TURN YIELD ON FLASHING YELLOW ARROW (R10-50) sign is the far side overhead signal that has a flashing left yellow arrow indication.
2. Secondary choice for mounting of the LEFT TURN YIELD ON FLASHING YELLOW ARROW (R10-50) sign is the far side ground mounted signal that has a flashing left yellow arrow indication.
3. Third choice for mounting of the LEFT TURN YIELD ON FLASHING YELLOW ARROW (R10-50) sign is the near side ground mounted signal that has a flashing left yellow arrow indication.

2-2-54 Stop for School Bus Flashing Red Lights State Law Sign — September 2009

PURPOSE

Wisconsin State Statute 346.48 mandates that motorists approaching a school bus from the front or rear **shall** stop when the bus is displaying the flashing red lights. The exception to this is oncoming motorists would not have to stop if there is a physical separation in the median, as in the case of divided highways. Oftentimes, requests come to the WisDOT Region offices to install signs for areas where motorist compliance is problematic. Typically, these are areas where there are multiple school bus stops and the sight distance does not warrant the placement of the SCHOOL BUS STOP AHEAD (S3-1) warning sign. In the past, the STOP FOR SCHOOL BUS FLASHING RED LIGHTS STATE LAW *R59-51) sign has been installed for these problem areas. However, due to a lack of statewide guidance, these signs have been used inconsistently.

MUTCD Section 2B.54 allows the customization of regulatory signs to aid in the enforcement of other laws or regulations. Therefore, the STOP FOR SCHOOL BUS FLASHING RED LIGHTS STATE LAW (R59-51) sign has been designed to reinforce Wisconsin State Statute 346.48 and aid law enforcement for problem areas. Listed below are criteria that *should* be followed when considering the placement of these signs.

DEFINITIONS

Freeways are defined as divided arterial highway facilities that have full controlled access, by means of grade separation at interchanges only.

Expressways are defined as divided or undivided roadway facilities that have partial control of access and generally with grade separations at major intersections.

Conventional highways are defined as divided or undivided roadway facilities that have limited access with no grade separations at intersections. These highways *may* be two-lane or multi-lane facilities.

POLICY

Below are policy criteria that *should* be applied when considering installations of the STOP FOR SCHOOL BUS FLASHING RED LIGHTS STATE LAW (R-59-51) sign.

1. For installation of the STOP FOR SCHOOL BUS FLASHING RED LIGHTS STATE LAW (R59-51) sign on expressways, TEOpS 2-3-55 *should* be followed.
2. If a specific school bus stop has a sight distance less than the minimum visibility distance for warning signs per the MUTCD, the SCHOOL BUS STOP AHEAD (S3-1) warning sign *should* be used.
3. The STOP FOR SCHOOL BUS FLASHING RED LIGHTS STATE LAW (R59-51) sign *may* be used for segments of conventional highways that have the following criteria:
    a. Multiple stops on a segment of roadway
    b. Documented compliance problems exist,
    c. Sight distance is not a factor that would not allow the use of warning signs for most of the stops in the segment of roadway.
4. If the STOP FOR SCHOOL BUS FLASHING RED LIGHTS STATE LAW (R59-51) sign is warranted, it *should* be installed at the beginning of the segment and *may* be repeated every five miles if the segment is greater than 5 miles or after major intersections (at the discretion of the Region Traffic Engineer).
5. In considering the usage of this sign, the Regions are encouraged to obtain a school bus route map or other information supplied by the school district to identify the locations of the stops. The Region *should* contact the school districts annually to determine where stops are no longer made so that signing can be adjusted accordingly.

2-3-10 Use of Chevrons **February 2018**

GENERAL

The WisMUTCD classifies the chevron as an alignment sign, but it is basically a delineator with a directional connotation, which is the aspect of the sign that relegates its use to horizontal curves. It is not to be used at roadway width transitions, lane drops, or approaches to narrow bridges. It is also not to be used singly, because that will not adequately develop the directional message. Another inappropriate use is in a cluster at the end of a T-intersection.

Chevrons (W1-8) signs *may* be used in combination with the large night arrow (W1-6) sign or without the large night arrow sign. Table 2C-5 of the WisMUTCD provides guidance as to when chevron signs are used.

The WisMUTCD, Table 2C-6 contains spacing criteria for installations of chevrons, which has been included as part of this policy.

GUIDANCE

The following guidelines apply to these signs:

1. It is desirable to position one chevron directly ahead of an approaching vehicle while the vehicle is on the approach tangent, and begin spacing in both directions from that point.
2. Extend to the point of curvature, and to the point of tangency; do not alter the spacing to meet these points, however.
3. A minimum of three signs **shall** be used, even if they extend beyond the point of curvature. Also, per the WisMUTCD, the spacing of chevron signs *should* be such that the road user has at least two in view, until the change in alignment eliminates the need for the signs.
4. Chevron signs **shall not** be placed on the far side of a T-intersection to warn drivers that a through movement is not possible.
5. Chevron signs **shall not** be used to mark obstructions within the roadway.
6. Follow the spacing table below, making adjustments for conflicts with driveways, signs, etc. The chevron spacing shown below are maximum distances between chevrons. Chevrons may be spaced closer to address curves with tighter radius measurements.

Chevron signs **shall** be mounted at a 4-foot minimum height (measured from the bottom of sign to the elevation of the near edge of traveled way). They **shall** be aimed toward traffic rather than located perpendicular to the curve.

The chevron sign *may* be used only where an emerging or demonstrated crash problem exists. On highways to be reconstructed it is unlikely that crashes will be expected to occur on the re-alignment. Therefore, chevron signs *should not* normally be specified on new construction, unless required by Table 2C-5 of the WisMUTCD.

CHEVRON ALIGNMENT SIGN SPACING

Posted Advisory Speed (mph)	Maximum Spacing (feet)
15 mph or less	40
20	80
25	80
30	80
35	120
40	120
45	120
50	160
55	160
60	160
65	200

7. Existing signs not installed at this spacing *should* be adjusted when opportunity permits, due to improvement projects, knockdowns or if problems are present.

2-3-14 Hill Blocks View Signs — June 2005

PURPOSE

The WisMUTCD section 2C.18 says the Hill Blocks View sign (W7-6) *may* be used in advance of a crest vertical curve to advise road users to reduce speed as they approach and traverse the hill as only limited stopping sight distance is available. If used, it *should* be supplemented by an advisory speed (W13-1) plaque indicating the recommended speed for traveling over the hillcrest based on available stopping sight distance. See WisMUTCD section 2C.36 for visibility chart for various speeds. Advisory speed plaque speed is based on available visibility distance. This policy provides guidance on when these signs *may* be considered for usage of state-maintained highways.

TRUCK ENTRANCE signs have been commonly used for driveways with limited sight distance; however, their usage is exclusive to driveways or side streets with high truck traffic volumes.

POLICY

While guidance on crossroad and side road warning sign usage and criteria are provided in the WisMUTCD, less guidance is provided on driveways. This policy provides for the use of HILL BLOCKS VIEW sign where driveways are after a crest vertical curve. Signs such as BLIND ENTRANCE and HIDDEN DRIVEWAY are not in the WisMUTCD. However, the HILL BLOCKS VIEW sign is an approved sign in the WisMUTCD. It has been general practice not to provide warning signs for driveways. The HILL BLOCKS VIEW sign is intended for use in lieu of the BLIND ENTRANCE or HIDDEN DRIVEWAY signs, both of which are not approved in the WisMUTCD.

GUIDELINES

The following step-by-step criteria *should* be used to determine if a HILL BLOCKS VIEW sign is warranted for driveways:

1. First, the driveway must have inadequate sight distance per the visibility chart in the WisMUTCD section 2C.37 when determining the need for the sign due to a crest vertical curve. Vision problems due to horizontal curvature or vegetation **shall not** warrant use of this sign.
2. The volume of the driveway **shall** be a minimum of 50 ADT (25 in, 25 out). A typical one-family residence generates about 10 trips per day and therefore would not qualify for the sign. Note: a side road with 100 ADT or greater requires a type B1/B2 intersection as opposed to a type C/D intersection which would be used for under 100 ADT. 50 ADT provides for a driveway for a small business.
3. Verify that the volumes exceed 50 ADT at least once per week or 50 days per year.

NOTE: Crash history – if the driveway does not meet the volume criteria above, but a crash analysis indicates there is a crash history at the driveway location, a sign *may* be considered.

Location of the sign *should* be per WisMUTCD Table 2C-4.

2-3-18 Merge Sign Locations — March 2016

PURPOSE

This policy will define merge sign locations on all freeways and expressways.

POLICY

Merge signs should be placed in accordance with Condition A, Table 2C-4 of the WisMUTCD. This distance shall be measured in an upstream direction, starting at the theoretical gore.

In some cases, particularly existing ramps at tight urban interchanges, this distance may not be achievable, due to substandard geometrics. In these cases, the merge signs will have to be installed where they can be accommodated.

2-3-19 Divided Highway Warning Signing — September 2009

GENERAL

The WisMUTCD Sections 2C.22 and 2C.23 covers the usage of the divided highway warning signs (W6-1 and W6-2 signs). However, the WisMUTCD guidance is very general in nature and does not tie into specific factors such as posted speed and length of divided section. Oftentimes for shorter segments with lower speeds, the

DIVIDED HIGHWAY AHEAD warning signs *may* be deleted. This policy will provide for a statewide policy for consistent usage.

POLICY

Below is the statewide policy for the usage of divided highway signs.

1. The DIVIDED HIGHWAY AHEAD (W6-1) warning sign *should* be installed in advance of two-lane-to-four-lane transitions that are physically divided by a median. Standard Detail Drawing 15C21-3 shows a typical installation of this sign.
2. The DIVIDED HIGHWAY AHEAD (W6-1) sign *should* only be used in transition to a section of highway that is divided, not a specific intersection.
3. The DIVIDED HIGHWAY AHEAD (W6-1) warning sign *should not* be used for locations where there is two-way traffic to single-lane divided.
4. If posted speeds are 45 mph or above, the DIVIDED HIGHWAY AHEAD sign *may* be used if the divided area is greater than 1,000 feet. The signs would be used at the beginning of the divided section only.
5. A DIVIDED HIGHWAY ENDS (W6-3) sign *should* be used at the end of the divided highway section, in accordance with Standard Detail Drawing 15C21-3, to give warning and notice that traffic is now two lanes.

2-3-25 Single Diagonal Arrow Signs — February 2018

GENERAL

Section 2C-25 of the Wisconsin MUTCD allows the use of the Double Diagonal Arrow sign (W12-1D) to advise drivers that traffic is permitted to pass on either side of an obstruction. Section 2C-25 of the Wisconsin MUTCD further allows the use of a sign with a single diagonal arrow (W12-1L/R) to advise drivers that traffic is only permitted on one side of an obstruction. In practice, WisDOT has also utilized W12-1L/R signs to warn drivers of lane reduction situations that have experienced an above-average crash rate. This policy will establish guidelines for the use of W12-1L/R signs.

GUIDANCE

The following guidelines apply to these signs:

LANE REDUCTIONS

1. Single Diagonal Arrow signs *should* be used as a bank of signs, not as a single sign installation. A minimum of 3 signs *should* be used.
2. Signs *should* be installed along the entire length of the lane reduction taper, as space is available and geometrics allow. The signs *should not* extend beyond the beginning or end of the taper.
3. Single Diagonal Arrow signs are typically used on conventional roadways. On freeways and expressways, Type 5 pavement marking arrows (“pushover arrows”) are typically used for this purpose.
4. Follow the spacing table below, adjusting for conflicts with driveways, signs, etc. The spacings shown below are maximum distances between signs.

Single Diagonal Arrow signs *should* be mounted at a 4-foot minimum height (measured from the bottom of sign to the elevation of the near edge of traveled way). They **shall** be located perpendicular to the through traffic lanes.

The Single Diagonal Arrow sign *may* be used only where an emerging or demonstrated crash problem exists. On highways to be reconstructed it is unlikely that crashes will be expected to occur on the re-alignment. Therefore, Single Diagonal Arrow signs *should not* normally be specified on new construction, unless an existing geometric situation is not being rectified by the project.

SINGLE DIAGONAL ARROW SIGN SPACING

Posted Speed (mph)	Maximum Spacing (feet)
15 mph or less	40
20	80
25	80
30	80
35	120
40	120
45	120
50	160
55	160

60	160
65	200
70	200

5. Existing signs not installed at this spacing *should* be adjusted when opportunity permits, due to improvement projects, knockdowns or if problems are present.

MEDIAN ISLANDS

1. R4-7 "KEEP RIGHT" signs *should* be used to mark the beginning of medians. However, at some smaller median island locations, KEEP RIGHT signs would block the driver's view of other regulatory or warning signs or traffic signal faces. In these situations, Single Diagonal Arrow signs *may* be used to mark the beginning of medians.
2. When used to mark the upstream end of a median island, Single Diagonal Arrow signs should be mounted at a 2-foot minimum height (measured from the bottom of sign to the elevation of the near edge of traveled way).

2-3-27 BUMP and ROUGH ROAD Signs January 2013

PURPOSE

This policy provides guidance on the use of BUMP (W8-1) signs, BUMPS (W8-1A) signs, DIP (W8-2) signs and ROUGH ROAD (W8-8) signs.

DEFINITIONS

A sharp rise or depression is defined as a roadway deficiency that is sufficiently abrupt to create considerable discomfort to passengers, to cause shifting of the cargo, or to deflect a vehicle from its true course at normal roadway driving speeds.

A minor rise or depression is defined as a roadway deficiency that is noticeable enough to divers to cause a minor discomfort, but not enough of a deficiency to be a safety hazard.

POLICY

1. For sharp rises or depressions in the profile of the roadway, the BUMP or DIP sign *should* be installed both in advance of the condition and at the location of the rise or depression. The BUMP or DIP sign installed at the location of the rise or depression **shall** have the diagonal downward arrow sign (W16-7L or W16-7R) installed below it. The BUMP or DIP sign installed in advance of the condition **shall** have the AHEAD (W16-9P) installed below it.
2. For minor rises or depressions in the profile of the roadway, the BUMP or DIP sign *may* be installed both in advance of the condition and at the location of the rise or depression. The BUMP or DIP sign installed at the location of the rise or depression **shall** have the diagonal downward arrow (W16-7L or W16-7R) sign installed below it. The BUMP or DIP sign installed in advance of the condition **shall** have the AHEAD (W16-9P) sign installed below it. If the condition is the result of pavement buckling, BUMP signs **shall** be installed both in advance of the condition and at the location of the condition on higher-speed roadways (45 mph posted speed and above).
3. For segments of roadways with multiple sharp rises or depressions, the ROUGH ROAD sign or BUMPS sign *should* be installed in advance of the segment. The advanced location of the ROUGH ROAD sign or BUMPS sign **shall** be supplemented with the NEXT XX MILES (W57-51) plaque. The BUMP or DIP sign *should* be installed at locations of rises or depressions. The BUMP or DIP sign installed at the location of the rise or depression **shall** have the diagonal downward arrow (W16-7L or W16-7R) sign installed below it.
4. For segments of roadways with multiple minor rises or depressions, the ROUGH ROAD sign or BUMPS sign *may* be installed in advance of the segment. The advanced location of the ROUGH ROAD sign or BUMPS sign **shall** be supplemented with the NEXT XX MILES (W57-51) plaque. The BUMP or DIP sign *should* be installed at locations of rises or depressions. The BUMP or DIP sign installed at the location of the rise or depression **shall** have the diagonal downward arrow (W16-7L or W16-7R) sign installed below it.
5. Type A flashing lights or orange flags *may* be used on the advanced sign assembly, depending on the severity of the bump or dip.
6. Signs *should* have a yellow background. Orange background signs *should* only be used if the roadway deficiencies are construction related.

2-3-30 Speed Reduction Signs (Reduced Speed Ahead) March 2016

PURPOSE

This guidance is to establish the appropriate use and location of the speed reduction sign in relation to the speed limit sign for the lower speed zone. This policy pertains to signing on freeways, expressways and conventional highways.

BACKGROUND (AUTHORITY)

The WisMUTCD in Section 2C-38 covers the usage of the Reduced Speed Limit Ahead sign (W3-5 sign). The WisMUTCD Section 2C, Guidelines for Advanced Placement of Warning Signs, Table 2C-4, Condition B, addresses the placement of advanced warning signs with minimum distances. However, based upon experience and from the establishment of a “comfortable braking distance,” these distance guidelines have been increased per the chart contained herein.

POLICY

General Speed Reductions

A speed reduction (W3-5) sign **shall** be erected in advance of downward changes of the speed limit from 70, 65, 60 or 55 mph regardless of the amount of reduction, and from 50 mph or below for reductions of 15 mph or more. The speed reduction sign **shall not** be used for reductions of 10 mph or less for speeds of 50 mph or below.

School Speed Reductions

In accordance with Section 7B.16 of the WisMUTCD, a Reduced School Speed Limit Ahead Sign (S4-5) should be installed in advance for reductions of 15 mph or more (from posted speed limit to school speed limit).

1. **Sign Spacing in Advance of Reduced Speed Zone:** Signs **shall** be placed to provide adequate time for the driver to perceive, identify, decide and perform the speed reduction. The following table establishes the minimum distances to be used for the speed reduction signs. The table was developed by modifying the distance chart for Advanced Placement of Warning Signs, Table 2C-4, Condition B of the WisMUTCD, (deceleration to listed advisory speed). The modifications provide more time for the driver to respond, as opposed to the warning signs when a driver is required to decelerate to a specific speed, based on a road condition. The increased distance between the speed reduction sign and the speed limit sign provides additional time to decelerate. This is consistent with the guidance in the WisMUTCD, Section 2C-5 which indicates the time necessary for Perception, Identification/understanding, Emotion/decision making, and Volition/execution of decision (PIEV) is higher for signs that involve more driver judgment, as opposed to warning signs. In particular, the comfortable braking distance and therefore the execution distance is being increased to the following:

SPEED REDUCTION SIGN DISTANCE IN ADVANCE OF SPEED LIMIT SIGN
MINIMUM DISTANCES (in feet)

From Speed Limit	To Speed Limit 65	55	50	45	40	35	30	25	20	15
70 --------------	700	700	700							
65 --------------		700	700	700	-	-	-	-	-	
60 --------------		600	600	600	-	-	-	-	-	
55 --------------	-		500	500	500	550	600	600	600	600
50 --------------	-	-	-	-		550	550	600	600	600
45 --------------	-	-	-	-	-		450	475	500	525
40 --------------	-	-	-	-	-	-		425	450	475
35 --------------	-	-	-	-	-	-	-		375	400
30 --------------	-	-	-	-	-	-	-	-		325

2. **Sizes of Signs:** Size of signs **shall** be in accordance with TEOpS 2-1-35.
3. **Double Marking:** Double marking (right and left side) **shall** be employed for any reduction from 70 mph or 65 mph and *may* be employed for other speed limit reductions, especially on divided or multi-lane highways and for added emphasis. If a double-marked REDUCED SPEED AHEAD sign assembly (R2-5A and W13-1W) is replaced on one side of the roadway with a W3-5 SPEED REDUCTION sign, the R2-5A and W13-1W sign on the other side of the roadway **shall** also be replaced with a W3-5 SPEED REDUCTION sign.
4. **Phase in Period:** Signs *should* be adjusted to conform to this guideline when opportunities arise, such as knockdowns or damage, when other work is occurring nearby, or projects make removal practical.

5. **Work Zone Traffic Control Speed Limit and Reduced Speed Ahead Signs:** The spacing shown in this policy does not apply to work zone traffic control speed limit changes. See the Work Zone Standard Detail Drawings for applicable requirements.

2-3-35 Advisory Speed on Curves — July 2012

PURPOSE

To establish uniformity and consistency when determining the proper advisory speed for turns and curves and subsequent installation of advisory speed plaques.

BACKGROUND

The WisMUTCD provides requirements for the proper use of horizontal alignment signing, Advisory Speed plaques, Truck Rollover Warning signs, Advisory Exit and Ramp Speed signs. They are contained in the following sections:

1. Horizontal Alignment signs – WisMUTCD Sections 2C.06 and 2C.07
2. Truck Rollover Warning signs – WisMUTCD Section 2C.13
3. Advisory Speed Plaques – WisMUTCD Section 2C.08
4. Supplemental warning plaques – WisMUTCD Section 2C.53 and 2C.54
5. Advisory Exit, Ramp and Curve speed signs – WisMUTCD Section 2C.14
6. Horizontal Alignment Sign Usage – WisMUTCD Table 2C-5

On state trunk highways it is required that all curves and turns less than posted or statutory speed be signed in advance, with curve warning signs for curves 35 mph or above, or turn warning signs for turns 30 mph or less. The WisMUTCD (Sections 2C.06 and 2C.07) has instructions related to signing curves, turns, winding roads, etc. The WisMUTCD states in Section 2C.06 that if the roadway is less than 1000 ADT, an advisory speed plaque *should* be used to supplement the curve or turn warning sign where the posted speed varies from the curve speed by 10 mph or more.

The WisMUTCD Table 2C-5 states that advisory speed plaques are:

1. Recommended where the difference between the speed limit and advisory speed is 5 mph.
2. Required where the difference between speed limit and advisory speed is 10 mph or more.

WisMUTCD Table 2C-5. Horizontal Alignment Sign Selection

Type of Horizontal Alignment Sign	Difference Between Speed Limit and Advisory Speed				
	5 mph	10 mph	15 mph	20 mph	25 mph or more
Turn (W1-1), Curve (W1-2), Reverse Turn (W1-3), Reverse Curve (W1-4), Winding Road (W1-5), and Combination Horizontal Alignment/Intersection (W1-10) (see Section 2C.07 to determine which sign to use)	Recommended	Required	Required	Required	Required
Advisory Speed Plaque (W13-1P)	Recommended	Required	Required	Required	Required
Chevrons (W1-8) and/or One Direction Large Arrow (W1-6)	Optional	Recommended	Required	Required	Required
Exit Speed (W13-2) and Ramp Speed (W13-3) on exit ramp	Optional	Optional	Recommended	Required	Required

INTRODUCTION

The determination and posting of advisory speeds for changes in horizontal alignment is a universal practice throughout the nation. It was initially tried by the State of Missouri in 1937 followed shortly thereafter by a number of other state highway departments. The preeminent research was done by R. A. Moyer and D. S. Berry (1) published by the Highway Research Board in 1940 as a recommendation for signing changes in roadway alignment. Curve advisory speed posting was adopted as a suggested option in the *1948 Manual on Uniform Traffic Control Devices* (2).

The initial research by Moyer and Berry established the basic need, procedures and criteria for determining advisory speeds. The use of a ball-bank Indicator was recommended as an acceptable instrument for establishing a “safe speed” on a horizontal curve. Their recommendations were the following ranges of values:

Table 1. Recommended Criteria for Curve Advisory Speed Determination
(Source: Moyer and Berry, 1940, Ref. 1)

Speeds (mph)	Ball Bank Reading	Side Friction Factor
≤ 20	14°	0.21
25 – 30	12°	0.18
≥ 35	10°	0.15

The Moyer/Berry research also indicated that the curve “safe speed” could be computed using the standard curve formula if the curve radii and super elevation were known using the above noted equivalent side friction factors. While they noted the advisory speed as being the “safe speed” for the curve, the advisory speed actually represented the comfortable speed that the curve could be driven without experiencing lateral acceleration discomfort.

This procedure and criteria for advisory speed determination has become nearly universally accepted in the highway engineering profession and typically is used by most transportation agencies. However, there has been concern that the ball-bank method of determining advisory speeds *may* be outdated and not the best procedure. The need to update the procedures and criteria has been noted by the highway community for a number of years. Recognizing the age of the research, minor variations have been made in the criteria and its application in some roadway jurisdictions (3).

Many motorists also have observed that advisory speed signing is overly conservative and many exceed the posted advisory speeds. Another factor is that current vehicles have suspension and steering systems that are significantly improved providing better stability, cornering capabilities and driving comfort compared with typical vehicles at the time of the initial research.

The following guidelines establish new values that satisfy the motorists’ needs. The current research has been reviewed with three methods addressed to determine an acceptable advisory speed. The recommended criteria have been adjusted to represent the current driving practices. While it is recognized that most roadways are posted with advisory speeds based on the older criteria, it appears logical to raise the values to provide realistic postings that are compatible with driving practices.

The provisions of the WisMUTCD encourage a restudy of the horizontal alignment signing. The WisMUTCD has a liberal compliance period of at least 10 years to implement the new horizontal alignment signing, so the engineering studies for curve advisory speeds can be done over a period of several years on a systematic basis with appropriate publicity so the public understands the revisions. Drivers will have to modify their driving habits so they do not incorrectly assume that posted advisory speeds can be driven at a higher speed. However, an adequate factor of safety is addressed in the new criteria so drivers even assuming a higher speed is acceptable *should not* be subjected to undue hazards. The older postings, while usually a lower speed, can remain in place until the new engineering study is completed and signs installed. It will be desirable to change all advisory speed plaques along a roadway at the same time to minimize motorist confusion.

DISCUSSION

There are several areas of concern/discussion:

- The ball-bank indicator method *may not* be current nor the best method for determining advisory speeds (5).
- The current practice results in advisory speeds that are too conservative and are far below the 85th percentile speed of drivers traversing the curves (5) (6) (7).
- Current vehicle suspension and cornering capabilities are substantially better than those of vehicles that were used to determine the older criteria (8). As a result, drivers today can comfortably drive curves at speeds higher than those that would have been comfortable with older vehicles.
- The criteria for curve advisory speeds *should* be comparable to the design criteria in the AASHTO *Policy on Geometric Design for Highways and Streets* (9).
- The curve advisory speed practices in some jurisdictions have deviated from an adequate and universally accepted criteria resulting in posted advisory speeds well below prevailing curve speeds (3)(6). This results in inconsistent curve advisory speed postings from one jurisdiction to another.
- The current criteria do not consider truck advisory speeds and truck roll-over considerations (10) (11).
- Some inconsistencies have been noted in comparing current ball bank criteria with side friction factors used for curve design (8).

The research generally documented that drivers are often exceeding the existing posted advisory speeds by 7 to 10 miles per hour. An increase of 2 degrees for ball-bank indicator readings and comparable side friction factors is equivalent to 8 to 10 miles per hour increase in advisory speeds. The application of an accelerometer that measures lateral acceleration provides a direct determination of side friction factors and accommodates new instrumentation for advisory speed determinations. Minor adjustments in the relationship between ball-bank readings and side friction factors makes the ball-bank procedure and accelerometer determinations comparable. The use of the horizontal curve design speed equation remains an acceptable procedure using the newly recommended side friction factors.

There appears to be no reason to limit the advisory speed determination methods but instead recognize that any of the three methods are acceptable:

- The traditional ball-bank indicator
- Design speed equation or
- Accelerometer.

There is a fourth method called the Compass Method by Texas Transportation Institute (TTI), but requires extensive field work (measuring points throughout the curve), so is not being considered for WisDOT. The expansion of acceptable determination methods and change in criteria *should* offset current procedural deviations with the new WisMUTCD requirements encouraging wider and universal application of acceptable advisory speeds. The recommended criteria for advisory speed determinations are as follows:

Table 2. Recommended Criteria for Curve Advisory Speed Determination
(Source: Adapted from Carlson and Mason 1999, Ref. 8)
Revised by WISDOT to include Truck Advisory data

Speeds (mph)	Ball Bank Reading	Lateral Acceleration (g)
≤ 20	16°	0.28
25 – 30	14°	0.24
≥ 35	12°	0.21
Truck (All Speeds)	10	0.17

The new criteria are comparable to the current AASHTO design criteria. Some research has proposed higher values, but those values result in advisory speeds that exceed the observed speeds of drivers in curves, are above comfortable lateral acceleration levels, and reduce the margin of safety. Studies show that maximum side friction factors developed between passenger car tires and wet pavement in poor condition can be as low as approximately 0.35 at high speeds (9) (14).

For large trucks, there is a potential danger of overturning if the truck enters a curve at too high of a speed. For sharp curves, such as loop exit ramps, it *may* be necessary to post truck advisory speeds. Current research indicates that truck-overturning situations are limited and inconsistent when side friction factors are less than 0.35 (12). Theoretically, truck advisory speeds could be determined based on a side friction factor of 0.21, or a ball-bank reading of 12 degrees, and still provide a reasonable overturning safety factor below the 0.35 overturning threshold. But this assumes that the truck follows the exact radius of the curve, which is unlikely in actual practice. Most drivers make steering corrections as they traverse a curve, sometimes steering a radius larger than the actual curve radius, sometimes steering a radius sharper that the actual curve radius. It must be recognized that if the truck is steered on a radius of ⅔ to ¾ of the actual curve radius, then the safety factor below the overturning threshold nearly disappears. As a result, it is recommended that the criteria for posting truck advisory speeds be based on a side friction factor of 0.17, or a ball-bank reading of 10 degrees, for all speed ranges to ensure a reasonable overturning safety factor. This would result in truck advisory speeds below the advisory speeds determined for passenger cars.

For New Construction Projects the following option *may* be used in lieu of the ball bank indicator method:

Method 1: Determining Advisory Speeds Using the Design Speed Equation

The design of highway curves is based on the relationship between design speed, radius of curvature, super elevation, and side friction (centripetal acceleration). The mathematical relationship between these variables is given by the equation (9):

$$V = \sqrt{15R(0.01e + f)}$$

Where: *V* = Design speed (mph)

R = Curve radius (feet)

e = Super elevation (%)

f = Side friction factor

The same equation can be used to calculate the advisory speed for a curve, if the curve radius and super elevation are known. The side friction factor is the same as lateral acceleration (measured in “g’s”), and is based on driver comfort. For highway design, side friction factors are set by AASHTO geometric design policies, and are generally in the range of 0.08 to 0.30 depending on design speed. As previously discussed, recent studies have suggested that the values in the current design manual are overly conservative, and when this equation is used to determine the advisory speed for a curve, the lateral acceleration rates contained in Table 2 can be used. This equation *may* have to be solved iteratively because the value for the side friction factor, *f*, is different for different ranges of advisory speed, *V*. For example, suppose that a curve has a 200-foot radius and a super elevation of 4%. If it is initially assumed that the value of the lateral acceleration is 0.21 (applicable for passenger car advisory speeds of 35 mph or more), the calculated advisory speed is 27 mph. This means that the lateral acceleration value *should* have been 0.24 (applicable for advisory speeds of 25 to 30 mph), and the advisory speed is recalculated as 29 mph. Calculated advisory speeds *should* be rounded to the nearest 5 mph increment, so a 30 mph advisory speed would be used for this curve. The rounded passenger car advisory speeds calculated for various combinations of super elevation and curve radius are shown in Table 3.

Table 3. Rounded Passenger Car Advisory Speeds (mph) Based on Design Speed Equation

Radius (ft)	Super elevation (%)				
	-2	2	4	6	8
100	20	20	20	20	20
200	25	30	30	30	30
400	35	35	40	40	40
600	40	45	45	50	50
800	50	55	55	55	60
1000	55	60	60	65	65

In some cases, the curve radius and super elevation can be taken from as-built plans for a roadway that has been constructed fairly recently. However, it must be considered that a roadway that has been in service for many years *may* have been resurfaced one or more times since original construction. As a result of resurfacing, the super elevation of the curve *may* have changed, and the original plans *may* no longer be representative of field conditions. In other cases, the original plans *may* no longer be available.

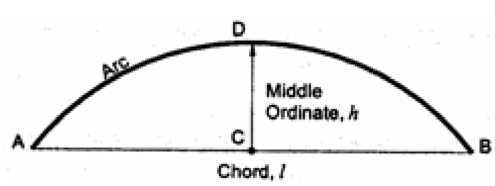
If aerial photography is available, the curve radius can be determined by comparing circular curve templates with the aerial photograph. In the field, the approximate curve radius can be determined by the chord and middle ordinate method of measurement. This is illustrated in Figure 2. To determine the curve radius, measure a chord of any convenient length (usually 100 feet), straight across from one point on the edge of the road to another point on the edge of the road within the curve (line AB in Figure 2) where the curvature is uniform. Also measure the middle ordinate from the center of the chord to the edge of the road (line CD in Figure 2). The radius of the curve can be calculated as:

$$R = \frac{l^2}{8h} + \frac{h}{2}$$

Where: *R* = Curve radius (feet)
l = Chord length (feet)
h = Middle ordinate (feet)

The precision of this calculation is obviously limited by the ability to accurately measure the middle ordinate which would be as small as 1.25 feet (assuming a chord of 100 feet) for a curve with a radius of 1000 feet.

Figure 2. Measurement of Curve Chord and Middle Ordinate



(Source: Northwestern University Center for Public Safety)

The super elevation can be measured in the field using a 4-foot carpenter's level. As illustrated in Figure 3, position the level across the lane. With one end of the level on the road surface, measure the vertical distance from the road surface to the other end of the level. The cross slope of the roadway can then be calculated as the vertical distance divided by the length of the level. The super elevation *should* be measured in several locations along the curve, since it *may* vary. Also, the super elevation *should* be measured separately for each lane of the roadway.

Figure 3. Measuring Super elevation with a Carpenter's Level
(Source: Northwestern University Center for Public Safety)

Another method for determining the super elevation in the field is to stop a vehicle equipped with a ball-bank indicator (discussed in the next section) on the curve and read the degrees of deflection on the ball-bank. The super elevation is calculated as:

$$e = (\tan D) \times 100\%$$

Where: e = Super elevation (%)

D = Degrees of deflection on ball-bank indicator

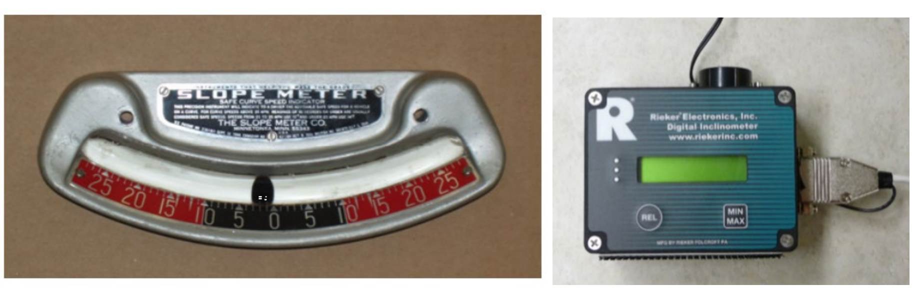
Again, this measurement *should* be made at several locations within the curve, and *should* be measured separately for each lane.

Method 2: Ball-Bank Indicator Method

Advisory speeds *may* be determined in the field using a vehicle equipped with a ball-bank indicator and an accurate speedometer. The simplicity of this technique has led to its widespread acceptance as a guide to determining advisory speeds for changes in horizontal alignment. Figure 4 shows a typical ball-bank indicator.

The ball-bank indicator consists of a curved glass tube, which is filled with a liquid. A weighted ball floats in the glass tube. The ball-bank indicator is mounted in a vehicle, and as the vehicle travels around a curve the ball floats outward in the curved glass tube. The movement of the ball is measured in degrees of deflection, and this reading is indicative of the combined effect of super elevation, lateral (centripetal) acceleration, and vehicle body roll. The amount of body roll varies somewhat for different types of vehicles, and *may* affect the ball-bank reading by up to 1°, but generally is insignificant if a standard passenger car is used for the test. Therefore, when using this technique, it is best to use a typical passenger car rather than a pickup truck, van, or sports utility vehicle.

Figure 4. Ball-bank Indicator



To ensure proper results, it is critical that the following steps be taken before starting test runs with the ball-bank indicator:

- Inflate all tires to uniform pressure as recommended by the vehicle manufacturer
- Calibrate the test vehicle's speedometer
- Zero the ball-bank indicator

The vehicle speedometer *should* be calibrated to ensure proper and consistent test results. This can be done by checking the vehicle speed with a radar or laser speed meter, or by timing the vehicle over a measured distance (such as milepost spacing). Alternatively, a moving radar unit can be used to measure speed while conducting the ball-bank test runs rather than relying on the vehicle's speedometer.

The ball-bank indicator must be mounted in the vehicle so that it displays a 0° reading when the vehicle is stopped on a level surface. The positioning of the ball-bank indicator *should* be checked before starting any test. This can be done by stopping the car so that its wheels straddle the centerline of a two-lane highway on a tangent alignment. In this position, the vehicle *should* be essentially level, and the ball-bank indicator *should* give a reading of 0°. It is essential that the driver and recorder be in the same position in the vehicle when the ball-bank indicator is set to a 0° reading as they will be when the test runs are made because a shift in the load in the vehicle can affect the ball-bank indicator reading.

Starting with a relatively low speed, the vehicle is driven through the curve at a constant speed following the curve alignment as closely as possible, and the reading on the ball-bank indicator is noted. On each test run, the driver *should* reach the test speed at a distance of at least ¼ mile in advance of the beginning of the curve, and maintain the same speed throughout the length of the curve. The path of the car *should* be maintained as nearly as possible in the center of the innermost lane (the lane closest to the inside edge of the curve) in the direction of travel. If there is more than one lane in the direction of travel, and these lanes have differing super elevation rates, drive in the lane with the lowest amount of super elevation. Because it is often difficult to drive the exact radius of the curve and keep the vehicle at a constant speed (cruise-control helps to maintain a constant speed), it *may* take several test runs in each direction be made to more accurately determine the ball-bank reading for any given speed. On each test run, the recorder must carefully observe the position of the ball throughout the length of the curve and record the deflection reading that occurs when the vehicle is as nearly as possible driving the exact radius of the curve.

If the reading on the ball-bank indicator for a test run does not exceed an acceptable level (as indicated by the recommended criteria in Table 2), then the speed of the vehicle is increased by 5 mph and the test is repeated. The vehicle speed is repeatedly increased in 5 mph increments until the ball-bank indicator reading exceeds an acceptable level. The curve advisory speed is set at the highest test speed that does not result in a ball-bank indicator reading greater than an acceptable level.

Figure 5 is an example of a data collection form that can be used to record the results of ball-bank indicator test runs. In the example in Figure 5, test runs were started at 25 mph, with ball-bank indicator reading of about 6°. This is well below the suggested criteria of 14° for a speed of 25 mph. The speeds of the test runs were gradually increased until the speed of 35 mph gave readings of 10° to 12°. These are the highest readings attained without exceeding and the suggested criteria of 12° for a speed of 35 mph or more. This study would result in posting an advisory speed of 35 mph for both directions of travel for this curve. Several alternative field data collection and supervisor approval forms are shown in the Appendix.

Figure 5. Sample Ball-Bank Indicator Data Collection Form

BALL-BANK INDICATOR STUDY						
LOCATION: ***STATE ROUTE 43***						
COUNTY: ***DAVIS***			SECTION:			
POSTED SPEED (MPH): ***55***			PAVEMENT CONDITION: ***DRY***			
DATE:			VEHICLE: ***2008 CHEVROLET IMPALA***			
DRIVER: ***SEYFRIED***			RECORDER: ***PLINE***			
REMARKS:						
DIRECTION OF TRAVEL	PHOTO LOG MILE		SPEED (MPH)	BALL-BANK READING (DEGREES)		
	START CURVE	END CURVE		RUN 1	RUN 2 IF NEEDED	RUN 3 IF NEEDED
NORTH	***8.32***	***8.65***	***25***	***6***	***7***	***6***
			30	***9***	***10***	***10***
			35	***12***	***12***	***11***
			40	***15***	***13***	***14***
SOUTH	***8.65***	***8.32***	***25***	***6***	***6***	***5***
			30	***9***	***8***	***9***
			35	***11***	***10***	***11***
			40	***13***	***14***	***14***

Method 3: Accelerometer

An accelerometer is an electronic device which can measure the lateral (centripetal) acceleration experienced by a vehicle as it travels around a curve. Typically, method 1 and 2 are used. However, if the Region has an accelerometer, this method is acceptable to use as an alternative to the ball-bank indicator method.

Establishing Advisory Speeds

Using any of the three methods noted above *should* result in the same advisory speed for a curve. It is important to reiterate that the advisory speed criteria are based on driver comfort, not safety. A sufficiently skillful driver *may* be able to traverse a curve on dry pavement at a speed considerably higher than the advisory speed without exceeding the friction capabilities of the pavement. However, most drivers would choose not to drive at a higher speed because they would experience uncomfortable levels of lateral acceleration.

The WisMUTCD indicates that the “advisory speed **shall** be determined by an engineering study that follows established engineering practices” (Section 2C.08). The Manual further defines an engineering study as “the comprehensive analysis and evaluation of available pertinent information, and the application of appropriate principles, Standards, Guidance, and practices as contained in this Manual and other sources, for the purpose of deciding upon the applicability, design, operation, or installation of a traffic control device. An engineering study **shall** be performed by an engineer, or by an individual working under the supervision of an engineer or sign shop supervisor, through the application of procedures and criteria established in this policy. An engineering study **shall** be documented” (WisMUTCD Section 1A.13).

Therefore, the establishment of advisory speeds must follow standard procedures developed and adopted by the engineering personnel of an agency. All field work used for determining the advisory speeds must be performed under the supervision of an engineer or sign shop supervisor. Finally, the data collected and analysis performed must be preserved in written documentation. The Appendix contains a sample curve advisory speed study supervisor approval form that can be used to document the field data collection.

The maximum comfortable operating speed on a curve can be determined using any of the three methods discussed above (design speed equation, ball-bank indicator, or accelerometer). The advisory speed for the curve *should* be set at the 5-mph increment nearest to this maximum comfortable speed. The advisory speed to be posted *should not* be arbitrarily reduced below the comfortable speed determined using these methods, because an unrealistically low advisory speed will lose credibility among drivers, and create inconsistencies that *may* lead drivers into traveling at too high a speed through other curves.

Advisory speed plaques are only used in conjunction with appropriate warning signs, and never alone. Turn, Curve, Reverse Turn, Reverse Curve, and Winding Road signs are used in locations where it is desirable to warn drivers of changes in the horizontal alignment of the roadway. The WisMUTCD indicates that the use of Turn or Reverse Turn signs *should* be limited to changes in alignment where the advisory speed is 30 mph or less. The Curve or Reverse Curve signs are intended for use where the advisory speed is greater than 30 mph.

Where a Reverse Curve warning sign or a Winding Road warning sign is used, the advisory speed *should* be based on the curve with the lowest comfortable operating speed. However, if one curve in the series has a dramatically lower comfortable speed, it would be desirable to place a separate warning sign with the appropriate advisory speed for that individual curve.

In some cases, there *may* be other factors that influence the selection of the advisory speed in addition to the comfortable operating speed on the curve. Available sight distance or deceleration distance (on an exit ramp) *may*, in some cases, require an advisory speed lower than the comfortable operating speed for the curve.

Truck Advisory Speeds

The appropriate warning signs for truck rollover concerns require more than just determination of truck advisory speeds. Large trucks, tank trailers and truck freight trailers have a high center of gravity and are susceptible to rollover crashes on a sharp curve. The loop ramps on freeway interchanges and direct freeway-to-freeway connections are sometimes subject to truck rollover problems. The potential for such crashes *may* increase because of radius of horizontal curvature, inadequate deceleration length or deficient specific signing. Truck rollover theoretically can occur when the lateral acceleration exceeds 0.30, but no calculated lateral acceleration less than 0.35 has been determined in any truck rollover collisions. A Ball Bank reading of 10 degrees (side friction = 0.17) be used to provide a reasonable factor of safety. This value is about half the critical side friction factor accommodating those occasions where the truck *may* exceed the posted truck advisory speed or the truck travels a curve radius that is less than the actual roadway curvature. These criteria will generally produce a truck advisory speed that is approximately 5 mph less than the advisory speeds determined for passenger cars, except for the lower speed ranges.

The WisMUTCD, Section 2C.13, Section 2C.14 and Table 2C-5 (Figure 1 of this policy), covers the use of the Truck Rollover Warning sign (W1-13), Advisory Exit Speed sign (W13-2), and the Advisory Ramp Speed sign (W13-3). The application of these signs **shall** be based on an engineering study that considers the roadway and operational characteristics that *may* contribute to a loss of vehicle control and potential truck rollovers. It is suggested that the engineering study for Truck Rollover Warning signs address the following considerations;

1. Speed data and advisory speed determinations.
2. Traffic characteristics.
3. Roadway geometrics.
4. Recommended traffic control devices.

It *should* be noted that any posted Advisory Speed for the Truck Rollover signing *should* reflect the truck advisory speed determination. The WISMUTCD provides a number of other devices that can be used in conjunction with the above signs to address truck rollover consideration such as:

- Chevron Alignment signs (W1-8)
- Combination Horizontal Alignment/Advisory Speed sign (W1-1a and W1-2a)
- One Direction Large Arrow sign (W1-6)
- Combination Horizontal Alignment/Advisory Exit and/or Advisory Ramp Speed Signs (W13-6 and W13-7).

See TEOpS 2-3-36 for policies related to exit advisory speed signage.

Additionally, the warning can be enhanced with enlarged signing, a TRUCK header panel, or flashing beacons. The traffic engineering study *should* address the recommended signing for the specific field conditions.

POLICY

FIELD REVIEW OF CURVES AND TURNS

1. The setting of advisory speeds on existing curves and turns *should* be performed by the ball-bank indicator method for existing roadways utilizing Table 2 above.
2. The Accelerometer (Method 3) *may* be used as an alternative to the ball-bank indicator for Regions that

have this device.

3. For ramps that have problems with truck rollovers and/or have the tippy truck signs installed, the truck ball bank reading of 10 degrees *should* be used.
4. For new construction, the design speed chart (Table 3) noted above *may* be used where the super elevation and radius are known.

Curve signing determined on the basis of calculated values *should* always be verified in the field by the ball bank method.

SIGNING IMPLEMENTATION

1. For consistency of motorist expectation, signing field changes *should* be organized where entire routes are done at approximately the same time. Breakpoints *should* occur in the route at locations where the highway travels through a community that has a speed zone reduction.
2. Signing field changes *should* be incorporated into improvement projects as much as possible. Roadway segments on each side of the improvement project *should* terminate at a STH/STH or municipal limit breakpoint.
3. Table 2C-5 in the WisMUTCD (see Figure 1 of this policy) **shall** be utilized in the determining the proper treatment of horizontal alignment sign(s).
4. For advisory speed reductions of 25 mph or greater, chevrons (W1-8 signs) *should* be used. For these advisory speed reductions, a night arrow (W1-6 sign) *may* be used to supplement the chevrons for advisory speed reductions of 25 mph or greater.
5. For advisory speed reductions that are greater than 5 mph and less than 25 mph, the usage of the night arrow (W1-6 sign) is the first choice of sign that *should* be used. For these advisory speed reductions, chevrons (W1-8 signs) are typically used in locations where there are demonstrated problems.
6. For a Winding Road (W1-5 sign)/Advisory speed (W13-1sign) application, where night arrows (W1-6 signs) and/or chevrons (W1-8 signs) are required on specific curves, the first curve in the series **shall** be signed with the night arrow and/or chevrons. Subsequent curves in the winding road series **shall** be signed with night arrows and /or chevrons if recommended/required by Table 2C-5 in the WisMUTCD (see Figure 1 of this policy).
7. For a Reverse Curve (W1-4 sign)/Advisory speed (W13-1 sign) application, the curves in the series **shall** be signed with night arrows and /or chevrons if recommended/required by Table 2C-5 in the WisMUTCD (see Figure 1 of this policy).
8. Turn warning signs **shall** be used where advisory speeds have been determined to be 30 mph or less.
9. Regulatory speed limit signs are normally not posted on ramps. For application of warning signs on service interchange ramps (non-freeway to freeway), relative to WisMUTCD Table 2C-5, a 10-mph reduction from the mainline posted speed should be used.
10. Each direction on the roadway should be evaluated independently of the other direction in the determination of the proper horizontal alignment signing.

PHASE IN COMPLIANCE

- In order to allow for resources to make the changes to the advisory speeds, the following **shall** apply:
- When signing is replaced with an improvement project, the advisory speeds **shall** be established based on the new policy. This can either be accomplished by one of the methods noted in this policy.
- For other sections of roadway, the changes **shall** be made for an entire segment of highway between two cities, towns or villages. Curve and turn advisories *should not* be changed for one isolated location; rather for an entire segment between communities or within a county.
- Phase in period – December 31, 2019 (WisMUTCD Compliance Date).

ACKNOWLEDGMENTS

NCUTCD – Regulatory and Warning Signs Technical Committee and Task Force and Bob Seyfried, Northwestern University Center for Public Safety.

REFERENCES

1. Guidelines for the Determination of Advisory Speeds (NCUTCD Task force from the Regulatory and Warning Signs Technical Committee.)
2. *Manual on Uniform Traffic Control Devices for Streets and Highways,* Public Road Administration, Washington, D.C., August 1948, page 39 and 53.
3. Paul J. Carlson and John M. Mason, "Relationship Between Ball Bank Indicator Readings, Lateral Acceleration Rates and Vehicle Body-Roll Rates", *Transportation Research Record 1658.* Washington DC: Transportation Research Board, January 1999.
4. *A Policy on Geometric Design of Highways and Streets,* American Association of State Highway and Transportation Officials, Washington, D. C., 2004.
5. R. Milstead, X. Qin, B. Katz, J. Bonneson, M. Pratt, J. Miles, and P. Carlson, "Procedures for Setting Advisory Speeds on Curves, Federal Highway Administration, Washington D.C., 2011.

APPENDIX

<u>SAMPLE FIELD DATA COLLECTION FORMS</u>

1. Curve Advisory Speed Calculations
2. Ball-Bank Indicator Test Supervisor Approval
3. Ball-Bank Indicator Study Form
4. Ball-Bank Indicator Test Summation
5. Curve Advisory Speed Determination Field Data Sheet

Advisory Speed Approval

Jurisdiction: ____

Location: ____

From: ________________________ **to:** __________________________

Project No. /Title: ____

Advisory Speed Study Attached:

Ball Bank Indicatory Study _____ **Date:** _____________

Speed Formula Calculations_____ **Date:** _____________

Accelerometer Readings _____ **Date:** _____________

Completed By: ____________________________ **Date:** _____________

Study Approval:

Name: ______________________________ **Title:** ____________________

Date: _____________

Curve Advisory Speed Calculations
Method # 1

Sheet ___of____

Completed By: _______________________________ **Date:** ______________

Jurisdiction: ____

Location: ____

From: __________________________ **To:** ____________________________

Project No. /Title: ____

$$V = \sqrt{15R(0.01e + f)}$$

DIRECTION OF TRAVEL	CURVE BEGIN STA.	CURVE END STA.	CURVE RADIUS (ft)	SUPER-ELEVATION (%)	SIDE FRICTION	ADVISORY SPEED (mph)	WARNING SIGN

Remarks: ____

Study Approval:

Name: __________________________________ **Title:** ______________________
Date: _______________

BALL-BANK INDICATOR STUDY						
LOCATION:						
COUNTY:			SECTION:			
POSTED SPEED (MPH):			PAVEMENT CONDITION:			
DATE:			VEHICLE:			
DRIVER:			RECORDER:			
REMARKS:						
DIRECTION OF TRAVEL	PHOTO LOG MILE		SPEED (MPH)	BALL-BANK READING (DEGREES)		
	START CURVE	END CURVE		RUN 1	RUN 2 IF NEEDED	RUN 3 IF NEEDED

BALL BANK INDICATOR TEST SUMMATION (OPTIONAL)

Jurisdiction: ______________________________ **Date:** _______________

Location: ____

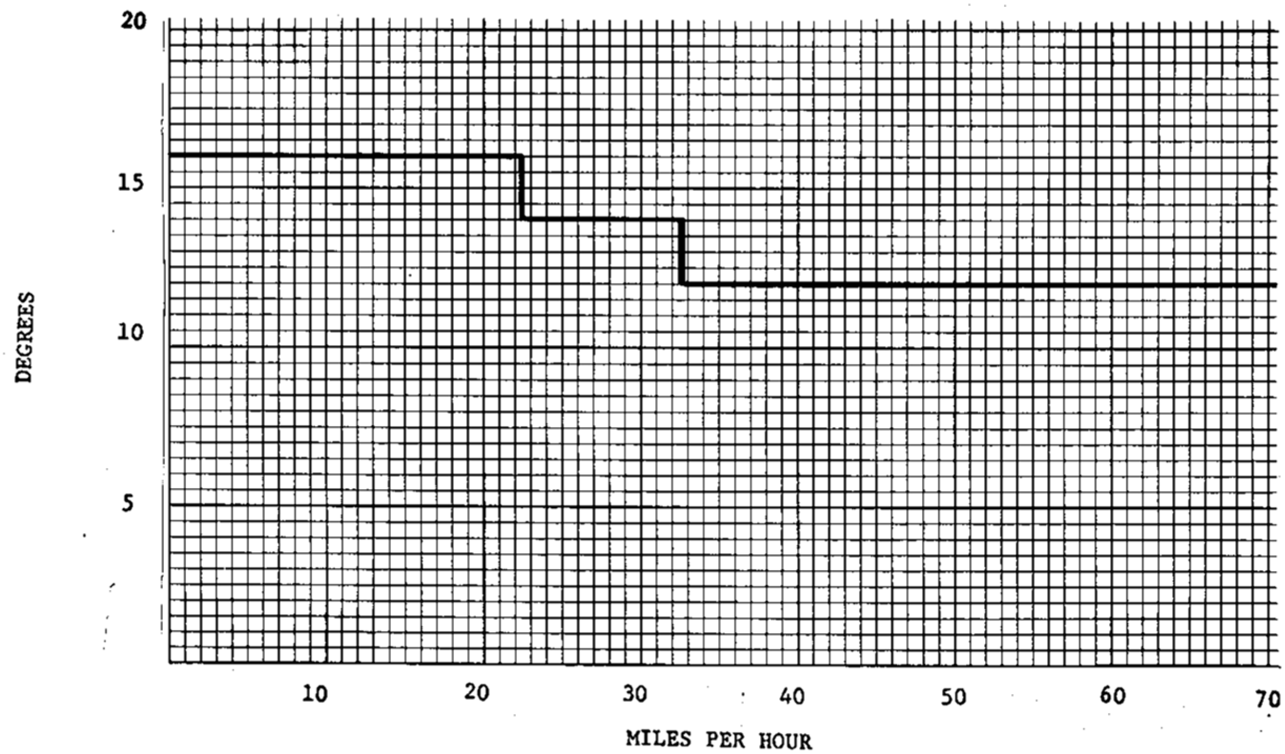
Weather: ______________________ **Road Surface:** __________________

Driver: ________________________ **Recorder:** ______________________

Vehicle: _______________________ **Posted Speed Limit:** _____________

Direction: ____________ **Begin Curve:** _________ **End Curve:** ________

Show each vehicle test run as a dot on the graph



SUMMARY FOR A SECTION OF ROADWAY

CURVE ADVISORY SPEED DETERMINATION FIELD DATA SHEET	
Highway:	**County:**
Section:	**Date:**
Posted Speed (mph):	**Pavement Condition:**
Vehicle:	**Driver/Recorder:**
Remarks:	
BALL BANK READINGS: 12 degrees for speeds of 35 mph or more 14 degrees for speeds of 25 to 30 mph 16 degrees for speeds of 20 mph or less	

Direction of Travel	Curve Direction		Beg. Curve	End Curve	Tangent Length	Ball Bank Reading	Advisory Speed (mph)		Curve Warning Sign	
	LT	RT	MP	MP	Miles	Degrees	Current	Recom-mended	Sign No.	Size

2-3-36 Ramp Warning Signs **August 2009**

PURPOSE

The WisMUTCD in Section 2C.36 sets forth standards for Exit, Ramp and Curve advisory speed signs, which *may* be used to advise motorists of the maximum recommended speed on a ramp. In usual practice, the speed and condition warned of is just beyond the gore of the ramp. Other guidance in 2C.36 indicates that where additional advisory speed indication is needed on the ramp well beyond the gore area, a standard warning sign with an ADVISORY SPEED plaque (W13-1) is to be used.

To provide for the uniformity of the application of the EXIT, RAMP, and CURVE advisory speed signs, the following use and application guidelines are prescribed where ramp speed control is determined to be necessary.

The WisMUTCD, Table 2C-4, provides advanced placement distances for EXIT, RAMP, and CURVE advisory speed signs along with other warning signs such as STOP AHEAD, YIELD AHEAD, SIGNAL AHEAD and ROUNDABOUT AHEAD. This is determined by the posted or 85th percentile speed and then suing Table 2C-4 in the WisMUTCD to determine the appropriate sign placement distance. Oftentimes for ramps there is no posted speed and speed studies are not normally performed. Utilization of the posted speed on the mainline roadway instead can result in an unreasonable placement distance that is too far back and the sign *may* end up on the mainline roadway, especially for shorter exit ramps. Ultimately, this can lead to inconsistencies in sign placement. Guidance is necessary for the placement of these signs.

POLICY

STOP AHEAD (W3-1), YIELD AHEAD (W302), SIGNAL AHEAD (W3-3) AND ROUNDABOUT AHEAD (W2-6 and W2-6P) Signs

The following methods *may* be utilized to determine the appropriate placement of STOP AHEAD, YIELD AHEAD, SIGNAL AHEAD and ROUNDABOUT AHEAD warning signs on ramps. Table 2C-4 *should* be used for placement of the signs.

1. Assumption of a 10 mph reduction from the mainline speed for the placement of the signs.
2. For ramps of a short length (where utilization of Table 2C-4 cannot be met), placement of the signs *should not* exceed a distance of 50 feet upstream of the EXIT gore sign (E5-1 or E5-1A).

EXIT Advisory Speed Sign (W13-2)

The EXIT SPEED sign will normally be used at:

1. Off-ramps on freeways and expressways when the ramp connects to a conventional state trunk highway or local crossroad.
2. Ramp connections between freeways where the guide signing establishes that the ramp is an exit. The EXIT DIRECTION sign will have an exit number panel. Ramps between freeways, which are not identified with an exit number on the EXIT DIRECTION sign *should* be signed with a CURVE or TURN sign with appropriate advisory speed when reduced speed is necessary.

The following methods *may* be utilized to determine the appropriate placement of EXIT ADVISORY SPEED signs. WisMUTCD Table 2C-4 *should* be used for placement of the signs.

1. Assumption of a 10 mph reduction from the mainline speed for the placement of the signs.
2. Utilization of a ball bank indicator or design speed equation, shown in TEOpS 2-3-35, to determine the start of curvature and the appropriate exit speed.

Modified EXIT ADVISORY SPEED Signs (W13-2A and W13-2B)

The modified exit advisory speed signs (see Figures 1 and 2) *may* be used at the following locations, provided the following criteria are met:

1. For advisory speeds of 30 mph or less for off-ramps on freeways and expressways or ramp connections between freeways where the guide signing establishes that the ramp is an exit.
2. Existing locations where there are run-off-the-road crashes as a result of a sharp horizontal alignment. The signs *may* also be installed in new locations that are perceived to be potential problem areas. The usage of signs in new locations **shall** be approved by the Region Traffic Engineer.

RAMP ADVISORY SPEED Sign (W13-3)

The RAMP ADVISORY SPEED sign will normally be used at:

1. Ramps along freeways or expressways that provide access to safety rest areas, scales, scenic outlooks and tourist information centers where traffic must return directly to the freeway or expressway upon leaving the facility.
2. Ramps from local roads or conventional state trunk highways serving as connections to freeways or expressways, or to other conventional highways.

CURVE ADVISORY SPEED Sign (W13-5)

The CURVE ADVISORY SPEED sign (W13-5) **shall not** be used on WisDOT roadways. For curve delineation on ramps, the standard curve warning sign (W1-2L or W102R) with ADVISORY SPEED plaque (W13-1) *should* be used. The standard curve warning sign with advisory speed plaque gives motorist s more positive guidance as to the direction of the curve versus the W13-5 sign.

General Criteria

In accordance with directions prescribed in Section 2C.36, the EXIT SPEED or RAMP ADVISORY SPEED sign *should* be posted along the deceleration lane. Final locations *should* be carefully established which are devoid of visual conflicts with other signs or physical roadway elements, such as bridge columns. Practically, the sign locations *should* be midway along the deceleration lane, but moved closer to the beginning of the ramp taper for conditions requiring significant reductions in speed. The distance values of Table 2C-4, Condition B, for general warning sign placement suggest desirable minimum values, but will have to be modified in order to keep the sign “along the deceleration lane” and far enough away from the EXIT DIRECTION signs to avoid its being hidden or obscured. Approach speeds *may* be assumed to be the posted speed limit.

Figure 1. W13-2A Sign

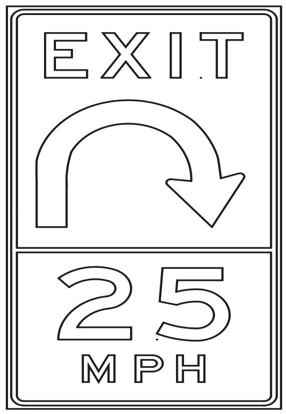
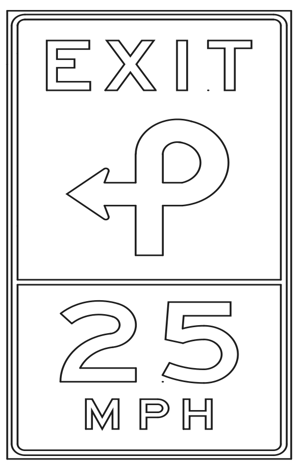


Figure 2. W13-2B Sign



2-3-38 NO PASSING ZONE Signs April 1996

NO PASSING ZONE (W14-3) signs **shall** be placed at the beginning of all no passing zones whether for sight restrictions, narrow bridges, passing lanes, divided highway and approaches or intersectional except as provided below. In making the pennant mandatory on state trunk highways in the early 1970s, it was the intent of the administration that they *should* be installed at all zones, including barrier lines at intersections. This is implied in a memo to all Regions on April 18, 1973.

Where a no passing zone related to sight conditions occurs at a stop sign-controlled or signal-controlled intersection, the zone will be broken for the intersection and resume on the other side. The continuation of the zone beyond the intersection does not require another W14-3 to be installed.

In communities where the state trunk highway is maintained by the Department, it is not necessary to install W14-3 signs at the beginning of no passing zones or barrier lines that occur within speed zones of 35 mph or less.

2-3-40 Trail Crossing Signs — September 2010

PURPOSE

This policy provides guidance on the use of TRAIL CROSSING signs where emphasis is needed to alert motorists of recreational vehicles crossing highways. In order for a trail crossing to be signed under this policy, the trail itself must be federal, state, or locally authorized and open to the public.

TRAIL CROSSING signs covered under this policy include the following signs:

1. SNOWMOBILE CROSSING (W11-6) sign
2. BICYCLE CROSSING (W11-1) sign
3. EQUESTRIAN CROSSING (W11-7) sign
4. BRIDLE PATH sign (W11-56) sign
5. TRAIL CROSSING, <u>symbol</u> message (W11-15) sign*
6. TRAIL CROSSING, <u>word</u> message (W11-15a) sign**

*The TRAIL CROSSING symbol message (W11-15) sign is normally used to sign trails that have predominantly pedestrian and bicycle usage.

**The TRAIL CROSSING <u>word</u> message (W11-15a) sign is normally used to sign trails that have other groups using the trail in addition or besides pedestrian and bicycle usage.

DEFINITIONS

<u>Freeways</u> are defined as divided arterial highway facilities that have full controlled access, by means of grade separations at interchanges only.

<u>Expressways</u> are defined as divided arterial highway facilities that have partial control of access and generally with grade separations at major intersections.

POLICY

1. Trail crossing signs are not permitted on freeways.
2. Trail crossing signs **shall** be installed for all 65 mph expressway trail crossings, whether there is a sight restriction or not. This only applies to non-intersection crossings on 65mph expressways (see Item 4 below).
3. Trail crossing signs *may* be placed on all other highways provided there is deficient sight distance per Section 2c.46 of the WisMUTCD. Sections 2C-49 and 50 of the WisMUTCD also give additional criteria when trail crossing signs *may* be desirable.
4. Trail crossing signs *may* also be used to alert motorists to unexpected entries of recreational vehicles, pedestrians or bicyclists in the roadway.
5. Trail crossing signs *should* only be used for non-intersection crossings. There *may* be extreme cases where there is a demonstrated crash history or site problems at intersections that would warrant trail crossing signs in addition to the crossroad or side road warning signing.
6. STOP signs (18” x 18”) are required on the recreational trail per the Wisconsin DNR trails handbook and they are required per the WisMUTCD for any shared-use path where bicyclists are required to stop. The trail owner **shall** install the STOP signs on the recreational trail prior to the installation of the trail crossing warning signs on the roadway.
7. Because the trail STOP signs are in the STH right-of-way, the Region **shall** issue a permit, in form of a letter, to the trail owner for the placement of the STOP signs on the trail. The permit *should* make it clear that the trail owner is responsible for the initial installation and long-term maintenance of the signs.

2-3-41 Deer Crossing Signing — August 2009

GENERAL

Deer crashes have been one of the highest crash types on state highways in recent years. There are a number of factors which *may* influence the deer crash rate, including herd population, herd migration, herd location, roadside vegetation management, roadway factors (speed limits, lighting, etc.), driver education, use of deer crossing deterrent devices (reflectors, scent boxes, vehicle whistles, wildlife underpasses, etc.), active warning devices such as motion detectors/warning light or static warning signs. Traditionally, static warning signs have been installed in areas with higher deer-vehicle crashes (DVCs). There has been much debate over the usage of static deer crossing signs and their effectiveness. Many transportation professionals recognize the fact that warning signs are most effective *result in alteration of speed and/or path choice) when there is an obvious danger ahead (example would be curve or turn). The use of warning signs that alert drivers to sporadic or general possibilities *deer crossing and slow children moving signs) have been shown to not have a consistent impact on driver behavior. The widespread use or sign proliferation also reduces the effectiveness of the sign and leads to driver disregard. Several states and agencies have performed studies to assess the effectiveness of static deer crossing warning signs. The studies have concluded that the usage of static deer crossing warning signs do not generally reduce vehicle speeds (one measure of warning sign effectiveness). As a result, the studies have yielded no reduction in DVCs.

SUPPORTING DOCUMENTATION

Static sign studies have been performed by the following states and/or agencies:

1. *Assessing the Effectiveness of Deer Warning Signs*. Published by Kansas Department of Transportation and University of Kansas at Lawrence, April 2006,
2. *Wildlife—Vehicle Collision and Crossing Mitigation Measures: A Toolbox for the Montana Department of Transportation*. Published by Montana Department of Transportation and Montana State University, May 2007.
3. *An Ecological Landscape Study of Deer-Vehicle Collisions in Kent County, Michigan*. Published by Kent County Road Commission and White Water Associates, Inc., January 2004.
4. *Deer Crossing Signs and Technologies*. Published by Deer-Vehicle Crash Information Clearinghouse (DVCIC), Maintained by Texas Transportation Institute, www.deercrash.com
5. *Deer Signs Research Study*. Published by Minnesota Department of Transportation and University of Minnesota, www.lrrb.gen.mn.us/pdf/200413.pdf

Several dynamic types of deer crossing signs are currently being explored as potential countermeasures and are discussed in the studies listed above. These types of signs have been designed to activate when deer are detected near the roadway. Studies are taking place in Indiana, Minnesota, Montana, Pennsylvania, Utah and Washington. The development of methods to control car/deer collisions is continuing to evolve, and over time policies such as this will be subject to change. At present, due to funding limitations, WisDOT is not utilizing dynamic deer crossing warning sign systems. However, WisDOT is periodically reviewing studies from other states and municipalities as they progress. WisDOT will consider issuing a permit to an entity to pursue the usage of dynamic deer crossing signs.

One effective countermeasure pointed out in the Kansas study is the usage of public awareness techniques to educate the motoring public regarding the seasonal and time of day characteristics of deer-vehicle crashes. This could be accomplished effectively through the different types of media outlets.

POLICY

Based upon the findings of various studies mentioned above, WisDOT will implement the following policy for usage of static deer crossing warning signs:

1. No new static deer crossing warning signs will be installed on state highways.
2. Static deer crossing signs that are currently in place will be allowed to remain until the end of their useful life or when opportunities for removal are available. These opportunities would include sign knockdowns and improvement projects.

2-3-43 Parallel On-Ramp Lane Reduction Signing — July 2012

BACKGROUND AND PURPOSE

At some interchange locations, long parallel (acceleration) entrance ramps are constructed to allow vehicles ample distance to get up to the mainline travel speeds, thus helping to eliminate slowing down of the mainline traffic. Questions have arisen as to whether warning signs, such as the LANE ENDS symbol (W4-2 sign). The WisMUTCD, Section 2C-42 states that LANE ENDS signs *should not* be installed in advance of the downstream end of an acceleration lane. It *should* also be noted that the WisMUTCD, Section 2C-42 states that a LANE ENDS sign *may* be installed on a freeway entrance ramp. These would be cases where the signs would be beneficial by exercising engineering judgment in certain locations. In absence of specific guidance in the WisMUTCD, this policy will provide additional guidance as to where the LANE ENDS sign *may* be utilized for long parallel entrance ramps.

GUIDELINES

The following is guidance relating to the usage of the LANE ENDS (W4-2) sign on long parallel (acceleration) ramps:

1. Issues with motorists not realizing that the entrance ramp is not a mainline or auxiliary exit lane. This could be exhibited by last-minute merge movements or braking.
2. Slowing down and last of mainline traffic caused by last-minute lane changes.
3. Crash issues relating to the last-minute, quick lane changes or braking.
4. The LANE ENDS (W4-2) sign *should not* be used on all parallel entrance ramps. Parallel entrance ramps should be evaluated on a case-by-case basis.
5. Parallel entrance ramps that have been previously signed *should* be evaluated as opportunities permit (improvement projects, routine sign replacements, knockdowns, etc.). This *should* be done prior to removing any signs. Any parallel entrance ramps not meeting the above guidance criteria *should* have the LANE ENDS (W4-2) sign removed.

2-3-45 Icy Bridge Deck Signing — April 1989

GENERAL

The Regional Traffic Engineer *may* use the BRIDGE MAY BE ICY (W8-64) sign on bridges which display problems caused by the formation of ice.

The use of the BRIDGE MAY BE ICY sign **shall** be based on Region discretion. The Region can be aided in this decision by checking with local maintenance and law enforcement officials to see if an ice problem exists at a bridge site. The Region can also analyze crash rates at the bridge site that are based on ice.

The WATCH FOR ICE ON BRIDGE sign **shall** no longer be used. The existing WATCH FOR ICE ON BRIDGE signs *should* be replaced as they wear out.

2-3-49 Determination of Sight Distance for Warning Signs — June 2015

PURPOSE

The WisMUTCD provides guidance for the installation of several types of vehicular and non-vehicular warning signs. Some of these signs include the SCHOOL BUS STOP AHEAD, SNOWMOBILE CROSSING, fire truck, side road and crossroad warning signs. The WisMUTCD states that many of these types of warning signs *should* be used where the road user's sight distance is restricted, or the condition, activity or entering traffic would be unexpected.

The May 25, 2011, WisMUTCD Section 2C.46, provides additional guidance regarding proper sight distance in determining the need for a warning sign. This table on minimum visibility distances references Table 9-6, pages 9-38 (intersection sight distance—left turn from stop) of the AASHTO Standard Highway and Street Design Manual. This table provides an added factor of safety beyond the traditional stopping sight distances.

It *should* be noted that the minimum visibility table shown below is just for determination if the warning sign is needed. These are not sign placement criteria. Sign placement criteria is provided in WisMUTCD Table 2C-4.

Minimum Visibility Distance

Posted or 85th Percentile Speed	Minimum Visibility Distance (ft.)
25 MPH	280
30 MPH	335
35 MPH	390
40 MPH	445
45 MPH	500
50 MPH	555
55 MPH	610
60 MPH	665
65 MPH	720
70 MPH	775

One question that has been commonly asked is "What are the acceptable field methods that can be utilized to determine the actual minimum visibility distance in order to provide accuracy and consistency?" Listed below are several guidelines that *may* be utilized to assist in this effort and to provide for a consistent application statewide.

GUIDELINES

Cone Method (Preferred)

1. A 28" height cone *should* be used as a target at the location of the hazard (i.e. snowmobile crossings, pedestrian crossings and school bus stops). In lieu of a 28" height cone, a mailbox or other alternative methods approved by the Region *may* be used as a target.
2. Set the Distance Measuring Instrument (DMI) when the entire cone is first visible and measure the distance to the cone.

Vehicle Visibility Method (Optional)

1. For the installation of side road and crossroad warning signs, park on the side road and determine where mainline vehicle is first visible. Measure the distance between the mainline vehicle and the side road vehicle to determine minimum visibility distance.
2. An optional method that *may* be used is to park at the intersection or crossing and count the seconds, starting when the mainline vehicle is first visible and equate the time to a distance. For example, at 60 mph, a vehicle travels approximately 88 feet per second. Therefore, at a minimum visibility distance of 665 feet, it would take 8 seconds for the vehicle to reach the intersection or crossing.

2-3-50 Horse Drawn Vehicles — January 2003

GENERAL

The use of highways by horse drawn vehicles is a common activity of some farming religious sects active in several regions of the state. These low-speed vehicles traveling on the roadway proper or on the shoulder introduces some hazards which are magnified because of the frailty of the horse drawn vehicles and the vulnerability of the occupants and the horse. In view of the potential for injury, HORSE DRAWN VEHICLE (W11-14) signs *should* be installed at locations which satisfy the following conditions:

1. The usage of the segment of the state trunk highway by horse drawn vehicles is on a frequent or recurring basis.
2. To the satisfaction of the region, the farmer(s) are using the state trunk highway only where other routes are not available or otherwise not safe or attractive. The Region *should* get input from the local highway and law enforcement officials and *should* make an effort to try and convince the religious sects to drive their horse drawn vehicles on the shoulder and not in the travel lane.
3. The Region *should* consider the shoulder width and configuration (i.e. rumble strips, etc.) and sight distance of the roadway in their decision on whether to sign the roadway.

Each segment being used *should* be identified by the Region and/or County Highway Safety Committee and HORSE DRAWN VEHICLE signs **shall** be posted at the beginning of the segment. The Region has the option of adding the NEXT XX MILES (W57-5 1) sign to the HORSE DRAWN VEHICLE sign. The HORSE DRAWN VEHICLE sign **shall** be placed after every major intersection, such as a STH or CTH intersection.

The Region *should* be alert for discontinuance of usage and remove the signs under that condition.

2-3-51 Pedestrian Crossing Warning Signs — July 2018

PURPOSE

The WisMUTCD provides general guidance for the installation of pedestrian related warning signs. These signs are considered to be the W11-2 (pedestrian crossing sign), W11-9 (wheelchair crossing sign) and the S1-1 (school crossing sign assembly).

There are some standards and guidance contained in the WisMUTCD. However, there are several undocumented state practices involving the application of these types of signs. There is a need to encompass the guidance and standards from all of these resources into a single document that will be able to assist the practitioner and provide for a consistent statewide application.

POLICY

Pedestrian Crossing Signs

1. Pedestrian crossing signs *should* be used where there are higher volumes of pedestrian activity and at mid-block crossings where crossings are unexpected or the visibility distance, as defined in WisMUTCD section 2C.46 is deficient. Pedestrian crossings signs *may* be used at unsignalized and non-stop control

intersections.
2. The Pedestrian Crossing Sign with AHEAD plaque (W16-9P) *may* be used in sight deficient areas where pedestrians walk along the edge of the roadway.
3. A Pedestrian Crossing Sign *may* be installed in locations without a crosswalk. For crosswalk markings, refer to TEOpS 3-2-3.
    a. A Pedestrian Crossing Sign *may* be installed in locations without a crosswalk.
    b. On state highways, crosswalks are maintained by the local unit of government by permit (DT 2136 form).
    c. A crosswalk *may* be installed without a pedestrian crossing sign for roadways with posted speeds of 40 mph or less.
    d. For roadways with posted speeds of 45 mph or higher, new marked crosswalks alone, without other measures to reduce traffic speeds, shorten crossing distances, enhance driver awareness of the crossing, and/or provide active warning of pedestrian presence, *should not* be installed across uncontrolled roadways (see WisMUTCD, Section 3B.19, paragraph 09).
4. Pedestrian Crossing Signs located on WisDOT maintained roadways, **shall** be installed and maintained by WisDOT.
5. Pedestrian Crossing Signs **shall not** be utilized at a signalized or stop controlled intersection. The Wheelchair Crossing Sign *may* be used at a signalized or stop controlled intersection.
6. Pedestrian Crossing Signs *may* be used at an unsignalized right turn bypass. Another option at an unsignalized right turn bypass is to utilize the Yield Here to Pedestrians (R1-5 sign) at the crosswalk location.
7. The Pedestrian Crossing Sign (W11-2) and arrow plaque (W16-7L/R) **shall** be placed at the point of crossing.
8. For roadways with posted speeds of 45 mph or greater, the Pedestrian Crossing Sign (W11-2) with ahead plaque (W16-9P) **shall** be installed in advance of the crossing.
9. For multiple pedestrian crossings that are close together on roadways with posted speeds that are lower than 45 mph, the Pedestrian Crossing Sign (W11-2) with ahead plaque (W16-9P) *may* be used in lieu of signs at the point of crossing.
10. The W11-15 or W11-15a, Recreational Trail Crossing sign **shall** follow the parameters listed above similar to the W11-2 Pedestrian Crossing Sign.
11. The W11-9 Wheelchair Crossing Sign **shall** follow the parameters listed above similar to the W11-2 Pedestrian Crossing Sign, with the exception that it *may* be used at signalized and stop controlled intersections.

School Crossing Signs

1. School Crossing Signs *may* be used at signalized controlled intersections.
2. Regardless of posted speed, the School Crossing Assembly (S1-1 sign with S16-7L/R plaque) **shall** be installed at every crossing. If two crossings are at one intersection (far side and near side), both crossings do not need to be signed.
3. For multiple School Crossings, the advance warning sign is not required in advance of every crossing.
4. Engineering Judgment should be utilized to determine if the advance sign is required in advance of each crossing in a series.
5. For placement of School Crossing signs, refer to TEOpS 2-3-54.

Refer to TEOpS 4-5-1 for pedestrian actuated warning device options.

2-3-54 School Area Signing — December 2018

PURPOSE

The WisMUTCD has expanded the usage of signing for school areas. This policy will summarize the standards and guidance contained in WisMUTCD Part 7 and will address three specific applications of School Area signing on the state highway system. This policy pertains to signing on conventional highways and expressways.

BACKGROUND

Part 7 of the WisMUTCD and Wisconsin State Statute 118.08 provide support for the guidelines listed in this policy.

POLICY FOR SCHOOL AREA SIGNING

The installation of School Area signing on the State Highway System can be addressed with three different types of applications:

1. School Zone Signing. School Zones are school areas that would include buildings and/or grounds that border the roadway, but would have no specific crossing. The grounds may or may not have fencing. "School grounds" refers to public and private schools and their surrounding grounds where any of grades K through 12 are regularly taught during the normal school year.

   Sites that provide only 4-year-old kindergarten do not qualify for school zone signing, as these sites typically do not meet the minimum number of instructional hours required of schools. Additionally, many school districts operate their 4-year-old kindergarten as community based programs, and these sites are therefore subject to change from year to year.

   a. The S1-1 School Warning sign **shall** be installed in advance of the school grounds at the prescribed warning sign distance outlined in WisMUTCD Table 2C-4.

   b. The supplemental S16-9P AHEAD plaque **shall** be installed under the S1-1 School Warning sign.

   c. The R2-6P FINES HIGHER plaque **shall** be installed under the School Zone assembly (S1-1 Sign with S16-9P plaque).

   d. The END SCHOOL ZONE (S5-2 Sign) **shall** be installed at the end of all school zones and areas. If there is a regulatory speed limit at the end of the school zone or area, the END SCHOOL ZONE (S5-2) sign should be mounted under the R2-1 sign. The mounting height of the END SCHOOL ZONE sign mounted under a speed limit sign should be 4' to the bottom of the secondary sign or 5' to the bottom of the lowest plaque in urban areas where there are pedestrians or parked cars.

2. School Advance Crossing Signing. The School Advance Crossing Signing is used to warn motorists that they are approaching a crossing where school children are present. The crossing may be in the same roadway where the school is located or may be on a neighboring roadway, based on the school's master plan of the school routes.

   a. The S1-1 School Warning sign **shall** be installed in advance of the school grounds at the prescribed warning sign distance outlined in WisMUTCD Table 2C-4.

   b. The supplemental S16-9P AHEAD plaque **shall** be installed under the S1-1 School Warning sign.

   c. The R2-6P FINES HIGHER plaque **shall** be installed under the School Zone assembly (S1-1 Sign with S16-9P plaque). The mounting height should be 4' to the bottom of the lowest plaque or 5' to the bottom of the lowest plaque in urban areas where there are pedestrians or parked cars.

   d. If the school crossing is located on a cross street in close proximity to the turning motorist, the S16-6P Advance Direction Arrow should be used in lieu of the S16-9P AHEAD plaque.

3. School Crossing Signing. The School Crossing signing is used at the location where the school children cross the roadway. Crosswalk marking is required whenever school crossing signs are used per the WisMUTCD. Crossing locations are established based on the school's route master plan as shown in the WisMUTCD, Section 7A.02.

   a. The S1-1 School Warning sign **shall** be installed at the crossing location.

   b. The S16-7L/R Diagonal down arrow warning sign **shall** be installed under the S1-1 School Warning sign.

4. End School Zone sign. Per WisMUTCD, the End School Zone sign is required to be installed whenever the R2-6P FINES HIGHER plaque is installed underneath an S1-1 School Warning sign. Therefore, the S5-2 END SCHOOL ZONE sign **shall** be installed downstream of all signed school zones and crossings.

If the school crossing is located on the same roadway as the school property, then the school advance assembly can function in a dual purpose as the advanced sign for the school bordering the roadway and the advance sign for the school crossing. The school advanced sign does not need to be duplicated for this situation (See Figures 2 and 3). The same is true for the end school zone sign.

POLICY FOR ADDITIONAL SIGNING FOR SCHOOL AREAS

Listed below are other signs covered in the WisMUTCD, Part 7, that are installed on the state highway system.

1. School Bus Stop Ahead (S3-1) Sign
   a. The word message SCHOOL BUS STOP AHEAD (S3-1 signs) shall no longer be used. The new sign is a School Bus / Children symbol that is fluorescent yellow green in color and is still the S3-1 sign code. The existing SCHOOL BUS STOP AHEAD word message signs in the field shall be replaced with the new symbol signs by no later than December 31, 2015.
   b. In order to determine if a School Bus Stop *qualifies* for a sign, the Minimum Visibility Distance table in WisMUTCD Section 2C.36 *should* be used.
   c. If a School Bus Stop qualifies for a sign (based on the Minimum Visibility Distance outlined above), WisMUTCD Table 2C-4 **shall** be used to determine field placement of the sign(s).
2. Reduced School Speed Limit Ahead (S4-5 Sign).
   a. A Reduced School Speed Limit Ahead Sign (S4-5) **shall** be installed for reductions of 15 mph or more.
   b. The distance table in TEOpS 2-3-30 *should* be used in determining the placement distance of the Reduced School Speed Limit Ahead Sign (S4-5) from the School Speed Limit (S4-51 Sign).
3. School Speed Limit (S4-51 Sign).
   a. Wisconsin State Statute 346.57 places a Statutory Fixed Speed Limit of 15 mph on school crossings when children are present and the crossing is properly signed. Wisconsin State Statute 349.11 allows the Department of Local units of government the authority to modify this speed restriction on their respective maintained roadways. WisDOT recommends that the school speed limit be 10 mph less than the speed limit of the roadway. The School Speed Limit (S4-51 Sign) **shall** be installed at all school areas and crossings where the speed restriction is modified.
   b. For school areas and crossings, the School Speed Limit (S4-51 Sign) should be installed in areas that are urban or have school children walking/crossing within the right-of-way.
   c. For school areas and crossings in fringe or rural areas, the School Speed Limit (S4-51 Sign) *may* be installed. However, the signs are generally not installed in these areas, unless school children are walking or crossing within the right-of-way. If the signs are installed in these areas, they should be 10 mph less than the posted speed limit of the roadway.
4. Flashing Beacons.
   a. The local unit of government *may* be allowed by permit to install a flashing beacon on one of the school area signs in each direction of roadway travel. RRFB's (Rectangular rapid flash beacons) may be allowed by permit on the school crossing sign assembly (S1-1 and S16-7L/R) only, since this would be the location of the physical crossing. Policy criteria for flashing beacon usage is covered in TEOpS 4-5-1 and the application/permit form (refer to conditions on DT 1877 form).

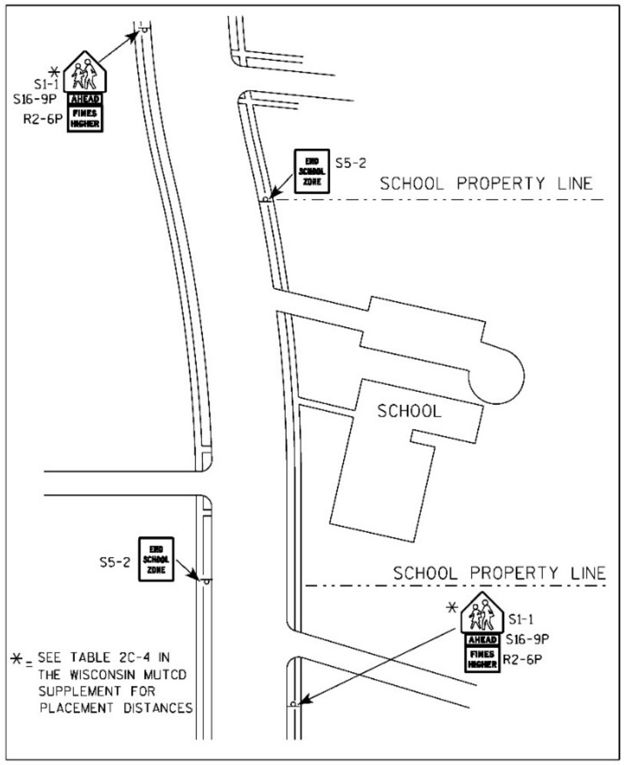


FIG. 1 RURAL SCHOOL WITHOUT CROSSING

NOTE: SIGNING IS SHOWN AS TYPICAL SIGN PLACEMENT. FIELD CONDITIONS MAY DICTATE CHANGES IN SIGN PLACEMENT.

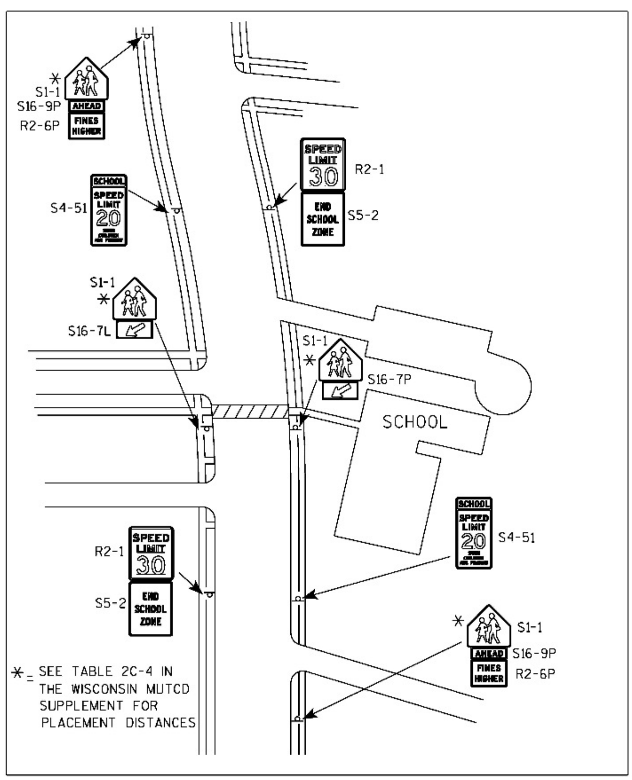


FIG. 2 URBAN SCHOOL CROSSING (WITHOUT REDUCED SCHOOL SPEED ZONE SIGNS)

NOTE: SIGNING IS SHOWN AS TYPICAL SIGN PLACEMENT. FIELD CONDITIONS MAY DICTATE CHANGES IN SIGN PLACEMENT.

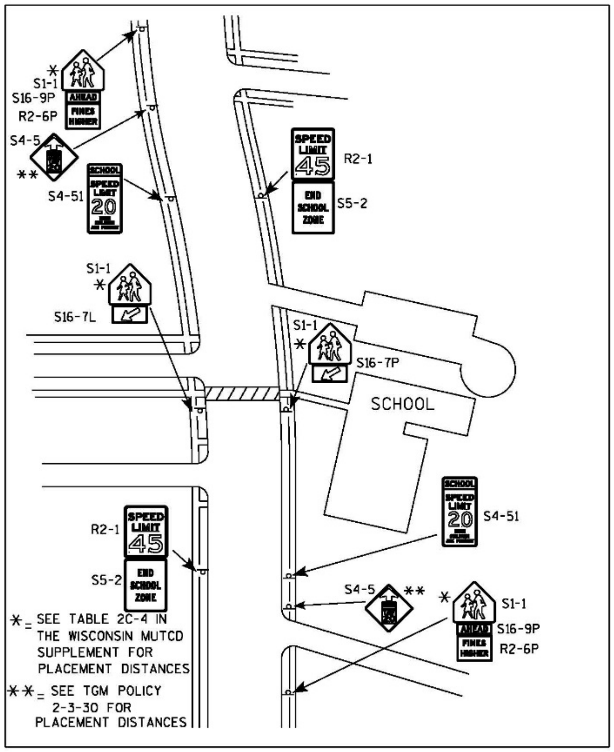


FIG. 3 URBAN SCHOOL CROSSING (WITH REDUCED SCHOOL SPEED ZONE SIGNS)

NOTE: SIGNING IS SHOWN AS TYPICAL SIGN PLACEMENT. FIELD CONDITIONS MAY DICTATE CHANGES IN SIGN PLACEMENT.

2-3-55 School Bus Stops on 65 mph Expressway — December 2013

PURPOSE

The WisMUTCD Section 7B-13 states that school bus stop signs are not intended to be used at every school bus stop location. It *should* be used where terrain and roadway features limit the approach sight distance and where there is no opportunity to relocate the stop to another location with adequate visibility. However, with the expanding usage of 65 mph multilane expressways, there is a natural safety concern about school buses stopping on these routes. This concern stems from the fact that motorists typically do not expect to encounter school buses stopping on 65 mph highways and also because of the higher operating speeds of traffic. Therefore, inadequate sight distance is not exclusively a factor. As a result, the crash potential on 65 mph expressways between school buses and other vehicles is increased. The purpose of this policy is to provide a consistent statewide policy on the signing of school bus stops on 65 mph expressways. **This policy only applies to expressways having 65 mile per hour speed limits and having school bus traffic either on or beside the expressway.**

DEFINITIONS

Expressways are defined as divided arterial highway facilities that have partial control of access and generally with grade separations at major intersections. This definition of expressway includes both designated and non-designated expressways.

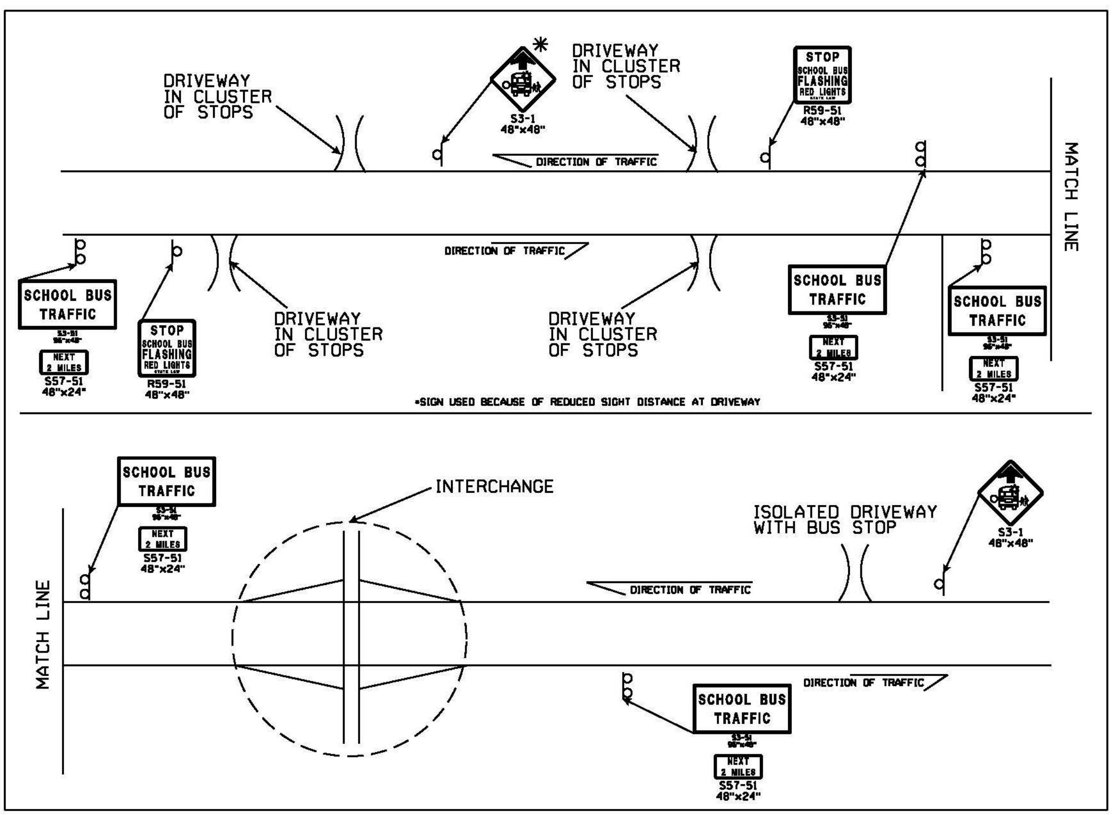
POLICY AND INSTALLATION GUIDELINES

For the application of this policy, the Region is encouraged to obtain a school bus route map or other information supplied by the school district to identify locations of the stops. The Region *should* contact school Districts each year as to where stops are no longer made so the signing can be adjusted accordingly, or where new stops are made. The Region *may* convey to the school officials that signs will be removed unless this information is provided. If the Region is not aware of stops, or the expectation of stops, the school bus stop signs will not be installed.

A map is provided by the Wisconsin Department of Public Instruction that shows all of the school district boundaries in the state. To order a copy of this map, the telephone number is 1-800-243-8782.

1. The “SCHOOL BUS TRAFFIC” (S3-51) sign, when required, *should* be placed on the right side of the roadway at the beginning of the segment of the expressway that includes the stops or driveways with potential stops. This sign is not intended to be used for isolated stops (see item #4 for isolated school bus stop signing). This sign **shall** be supplemented with the “NEXT __ MILES” (S57-51) sign. For this sign, the Region *may* permit the school district the option of supplementing it with one or two flashing yellow beacons mounted directly above the sign. The beacons **shall** be activated by 365 day timers to accurately define the periods of school bus activity. The school district will be solely responsible for the installation, operation and maintenance of the flashing beacons. All existing flashing beacons that have been installed, operated and maintained by the Regions can continue to be operated and maintained by the Regions.
2. The “STOP FOR SCHOOL BUS FLASHING RED LIGHTS STATE LAW” (R59-51) sign *should* be used at the beginning of the segment of the expressway that includes the stops or driveways with potential stops. This sign *should* be erected after the “SCHOOL BUS TRAFFIC” (S3-51) sign outlined in item 1 above.
3. The “SCHOOL BUS TRAFFIC” (S3-51) sign *should* be repeated after every interchange and *may* be repeated after every State Trunk Highway, County Trunk Highway or after higher volume local road intersections. These signs **shall** be placed on the right side of the roadway only. Higher volume local road intersections are those serving retail shopping, commercial activity, recreational activity or other activities with high concentrations of entering/leaving traffic or heavy slow moving vehicle traffic. The S3-51 sign would not be installed after at-grade intersections of lower volume local roads that are dead ends or only serve individual property owners. The “NEXT __ MILES” (S57-51) sign **shall** be used with these signs.
4. For individual school bus stops, within a cluster or isolated stops, the Region has the option of using the “SCHOOL BUS STOP AHEAD” (S3-1) warning sign at those selected stops. Criteria for this usage could be reduced sight distance, heavy volume of trucks, etc. The minimum site distance criteria for this facility is 720 feet, per the minimum visibility distance table for warning signs in the WisMUTCD 2C-36. If the Region elects to use these signs at selected stops, they *should* be placed a suggested minimum of 1000 feet in advance of the stop per the WisMUTCD 2C-05. Flags and double marking of these signs are also optional.

Figure 1.



2-3-60 Children at Play Signs May 2011

GENERAL

Section 2C.03 of the WisMUTCD allows for the development of customized word messages on warning signs. These customized word messages *may* be developed to fulfill signing needs based on engineering study or engineering judgment. However, Section 2C.02 of the WisMUTCD states that the usage of warning signs *should* be kept to a minimum, as the unnecessary use of warning signs tends to breed disrespect for all signs. The over usage of signs *may* result in information overload for the motorist, which can impact safety.

BACKGROUND

Periodically, the Department receives requests to install the following types of Child Crossing Signs:

Children at Play

Watch For Children

Slow Children

Usage of these types of signs has been discouraged by the Federal Highway Administration, Institute of Transportation Engineers, and many other States and Local Units of government for the following reasons:

1. Signs lose credibility with motorists when they appear too often.
2. Warning signs are most effective when they warn of consistent, not occasional conditions. Children are not likely to be consistently playing at a particular location in the street at all times (unlike at playgrounds or parks).
   As a result, the signs mentioned above could lose their effectiveness.
3. These signs provide parents and children with a false sense of security that their children are safe when playing in or near the street.
4. Some before and after studies have indicated no reductions in vehicle speeds or crashes with the signs present.
5. Because these signs are typically warning signs, they are not enforceable.
6. In lieu of signing, more effective countermeasures *may* be employed to increase motorist visibility on the roadway. Some of these countermeasures could include:
   a. Restricting parking or trimming vegetation to increase sight distance.
   b. Education and awareness efforts.
   c. Installation of traffic calming devices for urban low-speed areas.

POLICY FOR CHILD CROSSING SIGNS

1. No new Child Crossing Signs **shall** be installed on State Highways.
2. Existing Child Crossing Signs on State Highways *may* be allowed to remain until the end of their useful life. Other opportunities such as knockdown damage, improvement projects or change in conditions *may* make it possible to have the signs removed earlier.

2-3-64 Type I Object Markers under Keep Right Signs December 2011

GENERAL AND BACKGROUND

The WisMUTCD, Section 2C-64 allows the usage of a Type I Object Marker (W5-54 sign) to emphasize the approach end of a median island. This can give the median island additional visibility during nighttime, poor weather conditions or situations where the pavement markings or curb and gutter is covered by snow. The Object Marker can be especially helpful in higher speed areas (45 mph and above) and areas where medians start. Typically, many of these areas *may* have a Keep Right (R4-7) sign installed. An advantage of installing a secondary object marker (W5-54 sign) below the Keep Right will allow for increased visibility of the approach end of the median because the Object Marker (W5-54 sign) is mounted at 4 feet, which is more in the line of sight for a motorist. The Object Marker (W5-54 sign) is manufactured with fluorescent yellow sheeting, so it will reflect well at night and have better daytime conspicuity as well.

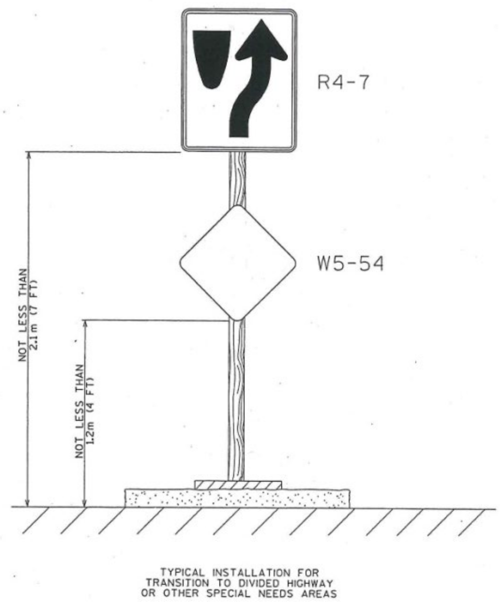
POLICY

1. The W5-54 sign **shall** be placed below the Keep Right (R4-7 sign) at all 45 mph or higher posted speed limits where the highway transitions from an undivided to divided roadway (See Standard Detail Drawing 15C21-3).

2. The W5-54 sign *should* be placed below the Keep Right (R4-7 sign) at the first median in a series of medians, where the posted speed in 45 mph or higher.
3. The W5-54 sign *may* be used (with or without the R4-7 sign) to emphasize approach ends of median islands for other areas that have exhibited problems with limited visibility or vehicle impacts.
4. The mounting height of the W5-54 sign **shall not** be less than 4 feet (see Figure 1).
5. The W5-54 sign *may* be placed on the back side of the post for the Keep Right (R4-7 sign), where additional emphasis is needed (typically areas with no curb and gutter). The W5-54 signs *should* be mounted back-to-back at the same mounting height.

IMPLEMENTATION

There is no formal phase-in period for installation of this signing. Signing field revisions *may* be accomplished through improvement projects or through the TMA process as Keep Right signs are routinely replaced. Signs *may* also be installed through the TMA process to address problem areas.



2-3-65 Rumble Strip Signing — January 2018

GENERAL

In an effort to reduce run off the road and head-on collisions, the Department has implemented the usage of continuous rumble strips on rural two-lane roadways, in accordance with FDM 11-15-1. The rumble strips will be installed on the centerline location and the edgeline locations. The centerline and/or edgeline marking can either be applied within the rumble strip or to the side of the rumble strip.

The usage of centerline and shoulder rumble strips has proven to be quite effective since they were installed on STH 142, Kenosha County in 2006 as a test location. A 2005 NCHRP Report (Synthesis 339) has shown several states where crashes were reduced as a result of centerline rumble strips. However, the NCHRP report did indicate some potential concerns with the application of the centerline rumble strips. Motorists are not normally accustomed to continuous rumbles, especially on the centerline. There is the concern that upon running over a centerline rumble, a motorist could “react to the left” and thus move to the left of the centerline. There are also concerns from ambulance drivers that the driving over a centerline rumble would potentially cause monitors to malfunction.

Because the centerline rumbles are more unexpected to the motorist than edgeline rumbles, and in response to the concerns outlined above from the NCHRP report, WisDOT previously installed the Centerline Rumble Strip (W8-70 sign) on roadway segments having the centerline rumbles as an interim measure to assist in the education of motorists. Since that time, additional rural two-lane roadway segments have received centerline rumble strips, and motorists have become more accustomed to them. Therefore, these signs are no longer necessary.

The policy below will address the installation of centerline rumble strip warning signs on WisDOT maintained roadways.

POLICY

1. The Centerline Rumble Strip (W8-70 sign) with a supplemental mileage plaque (W57-51 sign) **shall not** be installed.
2. Centerline Rumble Strip (W8-70 sign) with a mileage plaque (W57-51 sign) that have previously been installed on projects will be allowed to remain until the end of their useful life or when opportunities arise such as knockdown or damage or projects make removal practical.

2-3-70 Low Flying Plane Sign November 2016

GENERAL AND BACKGROUND

Federal Aviation Regulations require aircraft, except when necessary for takeoff and landing, to maintain a minimum altitude of 1000’ in congested areas, and 500’ in other-than congested areas. Exceptions are also granted for certain restricted category aircraft, such as crop-dusting airplanes. These exceptions may cause airplanes to fly at a low altitude over the roadway, causing potential hazard or concern for motorists.

In the past, various signs have been installed to alert motorists to these low-flying aircraft. This policy will clarify when these signs *may* be installed, and establish a statewide standard sign for these locations.

POLICY

Low flying plane warning signs *may* be installed at locations where planes regularly fly at altitudes below 500’ over or in the immediate vicinity of the roadway. Examples of these locations include airports with runways adjacent to the highway and fields with regular crop-dusting activities. FAA and Bureau of Aeronautics comments *may* also be taken into consideration.

Standard sign plate W11-57 has been developed for use at these locations. This sign *should* be installed per Condition B: Deceleration to the listed advisory speed (0 mph) in Table 2C.4 of the WisMUTCD. No sign is necessary at the crossing itself.

IMPLEMENTATION

There is no formal phase-in period for installation of this signing. Existing signs will be allowed to remain in place until the end of their useful life. Useful life ends when the sign message no longer meets legibility or condition standards. Existing signs *may* be replaced prior to the end of their useful life when opportunities arise such as knockdown or damage, when other work is occurring nearby, or when projects make replacement practical.

2-4-19.1 Business Route Marking April 1997

The Business Route Marker is an auxiliary marker used to identify Business Routes which have been established pursuant to either Section 84.02(4) or 84.02(6) of the Statutes. The latter section terms them Alternate Routes, but they **shall** be signed as Business Routes.

Business route establishment begins with a locally initiated request to the Regional office. The Region **shall** require that the request come from a municipal official or body of the local community, not an association or chamber of commerce, etc. The Region **shall** request information on the appropriateness of the route, the unity of community regarding the location and service provided, the structural and geometric adequacy of the route, the adequacy of the traffic control, and such other factors as *may* be pertinent.

If the Region office finds the establishment to be in the interests of the motoring public it **shall** make a favorable recommendation to the State Traffic Engineer, who **shall** have the authority for approval.

When the approved route falls completely upon the existing state trunk highway and connecting highway system the Department will initially install and subsequently maintain all route marking.

When all or any portion of the approved route is on local streets or highways, including county trunk highways, the Department will agree to install the initial markers, but subsequent maintenance of the markers will be the responsibility of the community. The Department will however maintain those markers at the beginnings of the route which face traffic on the regular state trunk highway route.

Failure of the city or village to properly maintain the signs or to comply with other conditions of the approval will be cause for the Department to withdraw approval and remove the signs. Regional offices will be responsible for periodically inspecting the condition of all signs to ensure that they are kept in good condition.

If a business route is proposed related to a U.S. Highway designation the route has to have the approval of AASHTO. Please contact the central office Bureau of Traffic Operations for instructions regarding this approval.

2-4-33 Trailblazer Assemblies April 1997

It *may* be desirable to provide trailblazing at key locations to enable unfamiliar motorists to find their way to certain major state trunk highways, particularly freeways. The Regions *should* analyze these needs and install or authorize the necessary signing. It is recommended that the trailblazing needs be discussed with the local officials and agreement reached as to the need for signing, the amount of signing and the details of locating and installing the signs. The Department *may* erect and maintain necessary signs on the STH system and on connecting highways, and *may* sell the signs to the local authority for installation on local streets. Locations on local streets *should* have Department approval. The Region is expected to inspect the signing periodically, regardless of who maintains it, and work out arrangements for correcting any deficiencies.

2-4-40 Historical Marker Guide Signs January 2018

GENERAL

All historical markers which have been approved by the State Historical Marker Committee and marked by the State Historical Society **shall** be signed in accordance with these guidelines.

1. Marker Adjacent to Any Highway. HISTORICAL MARKER ½ MILE (D5-63) signs, as appropriate, *should* be erected approximately one-half mile in advance of the marker. Distances other than ½ mile *may* be substituted where site conditions prevent using the distance of ½ mile. HISTORICAL MARKER (LEFT, OR RIGHT ARROW) (D5-64) signs **shall** be erected at the entrance to the marker.

   A wayside with a historical marker *should* have a HISTORICAL MARKER (DB569E) sign installed below the WAYSIDE signs.

2. Marker Remote from the State Trunk Highway System. The historical marker must be located not more than 2 miles from the state trunk highway. The point where traffic must leave the state trunk highway to get to the marker **shall** be a route giving access to the marker by the most direct route. A HISTORICAL MARKER (LEFT OR RIGHT ARROW) sign would be installed in advance of the appropriate intersecting

roadway (See TEOpS 2-4-41). Signing for both directions of traffic *may* be provided at one location or signing *may* be provided for one direction of traffic at one location and for the other direction at another location. In either case, only a maximum of 4 signs per each marker *may* be erected on the state trunk highway. No signing *may* be used to direct traffic from one state trunk highway to a historical marker on another state trunk highway Route. The sign HISTORICAL MARKER (LEFT OR RIGHT ARROW), **shall not** be placed until the required signing (Paragraph 1) on the local road has been installed by the maintaining authority.

All signs on the state trunk highway are furnished, erected and maintained by the Wisconsin Department of Transportation and all signs located on connecting streets or local streets are the responsibility of the maintaining authority.

2-4-41 Advance Supplemental Guide Signs — November 2016

PURPOSE

The Department places signs to various traffic generating facilities on the state highway system. In the past, several of these facilities have been signed with advance guide signs (…½ Mile or Road To…½ Mile) located ¼ to 1 mile in advance of the required turn, and directional guide signs (Name of Facility with arrow) located 0-1000’ from the turn. This practice has been inconsistent across the state. This policy will clarify when to install advance guide signs, and where both advance and directional guide signs *should* be located. This policy will not define which facilities *may* be signed for. Refer to TEOpS 2-15-3 for further information.

DEFINITIONS

Freeways are defined as divided arterial highway facilities that have <u>full</u> controlled access, by means of grade separation at interchanges only.

Expressways are defined as divided arterial highway facilities that have <u>partial</u> control of access and generally with grade separations at major intersections.

Conventional Highways are defined as either divided or undivided roadway facilities that have <u>no</u> control of access with grade separations at intersections. These highways can be two lane or multilane facilities.

Traffic Generators are defined as any facility, activity, or special point of interest which attracts large numbers of people, the majority of whom are unfamiliar with the local area and/or access route.

POLICY

<u>Facilities Adjacent to Any Highway</u>

These facilities have a driveway directly off of a State or US Highway. These facilities *may* be located on conventional highways or expressways. Facilities adjacent to a highway that qualify for traffic signage are typically publicly owned and operated locations serving the motoring public. Examples of these facilities include Waysides and Historical Markers.

Advance guide signs for qualifying facilities *should* be installed approximately one-half mile in advance of the driveway. Other distances *may* be substituted where site conditions prevent using the distance of ½ mile.

Directional guide signs **shall** be installed at the entrance to the facility.

<u>Facilities Remote from the State Trunk Highway System</u>

These facilities do not have driveways on a State or US Highway; therefore, the motorist would be required to turn off of the highway onto a county or local road to access the facility. Many types of facilities *may* qualify for this type of signing.

Advance guide signs (Road To…1/2 Mile) *should not* be installed for these facilities.

Directional guide signs for qualifying facilities *should* be installed approximately 500’ in advance of the appropriate intersecting roadway. This distance *may* be adjusted based on field conditions, but *should not* be less than 200’ in rural areas or 100’ in urban areas. A word message (Next Right, Second Left, etc.) *may* be used in place of an arrow where necessary.

IMPLEMENTATION

There is no formal phase-in period for installation of this signing. Existing signs will be allowed to remain in place until the end of their useful life. Useful life ends when the sign message no longer meets legibility or condition standards. Existing signs *may* be replaced prior to the end of their useful life when opportunities arise such as knockdown or damage, when other work is occurring nearby, or when projects make replacement practical.

2-4-43 Conventional Road Intersections August 2021

BACKGROUND AND PURPOSE

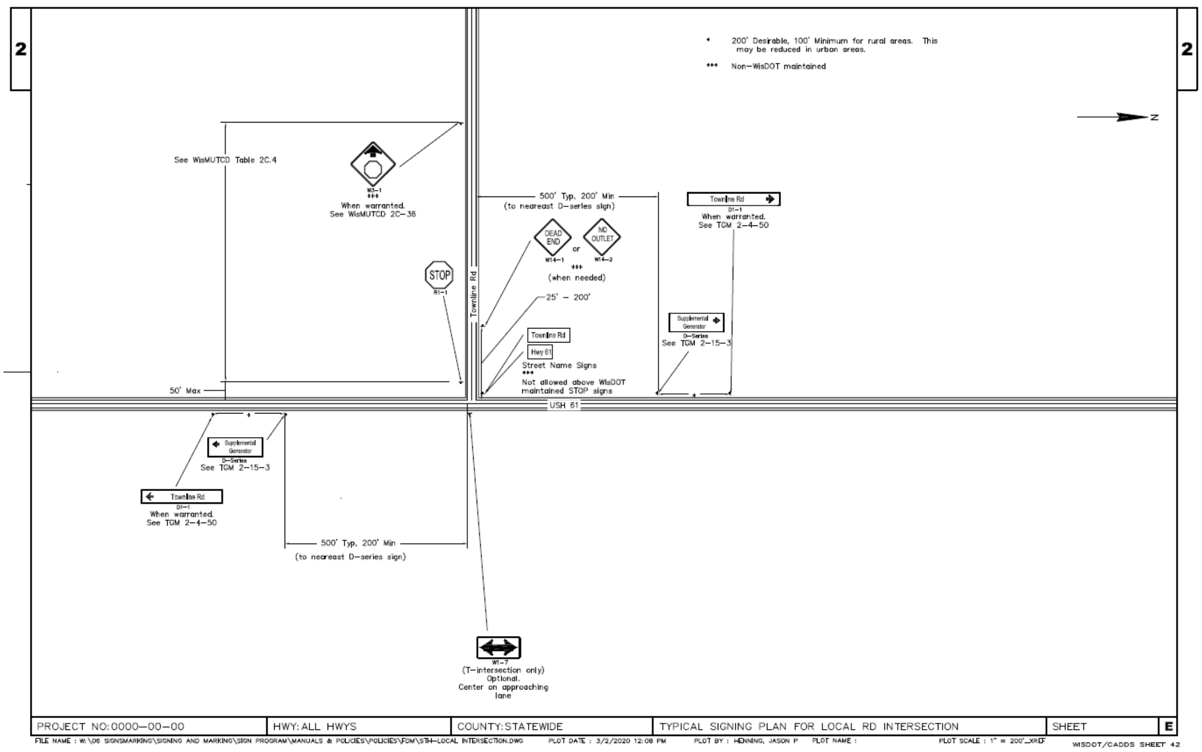
The MUTCD Section 2D-29 to 2D-32 provides additional guidance on route assembly signs. TEOpS Section 2 covers the cities that should be on each sign:

* Refer to section 2-15-3 and 2-15-5 for names of cities that *should* be placed on Destination Signs
* Refer to Section 2-4-48 for unincorporated towns that *should* be on the D1-1 Signs.
* Refer to Section 2-15-36 for names of cities that *should* be placed on Distance Signs.

Policy

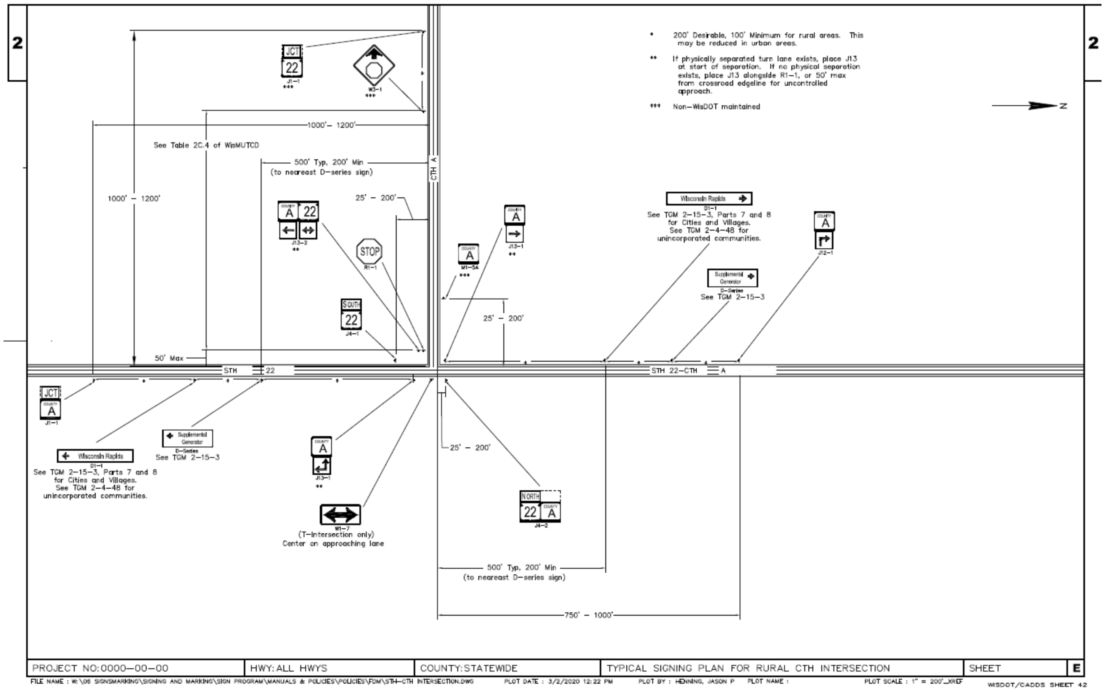
Local Approach to a STH

1. Install Destination signs (D1-series) and Supplemental Generators signs if warranted.
2. Double Night Arrow (W1-7) sign is optional.
3. Reassurance Assemblies (J4-series) *should* not be installed after these intersections.
4. Stop Sign (R1-1) or Yield Sign (R1-2) are required.
5. Install Speed Limit Signs (R2-1) 200’ for the intersection if it is required based on TEOpS 2-2-13.



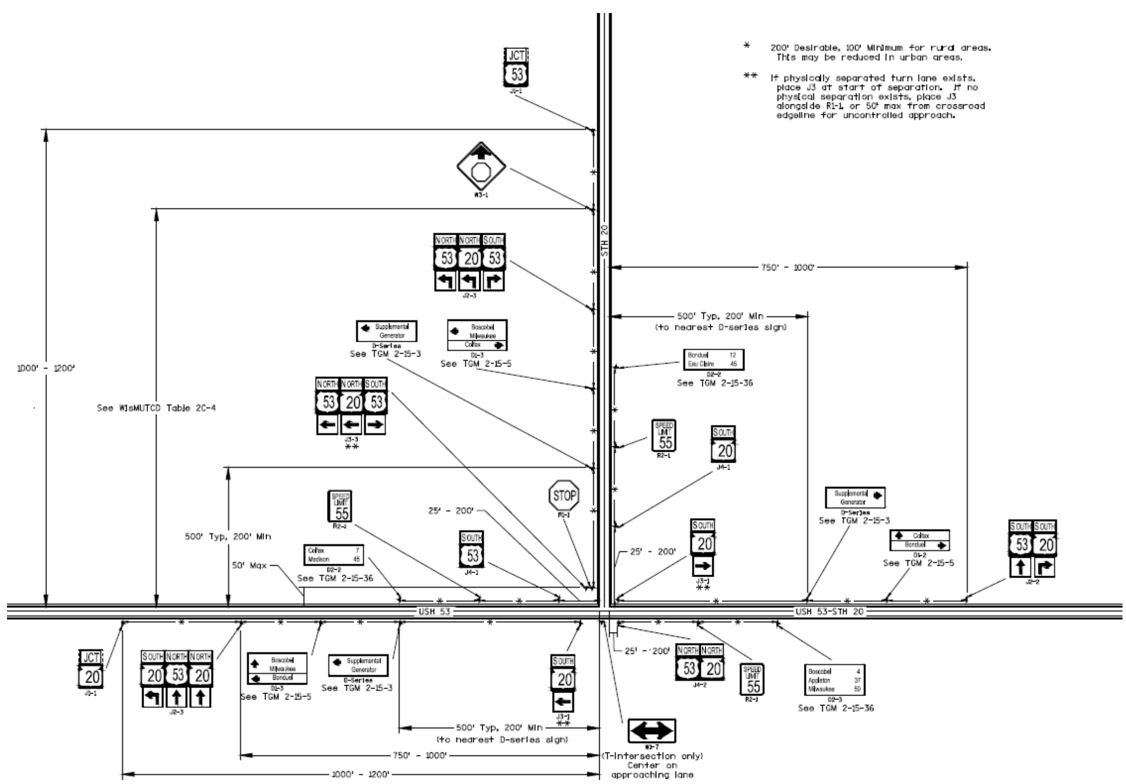
County Highway Approach to a STH

1. Install Destination signs (D1-series) and Supplemental Generators signs if warranted.
2. Double Night Arrow (W1-7) sign should be used at T intersections.
3. Route Assemblies (J-series) should be used:
    a. Junction to a Couth Highway J1 and J13
    b. Concurrent with a County Highway J12 and J13
4. Reassurances Assembly (J4-series) should be installed.
5. Stop Sign (R1-1) and Route Assembly (J13-series) are required.
6. Install Speed Limit Signs (R2-1) 200’ for the intersection if it is required based on TEOpS 2-2-13.



STH/USH Highway Approach to a STH

1. Destination signs (D1-series) and Supplemental Generators signs should be used.
2. Double Night Arrow (W1-7) sign **shall** be used on all T intersections.
3. Route assembly (J-series) signs should be used.
4. Reassurance assembly (J4-series), Distance (D2-series) and speed limit signs (R2-1) should be installed after all state to state or us to state highways.
5. Stop Sign (R1-1) and Route Assembly (J3-series) are required. J3 may be moved back from the intersection 200’ or raised to 8’ if there are determined to be sight issues.
6. If it is an all way stop, use the R1-3-P signs.



2-4-44 Conventional Roads on Approaches to Interchanges — August 2021

BACKGROUND AND PURPOSE

The MUTCD Section 2D-45 states that guide signing **shall** be utilized for multi-lane conventional roads approaching an interchange. The guide signs **shall** incorporate the destination, route shield and cardinal direction arrow.

"Enhanced" guide signs that incorporate the destination, route shield and cardinal direction arrow are referred to as Entrance Direction signs in the MUTCD. However, it *should* be noted that the MUTCD does not require the usage of Entrance Direction signs at all multi-lane conventional roads approaching an interchange. Entrance Direction signs can get quite large and costly to install and maintain. This *may* be especially true if there are right-of-way restrictions that require the usage of overhead guide signs.

However, there are applications on certain interchange crossroads where the enhanced type of Entrance Direction signs are valuable, specifically for arterial interchange crossroads with higher traffic volumes. Guide signing for collector/distributor types of interchange crossroads can, in most cases, be accomplished by traditional means with independent route assemblies (J-series) and destination/direction (D1-series) signs.

This policy will differentiate between the different types of guide signing for interchange crossroads (both single and multi-lane) and provide guidance as to the types of guide signing that *should* be used.

DEFINITIONS

Arterial interchange crossroads are defined as roadways used primarily by through traffic, usually on a continuous route or a highway designated as part of an arterial system.

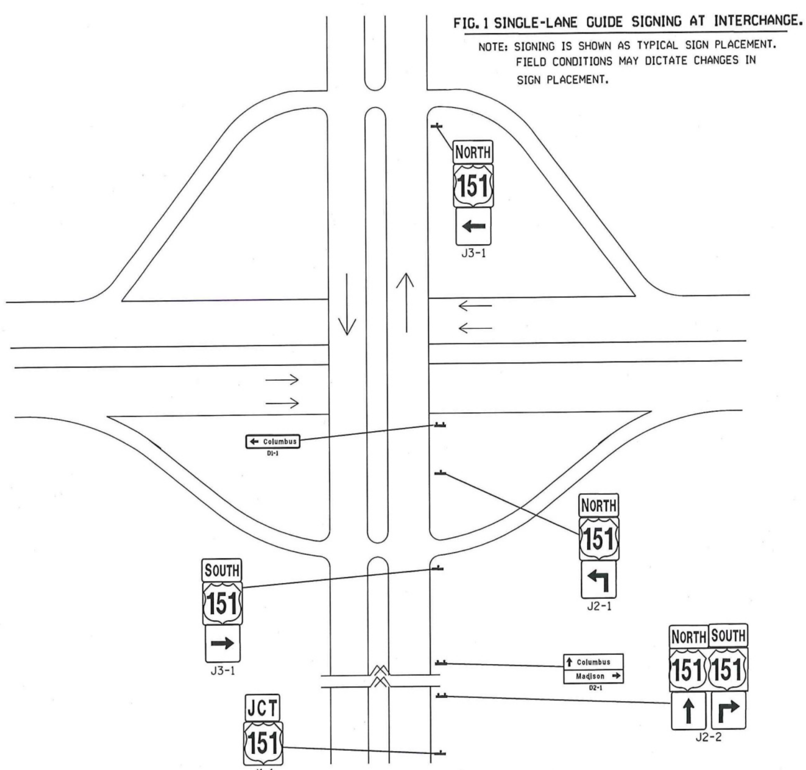
Collector/distributor interchange crossroads are defined as roadways that in rural areas connect small towns and local highways to arterials highways and in urban area provides land access and traffic circulation within residential, commercial, and business areas and connects local highways to the arterial highways.

POLICY

Single-lane Crossroad Approaches to Interchange (See Figure 1)

1. Traditional route assemblies (J-series) *should* be used.
2. Destination/Direction signs (D1-series) *should* be used.

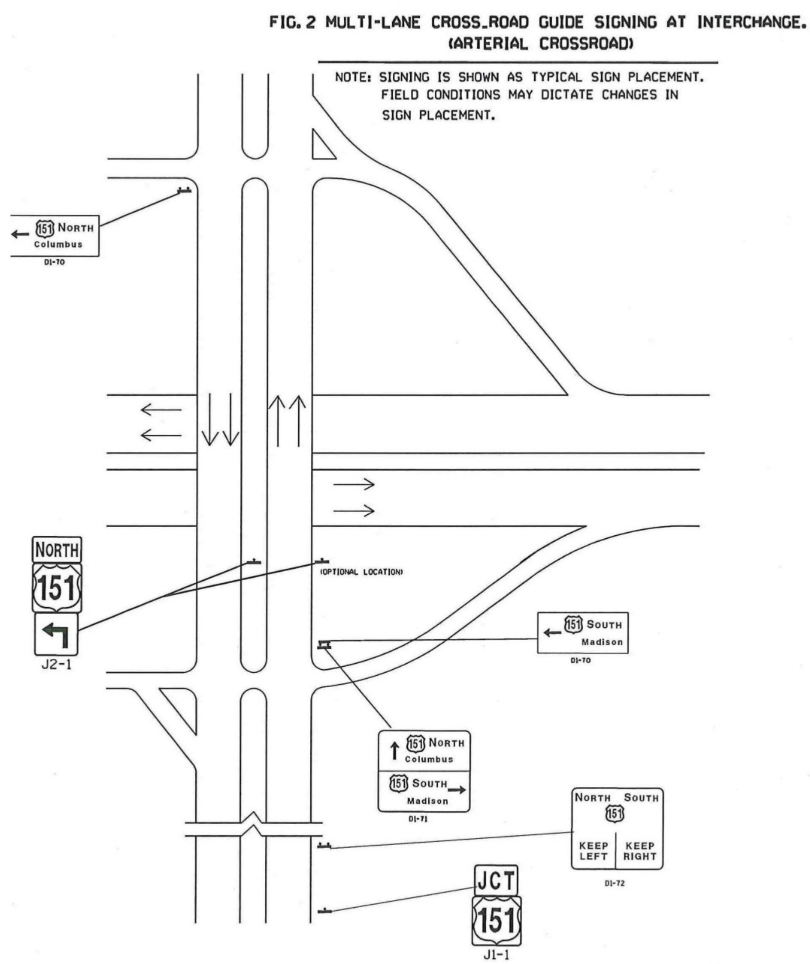
Figure 1. Single-lane Guide Signing at Interchange



Multi-lane **Arterial** Crossroad Approach to Interchange (See Figure 2)

1. The junction assembly (J1-series) *should* be the first sign used in the series.
2. The advanced Entrance Direction (D1-72 sign) *should* follow the junction assembly.
3. The Entrance Direction sign (D1-71) *should* be used to designate the direction of travel (left, right or ahead).
4. An advance left turn assembly (J2-series) *should* be used to provide guidance for the second ramp. The primary location of the advance left turn assembly *should* be in the median. The advance left turn assembly *may* be placed on the right side as an optional location.
5. An Entrance Direction sign (D1-70) *should* be used to provide guidance for the second ramp. It should be installed in the median unless space prohibits it. If space does not allow sign can be installed across in the median island or on the right side. Make sure visibility from the ramp is still adequate if installed on the right side.

Figure 2. Multi-lane Crossroad Guide Signing at Interchange (Arterial Crossroad)

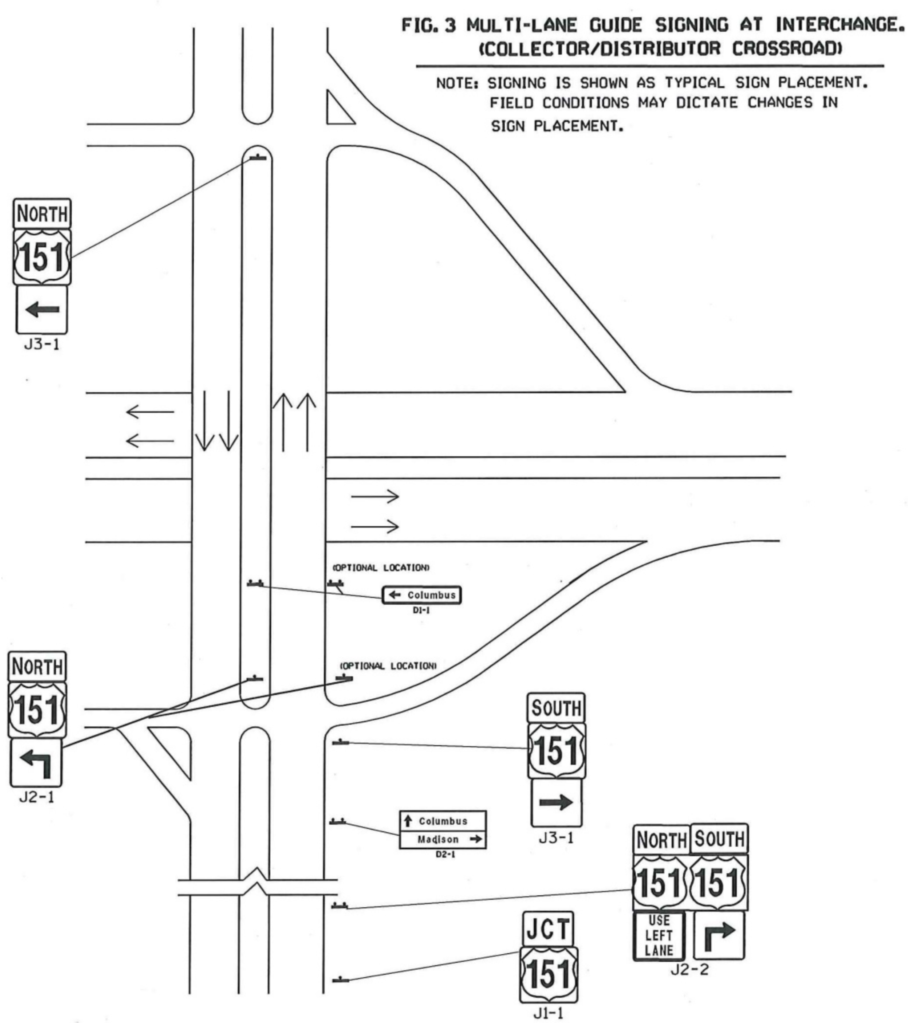


Multi-lane **Collector/Distributor** Crossroad Approach to Interchange (See Figure 3)

1. The junction assembly (J1-series) *should* be the first sign used in the series.
2. Advanced route assemblies (J2-series) *should* follow the junction assembly. The left movement *may* utilize an up arrow or the word USE LEFT LANE. The left lane portion of the advanced route assembly *may* be mounted in the median.
3. The traditional destination/direction sign (D1-series) *should* be used to designate the destination and direction of travel.
4. A route turn assembly (J3-series) *should* be installed for the first ramp.

5. An advance left turn assembly (J2-series) *should* be used to provide guidance for the second ramp. The primary location of the advance left turn assembly *should* be in the median. The advance left turn assembly *may* be placed on the right side as an optional location.
6. A route turn assembly (J3-series) *should* be installed for the second ramp.

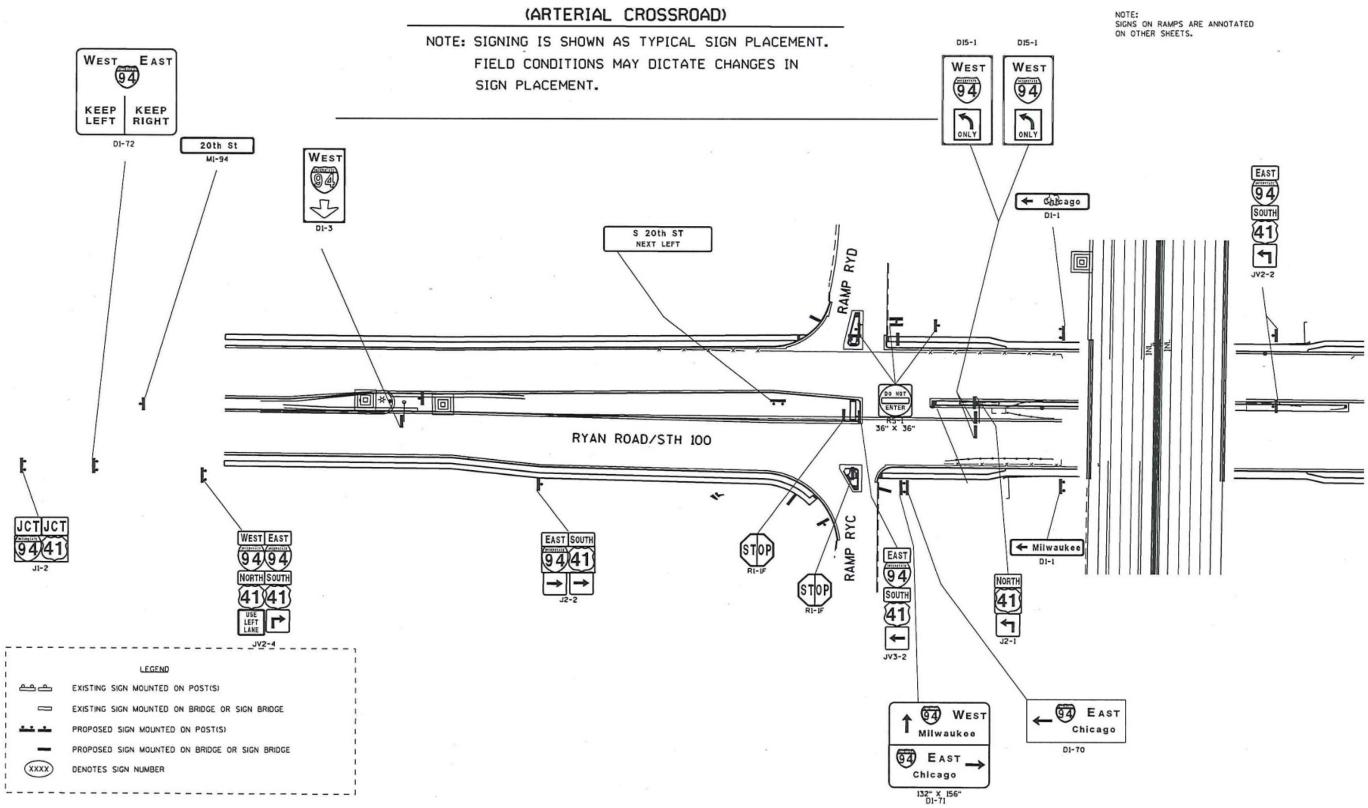
Figure 3. Multi-lane Guide Signing at Interchange (Collector/Distributor Crossroad)



<u>**Overhead Signing Options** for Multi-lane Arterial Crossroad Approach to Interchange (See Figure 4)</u>

Overhead guide signs *may* be used in lieu of the ground mounted Entrance Direction signs for some multi-lane arterial crossroad approaches to interchanges. Qualifying factors for overhead guide signs would be limited right-of-way that would prohibit the installation of ground mounted guide signs, high traffic volumes, dual/triple left turn lanes and look-ahead mandatory left-turn lanes.

Figure 4. Overhead Guide Signing Multi-lane Crossroad at Interchange



2-4-45.1 Emergency Hospital Signing — January 2018

PURPOSE

The purpose of the official Hospital sign is to designate hospitals with emergency care facilities. It is not intended for designating hospitals that cannot accept emergencies.

Signs (STANDARD SIGN D9-2 "H" symbol with appropriate arrow) will be furnished and maintained by the Department, on the state trunk highway system (if the state trunk highway does not lead directly past the hospital) for public and private hospitals meeting the American Medical Association (AMA) criteria. Thus signs would be warranted on a freeway or a state trunk highway that bypasses a community having a qualifying hospital. When a highway bypasses a municipality having a hospital, the Department will erect signs at appropriate locations on the bypass where motorists can best be directed into the municipality to the hospital.

Hospital signs and trailblazers on connecting streets and on local streets will not be furnished, erected, or maintained by the Department. At that point any further trailblazing is the responsibility of the local unit of government having maintenance jurisdiction over the highway carrying the route to the hospital.

No signing will be done on the state trunk highway system until signs have been erected on the local portion of the route to the hospital.

H signs *may* be erected only after being authorized by the Central Office, when the criteria in the following guidelines are met.

The following are guidelines for hospital signing:

1. A sign may be warranted for a public or private hospital which has continuous emergency care capability as defined by the American Medical Association and which is in their categorized report. Attached to the policy is a listing of hospitals that have been approved by the American Medical Association for Emergency Care Facilities. Hospitals included on this list may be signed provided they meet the rest of the criteria outlined in this policy.
2. A sign may be warranted on a freeway when the hospital is within a community contiguous to or near the freeway, or not more than 15 miles from the freeway.

3. A sign may also be warranted on a major highway which is not a freeway but which bypasses a community having a qualifying hospital.
4. On a freeway or other highway that bypasses a community having a hospital, a sign will be erected:
   a. Only at the point or points giving access to the most direct route to the hospital.
   b. Only once for traffic in each direction on a given highway.
5. Hospital signs will not be erected on State Trunk Highways leading directly into communities having hospitals except as those highways are HOSPITAL routes as described in item 6.
6. Hospital signs and trailblazers will be erected and maintained on the State Trunk Highway System by the Department but not until it receives assurance from the hospital administration that any Hospital Route Signs required on local roads and streets have been erected.
7. The name of the hospital will be utilized only in those cases where there is more than one hospital on the route, each of which appears on the list of hospitals, which have approved emergency facilities, and each of which is approximately the same distance from the point at which the routes to the hospitals diverge. The hospital name sign will be utilized only at that divergence point, and not with other trailblazers between the beginning of the signed hospital route and the point of divergence, nor between the point of divergence and the hospital itself.

The Department will remove signs from the state trunk highways when notified that a facility does not meet the criteria for an Emergency Care Facility and are not included on the attached lists.

City	Region	Hospital
Antigo	NC	Langlade Hospital - An Aspirus Partner
Berlin	NC	Berlin Memorial Hospital
Eagle River	NC	Ministry Eagle River Memorial Hospital
Friendship	NC	Moundview Memorial Hospital & Clinics, Inc.
Marshfield	NC	Ministry Saint Joseph's Hospital
Merrill	NC	Ministry Good Samaritan Health Center
Park Falls	NC	Flambeau Hospital
Rhinelander	NC	Ministry Saint Mary's Hospital
Shawano	NC	Shawano Medical Center
Stevens Point	NC	Ministry Saint Michael's Hospital
Tomahawk	NC	Ministry Sacred Heart Hospital
Waupaca	NC	Riverside Medical Center
Wausau	NC	Aspirus Wausau Hospital
Weston	NC	Ministry Saint Clare's Hospital
Wild Rose	NC	Wild Rose Community Memorial Hospital
Wisconsin Rapids	NC	Riverview Hospital Association
Woodruff	NC	Howard Young Medical Center
Appleton	NE	Appleton Medical Center
Appleton	NE	St. Elizabeth Hospital
Chilton	NE	Calumet Medical Center
Fond du Lac	NE	Agnesian HealthCare / St. Agnes Hospital
Green Bay	NE	Aurora BayCare Medical Center in Green Bay
Green Bay	NE	Bellin Hospital
Green Bay	NE	St. Mary's Hospital Medical Center
Green Bay	NE	Green Bay - St. Vincent Hospital
Manitowoc	NE	Holy Family Memorial Inc.
Marinette	NE	Bay Area Medical Center
Neenah	NE	Children's Hospital of Wisconsin - Fox Valley
Neenah	NE	Theda Clark Medical Center
New London	NE	New London Family Medical Center
Oconto	NE	Bellin Health Oconto Hospital
Oconto Falls	NE	Community Memorial Hospital
Oshkosh	NE	Aurora Medical Center in Oshkosh
Oshkosh	NE	Mercy Medical Center
Ripon	NE	Ripon Medical Center Inc.
Sheboygan	NE	Aurora Sheboygan Memorial Medical Center
Sheboygan	NE	St. Nicholas Hospital
Sturgeon Bay	NE	Ministry Door County Medical Center

Two Rivers	NE	Aurora Medical Center of Manitowoc County
Amery	NW	Amery Regional Medical Center
Ashland	NW	Memorial Medical Center
Baldwin	NW	Western Wisconsin Health
Barron	NW	Mayo Clinic Health System - Northland in Barron
Black River Falls	NW	Black River Memorial Hospital
Bloomer	NW	Mayo Clinic Health System - Chippewa Valley in Bloomer
Chippewa Falls	NW	St. Joseph's Hospital
Cumberland	NW	Cumberland Healthcare
Durand	NW	Chippewa Valley Hospital
Eau Claire	NW	Mayo Clinic Health System in Eau Claire
Eau Claire	NW	Oakleaf Surgical Hospital
Eau Claire	NW	Sacred Heart Hospital
Grantsburg	NW	Burnett Medical Center
Hayward	NW	Hayward Area Memorial Hospital
Hudson	NW	Hudson Hospital & Clinics
Ladysmith	NW	Rusk County Memorial Hospital
Medford	NW	Aspirus Medford Hospital & Clinics, Inc.
Menomonie	NW	Mayo Clinic Health System - Red Cedar, Inc.
Neillsville	NW	Memorial Medical Center
New Richmond	NW	Westfields Hospital
Osceola	NW	Osceola Medical Center
Osseo	NW	Mayo Clinic Health System - Oakridge in Osseo
Rice Lake	NW	Lakeview Medical Center
River Falls	NW	River Falls Area Hospital
Shell Lake	NW	Indianhead Medical Center / Shell Lake
Spooner	NW	Spooner Health System
St. Croix Falls	NW	St. Croix Regional Medical Center
Stanley	NW	Ministry Our Lady of Victory Hospital
Superior	NW	St. Mary's Hospital of Superior
Whitehall	NW	Gundersen Tri-County Hospital & Clinics
Brookfield	SE	Wheaton Franciscan - Elmbrook Memorial Campus
Burlington	SE	Aurora Memorial Hospital of Burlington
Elkhorn	SE	Aurora Lakeland Medical Center in Elkhorn
Franklin	SE	Midwest Orthopedic Specialty Hospital
Franklin	SE	Wheaton Franciscan Healthcare - Franklin
Glendale	SE	Orthopaedic Hospital of Wisconsin
Grafton	SE	Aurora Medical Center in Grafton
Hartford	SE	Aurora Medical Center in Hartford
Kenosha	SE	Aurora Medical Center in Kenosha
Kenosha	SE	Kenosha - UHS, Inc.
Lake Geneva	SE	Mercy Walworth Hospital and Medical Center
Menomonee Falls	SE	Community Memorial Hospital of Menomonee Falls, Inc.
Mequon	SE	Columbia Center
Mequon	SE	Columbia St Mary's Inc. - Ozaukee Campus
Milwaukee	SE	Aurora Sinai Medical Center
Milwaukee	SE	Aurora St. Luke's Medical Center / South Shore
Milwaukee	SE	Children's Hospital of Wisconsin
Milwaukee	SE	Columbia St. Mary's Hospital Milwaukee
Milwaukee	SE	Froedtert Memorial Lutheran Hospital Inc.
Milwaukee	SE	Wheaton Franciscan Healthcare - St. Francis
Milwaukee	SE	Wheaton Franciscan - St. Joseph Campus
Oconomowoc	SE	Oconomowoc Memorial Hospital
Racine	SE	Wheaton Franciscan Healthcare - All Saints, Inc.
Summit	SE	Aurora Medical Center in Summit
Waukesha	SE	Waukesha Memorial Hospital
Wauwatosa	SE	Midwest Spine and Orthopedic Hospital and Wisconsin Heart Hospital
West Allis	SE	Aurora West Allis Medical Center
West Bend	SE	St. Joseph's Community Hospital of West Bend Inc.
Baraboo	SW	St. Clare Hospital & Health Services
Beaver Dam	SW	Beaver Dam Community Hospitals Inc.
Beloit	SW	Beloit Health System
Boscobel	SW	Gundersen Boscobel Area Hospital and Clinics

Columbus	SW	Columbus Community Hospital
Darlington	SW	Memorial Hospital of Lafayette Co.
Dodgeville	SW	Upland Hills Health Inc.
Edgerton	SW	Edgerton Hospital & Health Services
Fort Atkinson	SW	Fort HealthCare
Hillsboro	SW	Gundersen St. Joseph's Hospital & Clinics
Janesville	SW	Mercy Hospital and Trauma Center
Janesville	SW	St. Mary's Janesville Hospital
La Crosse	SW	Gundersen Lutheran Medical Center
La Crosse	SW	Mayo Clinic Health System - Franciscan Healthcare in La Crosse
Lancaster	SW	Grant Regional Health Center
Madison	SW	Meriter-Unity Point Health
Madison	SW	St. Mary's Hospital
Madison	SW	UW Hospital & Clinics
Mauston	SW	Mile Bluff Medical Center
Monroe	SW	Monroe Clinic
Platteville	SW	Southwest Health Center
Portage	SW	Divine Savior Healthcare
Prairie du Chien	SW	Prairie du Chien Memorial Hospital
Prairie du Sac	SW	Sauk Prairie Healthcare
Reedsburg	SW	Reedsburg Area Medical Center
Richland Center	SW	The Richland Hospital Inc.
Sparta	SW	Mayo Clinic Health System - Franciscan Healthcare in Sparta
Stoughton	SW	Stoughton Hospital Association
Tomah	SW	Tomah Memorial Hospital
Viroqua	SW	Vernon Memorial Healthcare
Watertown	SW	UW Health Partners Watertown Regional Medical Center
Waupun	SW	Waupun Memorial Hospital

2-4-45.2 Emergency Medical Care Signing Policy — March 2016

PURPOSE

The purpose of emergency medical services signing is to provide direction for the motorist to the closest emergency medical care facility or hospital. The MUTCD, Section 2I.02 allows the usage of emergency medical care signing to facilities other than hospitals provided they meet certain criteria. The MUTCD also encourages states to develop guidelines for the usage of the Emergency Medical Services Sign. The Emergency Medical Care sign (D9-13C sign or E10-63 or E10-64 sign) provides direction to designated facilities other than hospitals that provide 24-hour emergency care.

Signs (Standard sign D9-13C with appropriate arrow or E10-63 or E10-64 sign) will be furnished and maintained by the Department on the state trunk highway system (if the state trunk highway does not lead directly past the emergency care facility) for emergency medical care facilities that meet the criteria specified in Section B of this policy. When a highway bypasses a municipality that has a qualifying emergency medical care facility, the Department will erect signs at appropriate locations on the bypass where motorists can best be directed into the municipality to the emergency medical care facility.

Signs and trailblazers on connecting streets and on local streets will not be furnished, erected, or maintained by the Department. At that point any further trailblazing is the responsibility of the local unit of government having maintenance jurisdiction over the highway carrying the route to the emergency medical care facility.

Signs *may* be erected only after being authorized by the Bureau of Traffic Operations, when the criteria in the following guidelines are met.

POLICY

The following are guidelines for emergency medical care facility signing:

1. A sign *may* be warranted for a public or private emergency medical care facility which has continuous emergency care capability as defined by the American Medical Association (AMA) and which is AMA Board Certified. Attached to the policy is a listing of emergency medical care facilities that are Board Certified by the AMA. Emergency Medical Care facilities included on this list *may* be signed provided they meet the rest of the criteria outlined in this policy.

2. The following criteria **shall** be used to determine if an Emergency Medical Care facility qualifies for signing:
    a. Continuous 24-hour, 7 days per week emergency care capability.
    b. Emergency department facilities with a physician trained in emergency medical procedures on duty (or emergency care nurse on duty within the emergency department with a physician on call).
    c. Board certified by the American Medical Association and a licensed medical care facility by the State of Wisconsin.
    d. Equipped for radio voice communications with ambulances and other hospitals.
3. A sign *may* be warranted on a freeway when the emergency medical care facility is within a community contiguous to or near the freeway, or not more than 15 miles from the freeway.
4. A sign *may* also be warranted on a major highway which is not a freeway but which bypasses a community having a qualifying emergency medical care facility.
5. On a freeway or other highway that bypasses a community having an emergency medical care facility, a sign will be erected:
    a. Only at the point or points giving access to the most direct route to the facility.
    b. Only once for traffic in each direction on a given highway.
6. Emergency Medical Care signs *should not* be erected on the same State Trunk Highway within the same community having a qualifying hospital that is already signed. An exception can be made if the emergency medical care facility is closer to the state trunk highway as described in Item 8.
7. Signs and trailblazers *may* be erected and maintained on the State Trunk Highway System by the Department but not until after trailblazer signs on local roads and streets have been erected.
8. If a new hospital is signed on the same highway in a community that has emergency medical care facility signing, the existing emergency medical care facility signs **shall** be removed. An exception can be made if the emergency medical care facility is closer than the hospital at the same intersection or interchange. In this case, both facilities could be signed.
9. The name of the emergency care facility will not be utilized on the signing unless there is more than one facility on the route, each of which appears on the list of approved emergency medical care facilities, and each of which is approximately the same distance from the point at which the routes to the facilities diverge. The emergency medical care facility name sign will be utilized only at that divergence point, and not with other trailblazers between the beginning of the signed route and the point of divergence, nor between the point of divergence and the emergency medical care facility itself.

The Department will remove signs from the state trunk highways when notified that a facility does not meet the criteria for an Emergency Care Facility, and are not included on the attached list.

Summary of AMA Board Certified Emergency Medical Care Facilities

Updated October 2015

Hospital	Address	City	Region	Remarks
St. Mary's Care Center	Reiner Rd.	Sun Prairie	SW	
Mercy Hospital and Trauma Center	3400 Deerfield Dr.	Janesville	SW	
Pro Health Care	240 Maple Ave.	Mukwonago	SE	

2-4-48 Signing for Unincorporated Communities — June 2021

PURPOSE

The purpose of this policy is to establish standards for the use of signs identifying or directing to unincorporated communities.

DEFINITIONS

Unincorporated communities are defined as historically named and recognized communities without official boundaries or government, generally located within a township, which often will have a different name.

Freeways are defined as divided highways with fully controlled access at interchanges only. Interstate highways are freeways with the interstate route designation.

Expressways are defined as divided highways with partially controlled access by a combination of interchanges, at-grade intersections, and driveways.

Conventional highways are defined as streets or roads other than freeways or expressways. They *may* be divided or undivided, two-lane or multi-lane, and access is available at intersections and driveways.

POLICY

Identifying Unincorporated Communities

Signs *may* be installed on conventional state trunk highways as near as possible to the generally recognized entrance to an unincorporated community, subject to WisDOT general signing criteria and the following guidelines.

1. The community *should* have a reasonable permanent population (a minimum of 50 people) within a reasonable geographic proximity (1/4 miles in each direction of a common intersection or ½ mile in diameter).
2. The request for signs request must come from residents and/or business owners within the unincorporated community and be approved in writing by the governing body of the township or municipality surrounding the unincorporated community.
3. Signs identifying unincorporated communities **shall not** be permitted on freeways or expressways.
4. These signs **shall** be made according to the unincorporated version of the DOT standard sign code I2-3.

Directing to Unincorporated Communities

Signs *may* be installed on expressways or conventional state trunk highways directing to an unincorporated community, subject to WisDOT general signing criteria and the following guidelines:

1. The unincorporated community must have unincorporated community signs on the state highway system.
2. The unincorporated community must be located within five miles of the State Highway intersection.
3. When the unincorporated community is located on a roadway other than a State Trunk Highway, signs identifying the community on that roadway must be in place prior to allowing any sign on a state highway directing to the community.
4. The sign(s) request must come from residents and/or business owners within the unincorporated community and be approved in writing by the governing body of the township or municipality surrounding the unincorporated community.
5. Signs directing to unincorporated communities **shall not** be permitted on freeways. Such signs *may* be permitted on expressway approaches to an at-grade intersection. They **shall not** be permitted on the expressway approaches to an interchange exit.
6. These signs **shall** be made according to the DOT standard sign code D1-1.

Existing unincorporated community signs that do not meet the WisDOT general signing criteria and above guidelines *may* remain until the end of their useful life. Useful life is defined as undamaged and legible to drivers. Once such non-conforming signs have reached the end of their useful life, they **shall** be removed and **shall not** be replaced.

2-4-48.1 Neighborhood Watch Signing — August 2009

PURPOSE

Wisconsin State Statute 66.0429 allows cities or villages to place Neighborhood Watch signs upon the highway right-of-way within its corporate limits. Per Statute, the program is required to be authorized by the law enforcement agency of the city or village and must be approved by the city council or village board. Furthermore, State Statute 66.0429 (2) states that the sign must be of a uniform design approved by the Department of Transportation. Often times the Department is requested to provide a detail of the official sign.

Communities that have adopted such a program often request signing on the state highway system. The

Department controls traffic signs on highways maintained by the state. Local governments do not have the authority to erect signs on those highways except when written permission is provided by the Department.

DEFINITIONS

Freeways are defined as arterial highway facilities that have full controlled access, by means of grade separation at interchanges only.

Expressways are defined as divided arterial highway facilities that have partial control of access and generally with grade separations at major intersections.

Conventional highways are defined as divided undivided roadway facilities that have limited access with no grade separations at intersections. These highways *may* be two lane or multilane facilities.

POLICY

The Department *may* permit local governments to place signs on highways under WisDOT jurisdiction subject to the requirements included here:

1. The city or village must have a neighborhood watch program in place that is authorized by the law enforcement agency of the city or village and approved by the city council or village board.
2. Requests for a permit to allow these signs must be in writing to the WisDOT Regional Office and *should* contain the following information:
    a. Locations where signs are to be installed, including State highway route number and distance to the nearest public roadway intersection
    b. Sign offset (distance from edge of travel lane) and type of post to be used
    c. Assurance that sign will be free standing (not attached to other signs)
    d. Documentation of city or village program.
3. The local government **shall** be responsible for supplying, installing, and maintaining the signs in conformance with the permit. The local government **shall** furnish their identification sticker on the sign.
4. The *recommended* sign for cities and villages is the NEIGHBORHOOD WATCH COMMUNITY sign (D12-50) (See Figure 1). There is a space for a 12” x 12” logo.
5. Acceptable logo designs are (See Figure 2):
    a. “Eye” style logo.
    b. Criminal logo.
6. There is no sunset date for signs already installed that do not conform to this policy. Rather, communities are encouraged to follow this consistent sign design.
7. The city or village must obtain the approval of the appropriate Regional office for location(s) of the signs(s).
8. Signs are only allowed at the corporate limits upon entering a community.
9. Per intent of State Statute 60.23 (17m) neighborhood watch signs **shall not** be allowed for townships on the state highway system. They *may* be placed on township maintained roadways and county roadways, if approved by the County Board.
10. For signs off the State Highway System, per State Statute 66.0429, WisDOT is required to approve the sign design.
11. Neighborhood Watch signs **shall not** be allowed on freeways, including ramps and 65 mph expressways.
12. Signs will be removed if official Neighborhood Watch program for the community no longer exists.

Figure 1

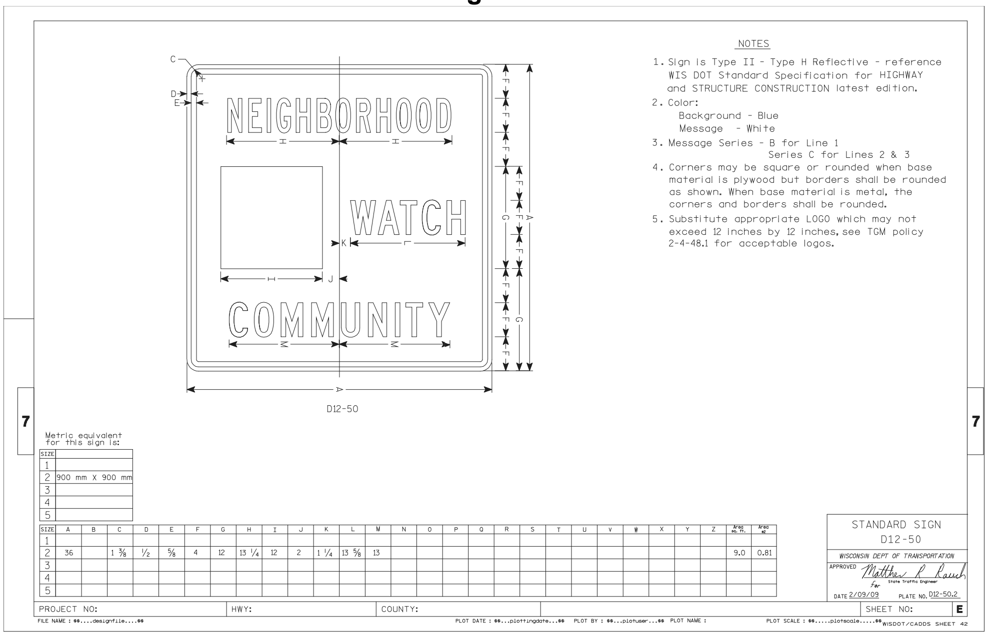


Figure 2 (Acceptable Logo Designs)

2-4-49 Street Name Signs — January 2015

PURPOSE

The MUTCD, Section 2D.43 states that street name signs *should* be installed at intersections. Standards and guidance are contained in Section 2D.43 of the MUTCD regarding letter sizes, colors and retroreflectivity of the street name signs.

Traditionally, local units of government have installed ground mounted street name signs at intersections of WisDOT maintained roadways. These ground mounted street name signs are installed and maintained by the local unit of government, in accordance with the MUTCD.

The MUTCD, Section 2D.43 also provides guidance and standards on the design of overhead street name signs at intersections. These types of overhead street name signs are commonly mounted on overhead traffic signal structures at the intersection. The overhead street name signs provide a lot of value in that they are larger and easier for the motorist to see (especially in urban environments where there are a lot of other competing signs, two or more travel lanes in each direction and closely spaced intersections). Now that the usage of traffic signal monotube arms have replaced the more traditional trombone arm traffic signal structure in Wisconsin, the attachment of overhead street name signs to the traffic signal structure has become much more practical.

The following policy criteria applies to both ground mounted and overhead street name signs that are installed on WisDOT roadways.

POLICY

<u>Ground Mounted Street Name Signs</u>

1. Local units of government are allowed to install ground mounted street name signs on WisDOT roadways. No permit is required for ground mounted street name signs.

2. Ground mounted street name signs **shall not** be installed on WisDOT maintained sign posts. Ground mounted street name signs **shall** be placed on their own supports and *should* be placed in the opposite quadrant as the STOP sign, typically on the left side so they do not obstruct the motorist's view of the STOP sign or any other signs.

3. The local unit of government **shall** pay for all costs associated with the manufacture, installation and maintenance of ground mounted street name signs.

Overhead Street Name Signs

1. WisDOT will install and maintain overhead street name signs on WisDOT maintained traffic signal monotube structures only.

2. In accordance with TEOpS 2-4-50, WisDOT **shall** also install advance crossroad name signs on divided roadways with posted speeds of 45 mph or greater and 2-lane conventional highways with posted speeds of 55 mph that are on the national Highway System. The Region has the option to additionally install advance crossroad name signing on divided roadways with posted speeds of less than 45 mph.

3. For overhead street name signs mounted on traffic signal monotube arms, in addition to the overall sign size restrictions, the sign **shall** not exceed a lateral mounting distance of 15 feet from the upright (distance from upright to center of sign). See SDD 9E-8 (sheets a-d) for the placement of overhead street name signs on traffic signal monotubes.

4. For WisDOT maintained overhead street name signs, only the standard M1-94H or M1-94S sign with white letters on green background will be allowed.

5. For existing overhead street name signs that have already been permitted on WisDOT maintained traffic signal monotube structures, WisDOT *may* assume the maintenance of the signs (permission needed from local unit of government), provided the signs meet WisDOT design standards. Otherwise, the signs would be grandfathered until they wear out and then replaced by signs that meet WisDOT design standards and maintained by WisDOT at that point.

6. For existing WisDOT maintained urban traffic signal monotube structures that do not currently have street name signs attached to them, the overhead street name signs *may* be installed as part of an improvement project. If the local unit of government wishes to have overhead street name signs installed prior to an improvement projects, they will need to incur the installation costs. Maintenance of the signs will be by WisDOT.

Sign Design and Manufacture

1. Due to wind loading restrictions on overhead traffic signal monotubes, overhead sign sizes *should not* exceed 18" in height or 108" in length. If larger street name signs are needed (i.e. longer street names or different street names in each direction), then the monotube wind loading calculations **shall** be calculated to ensure adequate wind loading (see Traffic Signal Design Manual 6-1-11).

2. For overhead street name signs, 12" initial upper case/9" lower case *should* be used for the street name. If overall sign size is a concern, 8" initial upper case/6" lower case letter heights *may* be used.

3. For all ground mounted street name signs, only blue, brown, white or green backgrounds **shall** be used. The legend for ground mounted street name signs **shall** be white for blue, brown or green background signs. The legend **shall** be black for white background signs. Overhead street name signs on WisDOT maintained traffic signal monotube structures **shall** be white letters on green background.

4. Pictographs in the form of a community symbol or highway route shield *may* be used on either non-WisDOT maintained overhead street name signs or any ground mounted street name signs. The height and width of the pictograph **shall not** exceed the height of the upper case letter of the principle legend on the sign. Pictographs **shall not** contain commercial advertising.

5. For new overhead and ground mounted street name signs, the mixture of initial upper case / lower case lettering **shall** be used. Existing street name signs with all capital letters are allowed to remain until they wear out or are replaced in projects.

6. Ground mounted street name signs *should* have a minimum letter heights of 6" initial upper case / 4 ½" lower case for 2 lane conventional highways (all posted speeds) and multi-lane conventional highways (posted speeds 40 mph or less). Ground mounted street name signs on multi-lane conventional highways with posted speeds greater than 40 mph *should* have minimum letter heights of 8" initial upper case / 6" lower case. 4" initial upper case / 3" lower case letters *may* be used on local two-lane streets with posted speed limits of 25 mph or less.

7. Supplementary lettering to indicate the direction (North, South, East or West) or the type of street (St, Ave, or Rd) *may* be used. For ground mounted street name signs, minimum supplementary letter heights of 3” upper case / 2 ¼” lower case letters *should* be used. For overhead street name signs with 12” initial upper case/9” lower case letter heights for the street name, supplementary letter heights of 6” initial upper case / 4 ½” lower case letters **shall** be used. If using 8” initial upper case/6” lower case letter heights for the street name, 4” initial upper case/3” lower case supplementary letters **shall** be used. If used, route shields on overhead street name signs **shall** be the same height as the upper case letters of the street name.

2-4-50 Advance Crossroad Name Signs December 2020

PURPOSE

This guideline provides information on the appropriate use of advance crossroad name signs. These signs are used on certain urban and rural roadways to identify and provide advance notice on the approach to intersections to allow safe reaction times and to orient unfamiliar motorists to their destinations.

These signs are provided for as optional street name signs in the MUTCD Section 2D.44. When an intersection warning sign (W2-1 through W2-6) is installed for the intersection, a similar function *may* be achieved with a supplemental advance street name plaque. Use of the advance cross road sign is preferred over the advance street name plaque. WisDOT has authority under ss. 86.19 to place these signs to guide and warn traffic.

POLICY

Advance crossroad name signs *should* be used selectively for at grade intersections. Two primary criteria exist for determining whether crossroad name signs *should* be used: the character of the highway and the character of the intersecting roadway. The use of signs *should* reflect both considerations.

1. Criteria related to the State Highway:
    a. Advance Crossroad Name Signs **shall** be used for at grade intersections of all urban and rural 4 lane divided highways with posted speeds 45 mph and greater.
    b. Use of Advance Crossroad Name Signs is optional on 4 lane urban and rural divided highways with posted speeds less than 45 mph. Problem situations on these types of highways *may* warrant this signing.
    c. Advance Crossroad Name Signs **shall** be used on all 2 lane conventional highways that are on the National Highway System which have a posted speed limit of 55 mph.
    d. The use of Advance Crossroad Name Signs **shall** be optional on all other 2 lane conventional highways that do not meet the criteria listed above in item 1c. Problem situations on this type of highway *may* warrant this signing.
2. Criteria related to the intersecting roadway:
    a. Advance crossroad name signs *should* be used for Intersecting roads that serve retail shopping, commercial activity, or other activities with high concentrations of entering or leaving traffic, or heavy slow moving vehicle traffic.
    b. Advance crossroad name signs are normally not used for intersections with another state highway or a county trunk highway. Those intersections *should* have junction signing in place and are referenced with highway numbers or letters rather than road names.
    c. Advance crossroad name signs **shall not** be used for intersections with roads that have no other outlet and serve less than 5 residences, unless directly opposite another crossroad that qualifies or criteria 2(a) above applies.
3. Sign placement and details:
    a. Directional arrows **shall** be used on all signs. For intersecting crossroads with different road names to the left and right, a D1-1 or D1-2 sign would be used. A D1-61 sign with two arrows would be used for intersecting roadways having the same name in both directions. In some locations, such as freeway off ramps with intersecting roadways having the same name in both directions, it may be beneficial to list the cardinal directions on the sign (D1-60 sign).
    b. In urban or semi-urban areas, there *may* be cases where there are closely spaced intersections or median cut-outs where the usage of directional arrows could cause potential motorist

confusing with turning at the wrong location. For these locations, in lieu of signs with directional arrows, an option would be to utilize sign with the word text of NEXT INTERSECTION (D1-63 sign), SECOND INTERSECTION (D1-64 sign) or NEXT SIGNAL (D1-65 sign).

c. Advance Crossroad Name Signs *should* be placed on the right side of the roadway. On divided highways, where there is a left turn only situation, the sign *should* be placed in the median. When there are three or more travel lanes in each direction, signs *should* be installed on the right side of the roadway and the median side of the roadway.

d. Placement of signs *should* follow the MUTCD Table 2C-4, condition B, deceleration to condition of 0 mph). The distance of these signs from the intersection *may* vary due to the presence of other signing in the area; however, it *should not* be less than 500 feet for speeds 45 mph and above.

e. Additional Advance Crossroad Name Sign size criteria for bypasses are contained in TEOpS 2-15-53 Bypass Signing.

f. Lettering sizes for Advance Crossroad Name Signs **shall** be as follows:

   i. High Speed Roadways (45 mph or above): 4 ½" lower case/6" upper case for conventional state trunk highways and 6" lower case/8" upper case for expressway crossroads; 4 ½" lower case/6" upper case or 6" lower case/ 8" upper case for 4 lane divided or undivided highways.

   ii. Low Speed Roadways (less than 45 mph): 4 ½" lower case/6" upper case.

2-4-51 Rustic Road Signs — August 2021

GENERAL

The Wisconsin Administrative Code Trans-RR 1 contains all of the rules for the application procedures and sign installation/maintenance criteria for Rustic Road Signing. The Wisconsin Department of Transportation has organized a Rustic Roads Board that maintains all of the rules in Wisconsin Administrative Code Trans-RR1. In addition to these rules, there is a need to also provide clear guidance on the minimum signing that is required to conform to the rules of the Rustic Roads Board. The goal of this guidance is to provide for a statewide consistent method of signing and clearly define what the signing the Department is responsible for and what signing the Local maintaining authority is responsible for.

POLICY

Below are the guidelines for the installation and maintenance of Rustic Road Signing:

1. A minimum amount of signing *should* be used in order to avoid additional sign clutter at intersections, which can lead to safety issues. Figure 1 shows examples of the minimum amount of signing required to conform to the rules of the Rustic Roads Board.

   a. JR99-1 assemblies (RR Marker, Rustic Road Number, Mileage) **shall** be used at all Rustic Road termini. The mileage listed **shall** be the entire length of that Rustic Road designation, regardless of any splits or loops, rounded to the nearest mile.

   b. JR99-1 assemblies (RR Marker, Rustic Road Number) **shall** be used at interior intersections with State or US Highways

   c. JR13-1 (RR Marker, arrow) signs **shall** be used at any turns or splits along the Rustic Road route.

   d. JR1-1 assemblies (End, RR Marker) **shall** be used at all Rustic Road termini.

   e. JR13-1 assemblies (RR Marker, arrow) *should* be used on State or US Highway approaches to Rustic Roads. For County Highways designated as Rustic Roads, this *may* be accomplished by combining Rustic Road signing with the Route Assemblies (J1/J12 and J13) for the County Highway.

   f. JR13-1 assemblies (RR Marker, arrow) *should* be used on County Highway approaches to Rustic Roads.

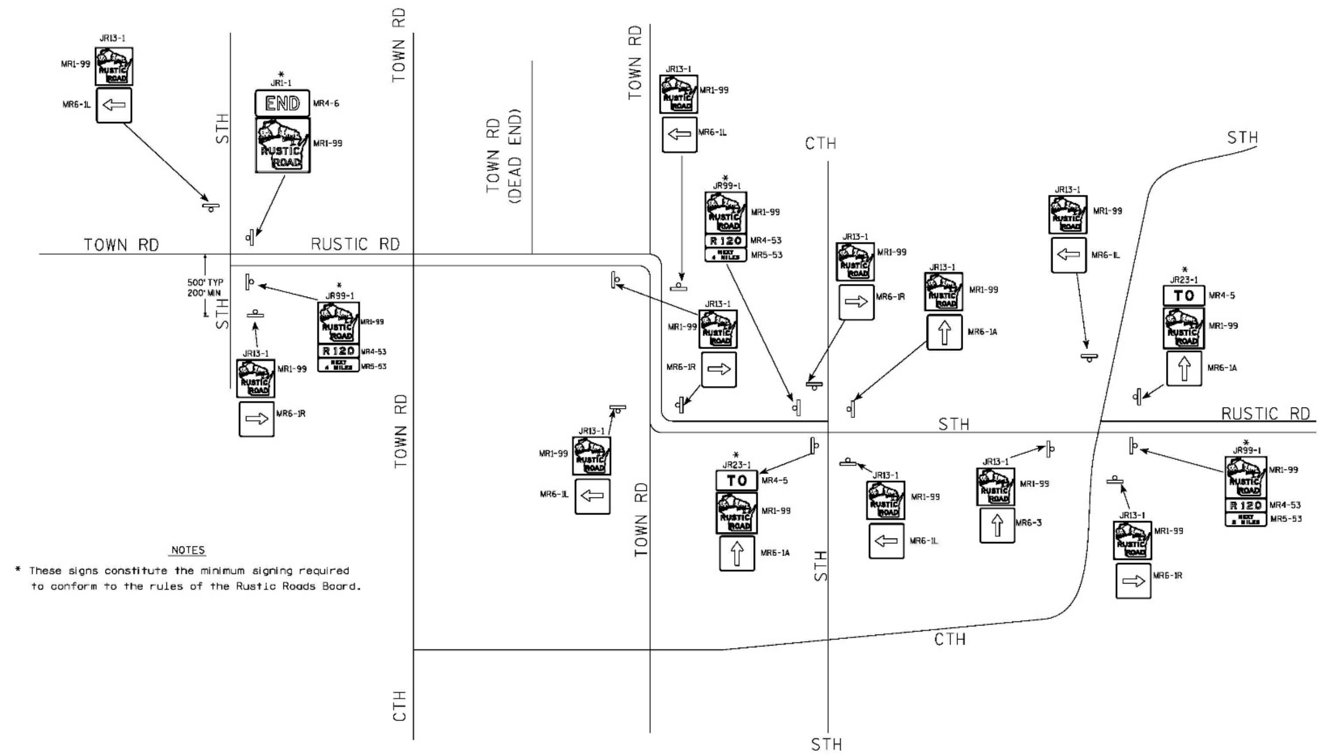
   g. Gaps in Rustic Road routes *should* be signed with JR23-1 assemblies (To Rustic Road w/arrow).

   h. No signing is typically necessary on local road approaches to Rustic Roads.

There is no formal phase-in period for installation of this signing. Existing signs will be allowed to remain in place until the end of their useful life. Useful life ends when the sign message no longer meets legibility or condition standards. Existing signs *may* be replaced prior to the end of their useful life when opportunities arise such as knockdown or damage, when other work is occurring nearby, or when projects make replacement practical.

2. The Department **shall** pay for the installation and maintenance of all Rustic Road signing. Major Rustic road signing efforts *should* be done in the fourth quarter of the calendar year. Minor sign replacement *may* occur throughout the year, as feasible.
3. As signs on the local system wear out and need to be replaced, the local unit of government *should* provide a list of signs needing replacement to the Department.

Figure 1



2-4-52 Heritage Directional Signs — December 2013

PURPOSE

In 1994, WisDOT and Wisconsin Department of Tourism enacted the Heritage Directional Signing program through a Cooperative Agreement between the two agencies. The Department of Tourism had the responsibility to work with the application process for businesses requesting signs and maintained a brochure of the eligible businesses. Tourism furnished the signs to WisDOT and the Department of Tourism covered installation and long term maintenance of the signs.

In August of 2013, the Department of Tourism indicated that they were no longer maintaining the Heritage Signing program and instead have focused on other means to promote this tourism effort. As a result, no new Heritage Direction signs will be installed on state highways from this time forward. This guideline provides information on the signing phase-out plan that was approved by Dept. of Tourism and WisDOT.

GUIDELINES

Listed below are guidelines for the installation and removal of Heritage Directional signing on WisDOT roadways, M1-85, M1-85C and M1-85d, which were agreed upon by the Department of Tourism and WisDOT:

1. New Heritage Direction signs **shall not** be installed on WisDOT roadways.
2. Existing Heritage Direction signs *may* be allowed to remain in place until the end of their useful life. Other opportunities such as knockdown damage, improvement projects or change in conditions *may*

make it possible to have the signs removed earlier.

3. If WisDOT staff receives a call from a business requesting a replacement Heritage Directional sign, refer the name and contact information to the State Signing Engineer, who in turn will work with the requestor and Tourism to find a potential alternative signing program (SIS, TODS, White Arrow boards).
4. If WisDOT removes a Heritage Directional sign, the Region *should* let the State Signing Engineer know, who will subsequently let Tourism know.

2-4-53 Auto Tour Signing Policy — December 2013

PURPOSE

Section 2H.07 of the MUTCD provides information on the appropriate use of Auto Tour Signs. These signs are used on certain urban and rural roadways to identify special routes that have certain cultural, historical or educational significance. These types of routes have been approved by the Wisconsin legislature and are included in the Wisconsin State Statutes. Examples of these routes are: The Rock River Trail, the Wild Rivers Trail, Lake Michigan Circle Tour, Lake Superior Circle Tour, Great River Road, and Green Bay Ethnic Trail.

This policy expands upon the language in the MUTCD by providing additional guidelines and standards on the usage of Auto Tour signs on WisDOT maintained roadways.

DEFINITIONS

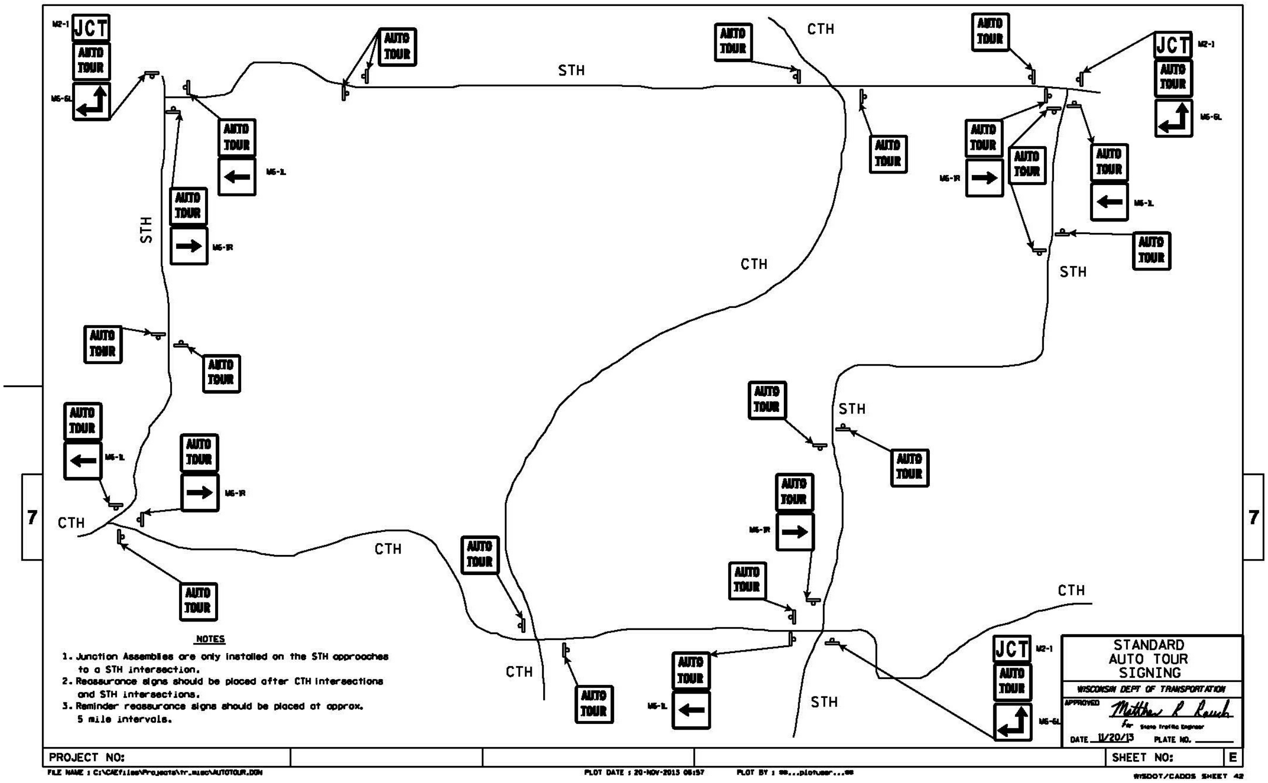
Freeways are defined as divided arterial highway facilities that have full controlled access, by means of grade separation at interchanges only.

Expressways are defined as divided arterial highway facilities that have partial controlled access and generally with grade separations at major intersections.

Conventional highways are defined as either divided or undivided roadway facilities that have no control of access with grade separations at intersections. These highways can be two-lane or multi-lane facilities.

POLICY

1. Auto Tour route signing is not intended to sign to a specific destination. Particular destinations tying into an Auto Tour route are typically listed on a website, brochure or other means.
2. Auto Tour route signs **shall not** be installed on freeways or expressways except as to provide continuity between discontinuous segments of conventional roadways that are designated as auto tour routes, for which the freeway or expressway provides the only connection between segments.
3. Auto Tour signing **shall** have the approval of the local unit(s) of government prior to signing on the state system.
4. A minimum amount of signing *should* be used in order to avoid additional sign clutter at intersections, which can lead to safety issues. Signs *should* also be close enough that the route can be easily followed without additional direction.
5. Design and Layout of Auto Tour Signing **shall** be approved by the Bureau of Traffic Operations.
6. For Auto Tour signs having the M1-92 or M1-98 sign code, the requesting groups **shall** pay all costs associated with installation and maintenance of Auto Tour signs. As signs on the local system wear out and need to be replaced, the local unit of government *may* request replacement signs from the Department at the local unit's expense.
7. For Auto Tour signs having the M1-7, M1-91, M1-93, M1-96, or M1-97 sign code, WisDOT **shall** pay for all cost associated with the installation and maintenance of the signs.



2-4-55 Stream/River/Lake Signs — September 2001

PURPOSE

Guide signs noting stream, river, and lake crossings have traditionally been installed on WisDOT roadways to assist motorists. When used in a controlled manner, these signs have benefits because they can help an unfamiliar motorist find their location when using a map and can also be informative on pointing out the location of important bodies of water for tourists or sporting use. However, in the past, usage of these signs has been uncontrolled, resulting in sign installations for everything from dry ditches to bodies of water not on the state map or recognized by the Wisconsin Department of Natural Resources. The intent of this policy is to establish control and statewide consistency on the usage of these signs.

DEFINITIONS

Freeways are defined as divided arterial highway facilities that have full controlled access, by means of grade separation at interchanges only.

Expressways are defined as divided arterial highway facilities that have partial controlled access, and generally by means of grade separation at major intersections.

INSTALLATION GUIDELINES

Stream, river and lake crossing guide signs *may* be used provided the following criteria are met:

1. For freeways and expressways. The body of water to be signed has a name shown on the current official State of Wisconsin Highway Map that is published by the Wisconsin Department of Transportation. Any bodies of water not having a name shown on this map **shall not** be signed for.
2. For conventional highways. The body of water to be signed has a name shown on the current official State of Wisconsin Highway Map or the current official County Highway Maps that are published by the Wisconsin Department of Transportation. Any bodies of water not having a name shown on these maps **shall not** be signed for.
3. Any existing stream, river, or lake crossing signs that are in place and do not meet the criteria listed in items 1 or 2 above, will be allowed to remain in place until the end of their useful life. Once the signs have reached their useful life, they **shall** be removed and not be replaced. Useful life is defined as the sign being legible for its intended usage.

2-4-60 Township Boundary and Land Use Zoning Signs — August 2000

PURPOSE

In the past, there have been requests by both urban and rural townships to have township boundary signs and land use zoning signs erected on WisDOT system roadways in order to identify themselves to motorists. In 1997, Assembly Bill 114 created a procedure that allows certain towns to become “urban towns” in order to specify the towns that are eligible to invoke this procedure and to define the authority granted to towns that become urban towns. As of the date of this policy, Assembly Bill 114 **did not pass.**

The intent of this policy is to establish a statewide policy and to control the clutter of signs on WisDOT system roadways by not allowing the use of these signs.

POLICY

Township Boundary signs and/or Township Land Use Zoning signs *should not* be installed on WisDOT system roadways, or right of ways, either individually or as part of a sign assembly. Zoning requirements are easily obtainable from local governments, thus making this signing unnecessary because these signs do not serve to guide or orient the average motorist. Similarly, township boundary signs do not have sufficient orientation value to warrant installation on the state highway or right-of-way system, since townships are not even shown on the state map.

In some cases, Township Boundary signs *may* be allowed by the Department for urbanized townships only. Requests for signing for urbanized township signs will be reviewed by the Department on a case-by-case basis and a permit *may* be granted.

Any existing Township Boundary signs or Township Land Use Zoning signs located on WisDOT system roadways that have not been permitted **shall** be removed no later than July 1, 2001.

2-4-65 Amenity Signs — April 2001

PURPOSE

The intent of this guideline is to establish standards for the use of signs which provide information about services provided at roadside facilities, including waysides and historical markers. The guideline is intended reduce the number of certain informational signs and messages in order to retain or improve the impact of other guidance and warning signs. The guideline also reflects the need to focus signing efforts and resources on the signs of highest value for safety and mobility.

Amenity signs, often referred to as “fingerboard” signs, have been installed in the past to give information about services available in the site. These signs were typically mounted below the advance signs to the facility.

The amenity signs covered under this policy include the DB5-69, DG5-69, and DN5-69 series:

- Toilet Sign (DB-5-69A, DG5-69A, and DN5-69A)
- Boat Landing Sign (DB5-69B, DG5-69B, and DN5-69B)
- Drinking Water Sign (DB5-69C, DG5-69C, and DN5-69C)
- Picnic Tables Sign (DB5-69D, DG5-69D, and DN5-69D)
- Historical Marker Sign (DB5-69E)
- Memorial Marker Sign (DB5-69F)

Motorists are accustomed to expecting certain amenities at waysides which reduces the value of some amenity signs. Signs are appropriate for other amenities that motorists are not accustomed to, or are not part of the standard expectation for the roadside facility.

POLICY

1. Toilet, Drinking Water, and Picnic Table signs shall not be installed on state highways. Those Toilet, Drinking Water, and Picnic Tables signs previously installed on state highways will be allowed to remain in place until the end of their useful life, when they should be removed and not replaced. Useful life ends when the sign message no longer meets legibility or condition standards. These signs may be removed prior to the end of the signs useful life when opportunities arise such as knockdown or damage, when other work is occurring nearby, or projects that make removal practical.
2. Boat Landing, Historical Marker, and Memorial Marker signs should continue to be installed on state highways. These signs should be mounted below the advance sign to the facility.

2-6-19 Exit Numbers

July 2024

The following is a listing of freeway exit numbers in Wisconsin. Changes or additions *should* be reported to the Signs and Markings Implementation Section to keep this listing current.

County	Direction of Travel	Interchange with	Exit No.
		USH 10	
Wood	E B and WB	STH 13 North and CTH A - Marshfield	187
Portage	EB and WB	STH 13 South and STH 34 South – Junction City and Wis Rapids	204
Portage	EB	STH 34 North, CTH P and CTH HH – Knowlton and Stevens Point	208
Portage	WB	STH 34 North, CTH P and CTH HH – Knowlton and Junction City	208
Portage	WB	IH 39 and USH 51 North - Wausau	213
Portage	EB and WB	CTH J	230
Portage	EB	Amherst Jct. and Lake Road	237
Portage	EB and WB	CTH B West – Plover and Amherst	238
Portage	EB and WB	CTH A and CTH B East - Amherst	240
Waupaca	EB	STH 49 North and STH 54 West - Waupaca	250
Waupaca	WB	STH 49 North and STH 54 West - Waupaca and Wis. Rapids	250
Waupaca	EB and WB	STH 22 South and CTH K - Waupaca and Wild Rose	252
Waupaca	EB and WB	Churchill St	253
Waupaca	EB and WB	STH 22 North, STH 54 East, CTH A, and CTH K North - Waupaca	254
Waupaca	EB and WB	STH 110 North and CTH A - Weyauwega	260A
Waupaca	WB	CTH F - Weyauwega	260B
Waupaca	EB and WB	STH 49 and STH 110 – Berlin and Fremont	264
Waupaca	EB and WB	STH 96, STH 110, CTH II - Fremont	267
Winnebago	EB and WB	USH 45 North – New London	273
Winnebago	EB and WB	USH 45 South – Oshkosh	276
Winnebago	EB and WB	STH 76 and USH 41 North – Oshkosh and Shiocton	284
Winnebago	WB	STH 76 – Oshkosh and Shiocton	284
Winnebago	EB and WB	CTH CB	286
Winnebago	EB and WB	USH 41 South - Oshkosh	287A
Winnebago	WB	USH 41 North - Green Bay	287B
Winnebago	EB and WB	CTH P - Racine St	289A
Winnebago	EB and WB	CTH AP - Midway Rd	289B
Winnebago	EB and WB	STH 47 - Appleton Rd	290
Winnebago	EB	Oneida St	291
		USH 12	
Sauk	EB and WB	CTH BD – Fern Dell Rd	212
Sauk	EB and WB	N Reedsburg Rd	214
Sauk	EB and WB	STH 33 WB – Pit Rd	215
Dane	EB and WB	Parmenter St	249
Dane	EB and WB	CTH M – Airport Rd and Century Ave	250
Dane	WB	Parmenter St	251B
Dane	EB and WB	USH 14 West	251A
Dane	EB and WB	Greenway Blvd.	252
Dane	EB and WB	Old Sauk Rd	253
Dane	EB and WB	CTH M and S - Mineral Point Rd	254
Dane	EB and WB	Gammon Rd	255
Dane	EB and WB	Whitney Way	257
Dane	EB and WB	USH 18 West and USH 151 South - Verona Rd and Midvale Blvd.	258
Dane	WB	Seminole Hwy.	258A
Dane	EB and WB	Todd Dr.	259
Dane	EB	CTH D South - Fish Hatchery Rd	260A
Dane	EB	CTH D North - Fish Hatchery Rd	260B
Dane	WB	CTH D - Fish Hatchery Rd	260B-A
Dane	EB	USH 14 East	261A
Dane	EB	USH 151 North - Park St.	261B
Dane	WB	USH 151 North - Park St and USH 14 East	261B-A
Dane	EB and WB	Rimrock Rd	262

Dane	EB and WB	John Nolen Dr.	263
Dane	EB and WB	South Towne Dr.	264
Dane	EB and WB	Monona Dr.	265
Dane	EB and WB	USH 51 - Stoughton Rd	266
Dane	EB	IH 90 East and IH 39 South	267A
Dane	EB	IH 90 West and IH 39 North	267B
Dane	EB and WB	CTH AB	269
Dane	EB and WB	CTH N	272
Walworth	EB and WB	IH 43 and CTH NN	321
Walworth	EB and WB	STH 120 North	328
Walworth	EB	STH 50 East	330A
Walworth	EB	STH 50 West and STH 120 South	330B
Walworth	WB	STH 50 and STH 120 South	330A-B
Walworth	EB and WB	Pell Lake Dr.	335
		USH 14	
Dane	EB	Mc Coy Rd	133
Dane	EB and WB	Lacy Rd	134
Dane	EB and WB	CTH MM	139
Dane	EB	STH 138	140
		STH 16	
Waukesha	EB and WB	CTH P North - Brown St. and Grifford Rd	176
Waukesha	EB and WB	CTH P South - Sawyer Rd	178
Waukesha	EB and WB	CTH C	179
Waukesha	EB and WB	STH 83	181
Waukesha	EB	CTH E and KC - North Ave. and Merton Ave.	182
Waukesha	WB	CTH KC and E - North Ave. and Merton Ave.	183
Waukesha	EB and WB	CTH JK and KE - Jungbluth Rd. and North Shore Dr.	184
Waukesha	EB and WB	CTH KF - Ryan St.	186
Waukesha	EB and WB	STH 190 - Capitol Dr.	187
Waukesha	EB and WB	CTH JJ - Main St.	188
		STH 26	
Rock	NB and SB	Harmony Town Hall Road	6
Rock	NB and SB	STH 59 and CTH M	8
Rock	NB and SB	CTH N	11
Jefferson	NB and SB	Business 26	17
Jefferson	NB and SB	STH 106	19
Jefferson	NB and SB	USH 12	21
Jefferson	NB and SB	Business 26	23
Jefferson	NB and SB	Business 26	25
Jefferson	NB and SB	USH 18	27
Jefferson	NB and SB	Business 26	30
Jefferson	NB and SB	Business 26 and CTH Y	39
Jefferson	NB	STH 19	43
Dodge	SB	STH 19	43
Dodge	NB and SB	STH 16 EB	45
Dodge	NB and SB	STH 16 and STH 60	52
		STH 29	
Dunn	WB	WB IH 94	60A
Dunn	WB	EB IH 94	60B
Dunn	EB and WB	USH 12 and STH 40	61
Chippewa	EB and WB	CTH T	68
Chippewa	EB and WB	90th St and Business 29	72
Chippewa	EB and WB	US 53 South	75A
Chippewa	EB and WB	US 53 North	75B
Chippewa		Seymour Cray and Business 29	79
Chippewa	EB and WB	CTH X	80
Chippewa	EB and WB	CTH J	81
Chippewa	EB and WB	CTH X	87
Chippewa	EB and WB	STH 27	91
Chippewa	EB and WB	CTH D	97
Chippewa	EB and WB	CTH H	101
Clark	EB and WB	STH 73 and CTH M	108
Clark	EB and WB	STH 73 and CTH T	118

Clark	EB and WB	CTH X – Cardinal Ave	122
Clark	EB and WB	CTH E	127
Clark	EB	Sprue St/ Highline Ave	131
Marathon	EB and WB	STH 13	132
Marathon	WB	Maple Rd/Spruce St	134
Marathon	EB and WB	STH 97	145
Marathon	EB and WB	CTH H	150
Marathon	EB and WB	STH 107	156
Marathon	EB and WB	72nd Ave	162
Marathon	EB and WB	STH 52	164A
Marathon	EB and WB	USH 51 North	164B
Marathon	EB	USH 51 South	none
Marathon	WB	USH 51 North	none
Marathon	EB and WB	Business 51	171
Marathon	EB and WB	CTH X	173
Marathon	EB and WB	CTH J	177
Marathon	EB and WB	CTH Q	181
Marathon	EB and WB	CTH Y	185
Shawano	EB and WB	USH 45 North and CTH M and Business 29	195
Shawano	WB	CTH Q and Business 29	196
Shawano	EB and WB	USH 45 South	198
Shawano	EB and WB	STH 22	225
Shawano	EB	STH 47 North and STH 55 North and CTH K	227
Shawano	WB	STH 47 North and STH 55 North and CTH K and Business 29	227
Shawano	EB and WB	STH 47 South and STH 117	234
Shawano	EB and WB	STH 55 South and STH 160	242
Brown	EB and WB	STH 32 and CTH Y	249
Brown	EB and WB	CTH VV - Marley St and Triangle Dr	253
Brown	EB and WB	CTH FF	255

INTERSTATE 39
(SEE USH 51- INTERSTATE HIGHWAY 39)
(ALSO SEE INTERSTATE 90 FOR I39/I90/I94)

STH 175

Milwaukee	NB and SB	IH 94-Eastbound	38A
Milwaukee	NB and SB	IH 94-Westbound	38B
Milwaukee	SB	USH 18 (Wisconsin Ave.) and Wells St.	38C
Milwaukee	NB	USH 18 - Wisconsin Ave. and Bluemound Rd.	38C
Milwaukee	SB	Vliet St. and State St.	39A
Milwaukee	NB	State St. and Vliet St.	39A
Milwaukee	NB	Washington Blvd.	39B
Milwaukee	NB	Lloyd St.	40A
Milwaukee	NB	USH 41 - Lisbon Ave.	40B

INTERSTATE HIGHWAY 41

Milwaukee	NB	STH 175 - Appleton Ave.	none
Milwaukee	SB	USH 41 - Appleton	47A
Milwaukee	NB and SB	CTH PP - Good Hope Rd	47B
Milwaukee	NB	STH 145 North and 124th St	48
Waukesha	SB	STH 145 - Fond du Lac Ave.	48
Waukesha	NB	STH 100 East - Main St.	50A
Waukesha	NB	CTH F West - Main St.	50B
Waukesha	SB	CTH F and STH 100 East - Main St.	50A-B
Waukesha	NB	Pilgrim Rd - Northbound	51A
Waukesha	NB	Pilgrim Rd - Southbound	51B
Waukesha	SB	Pilgrim Rd	51A-B
Waukesha	NB	CTH Q - County Line Rd	52
Washington	SB	CTH Q - County Line Rd	52
Washington	NB and SB	STH 167 East - Mequon Rd and CTH Y Lannon Rd	54
Washington	NB and SB	STH 167 West - Holy Hill Rd	57
Washington	NB	USH 45 North	59
Washington	NB and SB	STH 145	60
Washington	NB	STH 60 East	64A
Washington	NB	STH 60 West	64B
Washington	SB	STH 60	64A-B
Washington	NB and SB	STH 144	66

Washington	NB and SB	CTH K	68
Washington	NB and SB	STH 33	72
Washington	NB and SB	CTH D	76
Dodge	NB and SB	STH 28	81
Dodge	NB and SB	STH 67	85
Dodge	NB and SB	STH 49 and CTH KK	87
Fond du Lac	NB and SB	CTH B	92
Fond du Lac	NB and SB	USH 151	95
Fond du Lac	NB and SB	CTH VV - Hickory St.	97
Fond du Lac	NB and SB	CTH D and Military Road	98
Fond du Lac	NB and SB	STH 23 - Johnson St.	99
Fond du Lac	NB and SB	CTH OO - Winnebago St.	101
Fond du Lac	NB and SB	CTH N	106
Winnebago	NB and SB	STH 26	113
Winnebago	NB and SB	STH 44 and STH 91-Ripon Rd and South Park Ave.	116
Winnebago	NB and SB	9th Ave.	117
Winnebago	NB and SB	STH 21 - Omro Rd and Oshkosh Ave.	119
Winnebago	NB and SB	USH 45 and TO USH 10 West - Algoma Blvd.	120
Winnebago	NB and SB	STH 76 - Jackson St.	124
Winnebago	NB and SB	Breezewood Lane/Bell St.	129
Winnebago	NB and SB	STH 114 and CTH JJ - Winneconne Ave.	131
Winnebago	NB and SB	Main St. and Oakridge Rd	132
Winnebago	NB and SB	CTH II – Winchester Rd	133
Winnebago	NB and SB	USH 10 East and STH 441 North	134
Winnebago	NB and SB	CTH BB - Prospect Ave.	136
Outagamie	NB and SB	STH 125 - College Ave.	137
Outagamie	NB and SB	STH 96 - Wisconsin Ave.	138
Outagamie	NB and SB	STH 15 and CTH 00 - Northland Ave.	139
Outagamie	NB and SB	STH 47 - Richmond St.	142
Outagamie	NB and SB	CTH E - Ballard Rd	144
Outagamie	NB and SB	STH 441 South	145
Outagamie	NB and SB	CTH N	146
Outagamie	NB and SB	STH 55	148
Outagamie	NB and SB	CTH J	150
Outagamie	NB and SB	CTH U	154
Brown	NB and SB	CTH S	157
Brown	NB and SB	CTH F - Scheuring Road	161
Brown	NB and SB	CTH G - Main Ave.	163A
Brown	NB	Ashland Ave.	163B
Brown	NB and SB	CTH AAA - Oneida Street and Waube Lane	164A
Brown	NB and SB	STH 172	164B
Brown	NB and SB	CTH VK - Lombardi Ave.	167
Brown	NB and SB	STH 54 and STH 32 South - Mason St.	168A
Brown	NB and SB	STH 29 West and STH 32 North	168B
Brown	NB and SB	STH 29 East Shawano Ave.	168C
Brown	NB and SB	USH 141 South - Velp Ave.	170A
Brown	NB and SB	IH 43	170B

USH 41

Brown	NB and SB	CTH M - Lineville Road	173
Brown	NB and SB	CTH B - Sunset Beach Road	176
Oconto	NB and SB	Brown Road	179
Oconto	NB and SB	CTH S	182
Oconto	NB and SB	CTH D - Sampson Road	185
Oconto	NB and SB	USH 141	187
Oconto	NB	Business 41	197
Oconto	NB and SB	STH 22	198
Oconto	SB	Business 41	200
Marinette	NB and SB	CTH Y	212
Marinette	NB and SB	Schacht Road	216

INTERSTATE HIGHWAY 43

Rock	SB	IH 90 East and IH 39 South	1A
Rock	SB	IH 90 West and IH 39 North	1B
Rock	NB and SB	CTH X and Hart Road	2
Rock	NB and SB	STH 140	6
Walworth	NB and SB	USH 14	15

Walworth	NB and SB	CTH X	17
Walworth	NB and SB	STH 50	21
Walworth	NB and SB	STH 67	25
Walworth	NB and SB	USH 12 East	27A
Walworth	NB and SB	USH 12 West	27B
Walworth	NB and SB	STH 11	29
Walworth	NB and SB	Bowers Road	33
Walworth	NB and SB	STH 120	36
Walworth	NB and SB	STH 20	38
Waukesha	NB and SB	STH 83	43
Waukesha	NB and SB	STH 164	50
Waukesha	NB and SB	CTH Y - Racine Ave.	54
Waukesha	NB and SB	Moorland Road	57
Waukesha	NB	Layton Avenue	59
Milwaukee	SB	USH 45 and STH 100 - South	60
Milwaukee	NB	IH 894 West	61
Milwaukee	NB	Michigan St and 10th St	72A
Milwaukee	SB	IH 794 East - Lakefront	72B
Milwaukee	NB	IH 794 East – Lakefront	310C
Milwaukee	NB	Kilbourn Avenue	72C
Milwaukee	SB	IH94 West Madison	72D
Milwaukee	SB	Highland Avenue and 11th St	72E
Milwaukee	NB and SB	Fond du Lac Ave and McKinley Ave	73A
Milwaukee	NB and SB	North Avenue	73B
Milwaukee	NB and SB	Locust Avenue	74
Milwaukee	NB and SB	Keefe Avenue and Atkinson Avenue	75
Milwaukee	NB	STH 190 East - Capitol Dr	76A
Milwaukee	NB	STH 57 - Green Bay Ave and STH 190 West - Capitol Dr.	76B
Milwaukee	SB	STH 57 - Green Bay Ave and STH 190 - Capitol Dr.	76A-B
Milwaukee	NB	Hampton Avenue - Eastbound	77A
Milwaukee	NB	Hampton Avenue - Westbound	77B
Milwaukee	NB and SB	Silver Spring Drive	78
Milwaukee	NB and SB	Good Hope Road	80
Milwaukee	NB	Brown Deer Road - Eastbound	82A
Milwaukee	SB	STH 32 East - Brown Deer Road	82A
Milwaukee	NB and SB	STH 100 West - Brown Deer Road	82B
Milwaukee	NB	CTH W - Port Washington Road	83

Interchanges where IH 43 and IH 894 are concurrent are numbered as interchanges on IH 894

Ozaukee	NB and SB	STH 167 - Mequon Road	85
Ozaukee	NB and SB	CTH C	89
Ozaukee	NB and SB	STH 60 and CTH Q	92
Ozaukee	NB and SB	STH 32 North and CTH V South	93
Ozaukee	NB and SB	STH 33	96
Ozaukee	NB	STH 57	97
Ozaukee	NB and SB	CTH H West and STH 32 South	100
Ozaukee	NB and SB	CTH D	107
Sheboygan	NB and SB	STH 32 North and CTH LL	113
Sheboygan	NB and SB	CTH AA - Foster Rd	116
Sheboygan	NB and SB	CTH V and CTH OK	120
Sheboygan	NB and SB	STH 28	123
Sheboygan	NB and SB	STH 23 East	126A
Sheboygan	NB and SB	STH 23 West	126B
Sheboygan	NB and SB	STH 42	128
Manitowoc	NB and SB	CTH XX	137
Manitowoc	NB and SB	CTH C	144
Manitowoc	NB and SB	USH 151 and STH 42 South	149
Manitowoc	NB and SB	USH 10 East and STH 42 North and CTH JJ	152
Manitowoc	NB and SB	USH 10 West and STH 310	154
Manitowoc	NB and SB	CTH V	157
Manitowoc	NB and SB	CTH K	160
Manitowoc	NB and SB	STH 147 and CTH Z	164
Brown	NB and SB	STH 96 - CTH KB	171
Brown	NB and SB	USH 141 and CTH MM	178
Brown	NB and SB	STH 172	180
Brown	NB and SB	CTH JJ - Eaton Rd	181

Brown	NB and SB	CTH V - Mason St.	183
Brown	NB and SB	STH 54 and STH 57 - University Ave.	185
Brown	NB and SB	Webster Avenue and East Shore Drive	187
Brown	NB and SB	Atkinson Dr.	189
Brown	NB	USH 41 and USH 141	192A-B

USH 45 (IH 41)

Milwaukee	SB	IH 94 - Eastbound	38A
Milwaukee	SB	IH 94 - Westbound	38B
Milwaukee	SB	Bluemound Rd	39
Milwaukee	NB	Bluemound Rd	39
Milwaukee	NB and SB	Watertown Plank Rd	40A-B
Milwaukee	NB and SB	Mayfair Rd and North Ave. - Eastbound	42A
Milwaukee	NB and SB	North Ave. - Westbound	42B
Milwaukee	NB and SB	Burleigh St.	43
Milwaukee	NB and SB	Capitol Dr.	44
Milwaukee	NB and SB	Hampton Ave.	45
Milwaukee	NB and SB	Silver Spring Dr.	46
Milwaukee	NB	STH 175 West - Appleton Ave.	47A
Milwaukee	SB	STH 175 East - Appleton Ave.	47A

Interchanges where USH 45 / IH 41and USH 41 are concurrent are numbered as interchanges on USH 41/ IH 41

Washington	NB and SB	STH 145 - Fond du Lac Ave.	60
Washington	NB and SB	STH 60	63
Washington	NB and SB	CTH PV - Pleasant Valley Rd	65
Washington	NB and SB	Paradise Dr.	68
Washington	NB and SB	STH 33 and STH 144 - Washington St.	71
Washington	NB and SB	CTH D	73

USH 51

Dane	NB and SB	STH 19	61
Dane	NB and SB	Windsor Rd	63
Dane	NB and SB	CTH V	65

Interchanges where USH 51 and IH 39 are concurrent are found below

USH 51 and INTERSTATE HIGHWAY 39

Columbia	SB	IH 90/94 and STH 78 South	84
Columbia	NB and SB	Cascade Mountain Rd	85
Columbia	NB and SB	STH 33	87
Columbia	NB	STH 16 East	89A
Columbia	NB	STH 16 West 127 and To STH 127	89B
Columbia	SB	STH 16 and To STH 127	89B-A
Columbia	NB and SB	USH 51 South	92
Marquette	NB and SB	STH 23 West - CTH P	100
Marquette	NB	CTH D	104
Marquette	NB and SB	STH 23 East - STH 82	106
Marquette	NB and SB	CTH J and E	113
Waushara	NB and SB	STH 21	124
Waushara	NB and SB	CTH V	131
Waushara	NB and SB	STH 73	136
Portage	NB and SB	CTH D	139
Portage	NB and SB	CTH W	143
Portage	NB and SB	STH 54 - Bus. 51	151
Portage	NB and SB	CTH B	153
Portage	NB and SB	CTH HH	156
Portage	NB	USH 10 East	158A
Portage	NB	STH 66 West	158B
Portage	SB	USH 10 East and STH 66 West	158
Portage	NB and SB	STH 66 East	159
Portage	NB and SB	Business 51	161
Portage	NB and SB	Casimir Road	163
Portage	NB and SB	USH 10 West	165
Portage	NB and SB	CTH DB	171
Marathon	NB and SB	STH 34	175
Marathon	NB and SB	STH 153	179

Marathon	NB and SB	Kronenwetter and Mosinee (Maple Ridge Rd)	181
Marathon	NB and SB	Bus. 51	185
Marathon	NB and SB	STH 29 East	187
Marathon	NB and SB	CTH N	188
Marathon	NB and SB	CTH NN	190
Marathon	NB and SB	STH 29 West	191A
Marathon	NB	Sherman St.	191B
Marathon	NB and SB	STH 52 and Stewart Avenue	192
Marathon	NB and SB	Bridge St.	193
Marathon	NB and SB	CTH U	194A
Marathon	NB and SB	Bus. 51 CTH K	194B
Marathon	NB and SB	CTH WW	197
Lincoln	NB and SB	CTH Q	205
Lincoln	NB and SB	STH 17 and STH 64	208
Lincoln	NB and SB	CTH K	211
Lincoln	NB and SB	CTH S	225
Lincoln	NB and SB	STH 86 West and CTH D East	229
Lincoln	NB and SB	CTH A	231
Lincoln	NB and SB	USH 8	234

USH 53

La Crosse	NB and SB	STH 157 and Main St	6
La Crosse	NB and SB	CTH S and Sand Lake Rd	7
La Crosse	NB and SB	CTH OT	9
La Crosse	NB	STH 35 South, CTH HD, Business 35 and Holmen Dr	11
La Crosse	SB	STH 35 South, CTH HD and Holmen Dr	11
La Crosse	NB and SB	CTH MH and McHugh Rd	13
La Crosse	NB	STH 35 North and CTH HD	15
La Crosse	SB	STH 35 North, CTH HD, and Business 35	15
Eau Claire	SB	IH 94 East	84A
Eau Claire	SB	IH 94 West	84B
Eau Claire	NB and SB	Golf Rd	85
Eau Claire	NB and SB	STH 93 – Hastings Way	86
Eau Claire	NB and SB	USH 12 – Clairemont	87
Eau Claire	NB and SB	River Prairie Dr	89
Eau Claire	SB and NB	North Crossing and STH 312	90
Chippewa	SB and NB	Melby Street	92
Chippewa	SB and NB	CTH OO	94
Chippewa	SB and NB	STH 29 East	95A
Chippewa	SB and NB	STSH 29 West	95B
Chippewa	SB and NB	Business 29 – CTH X	96
Chippewa	SB and NB	CTH S	99
Chippewa	SB and NB	CTH B	102
Chippewa	SB and NB	STH 40	110
Chippewa	SB and NB	STH 64	112
Chippewa	NB and SB	CTH M	118
Barron	NB and SB	CTH I	126
Barron	NB and SB	USH 8	135
Barron	NB and SB	CTH 0	140
Barron	NB and SB	STH 48	143
Barron	NB and SB	CTH V	150
Washburn	NB and SB	STH 70	165
Washburn	NB and SB	USH 63 South	168
Douglas	NB and SB	USH 2 East	222

USH 61

Grant	NB and SB	STH 11 East and STH 35 South	1
Grant	NB	Badger Road and Eagle Point Rd	2
Grant	SB	Badger Rd and Eagle Point Rd	3
Grant	NB	CTH HHH and To CTH H	5
Grant	SB	CTH H and To CTH HHH	5
Grant	NB	USH 61 North Off Ramp at USH 151	8

STH 64

St. Croix	EB and WB	STH 35/CTH E	1
St. Croix	EB and WB	CTH V / Andersen Scout Camp Road	4
St. Croix	EB and WB	CTH VV / Bus 64	6

St. Croix	EB and WB	STH 35 / CTH C / Bus 64	9
St. Croix	EB and WB	CTH A / Bus 64	12

INTERSTATE HIGHWAY 90

La Crosse	EB and WB	CTH B	2
La Crosse	WB	STH 35 and USH 53 South	3
La Crosse	EB	STH 35 and USH 53 South	3A
La Crosse	EB	STH 35 North	3B
La Crosse	EB and WB	USH 53 North and STH 157	4
La Crosse	EB and WB	STH 16	5
La Crosse	EB and WB	CTH C	12
La Crosse	EB and WB	STH 162	15
Monroe	EB and WB	STH 27	25
Monroe	EB and WB	STH 16	28
Monroe	EB and WB	STH 131	41
Monroe	EB and WB	USH 12 and STH 16	43
Monroe	EB and WB	IH 94	45
Monroe	EB and WB	CTH PP	48
Juneau	EB and WB	CTH C	55
Juneau	EB and WB	STH 80	61
Juneau	EB and WB	STH 82	69
Juneau	EB and WB	CTH HH and CTH N	79
Juneau	EB and WB	USH 12 and STH 16	85
Sauk	EB and WB	STH 13	87
Sauk	EB and WB	STH 23	89
Sauk	EB and WB	USH 12	92
Columbia	EB and WB	STH 33	106
Columbia	EB and WB	STH 78 South	108A
Columbia	EB and WB	IH 39 North	108B
Columbia	EB and WB	CTH CS	115
Columbia	EB and WB	STH 60	119
Dane	EB and WB	CTH V	126
Dane	EB and WB	STH 19	131
Dane	EB and WB	USH 51	132
Dane	EB and WB	USH 151South	135A
Dane	EB and WB	USH 151 North	135B
Dane	WB	High Crossing Blvd	135C
Dane	EB and WB	IH 94 East	138A
Dane	EB and WB	STH 30	138B
Dane	EB and WB	USH 12 - 18 West	142A
Dane	EB and WB	USH 12 - 18 East	142B
Dane	EB and WB	CTH N	147
Dane	EB and WB	USH 51 North	156
Dane	EB and WB	USH 51 South - STH 73 and STH 106	160
Rock	EB and WB	STH 59	163
Rock	EB	STH 26	171A
Rock	WB	STH 26 North	171A
Rock	EB	USH 14 West	171B
Rock	WB	USH 14 West and STH 26 South	171B
Rock	EB and WB	STH 14 East	175C
Rock	EB and WB	Racine Street	175A
Rock	EB and WB	STH 11 East	175B
Rock	EB and WB	STH 11 West and Avalon Rd	177
Rock	EB and WB	CTH S	183
Rock	EB and WB	IH 43 North	185B
Rock	EB and WB	STH 81 West	185A

INTERSTATE HIGHWAY 94

St. Croix	EB and WB	STH 35 North	1
St. Croix	EB and WB	CTH F - Carmichael Rd	2
St. Croix	EB and WB	STH 35 South	3
St. Croix	EB and WB	USH 12 - CTH U	4
St. Croix	EB and WB	STH 65	10
St. Croix	EB and WB	CTH T	16
St. Croix	EB and WB	USH 63	19
St. Croix	EB and WB	CTH B	24
St. Croix	EB and WB	STH 128	28

Dunn	EB and WB	CTH Q	32
Dunn	EB and WB	STH 25	41
Dunn	EB and WB	CTH B	45
Dunn	EB and WB	USH 12 - STH 29 and 40	52
Eau Claire	EB and WB	STH 312 and CTH EE	59
Eau Claire	EB and WB	STH 37	65
Eau Claire	EB and WB	STH 93	69
Eau Claire	EB and WB	USH 53	70
Eau Claire	EB and WB	CTH HH	81
Trempealeau	EB and WB	USH 10	88
Jackson	EB and WB	STH 121	98
Jackson	EB and WB	STH 95	105
Jackson	EB and WB	USH 12 and STH 27	115
Jackson	EB and WB	STH 54	116
Jackson	EB and WB	CTH O	128
Monroe	EB and WB	CTH EW	135
Monroe	EB	USH 12	143
Monroe	WB	STH 21	143
Monroe	EB and WB	Industrial Ave	145
Monroe	EB and WB	IH 90	147

Interchanges where IH 90 and IH 94 are concurrent are numbered as interchanges on IH 90

Dane	WB	STH 30 West	240
Dane	WB	IH 90 East and IH 39 South	4A**
Dane	EB and WB	CTH N	244
Dane	EB and WB	STH 73	250
Jefferson	EB and WB	STH 89	259
Jefferson	EB and WB	STH 26	267
Jefferson	EB and WB	CTH F	275
Jefferson	EB and WB	Willow Glen Rd	277
Waukesha	EB and WB	STH 67	282
Waukesha	EB and WB	CTH P	283

**Existing Exit Number is 4A, Future Exit Number should be 240A

Waukesha	EB and WB	CTH C	285
Waukesha	EB and WB	STH 83	287
Waukesha	EB and WB	CTH SS	290
Waukesha	EB and WB	CTH G	291
Waukesha	EB and WB	CTH T	293
Waukesha	WB	STH 16	293C
Waukesha	EB and WB	CTH J South and STH 164 North	294
Waukesha	EB and WB	CTH F	295
Waukesha	EB and WB	USH18/STH164 South/CTH JJ/Barker Rd	297
Waukesha	EB	Moorland Rd	301A-B
Waukesha	WB	Moorland Rd	301A
Waukesha	WB	Moorland Rd	301B
Milwaukee	EB	STH 100	304
Milwaukee	WB	STH 100	304
Milwaukee	WB	IH 41 (USH 45) North	304
Milwaukee	EB and WB	USH 45 North	305B
Milwaukee	EB and WB	IH 894 East and USH 45 South	305A
Milwaukee	EB and WB	STH 181 - 84th St.	306
Milwaukee	EB and WB	68th St. - 70th St.	307A
Milwaukee	EB and WB	Hawley Rd	307B
Milwaukee	EB and WB	V. A. Center - Mitchell Blvd.	308A
Milwaukee	EB and WB	Miller Park Way (STH 175) - South	308B
Milwaukee	EB and WB	STH 175 - North	308C
Milwaukee	EB and WB	35th St.	309A
Milwaukee	EB	26th St. and St. Paul Ave.	309B
Milwaukee	WB	25th St. and Clybourn St.	309B
Milwaukee	EB	13th St.	310A
Milwaukee	EB and WB	IH 43 - Northbound	310B
Milwaukee	EB and WB	IH 794 - Eastbound	310C
Milwaukee	EB	STH 59 - National Ave. and 6th St.	311
Milwaukee	WB	STH 59 - National Ave.	311

Milwaukee	EB	Lapham Blvd. - Mitchell St.	312A
Milwaukee	EB	Becher St. - Lincoln Ave.	312B
Milwaukee	WB	Becher St. - Mitchell St., Lapham Blvd - Greenfield Ave.	312A-B
Milwaukee	EB	Holt Ave.	314A
Milwaukee	EB	Howard Ave.	314B
Milwaukee	WB	Howard Ave	314B
Milwaukee	WB	Holt Ave	314A
Milwaukee	EB	IH 43 and IH 894	none
Milwaukee	WB	IH 894 West - IH 43 South IH 41 North and 894 Bypass	317
Milwaukee	EB and WB	Layton Ave.	316
Milwaukee	EB and WB	Airport - Mitchell Field	318
Milwaukee	EB and WB	College Ave.	319
Milwaukee	EB and WB	Rawson Ave.	320
Milwaukee	EB and WB	STH 100 - Ryan Rd	322
Racine	WB	STH 241 - North 27th St.	325
Racine	EB and WB	Seven Mile Rd	326
Racine	EB and WB	CTH G	327
Racine	EB and WB	CTH K	329
Racine	EB and WB	STH 20	333
Racine	EB and WB	STH 11	335
Kenosha	EB and WB	CTH KR	337
Kenosha	EB and WB	CTH E	339
Kenosha	EB and WB	STH 142	340
Kenosha	EB and WB	STH 158	342
Kenosha	EB and WB	STH 50	344
Kenosha	EB and WB	CTH C	345
Kenosha	EB and WB	STH 165 and CTH Q and Tourist Info	347
Kenosha	WB	Truck Weigh Station	None

STH 145

Milwaukee	NB	Fond du Lac Avenue	None
Milwaukee	SB	Grantosa Drive and Villard Ave.	7A
Milwaukee	NB	STH 181 North - 76th Street	7B
Milwaukee	SB	STH 181 - 76th Street	7B
Milwaukee	NB	Silver Spring Drive - Westbound	8
Milwaukee	SB	Silver Spring Drive - Eastbound	8
Milwaukee	NB and SB	91st Street	9
Milwaukee	NB	Green Tree Road and 102nd Street	10A
Milwaukee	NB	107th Street and Good Hope Road	10B
Milwaukee	SB	107th Street and Fond du Lac Avenue	10B
Milwaukee	NB	Park Place	10C

USH 151

Interchanges where USH 151 and USH 61 are concurrent are numbered as interchanges on USH 61

Grant	SB	STH 35 North/USH 61 North/CTH HH	8
Grant	NB	CTH D and Business 151	18
Grant	SB	CTH D	18
Grant	NB and SB	STH 80/81	19
Grant	NB	CTH XX	21
Grant	SB	CTH XX and Business 151	21
Lafayette	NB and SB	STH 126 South and CTH G	26
Iowa	NB	CTH O and Business 151	37
Iowa	SB	CTH O	37
Iowa	NB	STH 23 South and To STH 39	40
Iowa	SB	STH 23 South and To STH 39 and Bus 151	40
Iowa	NB and SB	STH 23 North	44
Iowa	NB and SB	USH 18 West	47
Iowa	NB and SB	CTH BB and CTH HHH	52
Iowa	NB and SB	CTH ID	58
Dane	NB	STH 78 and Business 18/151	65
Dane	SB	STH 78	65
Dane	NB	CTH ID	69
Dane	SB	CTH ID and Business 18/151	69
Dane	NB and SB	CTH PD and To CTH P	70
Dane	NB and SB	CTH G/Dairy Ridge Rd.	75
Dane	NB	CTH MV and Business 18/151	76

Dane	SB	CTH MV	76
Dane	NB and SB	STH 69	77
Dane	NB and SB	CTH PB and To CTH M	79
Dane	SB	CTH MV and Business 18/151	81
Dane	NB and SB	CTH PD/McKee Rd	83A
Dane	NB and SB	Williamsburg Way	83B

Interchanges where USH 151 and USH 12 are concurrent are numbered as interchanges on USH 12.

Dane	NB and SB	IH 90/94 East and IH 39 South	97A
Dane	NB and SB	IH 90/94 West and IH 39 North	97B
Dane	NB and SB	Nelson Road	98A
Dane	NB and SB	American Parkway	98B
Dane	NB and SB	CTH C and Reiner Road	100
Dane	NB	Main Street and Business 151	101
Dane	SB	Main Street	101
Dane	NB and SB	STH 19 - Windsor Street	102
Dane	NB	CTH N - Bristol Street	103
Dane	SB	CTH N - Bristol Street and Business 151	103
Dane	NB and SB	CTH VV	108
Dane	NB and SB	CTH V	111
Columbia	NB and SB	STH 73 and Business 151	115
Columbia	NB and SB	STH 16/60	118
Dodge	NB	STH 73	120
Dodge	SB	STH 73 and Business 151	120
Dodge	NB	CTH D and Business 151	129
Dodge	SB	CTH D	129
Dodge	NB and SB	CTH G	130
Dodge	NB and SB	STH 33	132
Dodge	NB	Industrial Dr.	134
Dodge	NB and SB	CTH B and Business 151	135
Dodge	NB and SB	CTH A	136
Dodge	NB	CTH M and Business 151	142
Dodge	NB and SB	STH 26	144
Dodge	NB and SB	STH 49	146
Fond du Lac	SB	STH 26 South	147
Fond du Lac	NB and SB	STH 26 North	148
Fond du Lac	NB and SB	CTH D	160
Fond du Lac	NB and SB	Hickory St	161
Fond du Lac	NB and SB	STH 175	162
Fond du Lac	NB and SB	USH 45 South and CTH V	164
Fond du Lac	NB and SB	STH 23	168

STH 441

Calumet	NB	CTH KK – Calumet St	7
Outagamie	SB	CTH KK – Calumet St	7
Outagamie	NB and SB	CTH CE – College Ave	8
Outagamie	NB and SB	CTH OO – Northland Ave	10
Outagamie	NB	IH 41 South	11A
Outagamie	NB	IH 41 North	11B

INTERSTATE HIGHWAY 794

Milwaukee	WB	IH 94 West, USH 41 North	1A
Milwaukee	WB	IH 94 East, USH 41 South – IH 43 South	1B
Milwaukee	WB	IH 43 North	1C
Milwaukee	EB	Plankinton Ave.	1D
Milwaukee	EB	Jackson St. - Van Buren St.	1E
Milwaukee	WB	Milwaukee St.	1E
Milwaukee	EB	Lincoln Memorial Dr. – Lakefront	1F
Milwaukee	WB	Michigan St.	1F
Milwaukee	EB	J Lovell St. – St. Paul Ave	1H
Milwaukee	EB	Carferry Dr.	3

INTERSTATE HIGHWAY 894

Milwaukee	WB	IH 94 East	1A
Milwaukee	WB	IH 94 West	1B
Milwaukee	EB and WB	STH 59 and Greenfield Ave.	1D

Milwaukee	EB	Lincoln Ave.	1E
Milwaukee	WB	National Ave.	2A
Milwaukee	EB	National Ave. - Westbound	2A
Milwaukee	EB	Oklahoma Ave.	2B
Milwaukee	EB and WB	Beloit Rd	3
Milwaukee	EB and WB	IH 43 and USH 45 South	4
Milwaukee	WB	STH 24 West - Forest Home Ave.	5A
Milwaukee	WB	South 76th St.	5B
Milwaukee	EB	South 76th St. - South 84th St.	5A-B
Milwaukee	EB and WB	South 60th St.	7
Milwaukee	EB	STH 36 - Loomis Rd	8A-B
Milwaukee	WB	STH 36 - Loomis Rd South	8A
Milwaukee	WB	STH 36 - Loomis Rd North	8B
Milwaukee	EB and WB	STH 241 - South 27th St.	9
Milwaukee	EB	IH 94 West	10A
Milwaukee	EB	IH 94 East (41 South)	10B

2-6-21 Overhead Arrow-Per-Lane Guide Signs — January 2013

BACKGROUND AND PURPOSE

WisDOT has many interchanges in place that have optional exit/ahead lanes. These types of exits enhance the capacity of the exit ramps while at the same time improve the efficiency of traffic on the mainline. Traditionally, overhead signing has been installed at just the theoretical gore showing a two-lane exit only. This approach has worked with success in many locations. However, this signing approach does not fully emphasize to motorists that the lane adjacent to the exit only lane is an option lane and in some cases this has led to traffic queuing up unnecessarily in the exit lane instead of taking advantage of the optional lane.

The MUTCD Section 2E-20 requires that Overhead Arrow-Per-Lane or Diagrammatic guide sign designs be used for all multi-lane exits at major interchanges that have an optional exit lane. For all new or reconstructed freeways and expressways that meet the above conditions, the MUTCD Section 2E-21 requires that Overhead Arrow-Per-Lane guide signs be used in lieu of Diagrammatic guide sign designs. Diagrammatic guide sign designs are not allowed on new or reconstructed facilities.

It *should* be pointed out that the Overhead Arrow-Per-Lane guide signs *may not* be practical at all interchanges with optional lanes. For example, Overhead Arrow-Per-Lane guide signs *may* be too confusing for an interchange with split exits (A-B). Therefore, in these cases, the MUTCD Figures 2E-8 and 2E-9 still allow the usage of down arrows on guide signs.

Technically the Overhead Arrow-Per-Lane guide signs have an arrow over each travel lane. This practice *should* be utilized for system interchanges (freeway-freeway) because at these interchanges, WisDOT has traditionally shown the pull through or ahead movement. However, due to the large size of the signs and the fact that pull through movements have typically not been utilized at service type interchanges, the option for a “truncated” style overhead arrow-per-lane guide sign *should* be available. The “truncated” style overhead arrow-per-lane guide sign only shows one arrow above the optional lane and one arrow above the exiting lane. Even though the usage of the “truncated” style overhead arrow-per-lane guide signs are not adopted as part of the MUTCD, the General Counsel of the National Committee on Uniform Traffic Control Devices, endorsed usage of them at the June 2012 meeting.

DEFINITIONS

System interchanges are defined as freeway interchanges with other freeways.

Service interchanges are defined as freeway interchanges with local streets, County Trunk, State Trunk, U.S. or Interstate Highways.

POLICY

Overhead Arrow per Lane Guide Signs for System Interchanges

1. Overhead arrows *should* be used over each travel lane.
2. Due to the large size of the signs, a vertical splice *should* be placed at about the midpoint of the sign, so future replacement of the sign will be easier for field crews and less disruptive to traffic.
3. The overhead guide sign closest to the gore **shall** be placed at the beginning of taper for the option lane.

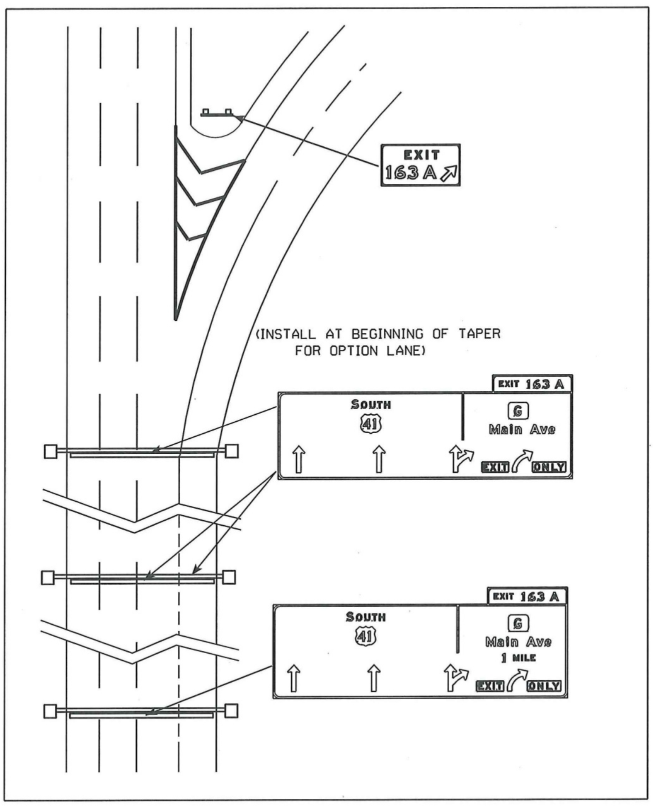
<u>Overhead Arrow per Lane Guide Signs for Service Interchanges</u>

1. At a minimum, overhead arrows *should* be utilized for just the option lane and exit only lane. Overhead arrows *may* be omitted for the ahead lanes.
2. The overhead guide sign closest to the gore **shall** be placed at the beginning of taper for the option lane.
3. A size 5 ground mounted regulatory (R3-33) RIGHT LANE MUST EXIT sign *should* be placed downstream of the advanced guide sign(s).

IMPLEMENTATION

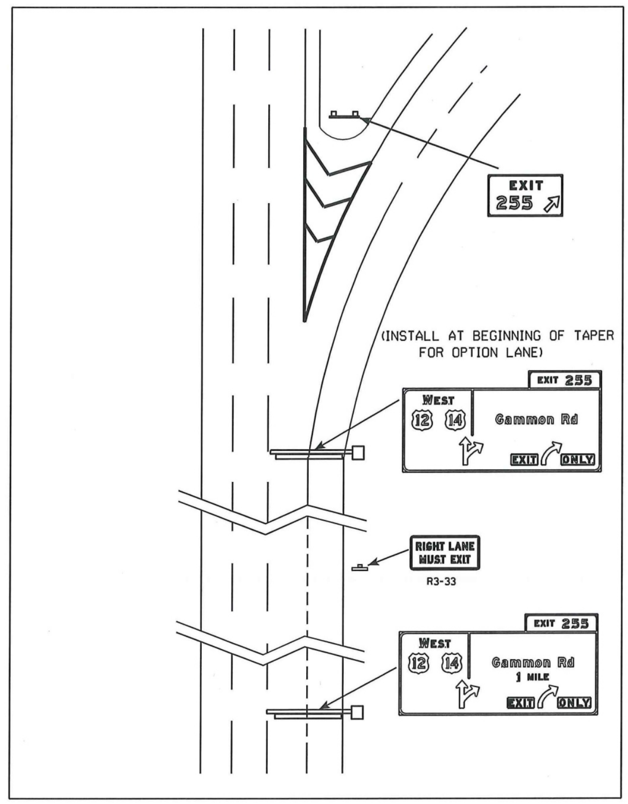
The FHWA does not have a mandated compliance date for this signing. Signing field revisions *should* be accomplished primarily through improvement projects.

Figure 1



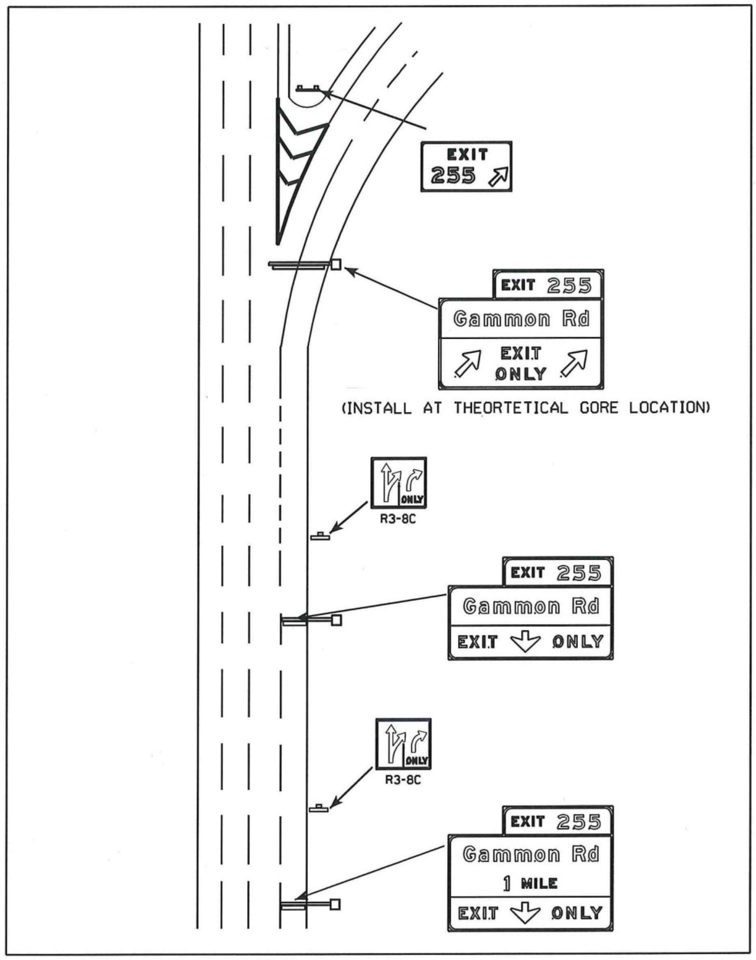
OVERHEAD ARROW PER LANE GUIDE SIGNS FOR SYSTEM INTERCHANGE

Figure 2



OVERHEAD ARROW PER LANE GUIDE SIGNS FOR SERVICE INTERCHANGE

Figure 3



OPTIONAL LANE SIGNING FOR EXISTING INTERCHANGES
(REPLACING SIGNS ON EXISTING SIGN BRIDGE STRUCTURES)

2-6-30 Grade Separated Crossroad Name Signs — December 2001

PURPOSE

Signs identifying grade separated roadway crossings (M1-94) have traditionally been installed on WisDOT freeways and expressways to help assist motorists. These signs can be very useful because they help an unfamiliar motorist find their location when using a map to orient themselves and *may* help motorists identify their location in case of emergency. The intent of this policy is to establish control and statewide consistency on the usage of these signs.

DEFINITIONS

<u>Freeways</u> are defined as divided arterial highway facilities that have full controlled access by means of grade separations at interchanges only.

<u>Expressways</u> are defined as divided arterial highway facilities that have partial controlled access and generally with grade separations at major intersections.

INSTALLATION GUIDELINES

Grade separated crossroad name signs can be used provided the following criteria are met:

1. <u>For freeways and expressways:</u> Signs **shall** be installed for all USH, STH, and CTH non-interchange crossroads. Signs *may* be installed for all other non-interchange crossroads.
2. <u>For freeways and expressways in urbanized areas:</u> Signs *may* be installed for all crossroads, interchanged or non-interchanged, but only where law enforcement and emergency medical personnel use them for incident identification.

3. Any grade separated crossroad name signs that are in place and do not meet the criteria listed in items 1 or 2 above will be allowed to remain in place until the end of their useful life. Once the signs have reached their useful life, they **shall** be removed and not be replaced. Useful life is defined as the sign being legible for its intended usage.

2-6-35 Tourist Information Signs — April 2010

GENERAL

The usage of general services signs is covered in Section 2D.45 of the MUTCD. One such general service sign that is permitted by the MUTCD is for tourist information. Oftentimes the department receives requests to install tourist information signs on state maintained highways. The intent of this signing is to **not** advertise for a particular tourist facility, but to provide a service in guiding motorists who are not familiar with an area to local and/or regional tourist activities and events.

DEFINITIONS

Freeways are defined as divided arterial highway facilities with full controlled access by means of grade separations at interchanges only.

Expressways are defined as divided highways with partial controlled access by a combination of interchanges, at-grade intersections and driveways.

Conventional highways are defined as streets or roads other than freeways or expressways. They *may* be divided or undivided, two-lane or multi-lane, and access is available at intersections and driveways.

POLICY

Tourist information signs *may* be approved for installation on state-maintained roadways under the following conditions.

Freeway or expressway:

1. The information booth is no more than three miles driving distance from the exit
2. The booth must be open and staffed a minimum of eight hours a day, seven days a week by staff whose sole duty is to operate the booth
3. The booth **shall** be the sole information service to that highway for that particular county segment, operated by the county government or by a countywide tourist business association
4. Signing from one freeway/expressway to another freeway/expressway **shall not** be allowed.

Conventional State Trunk Highway

1. The booth is within one mile driving distance from the state trunk highway
2. The booth is open and staffed a minimum of four house per day, five days per week
3. The booth **shall** be the sole information service in the municipality on that particular highway endorsed by the municipality or the local tourist business association.
4. Signing from one conventional state highway to another conventional state highway **shall not** be allowed.

General Conditions

In addition to the above, other requirements and conditions apply to sings on both types of highways:

1. When trailblazing off the state trunk highway system is required, each maintaining agency **shall** install signing before the signing on the state trunk highway is erected
2. Signing on the state trunk highway will be removed by crews under the direction of the department during the period when a seasonal booth is not operated. An alternate to removal is the application of a CLOSED panel.
3. The cost for fabrication, installation and maintenance of this signing **shall** be the responsibility of the requestor or managing organization or agency. WisDOT **shall** coordinate the fabrication, installation, and maintenance of all signs on state-maintained roadways, including ramps, and **shall** be reimbursed for all costs.

4. Signs will read "Tourist Information" in conformance with state standards.
5. Adequate parking facilities must be provided in the immediate vicinity of the booth.

2-6-36 Parallel Off-Ramp Exit Direction Signing July 2012

BACKGROUND AND PURPOSE

The MUTCD Section 2E-36 states that post mounted Exit Direction signs *should* be mounted at the beginning of the deceleration lane. If there is less than 300 feet from the upstream end of the deceleration lane to the theoretical gore, the Exit Direction sign *should* be installed overhead over the exiting lane in the vicinity of the theoretical gore.

Occasionally long parallel (deceleration) exit ramps are constructed to provide for additional capacity for exiting traffic, thus helping to eliminate traffic slowing and queuing in the mainline travel lanes. Some of these parallel exit ramps can be up ½ mile in length. The challenge with interchange guide signing of long parallel exit ramps is that the motorist *should* know as soon as possible that the far right lane is for the Exit Only. This will allow an exiting motorist to shift from the mainline lane (s) to the exit ramp as soon as possible. This will maximize efficiency and safety of the freeway exit by helping to avoid last minute lane changes and traffic backups.

This policy will differentiate between the different lengths of parallel exit ramps and provide guidance as to the types of guide signing that *should* be used. Sight distance will play a factor as to what types of guide signing that *should* be used as well. Overhead exit direction signs *may* be required if sight distance is compromised by geometrics or if the theoretical gore location is beyond a bridge.

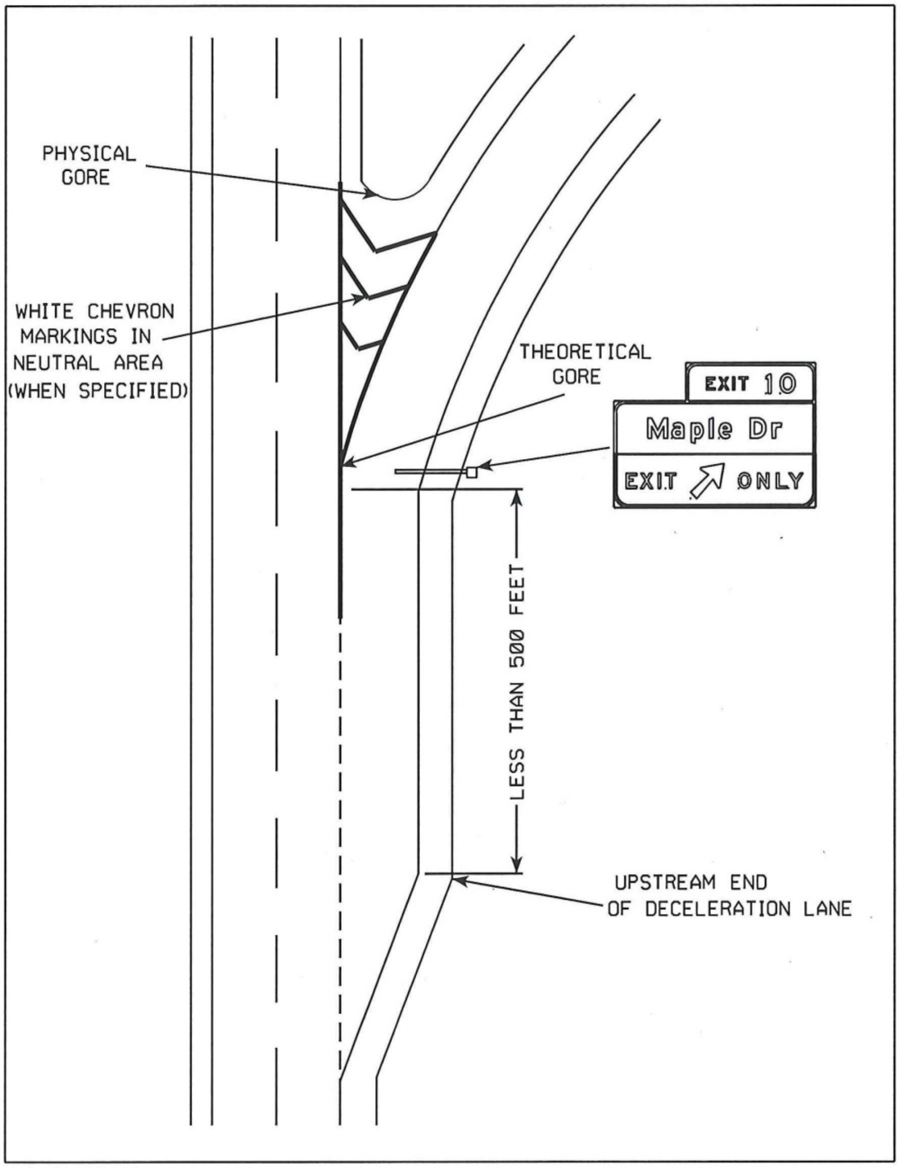
POLICY

<u>If parallel off-ramp is less than 500 feet from upstream end of deceleration lane to theoretical gore</u>

1. An overhead Exit Direction guide sign at the upstream end of the deceleration lane *should* be used.
2. Typically no Exit Direction guide sign would be needed at the theoretical gore location.
3. If the parallel exit ramp is greater than ¼ mile in length, then the ramp *should* be considered an auxiliary exit lane and have <u>both</u> an Exit Direction guide sign at the upstream end of the deceleration lane and Exit Direction guide sign installed at the theoretical gore location.

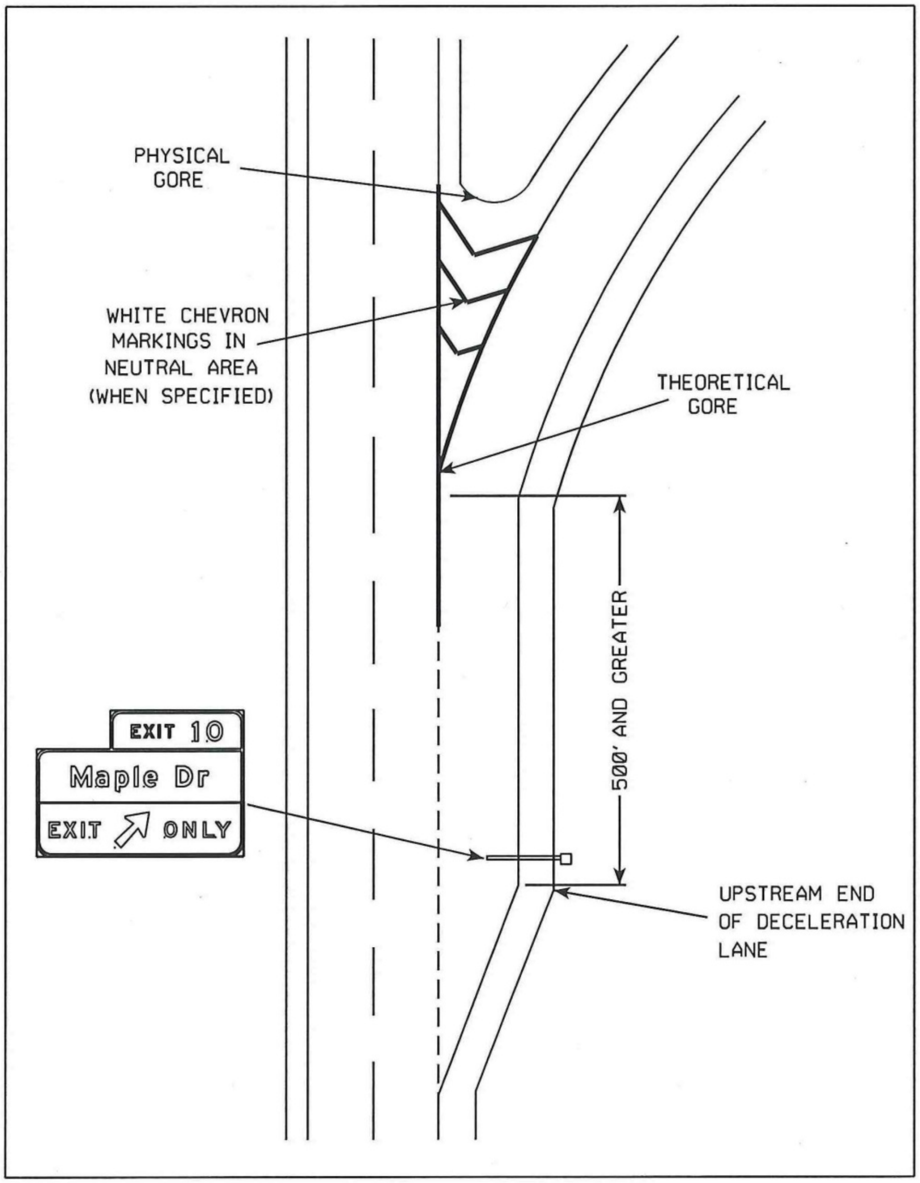
<u>500' or greater parallel exit ramp (retrofit situation), where parallel exit ramp has been extended and existing overhead Exit Direction sign at theoretical gore is allowed to remain</u>

1. A ground mounted Exit Direction guide sign at the beginning of the taper for parallel exit ramp *should* be used.
2. The overhead Exit Direction guide sign at the theoretical gore location would not have to be moved to the upstream end of the deceleration lane.
3. If the parallel exit ramp is greater than ¼ mile in length, then the ramp *should* be considered an auxiliary exit lane and have <u>both</u> an Exit Direction guide sign at the upstream end of the deceleration lane and Exit Direction guide sign installed at the theoretical gore location.



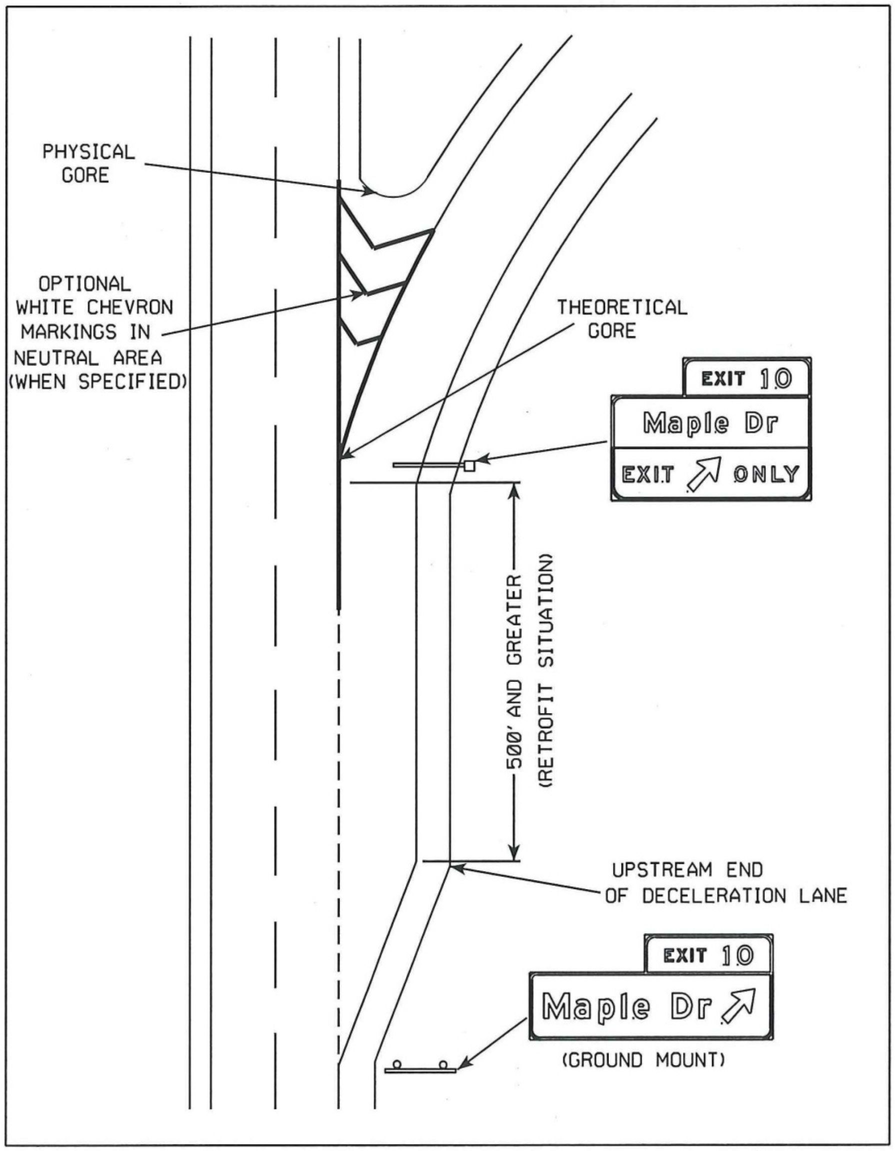
(LESS THAN 500 FEET FROM UPSTREAM END OF DECELERATION LANE TO THEORETICAL GORE)

FIGURE 1



(500' AND GREATER FROM UPSTREAM END OF DECELERATION LANE TO THEORETICAL GORE)

FIGURE 2



(500' AND GREATER FROM UPSTREAM END OF DECELERATION LANE TO THEORETICAL GORE)

(RETROFIT SITUATION)

FIGURE 3

2-6-40 No Re-Entry to Freeway Signs — July 2012

PURPOSE

In an effort to control construction costs, there are several interchanges that have been constructed as half diamond or partial cloverleaf interchanges. These are typically interchanges that do not allow access back on to the mainline (freeway/expressway). Motorists *may* have to drive a substantial distance to get back onto the mainline, which can cause potential confusion. This is especially true if adequate trailblazing is not in place to direct motorists back to the mainline. This policy provides guidance for the installation of signs on the freeway/expressway to warn motorists of the approaching half interchange.

DEFINITIONS

<u>Freeways</u> are defined as divided arterial highway facilities with full controlled access by means of graded separations at interchanges only.

<u>Expressways</u> are defined as divided arterial highway facilities with partial controlled access, generally with grade

separations at major intersections.

POLICY

1. The “NO RE-ENTRY TO FREEWAY” (W6-54) sign *may* be used by the Region where freeway/expressway interchanges are far apart or access to the next interchange is not apparent. This sign *should* only be used at freeway exit locations where there is no other on ramp in either cardinal direction to get back onto the freeway.
2. For freeway exit locations where there is a freeway on ramp in the opposite cardinal direction, the “NO *****BOUND RE-ENTRY TO FREEWAY (W6-54A-D) series signs *should* be used.
3. The signs *should* not be used if adequate trailblazing back to the mainline is already in place.
4. If used, the signs **shall** be mounted immediately below the advance guide sign for the interchange (typically the E1-1A ground mount advance sign or E6-51 overhead advance sign). The minimum height requirements for a secondary Type I sign *should* be followed (see A4-1 standard sign plate).

2-6-50 Community “Downtown” Signing — February 2017

GENERAL

Supplemental guide signs *may* be allowed to direct motorists on freeways and expressways to a community’s “downtown” area, subject to the conditions described in this guideline.

DEFINITIONS

Downtown is the area, usually within the central city that has governmental offices, business offices, retail shopping, and other amenities closely associated with each other in a contiguous re, and will normally be referred to by the community and its usual residents as downtown or the central business district. Unfamiliar motorists directed from the freeway or expressway to downtown *should* have this same expectation.

ELIGIBILITY

Communities are eligible for freeway or expressway signs directing motorists to downtown when the following criteria are met:

1. The community must be served by at least two interchanges from the freeway or expressway with the interchange highways leading toward the downtown area.
2. The freeway or expressway on which the downtown signs are located must:
   a. Be within five miles of the nearest boundary of the community, or
   b. Pass within the corporate limits of the community.
3. The community must agree to comply with this criteria and requirements of this guideline, and accept responsibility for all costs associated with signing for the community downtown under this guideline.

Communities *may* also be eligible for signs directing to downtown on conventional highways when the highway bypasses the downtown area and provided the signs designate the “city center” area.

SIGN REQUIREMENTS, LOCATION, AND INSTALLATION

Downtown signs on a freeway or expressway mainline are considered supplemental signing. The approval and installation is subject to all provisions of the Department’s policy on “Supplemental Guide Signing on Freeways and Expressways for Public and Private Facilities” in addition to the eligibility requirements and sign location and installation details of this guideline. Approval of signs for eligible communities is subject to the following criteria:

1. Only one downtown sign *may* be installed in each direction of travel on a freeway or expressway. The sign location in each direction of travel along the freeway or expressway *may* be at a different interchange.
2. The community must pass a resolution or similar official document which specifies the requested access location(s) for the downtown directional signs and **shall** submit the resolution to the Department’s Regional office as the official request. The location(s) selected **shall** remain fixed for ten years or the life of the signs before changes to the location(s) *may* be considered.
3. Specific location of the freeway or expressway signs will be determined by the Department.

4. The community must install and maintain confirmation signs suitable to the department on the selected access route(s), agree to comply with this guideline, and accept responsibility for all costs associated with signing for the community downtown under this guideline. These confirmation signs are required before signs *may* be installed on the freeway or expressway.
5. Freeway or expressway sign design and message will be determined by the department in accordance with applicable standards and in the interests of uniformity.
6. Freeway and expressway downtown signs will incorporate the name of the community within the sign message.
7. The community will be responsible for all costs incurred by the department, including installation and long-term maintenance of the signs. This includes signs on the freeway and expressway mainline and ramps along with all confirmation signs.
8. A combination of community downtown signs and "Historic Downtown" signs for the same community **shall not** be allowed.
9. Downtown signs with appropriate directional arrows *should* be placed at the junction of the ramp and crossroad at the access interchange.

2-6-54 Reference Location Signs — July 2012

PURPOSE

The installation of mileposts and enhanced reference markers, which are referenced in the MUTCD Section 2H.05 and 2H.06, are very useful to motorists for the following reasons:

1. Providing a means of identification of emergency incident locations.
2. Precise identification of crashes.
3. Aid in the location for highway maintenance and servicing.
4. Road inventory records.
5. Aid motorists in estimating their progress.

DEFINITIONS

Freeways are defined as divided arterial highway facilities with full controlled access by means of grade separated interchanges only.

Expressways are defined as divided arterial highway facilities with partial controlled access and generally with grade separations at major intersections.

REFERENCE LOCATION SIGNS (MILEPOST) POLICY

The MUTCD requires mileposts for all freeway facilities. Mileposts **shall** also be placed on expressway facilities that are located on a route where there is milepost continuity.

It is the intent of the department to install mileposts at additional locations which satisfy the following conditions:

1. Mileposts **shall** be installed for all urban and rural freeway facilities, regardless of the ADT or traveling speed.
2. Mileposts shall be installed for all urban and rural expressways in situations where freeway segments and expressway segments are combined. An example of this is STH 29.
3. Mileposts *should not* be installed on highways that are solely expressway facilities unless there are frequent grade separated interchanges and the speed limit is 65 mph.
4. Mileposts *should not* be installed on highways that are solely conventional highways.

Mileposts **shall** be installed in accordance with the provisions contained in the MUTCD. Signs **shall** be installed that conform to the D-10 series.

Overlapping Routes: Continuity **shall** be established for one of the routes. In one of the overlapping routes in an interstate route, that route **shall** be selected for continuity of distance numbering.

ENHANCED REFERENCE LOCATION SIGNS POLICY

The Southwest and Southeast Regions have completed studies first initiated by the Southeast Region Traffic Incident Management Enhancement (TIME) committee. 1/10 and 2/10 enhanced reference location signs have been installed along various freeway segments with positive evaluation results.

Enhanced reference location signs *should* be utilized where the following conditions occur:

1. Rapid identification of emergency incident locations by enforcement personnel, dispatchers and the motoring public.
2. Precise identification of crashes.
3. Identification of disabled vehicles on freeway systems to provide for rapid deployment of enforcement and other emergency personnel to remove the vehicle from the highway to reduce travel delays by the motoring public and to return the facility to a normal traffic flow.
4. Where a uniform system of identification on a system wide basis is necessary for 911 dispatchers and emergency and enforcement personnel.

The MUTCD Section 2H.06 provides for an option to utilize an enhanced reference location sign numbering system, and spacing the signs at 1/10, 2/10 or 5/10 miles.

The WisDOT practice is as follows:

1. **Urban areas:** All locations on freeway segments where there is a median barrier, 1/10 mile enhanced reference location signs *should* be installed as a system-wide installation. For example, to provide for a system-wide installation, all of Milwaukee County *should* have enhanced reference location signs. This provides for full use of the system rather than utilizing crossroads as identifiers by dispatchers for some locations and 1/10 enhanced reference location signs on some sections of the system.

   For locations without median barrier in urban areas, the enhanced reference location signs *may* still be installed if it provides for continuity and completion of a system.

   Option: Signs *may* be installed at 2/10 mile spacing but must be consistent for a corridor and system-wide at regional discretion.

2. **Outlying areas—semi urban:** 1/10 or 2/10 enhanced reference location signs are optional at Region discretion based on maintaining a system-wide or corridor segment continuity. Outlying areas are defined as areas with significant traffic volumes approaching 2000 vehicles per hour per lane.
3. **Rural areas:** 5/10 or 2/10 mile enhanced reference location signs are optional based on need. Examples of need are:
   a. High traffic volumes that exceed 40,000 ADT
   b. Incidents that are significantly reducing traffic flow a significant percentage of time similar to urban areas
   c. Continuity of a system such as I-94 in Madison transition into I-90/94 (rural to urban)
   d. High number of crashes above the statewide average.

   If used in rural areas, 2/10 mile enhanced reference location sign spacing *should* be used in rural areas in high crash or high incident locations, areas with three or more travel lanes in each direction or areas with median barrier. All other rural locations should utilize 5/10 mile spacing.

ENHANCED REFERENCE LOCATION SIGN INSTALLATION

Install signs in the median. It has been found that median mounted signs on barrier wall require less maintenance than devices mounted on the right (outside shoulder). Where there are median light poles, install signs on light poles as much as possible or provide separate metal post. Existing mileposts **shall** be removed. Enhanced reference location signs will replace the even mile system and the milepost system is incorporated into the enhanced reference sign system.

For locations with two single-faced barriers, median mounting location for 1/10 mile spacing is every other light pole or other available structure.

For locations with one double-faced barrier (with lighting, the median mounting location for 1/10 mile spacing is every other light pole or other available structure.

For locations with one double faced barrier (without lighting), mount on top of barrier wall utilizing square tube steel post with steel plate.

When median width is 30’ or more, intermediate reference location signs in opposing directions **shall** be on separate posts.

SIGN LAYOUT

See sign plate D10-5 and D10-5A for configuration of sign, sign color and letter sizes.

2-6-55 Community “Historic Downtown” Signing — June 2014

GENERAL

Supplemental guide signs *may* be allowed to direct motorists to certain community historic districts, specifically a “Historic Downtown,” subject to the conditions described in this guideline.

DEFINITIONS

A <u>district</u> is a definable geographical area that can be distinguished from surrounding properties by changes such as density, scale, type, age, style of sites, buildings, structures, and objects, or by documented differences in patterns of historic development or associations.

A <u>district</u> also possesses a significant concentration, linkage, or continuity of sites, buildings, structures, or objects united historically or aesthetically by plan or physical development. A <u>district</u> is considered a business district.

ELIGIBILITY

Communities are eligible for freeway or expressway signs directing motorists to a historic downtown district when that district is entered in the National Register of Historic Places by the Secretary of the Interior and listed in the State Register of Historic Places by the Wisconsin State Historic Preservation Officer. Official documents must be provided to the department affirming the national and state designations. To be eligible for signs, the area (“Historic Downtown”) within the community must be designated on the National Register under the category of “district.” Only downtown historic business districts may qualify for “Historic Downtown” signing. Historic residential districts or avenues do not qualify for “Historic Downtown” signing.

In addition, to be eligible for signs under this guideline, the community must agree to comply with the criteria and requirements of this guideline, and accept responsibility for all costs associated with signing for the historic downtown under this guideline.

SIGN REQUIREMENTS, LOCATION, AND INSTALLATION

The following criteria must be met:

1. No “Historic Downtown” signing *may* be erected within any city having a population over 500,000.
2. The freeway or expressway on which the “Historic Downtown” signs are located must:
    a. Be within five miles of the nearest boundary of the community, or
    b. Pass within the corporate limits of the community.
3. Only one “Historic Downtown” sign *may* be installed in each direction of travel on a freeway or expressway and only a total of two signs will be permitted for any one “Historic Downtown,” regardless of the number of highway routes that service the community. The access location for each direction of travel along the freeway or expressway *may* be at a different interchange or intersection. Ramp directional signs *may* be required if the motorist is expected to make a decision on the ramps.
4. The community must install confirmation signing on the selected access route(s), mutually suitable to both the department and community, before the freeway or expressway mainline and ramp signing is installed.
5. The location(s) selected will remain fixed for ten years or the life of the signing before changes to the location(s) *may* be considered.
6. The community will be responsible for all costs incurred by the department, including installation and long-term maintenance of the signs, plus any confirmation signing required.
7. Freeway or expressway sign design and message will be determined by the department in accordance

with applicable standards and in the interests of uniformity. Signs **shall** be white text with brown background. Sign message **shall** read “Historic Downtown [Name of Community]”. Pictographs **shall not** be allowed on historic downtown signing.

8. The physical location of the freeway or expressway signing on the approaches to the interchange(s) or intersection(s) identified by the community as the access points to the “Historic Downtown” district will be determined by the department.
9. “Historic Downtown” signs with appropriate directional arrows will also be placed at the junction of the ramp and crossroad at the access interchange or intersection.
10. A combination of community downtown signs and “Historic Downtown” signs for the same community **shall not** be allowed.

“Historic Downtown” signing on a freeway or expressway mainline is considered supplemental signing. The approval and installation is subject to all provisions of the department’s TEOpS 2-15-3, Sign Categories and Policy for Directional Signing, in addition to the eligibility requirements as set forth herein.

2-6-60 Cellular 911 Signs — November 2016

PURPOSE

The intent of this guideline is to restrict the usage of signs that inform the public about contacting 911 for road emergencies to locations that are most helpful to motorists.

Signs with the message “WISCONSIN ROAD EMERGENCY – CELLULAR 911” (D12-4) have been installed on state highways in the past. These signs were installed in a partnership between Bureau of Traffic Operations and Bureau of Transportation Safety to educate motorists that they can dial 911 on their cell phones for road emergencies. Since these signs were installed, the usage of 911 has been adopted pretty much nationwide and motorists are now well aware that 911 is to be used for road emergencies. The official state highway map also encourages motorists to use 911 for road emergencies. Therefore, these signs are no longer considered necessary.

POLICY

Cellular 911 signs (D12-4 signs) are declared non-essential on state highways. As a result, the following actions are expected:

1. No new Cellular 911 signs **shall** be erected on state highways.
2. Cellular 911 signs that have been installed on state highways will be allowed to remain in place until the end of their useful life, when they are to be removed and not replaced. Useful life ends when the sign message no longer meets legibility or condition standards. Cellular 911 signs *may* be removed prior to the end of the signs useful life when opportunities arise such as knockdown or damage, when other work is occurring nearby, or projects make removal practical.

2-6-61 511 Travel Information Signs — January 2009

PURPOSE

The intent of this guideline is to specify the usage of signs that inform the public about 511 travel information.

The 511 travel information program assists motorists by providing critical information. This information *may* pertain to impending severe weather or to traffic delays resulting from events such as roadwork or incidents.

Signs placed in appropriate locations along roadways can assist motorists by providing a reminder that this service is available. In general, signs *should* be placed at freeway and expressway locations at the state line and freeway-to-freeway split locations. The signs *may* also show benefit to motorists in higher AADT freeway locations because of a high frequency of travel information messages for motorists.

POLICY

1. 511 Travel Info signs **shall** be installed on freeways and expressway s at the state border points. These signs **shall not** be installed on conventional highways.
2. In rural areas, 511 Travel Info signs **shall** be installed at freeway locations consisting of a freeway-freeway split. Such installations *should* be located at a sufficient distance upstream of critical decision

points to enable drivers to safely access traveler information through the 511 Travel Info telephone-based system. This upstream distance could be two to five miles, and *should* be selected in consideration of relevant freeway exit guide signing. Some example locations would be Interstates 90 and 94 at Tomah and Interstates 39, 90 and 94 at Portage.

3. In urban areas involving Class I, II, and III cities as defined by the Wisconsin Blue Book, 511 Travel Info signs *should* be installed on approach to primary points of freeway entry to the metropolitan area. Within the metropolitan area, additional 511 Travel Info signs *may* be installed subject to site-specific review and justification based upon demonstrated need of 511 Travel Info users. These site-specific installations *may* include locations upstream of major freeway-to-freeway splits, areas of egress from major trip generators, or approaches to major intermodal facilities such as airports or train stations.

Below is a listing of the Class I, II, and III cities as defined by the Wisconsin Blue Book:

Class I

Milwaukee

Class II

Appleton	Oshkosh
Eau Claire	Racine
Fond du Lac	Sheboygan
Green Bay	Waukesha
Janesville	Wausau
Kenosha	Wauwatosa
La Crosse	West Allis
Madison	

Class III

Baraboo	Menasha
Beaver Dam	Middleton
Beloit	Muskego
Brookfield	Neenah
Chippewa Falls	New Berlin
Cudahy	Oak Creek
De Pere	Oconomowoc
Fort Atkinson	Pewaukee
Franklin	River Falls
Glendale	Stevens Point
Greenfield	Sun Prairie
Hartford	Superior
Kaukauna	Two Rivers
Manitowoc	Watertown
Marinette	West Bend
Marshfield	Wisconsin Rapids

2-6-65 Rest Area Amenity Signs — March 2016

PURPOSE

The intent of this guideline is to establish standards for the use of signs that provide information about services available at freeway and expressway rest area facilities. This policy does not include guidance for wayside amenity signs. Guidance for wayside amenity signs can be found in TEOpS 2-4-65.

This guideline is intended to reduce the number of certain informational signs and messages in order to retain or improve the impact of other guidance and warning signs. This guideline also reflects the need to focus signing efforts and resources on the signs of highest value for safety and mobility.

In the past, rest area amenities such as telephones, historical markers, vending machines, and weather information have been signed for on the advance guide signs for rest areas. Over time, motorists have become accustomed to expecting these certain amenities at rest areas. However, there are still certain amenities that motorists still do not typically expect at rest areas and may not be included at all rest areas. By policy, WisDOT does not allow signing of designated Veteran's Memorial Highways on the highway right-of-way itself. Signing for Veteran's memorial highways are encouraged in off right-of-way locations, such as inside a rest area. Therefore, it makes sense to allow the Veterans Memorial Highway Marker sign (E10-56 sign) to remain on the advanced rest area guide sign.

The NEXT REST AREA XX MILES supplemental sign (E5-62 sign) has also been mounted below the advance guide sign to rest areas, where conditions permit. This sign can be very useful in informing motorists of the distance to the next rest area.

POLICY

The NEXT REST AREA XX MILES supplemental sign (E5-62 sign) should continue to be installed below the advance guide sign, when applicable.

Any rest areas containing Veterans Memorial Highway Markers shall have the Veterans Memorial Highway Marker (E10-56 sign) installed below the advance guide sign.

All other rest area amenity signs previously installed will be allowed to remain in place until the end of their useful life, and then they should be removed and not replaced. Useful life ends when the sign message no longer meets legibility or condition standards. These signs may be removed prior to the end of the signs useful life when opportunities arise such as knockdown or damage, when other work is occurring nearby, or projects that make removal practical.

2-10-1 Special Events (Detour Planning) July 2012

PURPOSE

This policy establishes the signing policy for special events located on the highway right-of-way that result in a closure of the roadway. The roadway closure would necessitate the detouring of traffic on to other roadways.

If a road closure or detour is not needed for an event, but short-term activities will be occurring on the highway with live traffic, then refer to TEOpS 2-10-2.

AUTHORITY AND APPROVAL PROCESS

Section 84.07(4) establishes the conditions under which a city or village *may* detour State Trunk Highway traffic: "Except in the case of emergency, no city, village or town **shall** obstruct any street over which any State Trunk Highway is marked, unless it first makes arrangements with the Department for marking a detour."

This provides the statutory basis for the issuance of detour permits. The arrangements with the department must be documented in a detour permit.

The Region Traffic Engineer or designee has the authority to make decisions with regard to requests for permits to temporarily close or obstruct a street carrying the marked route of a state highway, or to detour the marked route of a state highway. Those decisions are subject to the conditions established in this policy. Permits **shall** be issued only to a municipality upon formal request from its governing body and **shall not** be issued to individuals or non-governmental organizations. All closures and restrictions require approval by the Regional Traffic Engineer (RTE) via the Lane Closure Planning System.

This policy **shall** also apply to connecting state highways, as it is critical for WisDOT to review these requests for coordination with the Lane Closure System, 511, OSOW, etc.

POLICY

Applications for permits and the approval thereof **shall** be made in writing on the standard form provided for the purpose (DT1479) with such attachments as are necessary, such as a map. When a permit application is denied, the denial *should* be in writing with a letter of explanation to the applicant.

In all instances, the region must be satisfied that traffic on the state highway rout will not be unduly inconvenienced and that an adequate detour will be provided.

The municipality **shall** agree to accept the terms and conditions of the permit as specified by the department. Refer to Figure 1 for the Permit Application by Municipality for Permission to Detour State Trunk Highway Traffic (form DT1479).

The region *may* impose additional reasonable requirements or restrictions to the permit as are necessary for the particular circumstances of that permit.

Requests to temporarily close a road for special events *may* be considered subject to the considerations listed. These types of special events include parades, celebrations, street fairs, races, movie or television production, and other activities officially supported by the municipality.

1. Closures **shall not** be allowed during peak traffic periods, as determined by the regional traffic section.
2. The duration of road closure *should not* exceed four hours. When a closure is necessary for an event, the duration *should* be determined based on when the last event participant has cleared the roadway.
3. A plan for traffic control and detour, and documentation of the means to implement it, *should* be submitted to the WisDOT region traffic engineer for review at least 90 calendar days in advance of the event.
4. A detour **shall** be required. Motorists **shall** be guided through the detour by signs and/or law enforcement personnel.
5. A detour permit application (form DT1479) **shall** be completed.
6. All traffic control and detour signs **shall** be in conformance with the standards established in the

MUTCD.

7. The requestor **shall** notify appropriate media, emergency services, and affected schools five (5) days prior to the detour.

8. The WisDOT region traffic engineer *should* notify the region communications manager of the special event once the DT1479 forma has been completed and signed.

9. All road closures and detours **shall** be coordinated with the State Patrol and/or the local law enforcement agency. The coordination **shall** be documented by the requestor.

10. The requestor **shall** be responsible for providing adequate traffic control for the duration of the event and effective coordination with law enforcement.

11. The requestor **shall** be responsible for all costs associated with providing the traffic control, law enforcement, and coordination of other services to accomplish the closure consistent with the permit requirements.

Figure 1

APPLICATION BY MUNICIPALITY FOR PERMISSION TO DETOUR STATE TRUNK HIGHWAY TRAFFIC
DT1479 6/2007 (Replaces ET604) s.84.07(4) Wis. Stats.

Wisconsin Department of Transportation

TO: REGIONAL TRAFFIC SECTION

Municipality	County
Area Code – Telephone Number	E-Mail Address
Name of Street(s) to be Closed ☐ STH ☐ USH	Streets Closed Between (Street Name) FROM: TO:
PROPOSED TEMPORARY ROUTE	
☐ MAP ATTACHED	Date and Duration of Detour Date: Time: a.m. to a.m.
Reason	
Name and Address to Whom Permit will be Returned	

The above municipality requests permission to close the marked route as described, during which time the municipality will provide temporary route as designated.

The municipality agrees to accept the following terms and conditions:

1. The municipality shall provide a detour having structural, geometric and traffic control characteristics, which are acceptable to the Region. A detour map which provides street names shall be submitted.

2. The municipality shall furnish, erect and remove signs and markers at the sole expense of the municipality, unless provided for in (3), or unless directed by officers for short routes and short timeframe (less than 3 days).

3. A Detour and Traffic Control Plan shall be submitted to the Region for approval. An example is Standard Detail Drawing 15C2-4C.

4. The municipality shall agree to minimize, as much as practicable, the duration of closure, including providing for assembly and dispersal of parades in areas removed from the state highway route.

5. The municipality shall accept full responsibility for any damage to local roads and streets resulting from closure and detour.

6. The requester shall arrange for adequate traffic control from either WisDOT or the appropriate county, and provide documentation of enforcement coordination.

7. The requester shall notify all media, emergency services and schools, five (5) days prior to the detour.

8. Additional conditions: . Attachments: ☐ Yes ☐ No

(Authorized Official Signature) (Title) (Date)

Permission is granted to temporarily close the designated segment of state trunk highway and to provide a detour, subject to the stated conditions.

(Permit Number) (Approved By) (Date)

2-10-2 Special Events (Roadway Open to Traffic) August 2013

PURPOSE

This policy establishes the signing policy criteria for special events that take place on the highway right-of-way. These are special events that can be conducted with the road open to traffic under certain conditions.

Road closures and detours for special events shall be governed by the guidance in TEOpS 13-10-1 and WisDOT permit form DT1479. Signing for special events off of the state highway system shall be governed by the guidance in TEOpS 2-10-3.

The department receives frequent requests to use the highway right-of-way for various activities. These activities are typically short-term, readily definable activities that fall in two categories:

1. Roadway or roadside modifications, repairs, or maintenance operations by a local unit of government, or permitted railroad or utility work
2. Certain types of special events, such as marathons, bicycle races, charity walks/runs, filming, etc.

Roadway or roadside operators, including utility work, are regulated under Chapters 90 and 96 of the Maintenance Manual and WisDOT permit form DT1812.

The basis for allowing the use of the highway for these special events is Wisconsin State Statute 349.185, which allows governments in charge of maintaining the highway the authority to regulate community events or celebrations, processions or assemblages on the highways. The word “assemblage” is interpreted to mean that the Department *may* consider activities such as street fairs, bike racing and marathons as legitimate reasons for traffic restrictions, up to and including closing the street and arranging for a detour if the municipality so chooses.

In general, use of the state highway right-of-way for special events will not be allowed unless a legitimate public interest (supported by the Local Government) is served and the activity does not cause safety or capacity problems. Requests for closing and detouring the highway **shall** come from the municipal government. Special event requests that only require temporary traffic restrictions *may* come from the municipality, individuals, private enterprises or a neighborhood community. In the case where the requestor is that other than a municipality, the requestor shall provide a letter from the affected municipalities as proof that the event is fully coordinated with them. Authorization for usage of the highway right-of-way for special events *may* be granted by the WisDOT Region office in the form of a permit, provided all pertinent criteria covered in these guidelines are satisfied. All closures and restrictions on Corridors 2030 roadways require approval by the Regional Traffic Engineer (RTE) via the Lane Closure Planning System.

DEFINITIONS

Freeways are defined as divided arterial highway facilities that have fully controlled access at interchanges only. Interstate Highways are freeways with the interstate route designation.

Expressways are defined as divided arterial highway facilities with partially controlled access by a combination of interchanges, at-grade intersections, and driveways.

Conventional Highways are defined as streets or roads other than freeways, expressways, or low-volume roads. They *may* be divided or undivided, two-lane or multi-lane, and access is available at intersections and driveways.

GENERAL POLICY CRITERIA

1. This policy applies for special events on the state highway right-of-way that are running concurrent with traffic (no road closure or detour). This policy **shall** also apply to Connecting State Highways as it is critical for WisDOT to review these requests for coordination with the Lane Closure System, 511, OSOW, etc. Special events on the highway right-of-way **shall not** be allowed on freeways, expressways or any roadway with a posted speed above 55 mph.
2. FHWA concurrence is required when the special event is on the Interstate Highway system.
3. The permit **shall** identify that the special event requestor agrees to assume the entire responsibility and liability for all damages or injury to all persons, whether employees or otherwise and to all property, arising out of, resulting from or in any manner connected with the operation of the special event. The requestor **shall** provide proof of General Liability Insurance Coverage and **shall** agree to defend and indemnify WisDOT, its agents and employees from all such claims including, without limiting the

generality of the foregoing, claims for which WisDOT *may* be paid or incurred to enforce the provisions of this paragraph, and the requestor **shall** further agree and pay for such general liability coverage which protects the state as an additional named insured.

4. The requestor *should* submit the permit application to the WisDOT Region Traffic Section at least 90 calendar days in advance of the event.
5. The requestor **shall** be responsible for any damage done to the highway property as a result of the special event.
6. The special event minimum attendance is typically 100 participants. This attendance number includes anticipated spectators.
7. A special event **shall not** occur more than once annually by the same sponsor in the same section of roadway. Special events **shall not** occur more than four times a year in the same section of roadway.
8. WisDOT is responsible for determining whether the event qualifies for special event signs, providing guidance on acceptable signs and placement, reviewing the permit application, and assuring compliance with the permit.
9. The Region Traffic Section will evaluate the safety of any nighttime special event requests.

DETAILED POLICY CRITERIA

1. Special Events **shall not** be allowed during peak traffic periods, as determined by the WisDOT Region Traffic Engineer.
2. The time duration of the Special Event *should not* exceed four hours or when the last event participant has cleared the roadway.
3. The use of the right-of-way **shall not** interfere with motorists' safe operation of their vehicles.
4. The use of the right-of-way **shall not** obstruct sight distance and **shall not** detract from motorists' view of traffic control devices.
5. A plan for traffic control and documentation of the means to implement it *should* be submitted to the WisDOT Region Traffic Engineer for review and approval at least 90 calendar days in advance of the event.
6. All traffic control signs **shall** be in conformance with the MUTCD.
7. Advance notices to the media **shall** be coordinated by the Requestor.
8. All special events **shall** be coordinated with the State Patrol and/or the local law enforcement agency as appropriate, by the requestor. Documentation of this coordination is required.
9. The WisDOT Region Traffic Engineer *should* notify the Region Communications Manager of the Special Event once the attached application form has been completed and signed.
10. Parking **shall not** be allowed on the state highway right-of-way, which includes the shoulders.
11. If the event will take place on highways maintained by other governmental agencies, the Requestor **shall** coordinate the event and provide proof by letter to the WisDOT Region Traffic Engineer that the necessary coordination has taken place with the other governmental agencies.
12. The usage of police powers for special events **shall not** substitute for appropriate signing.

SIGNING LIMITATIONS

The criteria below apply for signing on the specific roadway where the event is held. Advanced directional signing for special events is covered under TEOpS 2-10-3.

1. No commercial advertising is allowed on the signs. The inclusion of a brand name within the name of an event, such as "Brand X Racing Event" is permissible. The sign message *may* include the word "Event" or "Parking". Event names on signs *should* be as clear and concise as possible. Pictographs **shall not** be allowed on the signs, per interpretation of the MUTCD and guidance from FHWA.
2. The signing layout detail and installation locations **shall** be approved by the Regional Traffic Section and Bureau of Highway Operations.
3. Guidance signs with red, orange, yellow, or fluorescent yellow-green background **shall not** be used. Temporary work zone warning signs **shall** be fluorescent orange. Sign base material **shall** consist of

plywood or sheet aluminum. If banners are used, they must meet the requirements of the TEOpS policy on banners (TEOpS 13-12-1). Posts **shall** be of an approved type for highway signs per WISDOT standards. Signs **shall** be manufactured by a fabricator who has been in the traffic signing business for a minimum of three years.

4. Letter size, font, and spacing **shall** meet MUTCD guidelines. Minimum of 6" upper case letters and 4 ½" lower case letters **shall** be used.
5. If the event takes place at night, the signs **shall** be high intensity, retroreflective.
6. Changeable message signs *may* be used, subject to WisDOT policy requirements for use of changeable message signs. The Regional Traffic Section **shall** approve the message content, letter height, and sign location as specified in TEOpS 17-2-1. Larger letter heights are needed on changeable message signs for readability. Refer to the TEOpS 17-2-1 for additional provisions regarding PCMS usage.
7. Pre-event signing *may* be required up to 10 days in advance of the special event. The signing layout and installation details for pre-event signing **shall** be approved by the Regional Traffic Section and the Bureau of Traffic Operations.

IMPLEMENTATION COST

1. The event organization or requesting group **shall** pay for all costs associated with the special event signing, including costs to obtain the permit, which *may* include WisDOT review costs; any costs to acquire, install, and remove the special event signs, including changeable message signs; and any additional costs incurred by the department. The event organizer will be responsible for obtaining signs that conform to department standards and arranging to have those signs placed, operated, and removed consistent with the terms of the permit. All work on the highway right-of-way must be performed by a contractor or local government agency approved by WisDOT.
2. Installation by county forces *may* be an option in some situations. When that occurs, all costs are charged back to the requesting organization.

APPLICATION TO USE HIGHWAY RIGHT-OF-WAY FOR A SPECIAL EVENT

	Permit No.
Event Name/Type	Event date:
Event Director or Organizer	Telephone Number
Mailing Address	
Email Address	Estimated number of participants

I (We), ____

hereby make application for a special event on the State Highway __________ right-of-way

between ____________am/pm and ______________am/pm on _________________(date).

I (We) agree to strictly conform to the exhibits attached hereto, subject to all terms, conditions, agreements, stipulations and provisions contained in the application and permit, and the guidelines, rules and regulations, as set forth by the Wisconsin Department of Transportation and any other applicable regulations, laws or ordinances.

Event Description: (attach map and traffic control plan)

____

____

____

____

____

____

____

____

____

____

____

____

Prior to the event, I (we) agree to review the course to determine potential problems that could endanger participants or equipment and to notify the participants of them. If I (we) determine the problems to be severe, I (we) agree to cancel the event. I (we) have coordinated the Special Event with all affected governmental agencies.

Permittee must provide a certificate of insurance as evidence of an existing Comprehensive or Commercial General Liability Policy, including contractual liability coverage, with limits not less than $500,000 combined single limit for all claims arising out of a single accident or occurrence, and naming the State of Wisconsin, Wisconsin Department of Transportation as additional insured.

PERMITTEE SHALL DEFEND, HOLD HARMLESS AND INDEMNIFY THE STATE OF WISCONSIN, DEPARTMENT OF TRANSPORTATION, AND IT'S OFFICERS, AGENTS, EMPLOYEES, AND MEMBERS FOR ALL SUITS OR ACTIONS THAT MAY RESULT FROM ANY ACTIVITY BY THE PERMITTEE, IT'S OFFICERS, SUBCONTRACTORS, AGENTS OR EMPLOYEES.

____
Name (Please Print)

____
Signature

____
Date (minimum of 90 days prior to event)

☐ **APPROVED** ☐ **DENIED**

____
Regional Traffic Engineer or designee signature

____
DATE

☐ **APPROVED** ☐ **DENIED**

____
Regional Maintenance Engineer or designee signature

____
DATE

Attachment- Copy of letter from municipality (if applicable)

2-10-3 Special Events (Advance Directional Signing) December 2011

PURPOSE

The purpose of this guideline is to establish criteria on the usage of advanced directional signs for significant traffic generator events that are open to the public and temporary in duration. Consistent and well-planned usage of special event signing allows for safe and efficient flow of traffic at significant traffic generator events. These temporary traffic generator events would be for a facility, activity, or special point of interest that attracts large numbers of people, a majority of whom are unfamiliar with the local area and/or access routes.

DEFINITIONS

<u>Freeways</u> are defined as divided arterial highway facilities that have full controlled access, by means of grade separation at interchanges only.

<u>Expressways</u> are defined as divided arterial highway facilities that have partial control of access and generally with grade separations at major intersections.

<u>Conventional Highways</u> are defined as divided or undivided roadway facilities that have no control of access with grade separations at intersections. These highways *may* be two lane or multilane facilities.

POLICY

Qualifying Criteria

1. The event **shall** be open to the public. No commercial advertising is allowed on the signs. The inclusion of a brand name within the name of an event, such as "Brand X Racing Event," is permissible. The sign message *may* include the word "Event" or "Parking." Event names on signs *should* be as clear and concise as possible. Pictographs **shall not** be allowed on the signs, per interpretation of the MUTCD and guidance from FHWA.
2. For conventional highways, the minimum length of the event **shall** be one day and the maximum length of the event **shall** be two weeks.
3. For freeways and expressways, the minimum length of the event **shall** be three days and the maximum length of the event **shall** be two weeks.
4. The minimum special event attendance **shall** be 10,000 people per day. When the event involves more than one location, each signed location **shall** meet the minimum attendance of 10,000 per day.
5. The special event **shall** occur no more than once annually by the same sponsor in the same location.
6. When a facility has or qualifies for signing under the current policies for supplemental traffic generator signing (TEOpS 2-15-3), a special event sign cannot be installed for an event at that facility, unless a genuine traffic need can be demonstrated. For this situation, a changeable message sign **shall** be used to direct traffic appropriately if approved by the regional traffic section and Bureau of Traffic Operations Staff.
7. WisDOT is responsible for determining whether the event qualifies for special event signs, providing guidance on acceptable signs and placement, reviewing the permit application, and assuring conformance with the permit.

Signing Limitations

1. Trailblazing signs **shall** be installed before any mainline signs are installed.
2. Signing from freeways, expressways, and conventional STHs is allowed. No conventional STH to conventional STH trailblazing will be allowed.
3. The maximum distance of the event from the highway or nearest exit **shall** be five miles.
4. For a specific event, signing on freeways or expressways from two locations (maximum of 8 signs) will be allowed. One advance sign such as NEXT RIGHT and one exit sign at the exit taper *should* be used.
5. The signing layout detail and installation locations **shall** be approved by the regional traffic section and Bureau of Traffic Operations.
6. Signs with red, orange, yellow, or fluorescent yellow-green background **shall not** be used. Sign base material **shall** consist of plywood or sheet aluminum. Flexible banners are not allowed. Posts **shall** be of an approved type for highway signs per WisDOT standards. Signs **shall** be manufactured by a fabricator who has been in the traffic signing business for a minimum of three years.
7. Letter size, font, and spacing **shall** meet MUTCD guidelines. Minimum of 8" letters on freeways/expressways and minimum of 6" letters on conventional highways **shall** be used.

Implementation/Cost

1. Changeable message signs *may* be used, subject to WisDOT policy requirements for use of dynamic message signs. The Regional Traffic Section **shall** approve the message content, letter height, and sign location. Larger letter heights are needed on changeable message signs for readability.
2. The event organization or requesting group **shall** pay for all costs associated with the special event signing, including costs to obtain the permit, which *may* include WisDOT review costs; any costs to acquire, install, and remove the special event signs, including the changeable message signs; and any additional costs incurred by the department. The event organizer will be responsible for obtaining signs that conform to department standards and arranging to have those signs placed, operated, and removed consistent with the terms of the permit. All work on the highway right-of-way must be performed by a contractor or local government agency approved by WisDOT.
3. The requestor **shall** contact the county highway department or WisDOT-approved signing contractor for installation and removal of the signs.

APPLICATION FOR PERMIT TO INSTALL TEMPORARY SIGNING ON HIGHWAY RIGHT-OF-WAY DURING SPECIAL EVENT

APPLICANT:	
ADDRESS OF BUSINESS/ACTIVITY:	
PHONE:	
TYPE OF BUSINESS/ACTIVITY:	
PROPOSED SIGN LOCATION(S): (number and placement to be coordinated with Regional Traffic Engineer)	
On what highway?	At or approaching intersection with what highway?
1) On:	At:
2) On:	At:
3) On:	At:
4) On:	At:
5) On:	At:
6) On:	At:
7) On:	At:
8) On:	At:
Remarks:	
Two drawings MUST be attached: - One must show the proposed sign design(s) and dimensions - One must show the proposed sign location(s)	

I apply for permission to install and maintain temporary special event signs at the locations listed and in conformance with the guidelines attached to this application. I agree to comply with these guidelines and will remove all signs upon completion of the event, or when directed by the Regional Traffic Engineer.

I understand that signs *may* be removed without notice if they do not comply with the attached guidelines, do not match the attached drawings, or do not comply with any additional conditions stated on or attached to the permit. The Requestor **shall** contact the County Highway Department or WisDOT approved signing contractor for installation and removal of the signs.

Approved by: ______________________________ ______________________________

Regional Traffic Engineer   Applicant Signature

2-15-1.1 AASHTO Guide for Supplemental Signs — February 2021

GUIDELINES

Following is a copy of the 2001 AASHTO Guidelines for the Selection of Supplemental Guide Signs for Traffic Generators Adjacent to Freeways. These are the AASHTO Guidelines that are incorporated by reference in Section 2E.35 of the MUTCD. This section of the MUTCD also recommends that states *should* adopt an appropriate policy for installing supplemental signs using the AASHTO Guidelines for the Selection of Supplemental Guide Signs for Traffic Generators Adjacent to Freeways.

The department has adopted policy pursuant to Section 2E.35 which is found in TEOpS 2-15-3. Both the AASHTO Guidelines for the Selection of Supplemental Guide Signs for Traffic Generators Adjacent to Freeways" as incorporated in the MUTCD and the department policy found in TEOpS 2-15-3 apply.

PART I
Guidelines for the Selection of Supplemental Guide Signs for Traffic Generators Adjacent to Freeways

PART II
Guidelines for Airport Guide Signing

PART III
List of Control Cities for Use in Guide Signs on Interstate Highways

2001

© Copyright, 2001, by the American Association of State Highway and Transportation Officials. *All Rights Reserved.* Printed in the United States of America. This book, or parts thereof, may not be reproduced in any form without written permission of the publisher.

ISBN 1-56051-154-0

Published by the
American Association of State
Highway and Transportation Officials
444 North Capitol Street, N.W., Suite 249
Washington, D.C. 20001

PART I

Guidelines for the Selection of Supplemental Guide Signs for Traffic Generators Adjacent to Freeways

The *Manual on Uniform Traffic Control Devices for Streets and Highways* (MUTCD) is the national standard for installing traffic control devices on all roads open to public travel. The MUTCD contains the standards for signing freeways and expressways for motorists who are unfamiliar with an area, but who are traveling between and through the Nation's principal traffic generating centers.

The selection of information to be presented at an interchange is critical to the safe and efficient use of the highway system. The MUTCD provides mandatory requirements for installing many freeway signs, but leaves other signing discretion to the States. One of these discretions is the selection of destinations to be used on major guide signs and supplemental guide signs. Numerous facilities that warrant inclusion on supplemental guide signs, and the addition of new facilities, have posed signing problems in many states.

The guidelines contained herein were developed to assist the States in selecting the most appropriate generators for display on freeway supplemental guide signs. These guidelines provide a basis for development of individual State policies which should consider local needs, customs, and legal requirements.

The MUTCD provides several restrictions on the use of supplemental guide signs on freeways. Those portions of the MUTCD are repeated below.

Sec. 1A-3.1 "Traffic control devices shall be placed only by the authority of a public body or official jurisdiction, for the purpose of regulating, warning, or guiding traffic. No traffic control device or its support shall bear any advertising or commercial message, or any other message that is not essential to traffic control... All unofficial and non-essential signs should be removed."

Sec. 2F-20 "...the major signs at freeway interchanges and on their approaches are advance guide signs and exit direction signs. It is essential that the same destination messages be displayed on these signs. New destination information should not be introduced into the major sign sequence for one interchange, nor should information be dropped... Supplemental guide signing should be used sparingly, as provided in Section 2E-28."

Sec. 2E-28 "Information regarding destinations accessible from an interchange, other than places shown on the standard interchange signing, may be shown on a supplemental guide sign. Such a sign may list one or two destinations followed by the interchange number (and suffix) or if interchanges are not numbered, by the legend 'NEXT RIGHT' or 'SECOND RIGHT' or both, as appropriate. The supplemental guide sign installation should be erected approximately midway between the two major advance guide signs. If only one advance guide sign is used, the supplemental guide sign should follow by at least 800 feet.

Supplemental signing can reduce the effectiveness of the other important guide signing because of the possibility of overloading the vehicle operator's capacity to receive and make decisions on visual messages. The AASHTO *Guidelines for the Selection of Supplemental Guide Signs for Traffic Generators Adjacent to Freeways* is incorporated in this section as a guide. States may develop an appropriate policy for such signing. Such items as population, traffic generated, and distance should be taken into account.

Only one supplemental guide sign may be used on each interchange approach. If used, it is normally installed as an independent guide assembly. Guide signs directing motorists to park-and-ride facilities shall be considered as supplemental signs..."

Sec. 2F-34 "Scenic area signing should be consistent with that specified for rest areas. Standard messages should read 'SCENIC AREA' or 'SCENIC VIEW' or the equivalent."

Sec. 2H-16 "Supplemental guide signs with a white legend and border on a brown background may be used on an expressway or freeway when a park or recreational or cultural interest area is signed as a significant destination for users of these roads. The same color combination may be used for the advance guide sign and the exit direction sign for an interchange where the crossroad leads exclusively to a park, or to a recreational or cultural interest area.

Where the crossroads of an expressway or freeway leads to a destination other than a park or a recreational or cultural interest area, the advance guide sign and the exit direction sign shall retain the white on green color combination.

All gore signs shall have a white legend on a green background, regardless of the above conditions. The background color of the interchange exit number panel shall match the background color of the guide sign proper."

Secs. 2F-41, 2E-42, 2D-49 (paraphrased) If they do not interfere with signing for interchanges or, other equally critical points, miscellaneous guide signs, or various types may be used to show state, county, and other significant local jurisdictional boundaries. Signs of this character should not be installed unless there are specific reasons for orienting the users of the freeway or identifying control points for activities that are clearly in the public interest.

Sec. 2F-40 "The commonly used name or trailblazer symbol for a toll facility may be displayed on free sections of the Interstate System at

1. the last exit before entering a toll section of the Interstate System;

2. the interchange or connection with a toll facility, whether or not the toll facility is a part of the Interstate System; and

3. other locations within a reasonable approach distance of toll facilities when the name or trailblazer symbol for the toll facility would provide better guidance to drivers unfamiliar with the area than would place names and route numbers.

The toll facility name or marker may be included as a part of the guide sign installations on intersecting highways and approach roads to indicate the interchange with a toll section of an Interstate highway. Where needed for the proper direction of traffic, a trailblazer for a toll facility that is part of the Interstate System may be displayed with the Interstate trailblazer assembly."

General Criteria and Limitations

General signing criteria and limitations should be established by the States. Generators which have the greatest traffic should be shown on supplemental guide signs. This does not mean that all facilities that meet the criteria should automatically receive informational signing. Signing for traffic generators is considered supplemental to the overall signing system for freeways. Therefore, before a sign for a traffic generator is installed, sufficient space should exist to accommodate the placement of the sign without interfering or conflicting with required signing. Normally, supplemental guide signs for traffic generators should not be installed at freeway-to-freeway interchanges.

Not more than one supplemental guide sign for a traffic generator should be provided in each direction along any freeway. Signs for these facilities shall be located in advance of the interchanging road that provides the most direct route to the facility.

Information relating to a traffic generator should be displayed at the freeway exit nearest to the facility. Consideration may be given to displaying the information at a second freeway when the prime criterion is exceeded by at least 50 percent and the traffic generator is within two-thirds of the specified distance for the nearest freeway and within the specified distance for the farthest freeway. Supplemental guide signs should not be erected for a traffic generator that would require a motorist to travel on the interchanging road beyond a second freeway.

Signing for a seasonal generator may be displayed when warranted. Such signing shall be removed at the end of the season, or a changeable message type installation may be used.

Two traffic generators may be displayed on a single, permanent, or seasonal guide sign. When more than two traffic generators meet the signing criteria, generators having the greatest need for signing should be shown. Permanent supplemental guide sign and seasonal supplemental guide sign information for traffic generators may be installed on the same supports.

Signing for a traffic generator should not be displayed on a supplemental guide sign until signing has been installed at the ramp terminals and along the interchanging road and other roads as necessary to direct the motorist from the freeway to the traffic generator.

Specific Criteria

Certain types of generators appear through attendance or special activities to warrant signing with minimal traffic volume criteria. While it is recommended that criteria be established, signs may, at the option of the States, be erected for the following types of generators, without establishing a traffic volume warrant.

1. Major airports
2. Major military installations
3. Major colleges and universities
4. Federal and State parks
5. Major recreational areas
6. Other incorporated cities

Other generators that may qualify for signing on the conventional highway system are not normally of interest to the freeway user. Except under unusual circumstances, supplemental signing should not be considered for the generators shown in Table I. This table is not all-inclusive, but provides an indication of the type of facilities not normally warranting signs.

Table II provides guidelines to establish criteria for selection of destinations to be shown on supplemental guide signs. In view of the broad range of population densities throughout the Nation, numerical values may be altered as required by local conditions. A typical selection of generators was included in this table and geographical conditions, legal requirements, or administrative policy may require certain deletions or expansion of the table in individual states.

TABLE I
Traffic Generators That Do Not Normally Warrant Signing

Businesses
TV/Radio Stations
Theaters
Motels/Hotels/Inns*
Trailer Parks*
Industrial Parks and Plants
Shopping Centers

Cemeteries
Local or State
Private/Public
Military

Communities
Civil Centers Military
Libraries
Churches
Subdivisions

Governmental
Research/Experimental
County and City Facilities
Courthouses
Driver's License Centers
Highway Buildings
Jails/Prisons
Civil Defense Facilities
Maintenance Facilities
Power Plants

Historical
Homes and Buildings
Privately Owned Facilities

Medical
Mental Facilities
Research Facilities
Sanitariums
Infirmaries or Treatment Centers
Veterans Facilities
County, Fraternal, or Nursing Homes
Retirement Facilities
Humane Facilities
Emergency Medical Services*

Military
Sites or Detachments
Armories
Arsenals

Recreational/Conservational
Country Clubs and Golf Courses
Fish Hatcheries, Game Farms, Preserves, and Refuges
Tree Nurseries/Arboretums
Points of Interest
Camps: Scout, Church, 4 H, Youth, and YMCA/YWCA

Schools
Grade/High
Vocational/Trade
Seminaries
Private

*Items may be included on Motorist Service signs (GAS-FOOD-LODGING-HOSPITAL-CAMPING)

TABLE II

Guideline Criteria for Signing Traffic Generators

These numerical values are provided as guides and may be modified by each state as required by local conditions, laws, and customs.

Type of Generator	Specific Criteria	Major Metro Area[1]	Urban Area[2]	Rural Area
College or University	Total Enrollment Full & Part Time Students or	4,000	2,500	1,500
	No. of Trips[3] Generated Annually	900,000[3a] 1,200,000[3b]	550,000 750,000	300,000 450,000
	Distance from Interchange (mi)[4]	3	4	5
Military Bases	No. of Employees & Permanently Assigned Military Personnel or	5,000	4,000	3,000,000
	No. of Trips[3] Generated Annually	5,000,000[3c]	4,000,000	3,000,000
	Distance from Interchange (mi)[4]	5	7.5	10
Arenas Auditoriums Convention Halls	Annual Attendance	300,000	250,000	200,000
Stadiums	No. of Seats (If Applicable)	6,000	5,000	4,000

TABLE II (continued)

Type of Generator	Specific Criteria	Major Metro Area[1]	Urban Area[2]	Rural Area
State & National Parks Monuments Major Recreational Areas (Fairgrounds, Amusement Parks, Zoos, Etc.)	Distance from Interchange	5	5	5

[1] 50,000 or more population in Urban Area.

[2] 5,000-49,999 population in Urban Area.

[3] Trip: A single or one-direction vehicle movement to the generator. The following trip generation rates are suggested:

- [3a] College or University without dorms, each student=1.5 trips
- [3b] College or University with dorms, each student=2 trips
- [3c] One employee or military personnel=0.9 trips

[4] The distance may be increased 1/2 mile for each 10 percent over the minimum requirement listed to a maximum of two times the minimum distance listed.

Note: When the traffic generator is not located on the crossroad, written confirmation is required from the local government agency that they will install and maintain trailblazing signing for the logical direction of traffic to the facility.

2-15-3 AASHTO Guide for Supplemental Signs — April 2017

DIRECTIONAL AND INFORMATIONAL SIGN REQUESTS

The following is a table intended to provide preliminary information on the eligibility of specific sign requests for installation on the state trunk highway system, including freeways and expressways. It **shall** be used in combination with the rest of this subject, which gives more specific qualifying criteria.

Abbreviations:

Supplemental C: The category for traffic generator supplemental signing on conventional highways

Supplemental F: the category for traffic generator supplemental signing on freeways

SS (numbers): A reference to a numbered subsection of the state statutes

TEOpS (numbers): A reference to another subject in the Traffic Engineering, Operations and Safety Manual

Trans 200.nn: A reference to a subsection in Chapter Trans 200 of the Wisconsin Administrative Code

DESTINATIONS or INFORMATION	CATEGORIES	AUTHORIZATION	REMARKS
Agricultural Experiment	Guidance Signs	Trans 200.03	also TEOpS 2-15-60
Agricultural Farms	Not Permitted		
Air Traffic Control	Not Permitted		
Airport – Major	Govt. Transportation		
Airport – Public General Aviation	Govt. Transportation		
Amtrak Station	Govt. Transportation		
Amusement Parks	Supplemental C, SIS,	SS 86.195	Qualifying Criteria

	Guidance Signs	Trans 200.03	also TEOpS 2-15-60
Animal Hospitals, Emergency	Not Permitted		
Animal Ranches	Not Permitted		
Animal Shelters	Guidance Signs	Trans 200.03	
Arboretums	Supplemental C		Qualifying Criteria
Arenas, multi-purpose	Supplemental F & C		Qualifying Criteria
Armories, Reserve Ctrs	Supplemental C		Qualifying Criteria
Arrow Boards	Guidance Signs	Trans 200.03	aka Guidance signs
Athletic Fields and/or Facilities	Community wayfinder Guidance Signs	TEOpS 2-15-60Trans 200.03	
Attractions	SIS	SS 86.195	
Auditoriums	Supplemental F & C		Qualifying Criteria
Auto Repair	Not permitted		
Aviation Flight School	Guidance Signs	Trans 200.03	also TEOpS 2-15-60
Banners	Information	TEOpS 13-12-1	
Boat Landings	Inter-agency		Conventional Hwy only
Botanical Gardens	Supplemental C		Same as Arboretums
Braking, Engine (Jake)	Special	TEOpS 2-2-30	
Bus Terminals	Not Permitted		
Business District	Special Community wayfinder	TEOpS 2-6-50 TEOpS 2-15-6	Alternative to “Downtown”
Cabins, Cottages, Non-rental	Not Permitted		
Cabins, Cottages, Rental	Guidance Signs	Trans 200.03	also TEOpS 2-15-60
Camping, including Logo	SIS, TODS, Guidance Signs		Category depends upon highway type
Campgrounds (public)	Inter-agency		
Camps, Private	Guidance Signs	Trans 200.03	also TEOpS 2-15-60
Canoe, Kayak, Tubing Facilities	TODS	SS 86.196	
Casinos	Supplemental F & C		Qualifying Criteria
Cemeteries	Not permitted		See Veterans Cemeteries
Churches	Guidance Signs	Trans 200.03	also TEOpS 2-15-60
City Hall	Community wayfinder	TEOpS 2-15-6	
City Parks	Community wayfinder	TEOpS 2-15-6	
Civic Centers	Community wayfinder	TEOpS 2-15-6	
Clinics	Not Permitted		
Colleges	Supplemental F & C		Qualifying Criteria
Community Destination Signs	Community wayfinder	TEOpS 2-15-6	aka “Wayfinder” signs
Community Welcome Signs	Special/Not Permitted	TEOpS 2-1-41	
Conservation Center	Inter-agency		Conventional Hwy only
Convention Centers	Supplemental F & C Community wayfinder Guidance Signs	 TEOpS 2-15-6 Trans 200.03	Qualifying Criteria Also TEOpS 2-15-60
Correctional Institutions	Inter-agency		Conventional Hwy only
Country Clubs	Guidance Signs	Trans 200.03	also TEOpS 2-15-60
County Fairgrounds	Inter-agency		
County Institutions (Healthcare Facilities)	Inter-agency, Guidance Signs	 Trans 200.03	 also TEOpS 2-15-60
County Parks	Inter-agency		
Courthouses	Community wayfinder	TEOpS 2-15-6	
Crime Stoppers	Special/Not Permitted		
Cruises, Boat	Guidance Signs	Trans 200.03	also TEOpS 2-15-60
Dance Halls	Not Permitted		
D.A.R.E.	Special/Not Permitted		
DMV Service Center	State Govt. Service Centers/Intra-agency		Conventional Hwy only
DNR Service Center	State Govt. Service Centers		Conventional Hwy only
Dog Tracks	Supplemental F & C		Qualifying Criteria
Donation Centers	Community wayfinder	TEOpS 2-15-6	
Downtown	Special Community wayfinder	TEOpS 2-6-50TEOpS 2-15-6	

Drive-In Theatres	TODS	SS 86.196	
Emergency Medical Treatment	Special	TEOpS 2-4-45.1 & TEOpS 2-4-45.2	Emergency Room criteria
Emissions Testing Station	State Govt. Service Centers/Intra-agency		Conventional Hwy only
Environmental Center	Inter-agency Guidance Signs	Trans 200.03	Conventional Hwy only, also TEOpS 2-15-60
Events, Special	Special	TEOpS 2-15-25	
Exhibition, Exposition Center	Supplemental F & C Guidance Signs	Trans 200.03	Qualifying Criteria also TEOpS 2-15-60
Fairgrounds	Inter-agency		
Factories	Not permitted		
Ferries	Govt. Transportation		
Fish Hatcheries	Inter-agency		Conventional Hwy only
Food, includes logo	SIS, TODS	SS. 86.195 SS 86.196	
Forest boundaries	Not permitted		
Forest Headquarters	Inter-agency		
Freight Terminals	Not Permitted		
Fuel (with logo)	SIS, TODS	SS. 86.195 SS 86.196	
Game Farms	TODS		
Gas, (with logo)	SIS, TODS	SS. 86.195 SS 86.196	
Golf Courses	Guidance Signs	Trans 200.03	also TEOpS 2-15-60
Government Offices	State Govt. Service Centers		Also the State Capitol
Gun Clubs, Ranges	Guidance Signs	Trans 200.03	also TEOpS 2-15-60
Half-way Houses	Not Permitted		
Health Clubs	Not Permitted		
Heritage Tourism Sites	Program discontinued as of 12/1/13		Also TEOpS 2-4-52
Highway Departments	Not Permitted		
Highway Maintenance Facilities	Not Permitted		
Historic Buildings	Special or Inter-Agency		Could be Community wayfinder
Historic District / Historic Downtown	Special or Community wayfinder	TEOpS 2-6-55 TEOpS 2-15-6	
Historic Neighborhoods	Not Permitted		
Historic Sites	Special or Inter-Agency		Conventional Hwy only
Historic Society Sites	Special or Inter-Agency		
Historical Markers		TEOpS 2-4-40	
Horseback Riding	Guidance Signs	Trans 200.03	also TEOpS 2-15-60
Hospitals	Special	TEOpS 2-4-45.1	Emergency Room criteria
Hotel (See Lodging)	SIS, TODS, Guidance Signs	Trans 200.03	also TEOpS 2-15-60
Humane Society Shelter	Guidance Signs Community wayfinder	Trans 200.03 TEOpS 2-15-6	also TEOpS 2-15-60
Ice Arenas, community	Community wayfinder	TEOpS 2-15-6	
Industrial Parks	Supplemental C		
Jails	Not Permitted		
Jurisdictional Boundary Signs	Information	TEOpS 2-1-41	
Kennels	Not Permitted		
Lake, River, Stream	Information	TEOpS 2-4-55	
Libraries	Community wayfinder Guidance Signs	TEOpS 2-15-6 Trans 200.03	alsoTEOpS 2-15-60
Local Parks	Community wayfinder Inter-agency	TEOpS 2-15-6	
Lodging (with logo) (without logo)	SIS TODS Guidance Signs	SS. 86.195 SS 86.196 Trans 200.03	also TEOpS 2-15-60
Logos on Signs	SIS	SS. 86.195	also TEOpS 2-15-4
Main Street Community	Special/Not permitted		

Malls	Not Permitted		
Marinas (Public)	Inter-agency		Qualifying Criteria
Marinas (Privately owned)	Guidance Signs	Trans 200.03	also TEOpS 2-15-60
Memorial Facilities	Information	SS. Chapter 84	Legislated
Mental Facilities (Public)	Not Permitted		
Military Academies	Community wayfinder	TEOpS 2-15-6	
Military Bases, Major	Inter-agency		
Mobile Home Parks	Not Permitted		
Motel (See Lodging)	SIS, TODS, Guidance Signs	Trans 200.03	also TEOpS 2-15-60
Museums	Supplemental F & C TODS, Guidance Signs	SS 86.196 Trans 200.03	Could also be Community Wayfinder
National Forest boundaries	Not Permitted		Off R/W only
National Historic Landmark	Inter-agency		Could also be Historical Marker Guide Signs (TEOpS 2-4-40)
Neighborhood Watch	Special	ss. 66.0429(2) ss. 60.23(17m)	ss. 86.19 & TEOpS 2-4-45.3
NEXT (n) EXITS	Information		Primary signing, freeway only
Nursing Homes – Private	Not Permitted		See County Institutions
Office Buildings	Not Permitted		See Government Offices
Orchards	TODS	SS 86.196	
Park & Ride Lots	Govt. Transportation		
Parks, State/county/local	Inter-agency		Or Community wayfinder
Parking Lots, municipal	Community wayfinder	TEOpS 2-15-6	
Parking Restrictions	Special	ss. 349.13 TEOpS 2-2-41	MUTCD 2B.41
Pharmacy	Not Permitted		
Police Stations	Community wayfinder	TEOpS 2-15-6	
Population Signs	Information	TEOpS 2-1-41	
Ports	Supplemental F & C		Great Lakes Shipping only
Post Offices	Community wayfinder	TEOpS 2-15-6	
Power Plants (utilities)	Not Permitted		
Preserves, Nature/Wildlife	Not Permitted		See Wildlife Refuges & Watchable Wildlife
Prisons	Inter-agency		Conventional Hwy only
Private Camps	Guidance Signs	Trans 200.03	also TEOpS 2-15-60
Public Access, lake/river	Inter-agency		
Race Tracks	Supplemental F & C		Qualifying criteria
Rail Passenger Stations	Govt. Transportation		Amtrak only
Recreation Trails	Guidance Signs	TEOpS 2-15-15 Trans 200.03	also TEOpS 2-15-60
Recycling Centers	Community wayfinder	TEOpS 2-15-6	
Rehabilitation Centers	Not Permitted		
Religious Camps	Guidance Signs	Trans 200.03	also TEOpS 2-15-60
Religious Worship	Guidance Signs	Trans 200.03	also TEOpS 2-15-60
Research Facilities	Guidance Signs	Trans 200.03	also TEOpS 2-15-60
Resorts	TODS, Guidance Signs	SS 86.196 Trans 200.03	also TEOpS 2-15-60
Restaurants	SIS, TODS, Guidance Signs	Trans 200.03	also TEOpS 2-15-60
Retirement Facilities	Not Permitted		
River, Lake, Stream	Information	TEOpS 2-4-55	
Sanitariums (Public)	Community wayfinder Supplemental C	TEOpS 2-15-6	
Schools, High, Middle, Elementary	Community wayfinder Guidance Signs	TEOpS 2-15-6 Trans 200.03	also TEOpS 2-15-60
Scientific Experiment (public owned)	Guidance Signs	Trans 200.03	also TEOpS 2-15-60
Seminaries	Guidance Signs	Trans 200.03	also TEOpS 2-15-60
Service Organization	Not Permitted		
Sheriff Freeway Patrol Substations	Inter-agency		Freeways Only
Shooting Ranges	Guidance Signs	Trans 200.03	also TEOpS 2-15-60

Shopping Centers	Not Permitted		
Ski Areas, Downhill	Inter-agency		
Skiing – Cross Country Trails	Inter-agency		Conventional Hwy only, For trailheads only
Snowmobile Trails (named)		TEOpS 2-1-50 TEOpS 2-15-15	
Stadiums	Supplemental F & C		Qualifying criteria
State Forest / State Parks Boundaries	Not Permitted		
State Forest / Parks HQs	Inter-agency		
State Historical Markers		TEOpS 2-4-40	
State Historic Sites	Supplemental or Inter-agency		Operated by WI Historical Society
State Patrol HQs	Intra-agency		
State Trails	Inter-agency	TEOpS 2-15-15	
Subdivisions	Not Permitted		
Supper Clubs	Guidance Signs	Trans 200.03	also TEOpS 2-15-60
Swimming Pools & Natatoriums	Community wayfinder	TEOpS 2-15-6	
Synagogue	Guidance Signs	Trans 200.03	also TEOpS 2-15-60
Taverns	Not Permitted		
Technical College	Supplemental F & C		Qualifying criteria
Theaters, Live	Guidance Signs	Trans 200.03	also TEOpS 2-15-60
Theatres, Movie	Not Permitted		
Tourist Information Centers		TEOpS 2-6-35	County or Local
Tourist Oriented Directional Signs	TODS category	ss. 86.196, Trans 200.08	
Township Boundary	Not permitted	TEOpS 2-4-60	
Trails, Recreation	 Guidance Signs	TEOpS 2-15-15 Trans 200.03	 also TEOpS 2-15-60
Train rides (Entertainment)	TODS Guidance Signs	SS 86.196 Trans 200.03	 also TEOpS 2-15-60
Train station	Govt. Transportation		See Amtrak & Rail Passenger Stn
Travel Information	Inter-agency		State Tourism
Tree City	Special / Not Permitted		
Tree Nurseries	Not Permitted		
Truck Stops, Truck Parking	SIS, TODS		
Tubing, River	TODS	SS 86.196	
TV/Radio Stations	Not Permitted		
Unincorporated Communities	Information and/or Special	TEOpS 2-4-48	
Universities	Supplemental F & C		Qualifying criteria
UW Extension Offices	Not Permitted		
Vehicle Emissions Testing Stations	State Govt. Service Centers/Intra-agency		Conventional Hwy only
Vehicle Registration	State Govt. Service Centers/Intra-agency		Conventional Hwy only
Veterans Cemeteries		TEOpS 2-15-20	
Veterans Centers	Inter-agency		
Veterans Memorials	Not Permitted		
Vocational Schools	Supplemental F & C		
Watchable Wildlife Area	Inter-agency		DNR designation
Wayfinder Signs	Community wayfinder	TEOpS 2-15-6	
Welcome To	Not Permitted	TEOpS 2-1-41	
Wildlife Refuges	Supplemental C Guidance Signs	 Trans 200.03	Conventional Hwy only, To Instructional Centers only
Wineries	TODS	SS 86.196	
Youth Camps	Guidance Signs	Trans 200.03	also TEOpS 2-15-60
Zoos	Supplemental F & C Community wayfinder Guidance Signs	 TEOpS 2-15-6 Trans 200.03	Qualifying criteria also TEOpS 2-15-60

Any facilities not included in this listing, **shall** be considered non-qualifying and **shall not** be permitted.

DEFINITIONS

Freeways are defined as divided highways with fully controlled access at interchanges only. Interstate highways are freeways with the interstate route designation.

Expressways are defined as divided highways with partially controlled access by a combination of interchanges, at-grade intersections, and driveways.

Conventional highways are defined s streets or roads other than freeways or expressways. They *may* be divided or undivided, two-lane or multi-lane, and access is available at intersections and driveways.

Traffic generators are defined as any facility, activity, or special point of interest which attract large numbers of people, the majority of whom are unfamiliar with the local area and/or access routes.

Trailblazing signs, in this context, are community destination signs or other directional guide signs that direct subsequent turns on local streets to reach a destination.

GENERAL PURPOSE AND GUIDELINES

Department Functions and Responsibilities

The Wisconsin Department of Transportation (hereinafter referred to as Department) has the primary responsibility to develop, maintain, and operate a state trunk highway system designed to move traffic from one destination to another in a safe, efficient, and expeditious manner. Erecting and maintaining highway traffic signs on the state highway system is a part of this responsibility.

Standards for the design and application of all highway traffic signs erected on public highways are specified in the MUTCD which, in turn, is required by statute to conform to national standards on highway signing. Refer to SS 84.02(4)(e) and (f), SS 84.60(1)(a) and SS 349.065.

Signing under permit is addressed in Chapter Trans 200.03 Wisconsin Administrative Code. Specific Information Signing (Logo), authorized pursuant to SS. 86.195, is addressed in Chapter Trans 200.06, Wisconsin Administrative Code.

The basic supposition of supplemental signing is that the facility or institution as a class is of interest and concern to a sufficient number of motorists to warrant special directional signing. It is also a basic assumption that the purpose of this signing is guidance and not advertising.

It is the purpose of these guidelines to describe all types of facilities and institutions for which signs *may* be erected on State Highway right-of-way by state forces or under contract to the state. Conversely signs will not be permitted for any type of facility or institution not addressed herein.

<u>Need for Signing Policy</u>

The Highway Beautification Act of 1965, public law 89-285, placed severe restrictions on billboard advertising. Governor Lee S. Dreyfus issued an administrative order in 1981, requiring the Department to permit supplemental guide signs, directing to the University of Wisconsin campuses. Ever since, there has been a substantial demand on the Department to permit additional directional signs on highway rights-of-way. In order to respond to all sign requests in a fair and consistent manner, the Department recognized the need to establish a signing policy that addressed all aspects of highway signing while maintaining a safe and logical sequence of informational displays in the highway environment. This document supersedes all previous policy guidance on supplemental signing for public and private facilities.

Although the WMUTCD contains standards for design and application of traffic control devices, it does not contain specific criteria on the following subjects:

(1) Allowable sign messages,

(2) Qualifications which permit placement of highway signs for various facilities and/or activities, or

(3) Priority (ranking) of the various sign groups on the basis of highway user needs which, in turn, *should* determine the selection process for sign installations.

These guidelines provide criteria by which to evaluate all highway signing requests in an equitable manner without penalizing the greater majority of highway users.

<u>Human Factors</u>

As vehicles move along a highway, each driver is confronted with many elements; the presence of other vehicles and pedestrians, roadway alignment and other design features, roadside signs and other obstacles, commercial development, wildlife, and adverse weather conditions. Any or all of these factors *may* affect highway safety, as well as the driver's ability to observe, assimilate, and react to pertinent highway sign messages.

Studies of human behavior have shown that a driver can focus attention on only one thing at a time, but he can respond very rapidly to several stimuli. However, receiving too much information in a short time can adversely affect the driver's ability to process information effectively, causing what is known as information overload. Information overload is a condition in which the driver is unable to perceive and/or use the information displayed. When this condition occurs, the driver will shift attention from one source of information to another and *may* overlook important sign messages.

Considering the large number of highway elements confronting each driver, it is apparent that the amount of information which can be effectively conveyed by traffic signs, is limited. Therefore, a system for avoiding information overload must be established.

<u>MUTCD References</u>

As a general background, several pertinent paragraphs from the MUTCD, as adopted by Wisconsin, are enumerated below.

Section 1A.01 Purpose of Traffic Control Devices

Support:

The purpose of traffic control devices, as well as the principles for their use, is to promote highway safety and efficiency by providing for the orderly movement of all road users on streets and highways throughout the Nation.

Traffic control devices notify road users of regulations and provide warning and guidance needed for the reasonably safe, uniform, and efficient operation of all elements of the traffic stream.

Standard:

Traffic control devices or their supports shall not bear any advertising message or any other message that is not related to traffic control.

Support:

Tourist-oriented directional signs and Specific Service signs are not considered advertising; rather, they are classified as motorist service signs.

Section 1A.02 Principles of Traffic Control Devices

Support:

This Manual contains the basic principles that govern the design and use of traffic control devices for all streets and highways open to public travel regardless of type or class or the public agency having jurisdiction. This Manual's text specifies the restriction on the use of a device if it is intended for limited application or for a specific system. It is important that these principles be given primary consideration in the selection and application of each device.

Guidance:

To be effective, a traffic control device *should* meet five basic requirements:

A. Fulfill a need;

B. Command attention;

C. Convey a clear, simple meaning;

D. Command respect from road users; and

E. Give adequate time for proper response.

Section 2D.02 Application

Support:

Guide signs are essential to direct road users along streets and highways, to inform them of intersecting routes, to direct them to cities, towns, villages, or other important destinations, to identify nearby rivers and streams, parks, forests, and historical sites, and generally to give such information as will help them along their way in the most simple, direct manner possible.

Section 2D.03 Color, Retroreflection and Illumination

Standard

Except where otherwise specified herein for individual groups of signs, guide signs on streets and highways shall have a white message and border on a green background. All messages, borders, and legends shall be retroreflective and all backgrounds shall be retroreflective or illuminated.

Historic downtown, State and National Historic Sites and Historical Marker signs shall have a white retroreflective message and border on a brown retroreflective background.

Section 2D.07 Amount of Legend

Support:

The longer the legend on a guide sign, the longer it will take road users to comprehend it, regardless of letter size.

Guidance:

Guide signs *should* be limited to three lines of principal legend. Where two or more signs are included in the same overhead display, the amount of legend *should* be minimized. The principal legend *should* include only place names, route numbers, and street names.

Option:

Symbols, action information, cardinal directions, and exit numbers *may* be used in addition to the principal legend where sign space is available.

Section 2E.02 Freeway and Expressway Signing Principles

Support:

The development of a signing system for freeways and expressways is approached on the premise that the signing is primarily for the benefit and direction of road users who are not familiar with the route or area. The signing furnishes road users with clear instructions for orderly progress to their destinations.

Section 2E.03 General

Support:

Signs are designed so that they are legible to road users approaching them and readable in time to permit proper responses. Desired design characteristics include: (a) long visibility distances, (b) large lettering and symbols, and (c) short legends for quick comprehension.

Standard:

Standard shapes and colors shall be used so that traffic signs can be promptly recognized by road users.

(End of MUTCD references)

Signing Priorities

Basic concepts of traffic engineering recognize that the primary function of traffic control signs is to warn, regulate, and guide traffic. Sign spacing and the amount of information displayed have an impact on the driver's ability to read and respond to sign messages in an expected, predictable manner.

Accordingly, traffic control signs on the highway are primarily intended to enable drivers to react promptly, naturally, and properly to the traffic and design conditions encountered; to advise of the regulations and use of streets and highways; to warn of potential roadway hazards; and to provide guidance to major destinations.

Secondary functions of traffic control signs are to advise drivers of various services normally required to complete an extended journey (emergency services, motorist services, public transportation), and of supplemental services, such as recreational facilities or points of interest.

Traffic control signs can be classified into eight basic sign groups. Following is the order of priorities for these sign groups, and a brief description of their specific function, as adopted by the national committees of the American Association of State Highway and Transportation Officials and the Institute of Transportation Engineers.

1. Regulatory Signs - Advise the driver of traffic laws or regulations concerning vehicle operation on the highway.
2. Warning Signs - Advise the driver of unexpected highway conditions which require extra care in driving.
3. Navigational Guide Signs - Identify the route, or routes, that the driver *should* follow to complete a trip. Navigational guide signs indicate directions and distances to cities and to other destinations or regions.
4. Emergency Services Signs - Advise of and direct the driver to facilities providing emergency medical service or assistance. Such facilities include state enforcement agencies and hospitals providing outpatient emergency medical treatment.
5. Motorist Services Signs - Advise of and direct the driver to basic services normally needed to complete a long trip (motor fuel, food, lodging, camping, tourist information centers, and rest areas).
6. Public Transportation Signs - Advise of and direct the driver to facilities providing commercial passenger travel service (airports, park and ride lots, rail passenger stations).
7. Traffic Generator Signs - Advise of and direct the driver to activities, facilities, or special points of interest which attract large numbers of people, a majority of whom are unfamiliar with the local area and/or access routes.
8. General Information Signs - Advise the driver of information that *may* be of interest, though not necessary for travel (municipal boundaries, landmarks).

Signing needs to be evaluated and signs installed in descending order of the priorities indicated as long as adequate space between signs is maintained, thus avoiding information overload and confusion to the driver.

It *may* be necessary to prioritize sign requests. An example of this situation would be where there are more qualifying traffic generators than can be accommodated under the established guidelines. In these circumstances, the several qualifying generators will be ranked according to which generator exceeds, by the greater percentage, the minimum criterion for signing. Those exceeding the warrants by the greatest percentage will be given priority. Where specific criteria are not applicable, those traffic generators closest to the intersection where signing is requested **shall** determine the priority for signing.

FREEWAY & EXPRESSWAY GUIDE SIGNING GENERAL POLICY CRITERIA & RESTRICTIONS

Guide signing can be divided into two basic categories: primary and supplemental. Each category is subject to various practical requirements.

Primary signing includes standard interchange and intersection signing, destination signs, distance signs, required motorist services signs, plus regulatory, warning, and route marker signs. This type of signing always takes precedence in the signing scheme of any intersection or interchange because it is directly related to the primary purpose of the intersection or interchange.

Supplemental freeway signing includes signing to places of lesser importance. Signing for traffic generators is considered secondary to primary signing needs. Highway signing is not intended for the purpose of advertising or promoting the facility, but to direct and guide traffic seeking that facility.

As stated in the MUTCD Section 2E-35:

Support:

Supplemental Guide signs can be used to provide information regarding destinations accessible from an interchange, other than places shown on the standard interchange signing. However, such Supplemental Guide signing can reduce the effectiveness of other more important guide signing because of the possibility of overloading the road user's capacity to receive visual messages and make appropriate decisions.

Guidance:

No more than one Supplemental Guide sign *should* be used on each interchange approach.

A Supplemental Guide sign (see Figure 2E-24) *should not* list more than two destinations. Destination names *should* be followed by the interchange number (and suffix), or if interchanges are not numbered, by the legend NEXT RIGHT or SECOND RIGHT or both, as appropriate. The Supplemental Guide sign *should* be installed as an independent guide sign assembly.

Where two or more Advance Guide signs are used, the Supplemental Guide sign *should* be installed approximately midway between two of the Advance Guide signs. If only one Advance Guide sign is used, the Supplemental Guide sign *should* follow it by at least 245 m (800 feet). If the interchanges are numbered, the interchange number *should* be used for the action message.

States and other agencies *should* adopt an appropriate policy for installing supplemental signs using "The AASHTO Guidelines for the Selection of Supplemental Guide Signs for Traffic Generators Adjacent to Freeways." In developing policies for such signing, such items as population, amount of traffic generated, distance from the route, and the significance of the destination *should* be taken into account.

Standard:

Guide signs directing drivers to park and ride facilities shall be considered as Supplemental Guide signs (see Figures 2E-25).

(End of MUTCD reference)

Placement of supplemental guide signs for a traffic generator **shall** be limited to the nearest freeway or expressway. Signing which would require a motorist to travel on the crossroad beyond another state highway and/or through a community **shall not** be permitted.

Supplemental signs **shall not** be permitted in advance of a system interchange connecting two freeways in which all legs or roadways are declared freeways.

The minimum spacing between guide signs *should not* be less than 800 feet on freeways and expressways (see Figure 1 on page 15). Actual sign installation will depend on whether there is sufficient longitudinal space to accommodate the new sign Installation without violating the minimum allowable 800 feet spacing between signs.

Along a freeway, only one supplemental guide sign **shall** be permitted in each direction of travel for a traffic generator. Signs for generators are to be located In advance of the interchanging roadway that provides the most direct and best route to the facility. In determining the most direct and best route, the Department will consider all relevant conditions including directness of route, speed of travel, length of travel, and ease of locating the facility.

Information relating to more than two traffic generators **shall not** be displayed on supplemental guide signs in advance of an interchange. Both traffic generators **shall** be shown on a single supplemental guide sign installation except where a traffic generator message is included as part of a major guide sign destination. The traffic generator message on the major guide sign **shall** count as one of the two acceptable signs, but an additional sign installation *may* be allowed in such cases.

In the event that there are more than two qualifying facilities, the two facilities that generate the greatest need for providing directional information to motorists **shall** have signs displayed. In determining which signs are most necessary, the Department will consider such factors as the amount of traffic generated, distance from the freeway exit, and ease of locating the facility. If a quantitative comparison is needed, the Principal Destination formula in TEOpS 2-15-5 *may* be used, substituting comparable attendance or enrollment figures for the population.

TABLE 1

GENERAL QUALIFYING CRITERIA FOR SIGNING TRAFFIC GENERATORS ON FREEWAYS OR EXPRESSWAYS

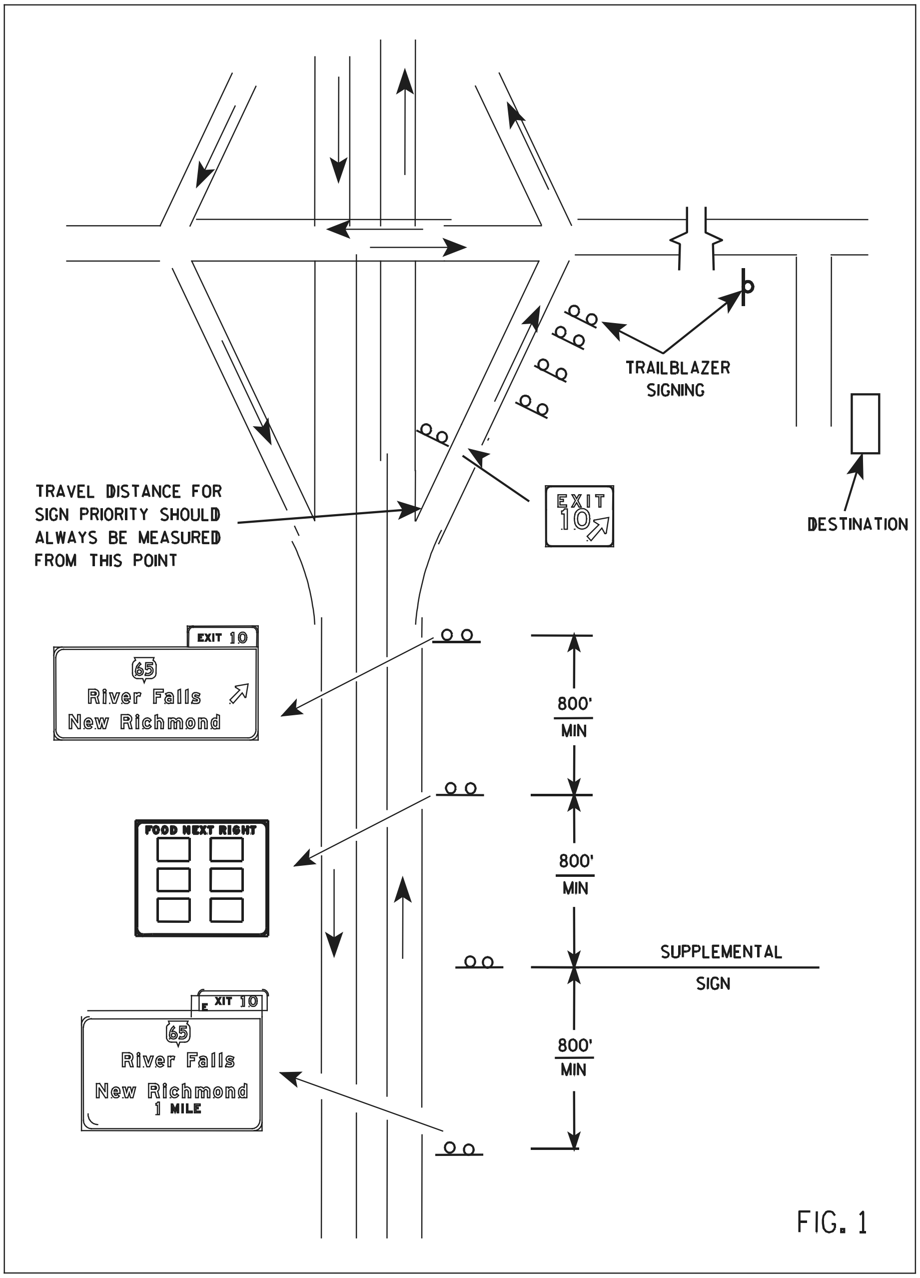
TYPE OF GENERATOR	SPECIFIC CRITERIA	POPULATION OF METROPOLITAN AREA		
		Major[1] OVER 500,000	Urban 50,000-500,000	Rural Under 50,000
Colleges, Universities, Vocational, Technical & Adult Education Colleges	Minimum Campus Enrollment[2]	2,500	1,000	1,000
	Maximum Distance From Interchange (mi.)	2	8	12
Multipurpose Arenas, Auditoriums, Fairgrounds, Museums, Race Tracks, Stadiums, & Zoos.	Minimum Annual Attendance	300,000	200,000	100,000
	Minimum No. of Seats (If Applicable)	6,000	5,000	4,000
	Maximum Distance from Interchange (mi)	2	5	7

[1] Major Metropolitan Area is defined as within Milwaukee County.

[2] Campus enrollment is defined as the total number of full and part-time students that physically attend classes on the specific campus site.

Information relating to traffic generators **shall not** be displayed on a supplemental guide sign until signing has been installed along the interchanging and/or intersecting minor roads to adequately direct the motorist from the freeway exit or intersecting road to the facility. (See SUBSEQUENT TRAILBLAZING SIGNING in **PART 5**.)

For additional specific criteria, see **PART 6** and **PART 7**.



CONVENTIONAL HIGHWAY GUIDE SIGNING GENERAL POLICY CRITERIA & RESTRICTIONS

1. All specific WisMUTCD requirements must be met in all situations.
2. Location and placement of all signing is dependent upon the availability of longitudinal spacing (200 feet desirable, 100 feet minimum) with respect to existing traffic control devices.
3. A significant portion of the traffic volume generated by the facility must be drivers who are unfamiliar with the local area and/or access routes to the facility. The adverse effects on highway operations created by motorists seeking a facility without guide signing will also be taken into consideration.
4. In designing signs and selecting locations for sign installation on state highways, the department retains the authority to specify message content (including abbreviations), size of sign, sign location, and combination of message, in accordance with standards for acceptable signing practice. The department also retains the authority to deny requests for signing where it deems acceptable standards cannot be met, including locations where other supplement al signs are already in place.
5. Signing for a specific traffic generator:
   a. **Shall** be limited to a maximum of four signs on state trunk highways

   b. **Shall** be installed only at an intersection that gives the best, most direct access to the traffic generator

   c. **Shall not** be installed at more than one intersection for each direction of traffic on a state trunk highway, but not necessarily at the same intersection for both directions.

6. Signing will normally not be permitted if the establishment is readily visible from the state trunk highway.
7. An on-premise sign identifying the facility is required. A sign *may* be installed on the highway fronting a facility if the on-premise sign is not feasible due to terrain-related visibility.
8. Supplemental signs and/or trailblazing signs **shall not** be permitted at an intersection from one state highway to another state highway.
9. Placement of supplemental guide signs for a traffic generator **shall** be limited to nearest state highway. Signing which would require a motorist to travel on the crossroad beyond another state highway and/or through a community **shall not** be permitted.
10. Facilities must be open a minimum of five days a week, including normal business hours.
11. The traffic generator must be located within the distance noting in Table 2 from the highway intersection at which signing is requested, unless a different distance is noted in other specific criteria.
12. Signing for a seasonal generator **shall** be covered, removed, or overlaid with a “CLOSED” plaque during the off-season.
13. When two or more qualifying facilities are affiliated with the same agency or institution and share a common access, only one specific name will be permitted on the sign to identify the conglomerate.
14. A facility *may*, at any time, request that a sign erected under these guidelines be removed and the department will arrange for its removal.

TABLE 2. General Qualifying Criteria for Signing Traffic Generators on Conventional Highways

TYPE OF GENERATOR	SPECIFIC CRITERIA	POPULATION OF METROPOLITAN AREA			
		Major[1] Over 500,000	Urban 50,000 – 500,000	Urban 20,000 – 50,000	Rural Under 20,000
Colleges, Universities, Vocational, Technical & Adult Education Colleges	Minimum Campus Enrollment[2]	2,500	750	500	500
	Maximum Distance from Intersection (mi.)	2	8	12	15[3]
All Other Traffic Generators	Minimum Annual Attendance	150,000	100,000	50,000	20,000
	Minimum No. of Seats (if applicable)	3,000	2,500	2,000	2,000
	Maximum Distance from Intersection (mi.)	2	7	10	15[3]

[1]Major Metropolitan Area is defined as within Milwaukee County.
[2] Campus enrollment is defined as the total number of full and part-time students that physically attend classes on the specific campus site.
[3]The distance designated, or half the distance to the next parallel State Trunk Highway, whichever is greater.

<u>Subsequent Trailblazing Signing</u>

Appropriate local road signing to guide motorists to a facility which will be signed from a State Highway or freeway is the responsibility of the facility and the local road authority.

Information relating to traffic generators **shall not** be displayed on a supplemental guide sign until signing has been installed along the interchanging and/or intersecting minor road and other roads to adequately direct the motorist from the freeway exit or intersecting road to the facility. In determining whether there is adequate signing to direct the motorist from the State Highway to the facility, the Department will consider such factors as the directness of the route, the distance involved, and the environment in which the signs are installed.

These signs, used only on non-freeways, are to be placed at sufficiently frequent intervals to adequately guide and reassure motorists. A trailblazing sign with the appropriate arrow **shall** be placed in advance of each intersection where the route changes from one highway to another or where there *may* be confusion as to the direction, which the route takes.

The Department *may* issue a written permit for trailblazing signing on a conventional State Highway to a qualifying traffic generator, which has been signed from a freeway or expressway exit ramp. Subsequent trailblazing signing **shall not** be erected on a State Trunk Highway without such written authority.

Supplemental signs and/or trailblazing signs **shall not** be permitted through a system interchange from one freeway to another or at an intersection from one conventional State Highway to another conventional State Highway.

CATEGORIES & SPECIFIC CRITERIA

The following are categories and relevant information regarding directional and informational signs permitted on the state trunk highway system. References are made to authorization in the statutes, administrative rules, MUTCD, and other subjects in the TEOpS. For each type of sign listed earlier, there is a category below, a TEOpS reference, and/or a notice that the sign is not permitted.

Community Destination (Wayfinder) Signs

These signs are installed, owned and maintained by the community. They direct to area destinations such as Downtown, or Historic District, and individual destinations such as City Hall, Convention Center, museums, and local parks. The individual destinations are generally publicly owned and operated for public use or privately owned non-profit and open to the public. Complete guidance is in TEOpS 2-15-6.

Government Service Centers

State agencies *may* request signs to be installed on state trunk highways to direct traffic to certain service centers. This policy pertains only to state agencies. Local agencies are not included since local agencies generally serve local traffic and the need is not as significant.

Signs *may* be permitted on a state highway only when the service center is not located directly on the state highway system; signs will not be permitted on the state highway system when extensive trail blazing would be required or when guidance *may* be reasonably provided to the service center using street names and addresses.

No signs will be permitted on freeways or expressways.

Signs *may* be allowed at only two intersections of the state trunk highway system with county or local roads for any service center or complex of service centers.

Sign messages must be approved by the department and signs *may* only be installed under the direction of the department.

Service centers are those governmental offices whose primary purpose is to provide direct customer service to the public. Service centers do not include those offices that are predominantly administrative or serving internal agency operations. The extent of external customer traffic will be considered in determining eligibility for service center signs.

The service center requesting the sign is responsible for all costs related to those signs which are incurred by the department.

This guidance is premised on the view that only a select number of locations will qualify for signs. *Should* the number of signs allowed under this guidance adversely affect the safe and efficient operation of the state highway system, signs *may* be further restricted.

Government Transportation Facilities

Guide signs are Department funded and installed on freeways and conventional highways.

Major Airport

The facility must provide regularly scheduled commercial passenger flights and be located within 15 miles of the freeway or expressway, or within 5 miles of a conventional state trunk highway. Signing to General Mitchell International Airport and Austin Straubel International Airport **shall** be evaluated as a special case.

Public Airport, General Aviation

The facility must be classified as a Large General Aviation Airport or Medium General Aviation Airport, as listed in the Wisconsin State Airport System Plan that is published by the Wisconsin Department of Transportation, Bureau of Aeronautics. The General Aviation airport **shall** be located within 15 miles of the freeway or expressway, or within 5 miles of a conventional state trunk highway.

Park & Ride Lots

The facility must provide free parking, be approved by the Department, and be located within ½ mile of the state trunk highway.

Ports and Harbors

The port or harbor facilities must serve commercial Great Lakes shipping and be located within 10 miles of the freeway or expressway, or within 5 miles of the conventional state trunk highway.

Amtrak Passenger Stations

Facility must provide regularly scheduled intercity passenger service, protection for passenger comfort, public parking, and be within 5 miles of the state trunk highway.

Ferries

Facility must provide regularly scheduled passenger service, protection for passenger comfort, public parking, and be within 5 miles of the state trunk highway.

Guidance Signs

Sometimes called arrow boards, guidance signs are only permitted on conventional state highways or expressway approaches to at-grade intersections. As prescribed in the Wisconsin Administrative Code Chapter Trans 200, these narrow horizontal sign panels *may* bear the names of, and direct to:

- Resorts,
- Hotels,
- Places of public entertainment or instruction,
- Any place of religious worship,
- County institutions,
- Scientific experimental locations for the furtherance of agriculture, science or art.

The term “entertainment” in this case does not include nightclubs, taverns, or similar establishments.

The regions *may* issue a permit; there is no permit fee, and installation **shall** be by the requestor’s choice of a WisDOT approved signing contractor or county signing crew. Detailed department guidelines and the permit application Form DT1903 are contained in TEOpS 2-15-60.

Information Signs

Information signs *may* be permitted or installed by the Department to identify geographic features and/or provide information to the traveling public. Qualifying geographic features are those found on the official state highway map.

The following specific guidelines **shall** be applied to these individual signs.

- City or village population signs limit signs *may* be installed and maintained by the Department in accordance with TEOpS 2-1-41.
- County Line signs **shall** be installed by the Department on all state highways at or near the county line. No other signs **shall** share the supports.
- Lake, River or Stream signs *may* be installed and maintained by the Department in accordance with TEOpS 2-4-55.
- Memorial Facilities signs **shall** be installed and maintained by the Department in accordance with Chapter 84 of the State Statutes.
- NEXT (n) EXITS signs *may* be installed and maintained on freeways by the Department, upon request by an incorporated city or village being appropriately served by two or more consecutive exits.
- Street Name Signs *may* be independently installed and maintained on the STH right-of-way by the municipality with jurisdiction over the side road or crossroad.
- Unincorporated Community signs *may* be installed and maintained by the Department in accordance with TEOpS 2-4-48.
- Advance Crossroad Name signs *may* be installed and maintained by the Department in accordance with TEOpS 2-4-50.

Inter-Agency Facilities

Signs *may* be permitted on the basis of agreements with other state, federal, and county agencies, such as state and county historical societies, the Department of Natural Resources, and Department of Tourism. In most cases, the Department of Transportation will arrange for sign installation and maintenance and request reimbursement. Agreements and permits are subject to the department's evaluation and approval based on the following specific requirements.

- Boat landings; public access to lakes & rivers
  - Conventional highways only.
  - No attendance criteria.
  - A sign **shall not** be permitted unless the access point is located on a road that is sufficiently improved so that a passenger car can use the road without being scratched, dented, or otherwise damaged.
  - Additional criteria:
    - Maximum distance from state trunk highway intersection: 2 miles
    - Parking provided at access site
    - Gravel surface (or better) at access site
    - Improved boat-launching ramp
- Campgrounds, public
  - Conventional highways only
  - No attendance criteria
  - Signing *may* be permitted on conventional highways only, subject to all other general criteria applicable to each facility and location
  - Additional criteria:
    - Public-owned and operated campgrounds *may* be signed if they have a minimum of 50 campsites, adequate toilet facilities, and safe drinking water
    - Only requests from the public agency owning the campground **shall** be considered
    - Campgrounds that are a part of a national, state, county, or local park **shall not** be signed separately, but signing *may* be considered for the park
  - Privately-owned camping facilities *may* qualify for signing under the Specific Information Sign (SIS), Tourist-Oriented Directional Sign (TODS)< or Trans 200 Guidance Sign programs
- Conservation or environmental centers
  - Supplemental signing *may* be permitted on conventional highways, subject to the general criteria applicable to each facility and location and the following additional criteria:
    - Provide on-site, off-street parking for minimum 50 vehicles
    - Provide educational programs and/or audio/visual presentations
  - Centers that are part of a national, state, county, or local park or forest **shall not** be signed separately, but signing *may* be considered for the park or forest headquarters entrance
- Corps of engineering facilities (such as lock and dam sites)
  - Conventional highways only
  - No attendance criteria
  - Signing *may* be permitted on conventional highways only, subject to all other general criteria applicable to each facility and location
  - Additional criteria:
    - Must provide picnic and park facilities
    - Must provide viewing provisions for the public
    - Must provide parking for 25 vehicles or more
- Fairgrounds, state and county
  Supplemental signing *may* be permitted on freeways or conventional highways, subject to all the general criteria applicable to each facility and location
- Fish hatcheries
  - Conventional highways only
  - No attendance criteria
  - Signing *may* be permitted on conventional highways only, subject to all other general criteria applicable to each facility and location
  - Additional criteria:
    - Must be state-owned facilities
    - Must provide visitor accommodations
- Forest headquarters
  - No attendance criteria

    - Supplemental signing *may* be permitted on freeways or conventional highways, subject to all other general criteria applicable to each facility and location
    - Additional criteria:
        - Provide on-site, off-street parking for minimum 50 vehicles
        - Provide educational programs and/or audio/visual presentations
    - Only requests from the public agency managing the forest **shall** be considered
- Historic sites
    - Conventional highways only
    - No attendance criteria
    - Sings on freeways or conventional highways *may* be permitted for state historical sites operated by the Wisconsin Historical Society, subject to all other general criteria applicable to each facility and location
- Institutions, county (publicly-owned nursing homes)
    - Conventional highways only
    - No attendance criteria
    - Signing *may* be permitted on conventional highways only, subject to all other general criteria applicable to each facility and location
- Marinas (publicly-owned)
    - Signs on freeways or conventional highways *may* be permitted for marinas, subject to all other general criteria applicable to each facility and location
    - Additional criteria:
    - To qualify for freeway signs, the marina **shall** have a minimum of 500 boat slips
    - To qualify for conventional highway signs, the marina **shall** have a minimum of 125 boat slips
- Military bases, major
  Signs *may* be permitted to Fort McCoy, Volk Field, and Camp Williams
- National historic landmarks
    - Signs *may* be permitted for freeways, expressways and conventional highways, subject to all other general criteria applicable to each facility and location
    - Additional criteria:
        - The site **shall** be a documented national historic landmark that is officially on the listing for National Historic Landmarks in Wisconsin designated by the secretary of the U.S. Department of the Interior (www.nps.gov/nhl/find/statelists/wi/WI.pdf)
        - Only historical sites are eligible, not individual buildings
        - A historical site is comprised as a complex of buildings or an entire district that is a documented national historic landmark
- Parks, national state, and county freeway
    - Supplemental signing *may* be permitted, subject to the general criteria applicable to each facility and location
    - No annual attendance criteria
    - Signing *may* be erected for state parks with the Department of Transportation and the Department of Natural Resources mutually agreed upon. The following **shall** be provided as a minimum:
        - Off-highway parking
        - Safe drinking water
        - Toilet facilities
        - 50 camping sites
        - Swimming
        - Handicapped-accessible camping and picnic areas
        - State parks **shall** also offer other special attractions, such as skiing, nature trails, improved hiking trails, interpretive centers, vistas and overlooks, or be of statewide historical significance
        - Signs directing to National, County and local parks *may* be permitted on freeways or conventional highways if the criteria applicable to state parks are satisfied and the ownership agency and operating authority has requested the signing.
- Parks, Conventional highway
    - Supplemental signing *may* be permitted, subject to the general criteria applicable to each facility and location
    - No annual attendance criteria
    - Signing *may* be erected for state parks with the Department of Transportation and the Department of Natural Resources mutually agreed upon. The following **shall** be provided as a

minimum:
    - Off-highway parking
    - Safe drinking water
    - Toilet facilities
    - Handicapped-accessible picnic areas
    - State parks *should* also offer other special attractions, such as camping, swimming, skiing, nature trails, improved hiking trails, interpretive centers, vistas and overlooks, or be of statewide historical significance
    - Signs directing to National, County and local parks *may* be permitted on freeways or conventional highways if the criteria applicable to state parks are satisfied and the ownership agency and operating authority has requested the signing.
- Prisons, federal/state
    - Conventional highways only
    - No attendance criteria
    - Signing *may* be permitted on conventional highways only, subject to all other general criteria applicable to each facility and location
- Sheriff freeway substations
    - Signs on freeways *may* be permitted for county sheriff freeway substations
    - County sheriff's office **shall** have unique statutory authority for patrolling the freeway system to qualify for signage. Presently, only Milwaukee County has this statutory authority.
- Ski areas, downhill
    - No attendance criteria
    - Signs on freeways or conventional highways *may* be permitted for downhill ski areas, subject to all other general criteria applicable to each facility and location
- Travel information, state
    - No attendance or usage criteria
    - Subject to other general criteria, state travel information stations *may* be signed under mutual agreement between the Department of Transportation and the Department of Tourism. As a minimum, the locations **shall** provide parking facilities and public restrooms.
- Veterans centers/facilities
    - No attendance or usage criteria
    - Signs on freeways or conventional highways *may* be permitted for veterans centers with hospitals providing major medical or outpatient services, subject to all other general criteria applicable to each facility and location
- Intra-agency
  Signs are permitted under agreements with other divisions in the Department of Transportation, such as DMV and DSP. No reimbursement is required.
- Special
  This category addresses these specific types of signs which are described in other parts of the TEOpS or in other policies
    - Downtown: the department permits downtown sign(s) at strategic freeway or expressway exit(s) into the city in accordance with TEOpS 2-6-50
    - Historic downtown/district: the department permits historic downtown or historic district sign(s) at strategic freeway or expressway exit(s) into the city in accordance with TEOpS 2-6-55
    - Business district: as an alternative to downtown, the department permits business district signs on conventional highways at main street intersections
    - Emergency medical: standard hospital or emergency medical services signs are installed by the department on state trunk highways to direct to facilities which meet the qualifying criteria in TEOpS 2-4-45.1 and 2-4-48
    - Unincorporated communities: the department *may* install signs directing to unincorporated communities in accordance with TEOpS 2-4-48
    - Engine braking: WisDOT standard signs are permitted on conventional highway entrances to communities in accordance with TEOpS 2-2-30
    - Events, special: the department *may* permit signs directing to special events in accordance with TEOpS 2-15-25
    - Heritage tourism: program has been discontinued as of 12/1/13 in accordance with TEOpS 2-4-52
    - Neighborhood watch: approved signs are permitted within cities and villages under State Statute 66.0429(2). Further guidance is provided in TEOpS 2-4-45.3
    - Parking restrictions: no parking zones and seasonal or overnight parking restrictions *may* be

signed by the department or cities and villages in accordance with State Statute 349.14. Sign messages *should not* attempt to detail complex parking ordinances. Further guidance is provided in MUTCD Section 2B.41 and TEOpS 2-2-41.
    - Miscellaneous non-permitted: some municipalities desire various nonstandard promotional signs. Examples include, but are not limited to, CRIME STOPPERS, DARE COMMUNITY, MAIN STREET USA, TREE CITY, COMMUNITY RECYCLING, SERVICE CLUBS, WELCOME TO ____, and HOME OF THE ____. Such signs **shall not** be permitted on the state highway right-of-way under WisDOT jurisdiction. They *may* be displayed at or outside the right-of-way line.
- Special information signs (SIS)
    - References: State Statute 86.195 and Administrative Code Trans 200.06. Specific information signs are only allowed on the highway segments listed in this statute.
    - Business signs are separately attached rectangular plates which show the brand, symbol, trademark, name or combinations of these for motorist services accessible from an approaching interchange or intersection. They are commonly called “logos” and are confined to five categories: fuel, meals, lodging, camping, and attractions.
    - Specific information signs are technically the blue rectangular sign panel on which the business signs are mounted along with directional information.
    - Interstate Logos Wisconsin is under contract to administer this signing program for the department. The contractor verifies applicant qualifications, and installs and maintains all signs. Annual permit fees are charged.
    - All inquiries, including damage reports, *may* be referred to Joel McClean at (608) 579-1570 or visit the website.
- Tourist-oriented directional signs (TODS)
    - References: State Statute 86.196, and Administrative Code Trans 200.08
    - These signs are blue panels in rural areas (outside urban area boundaries) on conventional or expressway state highways that are not under the SIS sign program. Businesses which make all or most of their sales to visitors or tourists *may* be eligible. Applications, installation, and maintenance *should* be arranged by the county, subject to the approval of the maintaining authority. Application and renewal fees are charged. These signs are not permitted on the freeway system.

SPECIFIC POLICY FOR SUPPLEMENTAL SIGNS ON FREEWAYS & EXPRESSWAYS

The document, *Guidelines for the Selection of Supplemental Guide Signs for Traffic Generators Adjacent to Freeways*, published in 2001 by the American Association of State Highway and Transportation Officials, has been used as the basis for WisDOT policy in order to be in substantial conformance with the national standards, required by Federal and State law. This AASHTO document is reprinted with permission in TEOpS 2-15-1.1.

Supplemental guide signs, directing to municipalities, *may* be permitted, upon request, as provided for in ss. 86.19(6), but subject to the other general policy criteria & restrictions in PART 4. Qualifying municipalities **shall** be incorporated cities or villages shown on the official State Highway map and **shall** be within 5 miles of the freeway exit. The municipality **shall** be billed for all costs of fabrication, installation, maintenance and removal. The Department **shall** specify the sign design and *may* arrange for fabrication, installation, maintenance and/or removal.

Signing for a municipality or traffic generator *should not* be displayed on a supplemental guide sign until signing has been installed at the ramp terminals and along the interchanging road and other roads as necessary to direct the motorist from the freeway exit to the municipality or traffic generator.

Signing for a seasonal generator *may* be displayed when warranted. Such signing **shall** be removed, covered, overlaid with a "CLOSED" plaque, or fitted with a “CLOSED” flip-panel during the off-season.

The cost of signs erected under this section of the guidelines, **shall** be segregated from other signs in order to properly invoice the municipality or facility to cover the cost of installation and maintenance of these signs. The cost of the installation **shall** include the cost of the signs, posts, mounting hardware, labor, vehicles and miscellaneous materials.

Sign installation and cost reimbursement methods are in **PART 9**.

If only one municipality or facility makes a request but others could qualify later, the initial facility will be invoiced for the total initial installation cost. The subsequent facility will be invoiced only for the additions to the existing installation. The facilities *may* agree between themselves to share the costs in a different manner, but no such agreement **shall** involve the Department. (For example: The first facility *may* request the second to reimburse it for a portion of the post cost.)

Maintenance costs associated with these signs **shall** be shared equally by all destinations on the installation. Maintenance includes replacement of the signs when they wear out and the cost of repairing the signs in the case of damage, when that cost is not recovered from the person causing the damage.

A facility or municipality *may*, at any time, request that a sign erected under these guidelines be removed and the Department will arrange for its removal.

If a facility or municipality fails to pay any invoice within six months of billing, the Department will remove the sign.

In-Place Signing

1. Conforming to Policy: Signs which are in place and meet all established provisions of this policy *may* remain in place until they have reached the end of their useful life, or are rendered useless by damage or vandalism. If desired, the sign(s) will be replaced, and the facility served by the sign **shall** pay the full cost of replacement.

   Before replacing a sign when it wears out or is damaged, the Department will evaluate other requests for signing at the same location, selecting the request with the greatest priority among the requests. If there are no other requests, the Department will contact each facility on the sign to determine whether or not they wish their name retained and are willing to bear the replacement cost. The Department is not obligated to leave a sign in place after judging it to be worn out, merely because the facility is unwilling to pay for a replacement.

2. Non-conforming Signs will be allowed to remain until the end of their useful life, or are rendered useless by damage or vandalism, or are removed under a sign replacement or highway reconstruction project. Prior to the removal of any non-conforming signs, the Region **shall** contact the Bureau of Traffic Operations to discuss potential political impacts and acceptable signing alternatives.

3. Sign Replacement Program: Periodically, the Department replaces traffic signs along a complete segment of a highway route, so that all devices are uniformly maintained and proper retroreflectivity is assured on all signs. When this activity occurs, supplemental guide signing to traffic generators will generally be included in the replacement program, and facilities will be billed for their particular sign costs.

Milwaukee Metropolitan Area: Specific Policy

Because of the numerous and often closely-spaced interchanges, the frequency of in-place primary signing, and the adequacy of route and str5eet identification signing already in place, supplemental signing is limited by these additional restrictions:

1. All supplemental signing—downtown loop:

   Other than supplemental guide signing for National Major League Sports teams venues, signing for any other specific facility or generator (including educational institutions) **shall not** be permitted on the entire length of I-794, nor on any downtown freeway comprising a loop bounded by McKinley Avenue on the north, I-43 on the west, I-794 on the south and Lincoln Memorial Drive on the east. The only exceptions to these restrictions *may* be: LAKEFRONT, PORT OF MILWAUKEE, DOWNTOWN, or any large area within the loop boundaries which can be meaningful to the visitor and whose area name has broad community support (subject to Department approval). Signing for such large area(s) will be considered on the basis that it is a substitute for other exceptions named herein and in consideration of the other space restrictions cited in this policy. If a substitute is approved, it *may* be funded with Department funds. National Major League Sports teams venues *may* be permitted if they follow all other criteria as spelled out in this policy.

2. Medical facilities:

   Signing to the Milwaukee Regional Medical Center (but not to individual facilities within the Regional Medical Center) will be permitted.

SPECIFIC POLICY FOR SUPPLEMENTAL SIGNS ON CONVENTIONAL HIGHWAYS

The basic supposition of supplemental signing is that the facility or institution as a class is of interest and concern to a sufficient number of motorists to warrant special directional signing. It is also a basic assumption that the purpose of this signing is guidance and not advertising.

Supplemental guide signs, directing to municipalities, *may* be permitted, upon request, as provided for in ss. 86.19(6), but subject to the other general policy criteria & restrictions listed previously. Qualifying municipalities **shall** be incorporated cities or villages shown on the official State Highway map and **shall** be within 5 miles of the state highway intersection. The municipality **shall** be billed for all costs of fabrication, installation, maintenance and removal. The Department **shall** specify the sign design and *may* arrange for fabrication, installation, maintenance and/or removal.

Signing for a municipality or traffic generator *should not* be displayed on a supplemental guide sign until signing has been installed along the intersecting road and other roads as necessary to direct the motorist from the intersection to the municipality or traffic generator.

Signing for a seasonal generator *may* be displayed when warranted. Such signing **shall** be removed, covered, overlaid with a "CLOSED" plaque, or fitted with a “CLOSED” flip-panel during the off-season.

Only one supplemental sign designating traffic generators *may* be erected under this policy on the approach to an intersection, and the maximum number of facilities listed on the sign **shall** be three.

Actual sign installation will depend upon sufficient longitudinal space to accommodate the new sign without violating the minimum spacing between signs.

Signing on connecting highways **shall** be the responsibility of the respective local unit of government having jurisdiction. The provisions of this policy **shall not** be construed to be the policy for the signing on connecting highways.

The cost of signs erected under this section of the guidelines, **shall** be segregated from other signs in order to properly invoice the municipality or facility to cover the cost of installation and maintenance of these signs. The cost of the installation **shall** include the cost of the signs, posts, mounting hardware, labor, vehicles and miscellaneous materials, and *may* be based on average costs for a typical installation.

Sign installation and cost reimbursement methods are in **PART 9**.

If only one municipality or facility makes a request but others could qualify later, the initial facility will be invoiced for the total initial installation cost. The subsequent facility will be invoiced only for the additions to the existing installation. The facilities *may* agree between themselves to share the costs in a different manner, but no such agreement **shall** involve the Department. (For example: The first facility *may* request the second to reimburse it for a portion of the post cost.)

Maintenance costs associated with those signs **shall** be shared equally by all facilities in the installation. Maintenance includes replacement of the signs when they wear out and the cost of repairing the signs in the case of damage, when that cost is not recovered from the person causing the damage.

<u>In-Place Signing</u>

1. (1) Conforming to Policy: Signs which are in place and meet all established provisions of this policy *may* remain in place until they have reached the end of their useful life, or are rendered useless by damage or vandalism. If desired, the sign(s) will be replaced, and the facility served by the sign **shall** pay the full cost of replacement.

   Before replacing the sign when it wears out, the Department will evaluate other requests for supplemental signing at the same location (if any), selecting the sign with the greatest priority from among the requests prior to contacting a facility with the original sign to determine whether or not they wish the sign replaced and are willing to bear the cost. The Department is not obligated to leave a sign in place after judging it to be worn out merely because the facility is unwilling to pay for a replacement.

2. Non-conforming Signs will be allowed to remain until the end of their useful life, or are rendered useless by damage or vandalism, or are removed under a sign replacement or highway reconstruction project. Prior to the removal of any non-conforming signs, the Region **shall** contact the Bureau of Traffic Operations to discuss potential political impacts and acceptable signing alternatives.

3. Sign Replacement Program: Periodically, the Department replaces traffic signs along a complete segment of a highway route, so that all devices are uniformly maintained and proper retroreflectivity is assured on all signs. When this activity occurs, supplemental guide signing to traffic generators will generally be included in the replacement program, and facilities will be billed for their particular sign costs.

METHODS FOR SIGN INSTALLATION AND COST REIMBURSEMENT

There are several methods that can be utilized by the regions for the installation and maintenance of signs for supplemental traffic generators. County forces *may* be used for the installation and maintenance of Type II signs. The statewide open-end signing contractor *should* be used for all Type I signs and *may* be used for Type II signs also. Private individuals or facilities themselves **shall not** be allowed to install signs on WisDOT roadways.

The common methods for accomplishing sign installation are detailed below. The regions have the opportunity to work within these guidelines and select a method that best fits the region and/or situation.

Setting up a Professional and Technical Project ID (P & T ID)

When cost reimbursement is part of the permit agreement, the Region **shall** set up an individual P & T project ID to track all costs, which would include sign manufacturing, installation (either County or Contractor), subsequent maintenance and/or replacement, and any Region personnel field layout costs associated with the sign request. Under this method, if county crews install the signs, the signs **shall** be furnished by WisDOT. The Region *should* furnish the P & T project ID to the county to charge their time, fleet and material costs. WisDOT staff *should* stake the sign location(s).

If the statewide open-end contractor is utilized, it is expected that the contractor will furnish the signs. WisDOT will provide the sign fabrication detail to the contractor and field stake the location of the sign(s). Charge the P & T project ID for all sign manufacture, for county installation and/or contractor installation costs once invoices are received.

Permitting the County to Install a Sign Directing to a County Facility

This method would only be utilized if a county were to request a sign for one of their own facilities off the state trunk highway. WisDOT would permit the county to install the sign(s). If this option were utilized, WisDOT would field stake the sign location and *may* either provide a fabrication detail so the county can get the sign made or manufacture and sell the sign to the county. If WisDOT manufactures the sign for the county, the Region *should* utilize the Sales to Others Form (DT1668). The Region *should* fill out the form and send it to the Central Office Sign Mfg. Shop. The requestor will then be invoiced for the sign manufacture costs. This option would only be used for county facilities.

Signing for Government, State University Facilities

For these types of government facilities, the Region *may* elect to have them work directly with the county. If this option were utilized, WisDOT would field stake the sign location and provide a fabrication detail to the requesting agency. The requesting agency would then work directly with the county to get the sign(s) manufactured and installed. The county would direct bill all charges to the requestor.

WisDOT *may* manufacture the sign(s) also. If WisDOT manufactures the sign(s), the Region *should* utilize the Sales to Others Form (DT 1668 form). The Region *should* fill out the form and send it to the Central Office Sign Mfg. Shop. The requestor will then be invoiced for the sign manufacture costs.

Figure 2. REQUEST FOR GUIDE SIGN INSTALLATION ON STATE HIGHWAY (DT1332)

REQUEST FOR GUIDE SIGN INSTALLATION ON STATE HIGHWAY
Wisconsin Department of Transportation
DT1332 2/2018

Sign Requested For
☐ College/University
☐ Institution
☐ Municipality
☐ Other: ____________________

Name of Requesting Facility or Municipality		
Street Address	City	Zip Code
Contact Person: ________________		Phone: ____________
		Email: ____________

SIGN MESSAGE or What does the sign direct to?

PROPOSED SIGN LOCATIONS

Hwy. Interchange or Intersection	Town/City/Village	County of	Traffic Direction at Proposed Sign Site ________-bound on Hwy. _________
Hwy. Interchange or Intersection	Town/City/Village	County of	Traffic Direction at Proposed Sign Site ________-bound on Hwy. _________

Additional requests should be submitted on a separate form.

The requesting facility agrees to and will abide by the conditions contained within the Supplemental Guide Sign Policies and general signing policy provisions attached to this application, which is made by the undersigned official under proper authority to act on behalf of the facility represented above. The requestor agrees to pay for installation costs and costs to replace the signs when they have reached the end of their useful life or repairs if they become damaged, when the cost is not recovered from the person(s) causing the damage.

Signature of Authorized Official	Title	Date

☐ APPROVED
☐ DENIED

Regional Traffic Engineer ________________ Date

2-15-4 Pictographs on Signs March 2018

PURPOSE

This guideline provides criteria for determining when pictographs *may* be allowed on supplemental traffic generator signs which qualify for a permit under TEOpS 2-15-3 (Sign Categories and Policy for Directional Signing). The term "pictograph" is defined by the Federal Highway Administration as a pictorial representation used to identify a governmental jurisdiction, a governmental agency, a governmental approved university or college, or a branch of the military service. In general, the use of pictographs is limited to those conditions where an easily recognized, widely understood pictograph *may* add to the effectiveness of a standard text sign by providing a quick visual cue to drivers in need of guidance. This guideline establishes criteria for determining when pictographs *may* be used, and establishes standards for the type and design of pictographs in order to assure their effective use through consistent application. The guideline also is intended to prevent the inappropriate use of pictographs as a means of promoting or advertising destinations, as advertising on the right of way is not legal.

DEFINITIONS

Freeways are defined as divided arterial highway facilities that have full controlled access, by means of grade separation at interchanges only.

Expressways are defined as divided arterial highway facilities that have partial control of access and generally with grade separations at major intersections.

Conventional highways are defined as either divided or undivided roadway facilities that have no control of access with grade separations at intersections. These highways can be two lane or multilane facilities.

Pictographs are defined as a pictorial representation used to identify a governmental jurisdiction, a governmental agency, a military base or branch of service, a governmental-approved university or college, or a government-approved institution.

Logos are defined as a distinctive emblem or trademark that identifies a commercial business and/or the product or service offered by the business.

Symbols are defined as the approved design of a pictorial representation of a specific traffic control message for signs, pavement markings, traffic control signals, or other traffic control devices, as shown in the MUTCD.

POLICY

Pictographs *may* be used on supplemental traffic generator signs, provided that the following criteria are met:

- The supplemental traffic generator sign **shall** be approved for installation by meeting the criteria outlined in TEOpS 2-15-3 (Sign Categories and Policy for Directional Signing). Central office approval **shall** be obtained for any pictograph requests.
- Pictographs **shall** only be allowed for guide signs that are listed below:
  - Colleges/universities
  - Auto tour route (Great River Road, Lack Michigan/Superior Circle Tour)
  - Wayfinding signing
  - Airport signing
  - Street name signs, including overhead
  - Military branch
- College and university pictographs **shall** be the official seal adopted by the educational institution. Pictorial representatives of college and university programs are not permitted.
- Advanced street name signs **shall not** contain pictographs.
- Per an October 11, 2017 Official Ruling Letter from FHWA (2(09)-(136)I), federal government facilities (US Fish & Wildlife Service, National Park Service, US Forest Service) **shall not** contain pictographs.
- Auto tour route pictographs **shall not** be displayed on advance guide or exit direction signs. Auto tour route pictographs **shall** only be displayed on supplemental guide signs on freeways and expressways. For conventional highways, auto tour route pictographs **shall** be displayed on conventional route assemblies.
- Military branch pictographs **shall not** be displayed on advance guide or exit direction signs. Military branch pictographs, related to military installations, **shall** only be displayed on supplemental guide signs.
- Commercial graphics for businesses **shall not** be used on community wayfinding signs, including within the pictographs.
- Wayfinding signing **shall** be approved for installation by meeting the criteria outlined in TEOpS 2-15-6.
- The pictograph **shall** fit within the sign face and *should* be placed to the left of the accompanying message. Whenever the addition of a pictograph requires a change in the size or shape of a sign, all costs of the change must be paid by the requestor.
- The maximum dimension (height or width) of a pictograph **shall not** exceed the size of the route shield on the guide sign. If the guide sign does not include a route shield, the maximum size of the pictograph (height or width) **shall not** exceed two times the height of the destination legend.

Typical Sizes of Pictographs

Lettering Size on Sign	Pictograph Dimensions
6” upper case / 4 ½” lower case	12” x 12”
8” upper case / 6” lower case	16” x 16”
10” upper case / 8” lower case	20” x 20”
13.33” upper case / 10” lower case	26” x 26”
16” upper case / 12” lower case	32” x 32”
20” upper case / 15” lower case	40” x 40”

- Pictographs **shall** be retroreflective. Colors, arrows, and borders of the logos *should* meet the requirements defined in TEOpS 2-15-6.

- Pictographs that resemble an official traffic control device **shall not** be used.
- The sign requestor **shall** pay for the manufacture, installation, and maintenance of all pictographs, including the sign(s) and posts. The actual method of pictograph installation will be left up to the discretion of each regional traffic section.
- Pictographs currently installed that do not meet the criteria in this policy will be allowed to remain in place until the end of their useful life. Useful life ends when the pictograph message no longer meets legibility or condition standards. Existing pictographs **shall** be removed prior to the end of their useful life when opportunities arise such as knockdown or damage, when other work is occurring nearby, or projects make removal practical.

2-15-5 Destinations on Signs — January 2018

GENERAL

The display of appropriate destinations on guide signs can be particularly helpful to drivers, regardless of the type of road or highway. It is the purpose of this policy to set specific standards and guidelines for the selection of destination names for various types of guide signs on each classification of highway. General guidance is provide din the following sections of the MUTCD.

Section 2D.37 Destination Signs (D1 Series)
Section 2D.36 Distance Signs (D2 Series)
Section 2E.07 Characteristics of Urban Signing
Section 2E.10 Amount of Legend on Guide Signs
Section 2E.12 Pull-Through Signs
Section 2E.13 Designation of Destinations
Section 2E.30 Interchange Guide Signs
Section 2E.33 Advance Guide Signs
Section 2E.35 Other Supplemental Guide Signs
Section 2E.36 Exit Direction Signs
Section 2E.39 Distance Signs
Section 2E.40 Interchange Sequence Signs
Section 2E.41 Community Interchanges Identification Signs
Section 2E.42 NEXT X EXITS Sign

DEFINITIONS

1. Freeways are defined as divided arterial highway facilities that have full controlled access, by means of grade separation at interchanges only.
2. Expressways are defined as divided arterial highway facilities that have partial control of access and generally with grade separations at major intersections.
3. Conventional highways are defined as either divided or undivided roadway facilities that have no control of access or grade separations at intersections. These highways can be two-lane or multi-lane facilities.
4. A major state trunk highway (STH) is defined as
   a. A state highway operated as a freeway
   b. A highway designated as part of the National Highway System, or
   c. A state highway route or segment approved as such by the state traffic engineer, based on its character as a principal route for cross-state traffic, traffic between major cities in Wisconsin and adjacent states, or traffic from major cities to major northern resort areas.
5. A standard highway is defined as any conventional state or local highway which is not a major STH.
6. Urban areas are defined as
   a. An established urbanized area, based on the US Bureau of the Census and adjusted by metropolitan planning organizations and the DOT
   b. Two or more contiguous cities and/or incorporated villages, or
   c. A single city or incorporated village which is not contiguous with any other.
7. National control cities are Chicago, Milwaukee, Beloit, Rockford, Janesville, Madison, Wisconsin Dells,

La Crosse, Albert Lea, Eau Claire, St. Paul, Sheboygan, and Green Bay.

8. Regional Control Cities are defined as
   a. Urban areas in Wisconsin or within 60 miles of the state line with a population in the most recent decennial census of 30,000 or more.
   b. Other communities, such as Sturgeon Bay, Woodruff, Minocqua, and Lake Geneva, which are approved by the State Traffic Engineer based on their character as widely known tourism destinations, and
   c. Urban areas on or north of Highway 64 with a population exceeding 3,500, and urban areas south of Highway 64 with a population exceeding 10,000.
9. Communities are defined as
   a. Any urban area, or
   b. An unincorporated village which is identified on the official state highway map and is not adjacent to or within an urban area.

PRINCIPAL DESTINATION CALCULATION

A Principal Destination is defined as a community served by a standard highway and located within 25 miles of a major state trunk highway, as measured along the standard highway, and having a location and population such that

$$\frac{Pp}{Pc} \geq \frac{Dp}{Dc} \quad \text{where}$$

Pp = Population of Principal Destination (from official state highway map)

Dp = Distance in whole miles from the major STH to the Principal Destination

Pc = Population of the community closest to the major STH and in the same direction from it (from official state highway map)

Dc = Distance in whole miles to the closest community

If more than one community meets the above criteria, the community for which the term

$$\frac{Pp}{Pc} - \frac{Dp}{Dc}$$

is the greatest **shall** be selected.

Notes: When measuring distances Dp and Dc, it is recommended that consistency be applied in what points are being measured to.

Where the through highway passes adjacent to or within the closest community, Dc will approach zero, and $\frac{Dp}{Dc}$ will approach infinity.

Therefore, in this case, the closest community **shall** be the principal destination.

POLICY

On Hwy / Intersecting		Standard STH	Major STH	Interstate Highway
Standard Highway	**Ahead Destination**	Next Community	Regional Control City (1)	(2)
	Crossroad Destination	Next Community	Principal Destination	Principal Destination
Major STH	**Ahead Destination**	Next Community	Regional Control City (1)	(2)
	Crossroad Destination	Regional Control City	Regional Control City	Regional Control City
Interstate Highway	**Ahead Destination**	Next Community	Regional Control City (1)	National Control City
	Crossroad Destination	National Control City	National Control City	National Control City

1. If the major STH is constructed and signed as an expressway or freeway, an ahead destination is generally not displayed except as a pull-though sign at a system or directional interchange.
2. An ahead destination is generally not displayed except as a pull-through sign at a system or directional interchange.

SPECIFIC SELECTION CRITERIA

1. **On standard state trunk highways:** Destination signs (D1 series) *should* be used on the standard state highway approach to a numbered interstate. If designated, the "ahead" destination **shall** be the closest community on the through route. The first choice of destination names for the interstate **shall** be the closest national control city in each direction. The first choice of destination name for other freeways **shall** be the closest regional control city in each direction.
   a. If the intersecting route does not serve a national control city, then the regional control city, next community, or principal destination *may* be designated.
   b. Unincorporated communities meeting the qualifying criteria in definition 9 *may* be displayed on destination signs (D1 series) on conventional state highways.
   c. Unincorporated communities **shall not** be displayed on distance signs (D2 series) unless the community is designated a regional control city according to the definition 8b. However, they *may* be identified as unincorporated on the I2-3 name sign.
2. **On major state trunk highways:** Use regional control cities according to definition 8 and selected as follows:
   a. Select urban areas meeting the criteria of definition 8a & 8b
   b. If less than two meet the criteria of 8a or 8b, select urban area(s) meeting the criteria of 8c
   c. If the distance between areas selected above exceeds 160 miles, select urban areas between them, which meet the criteria of 8c.

   Unincorporated communities **shall not** be displayed on freeway or expressway exit signs, unless the community has been designated a regional control city according to the definition 8b.
3. **On interstate highways:** Use national control cities, except regional control cities or principal destinations *may* be selected as appropriate for intersecting highway destinations.
4. **Urban areas with more than one city or village:**
   a. On highways which serve the largest city in the urban area, only the largest city **shall** be named and **shall** be considered to represent the entire urban area.
   b. Destination signs **shall not** be erected within an urban area directing to a city or village within the same urban area, except:
      i. On major state trunk highways, signs *may* direct to the central business district of the largest city
      ii. On highways near the edge of urban areas, signs *may* direct to the largest city in the urban area which is served by the crossroad

iii. In bi-state urban areas, signs *may* direct to the largest out-of-state city.

5. **Control cities beyond the end of a highway:**

   A national or regional control city located beyond the end of a highway *may* be considered to be served by that highway if the connecting route:

   a. Is of the same or higher classification, and

   b. Continues in the same general direction as the ending highway, and

   c. Carries considerable through traffic from the ending highway.

6. **Bi-state urban areas:**

   In determining the population of an urban area, part of which is in Wisconsin and part of which is in an adjacent state, for the purpose of selecting regional control cities, the population of the in-state and out-of-state cities **shall** be added. Directional signs *may* name the largest Wisconsin city and/or the largest out-of-state city, as provided in criteria 4c(3) above.

7. **Other supplemental guide signs:**

   Additional communities are allowed on other supplemental guide signs. Only one supplemental guide sign with cities/communities **shall** be allowed per interchange, maximum of two cities/communities per sign.

8. When opportunity presents itself (improvement project, refurbishment project, etc.), the destinations on primary and supplemental guide signs *should* be reevaluated to ensure conformance to this policy.

2-15-6 Community Wayfinding Signs — January 2015

PURPOSE

This policy sets the uniform, Wisconsin state standards for signs, which communities *may* install <u>by permit</u> on conventional State Trunk Highways under DOT jurisdiction to provide directional guidance to public facilities and traffic generators within the community.

The MUTCD Section 2D.50 provides guidelines and standards for Community Wayfinding signing. Substantial conformance of these signs to the MUTCD and DOT policy is required by state law. Poorly designed and/or cluttered guide signs will not meet these requirements and could adversely impact safety.

On local streets and connecting highways, local agencies have the authority to install destination signs for local attractions and generators. If there is deviation from state and national standards to the extent that highway signing would adversely affect driving behavior, local agencies *may* face liability problems.

Therefore this policy establishes the following to be applied to Community Wayfinding Signing on State Highways under DOT jurisdiction:

1. the qualifying criteria for Community Wayfinding Signing;
2. guidance on qualifying destinations or facilities;
3. clarification of sign design and installation standards, applicable to WisDOT
4. the application and permit process for roadways under WisDOT jurisdiction.

DEFINITIONS

<u>Community Wayfinding Signs</u>

These are the signs, <u>allowed by permit</u>, which are owned and maintained by the community and direct to

1. municipal area destinations such as Downtown, or Historic District,
2. individual destinations that are publicly leased or owned and operated for public use, such as City Hall, Convention Center, and local parks, or
3. Privately owned non-profit facilities open to the public, such as a local museum or ice center.

<u>Trailblazing Signs</u>

In this context, these are community destination signs that direct subsequent turns on local streets to reach the destination.

Trailblazing (directional route signing) to state routes is the responsibility of WisDOT and will not be permitted on Community Wayfinding Signs.

POLICY FOR INSTALLATION ON STATE TRUNK HIGHWAYS

The Department will allow the local agency, by permit, to install and maintain community wayfinding signs on the right-of -way of the conventional state trunk highway system, subject to the destinations, design, location, and maintenance of the signs being reviewed and found satisfactory by the Department. These signs **shall not** be permitted on freeways or expressways.

WisDOT *may* fund the installation of wayfinding signs as part of a Community Sensitive Solutions project. For all Community Sensitive Solutions projects that include wayfinding signs, the sign design and locations **shall** be reviewed for conformity to WisDOT and MUTCD policies by the Region Traffic Operations. Wayfinding signs that are funded and installed as part of a Community Sensitive Solutions project **shall** be maintained by the community.

This policy does not apply to banners or civic displays, which are addressed in TEOpS 13-12-1.

Qualifying Criteria for Community Wayfinding Signing Programs

Community wayfinding signs will not be permitted outside a readily apparent urban developed area, usually characterized by a reduced speed limit, nearby transition to curb and gutter, and dense residential and/or business development adjacent to the highway.

Geographical areas or districts within a community *may* be permitted Community Wayfinding Signing. Two or more adjacent communities in an urbanized area *may* coordinate a common signing program, but the department will issue separate permits to each individual municipality.

No countywide programs will be permitted.

The community must develop a Master Plan for Community Wayfinding Signing, which contains the following information:

1. A map of the community, including the city street/local road system, which clearly identifies:
    a. Exact locations of destinations and attractions to be included in this signing program.
    b. State trunk highway approaches to city street/local road intersections where signing is proposed.
    c. Which destination(s) and attraction(s) are to be signed on each state trunk highway approach at each city street/local road intersection
    d. City street/local road intersections where trailblazing signing is required to direct motorists to each facility.
2. A concept design of a typical community wayfinding sign, which *may* include the city logo, a street name and up to a total of three destinations/attractions. A maximum of three destinations *should* be displayed on a sign.

The Master Plan **shall** be submitted to the WisDOT Regional Traffic Engineer for review. This submittal **shall** be initiated and coordinated by the community and **shall** identify one contact or lead person in the community, through which all Department correspondence and contact will be made.

If a community obtains DOT approval for Community Wayfinding Signing, no new requests for traffic generator signing, which would qualify for Community Destination Signs, will be approved within the community.

Qualifying Destinations or Facilities

Destinations or attractions must be of general interest to the traveling public and **shall not** be a retail, business or manufacturing center. The individual destinations **shall** be publicly leased or owned and operated facilities for public use or privately owned non-profit facilities open to the public.

Destinations which qualify for either Supplemental Traffic Generator signing or Community Wayfinding Signing,

1. *should* be included on the Community Wayfinding Signs,
2. *may* be on permitted supplemental signing,
3. but **shall not** be on both at the same intersection approach.

A specific destination **shall** only be displayed on one sign structure in each direction on a highway unless straight ahead signing is also approved by the Regional Traffic Engineer.

This type of signing **shall not** display advertising for a commercial product or service.

IH, USH or STH directional signage **shall not** be allowed on Community Wayfinding signs.

Sign Design Standards

Shape

The shape of the signs **shall** be rectangular and *may* have rounded corners. A rounded or other regular geometric shape on the top will be allowed to accommodate a logo.

Pictograph

Only one community pictograph *may* be incorporated in the top of the sign subject to WISDOT approval. If used, it **shall** be simple and easily recognizable. The height of the pictograph **shall not** exceed two times the height of the upper-case letters of the principal legend on the sign. For coordinated programs, a unique pictograph for each municipality *may* be used.

If a community name is to be displayed at the top of the sign panel, instead of or in addition to a pictograph, the lettering **shall** be of a size, font style and high color contrast for motorists to read at the posted speed.

All signs in a Community Wayfinding Signing program **shall** have the same format. If a community pictograph, and/or name, and/or street name, is to be used on any sign, it **shall** be used on all signs in the community program.

Pictographs for destinations and attractions **shall not** be permitted, since the traveling public will not recognize pictographs of local destinations.

Facing

Sign panel legends and backgrounds **shall** be reflective to meet the minimum standards of High Intensity sheeting.

Fluorescent reflective sheeting of any color **shall not** be permitted on these signs.

The sign **shall not** contain any animated or moving parts, flashing or moving lights, or flashing disks.

Color

Colors **shall** meet the standards for highway colors specified by the Federal Highway Administration. Color combinations **shall** have high contrast. Two-color combinations which *may* be used are:

1. White or yellow on blue, green or brown.
2. Blue, green, black or brown on white.
3. Red or orange on white, but not the reverse.
4. A third color, if used, must provide suitable contrast (i.e., not red on blue).

The background colors of orange, red, yellow, purple, or the fluorescent versions thereof, fluorescent yellow-green and fluorescent pink **shall not** be permitted on Community Destination Signs. One background color is preferred. A third color for the logo area *may* be used, or that area *may* be reversed in color. Color plaques or accents **shall not** be used under arrows or destination names. Lettering, arrows, and border **shall** be the same color.

Border

Border is optional. If used, it **shall** be plain, retroreflective, not decorative, and the same color as the letters.

Lettering & Sign Size

A minimum Series B font as specified in the Standard Highway Signs manual is preferred. A similar font is allowable, unless the style detracts noticeably from legibility.

The preferred letter size is 6” Upper Case/ 4 ½” Lower Case. In areas, where the posted speed is less than 35 mph, a minimum 5” Upper Case/ 3 ¾” Lower Case or 5” Capital Letters will be allowed.

The resulting sign width **shall not** exceed five feet adjacent to a roadway posted at 35 MPH or above. The sign width **shall not** exceed four feet adjacent to a roadway posted at 30 MPH or below.

Arrows

Arrows **shall** be as big in dimension as the lettering, and the same color as the adjacent lettering. The arrows **shall not** have encircling accents, or contrasting mini-backgrounds.

Arrows **shall** be left of the message for left destinations, and right of the message for right destinations.

Ahead arrows **shall not** be used except in combination with left and/or right arrow(s) and destination(s) to pull through to one major area destination, such as DOWNTOWN, or direct ahead to one or more qualifying destinations where the through route turns. When used, ahead arrows **shall** be on the left side of the top line.

Destinations

Destinations/attractions on a community destination sign **shall** be displayed (from top to bottom of sign) in the following sequence:

1. ahead destination (if used);
2. left-oriented destinations/attractions (closest to furthest);
3. right-oriented destinations/attractions (closest to furthest).

Community Wayfinding Signs *should* be limited to three destinations per sign.

Sign Installation Standards

Signs **shall** be installed by the community on separate supports furnished and typically used by the community. They **shall not** be combined with other signing by the community or the Department.

If signing is approved on the state trunk highway directing to a facility, any necessary trailblazing signing **shall** be installed on the city streets/local roads by the community before signing is installed on the state trunk highway.

The community **shall** affix an identification code number label to the back of each sign in accordance with State Statute Section 86.19(5) and TEOpS 2-1-30.

Sign supports **shall** conform to TEOpS 2-15-52.

Sign installation and placement **shall** be in accordance with WisDOT Standard Sign Details A4-3, A4-4, and A4-8, A4-9, A4-11, or A5-9, as applicable.

Signs **shall** be placed in advance of the intersection where a turn would be required.

Only one sign **shall** be permitted in each direction approaching an intersection and it *should* be located on the right side of the roadway.

The preferred sign spacing is 200 feet from any other highway sign. The minimum spacing **shall** be 100 feet.

Signs erected on the state trunk highway system **shall** have their locations approved by the Regional Traffic Engineer. Signs at all locations *should* be installed with due care to be visible, and to not obscure other traffic control devices. Further guidance on location is contained in Section 2A.16 of the MUTCD.

Application and Permit

Sign destinations, designs, and locations on State highways under DOT jurisdiction **shall** be approved by the WisDOT Regional Traffic Engineer. Installation of these signs **shall** be through this permit process.

Upon receipt of a master plan for Community Wayfinding Signing, including the typical standard sign design and the identification of the community contact person, the Regional Traffic Engineer will review the plan for

1. appropriate qualifying destinations,
2. direct and effective routing to the destinations, including trailblazing on local roadways,
3. appropriate sign locations,
4. individual sign designs, and
5. roadside conditions and constraints.

In order to expedite the process, the community *should* prepare the master plan in compliance with the guidelines in this policy. Any necessary denials or revisions *may* cause a return of the plan to the community contact person, resulting in a delay of the permit.

The permit will consist of an approved master plan attached to a permit letter signed by the Regional Traffic Engineer, and *may* include the necessary standard sign installation details mentioned above.

All sign panel designs *should* be reviewed and approved by the Regional Traffic Engineer before fabrication.

The community **shall** be responsible for the construction, installation and maintenance of the community wayfinding sign structures and sign panels at its own expense.

If community wayfinding signs are not properly maintained, the community **shall**, upon request by WisDOT, replace or remove the signs at its own expense. If not replaced or removed within 30 days of notification, WisDOT will remove the community wayfinding signs at the expense of the community.

Roadway reconstruction and/or installation of new regulatory, warning or guide signs *may* necessitate relocation or removal of community wayfinding signs by the community at its own expense.

GRANDFATHER CLAUSE

Existing permitted Community Wayfinding Signs will be allowed to remain temporarily without modification or replacement until the end of their useful life, or December 31, 2015, whichever comes first. Unpermitted signs **shall** be removed as soon as possible, unless they meet the standards contained in this policy. In that case, the community *may* apply for a retroactive permit by submitting the required master plan.

SAMPLE PERMIT FORM LETTER

Copy and paste to your Region letterhead.
Provide date, contact name, and address
Modify as needed.

RE: **Community Wayfinding Signing Permit**

This letter **shall** serve as the Community Wayfinding Signing Permit for (city, village, town) of (name) to install and maintain guidance signing on STH (number) as contained and approved in the attached master plan.

No additions or changes will be allowed without a revised and approved master plan.

WisDOT Standard Sign Installation Details, A4-3, A4-4, and (others as needed), are attached. Adherence to these standards is required.

Sincerely,

(signature)

(name, P.E.)
(Region) Traffic Engineer

2-15-7 Temporary Traffic Generator Signing on Improvement Projects — January 2013

BACKGROUND AND PURPOSE

Section 2E-35 of the MUTCD allows states and other agencies the option to adopt policies for Supplemental Traffic Generator (Directional Signing). Correspondingly, WisDOT has adopted a Supplemental Traffic Generator policy for permanent signs (TEOpS 2-15-3). However, there are cases (most notably improvement projects) where temporary Supplemental Traffic Generator signs are needed. Temporary Traffic Generator signs *may* be needed to temporarily replace SIS signs or previously approved Supplemental Traffic Generator signs that were previously installed on the roadway, but taken down temporarily for the project. There are other times where a business *may not* have been previously signed, but the improvement project closes off an access to a business and temporary signs *may* be needed to ease the construction impact to the business. In some of these cases, a Temporary Business Guidance Sign *may* be permitted.

The following policy provides guidance on the different types of Temporary Traffic Generator signs that *may* be utilized on improvement projects.

DEFINITIONS

Freeways are defined as divided highways with fully controlled access at interchanges only. Interstate highways are freeways with the interstate route designation.

Expressways are defined as divided highways with partially controlled access by a combination of interchanges, at-grade intersections, and driveways.

Conventional Highways are defined as streets or roads other than freeways or expressways. They *may* be divided or undivided, two-lane or multi-lane, and access is available at intersections and driveways.

POLICY

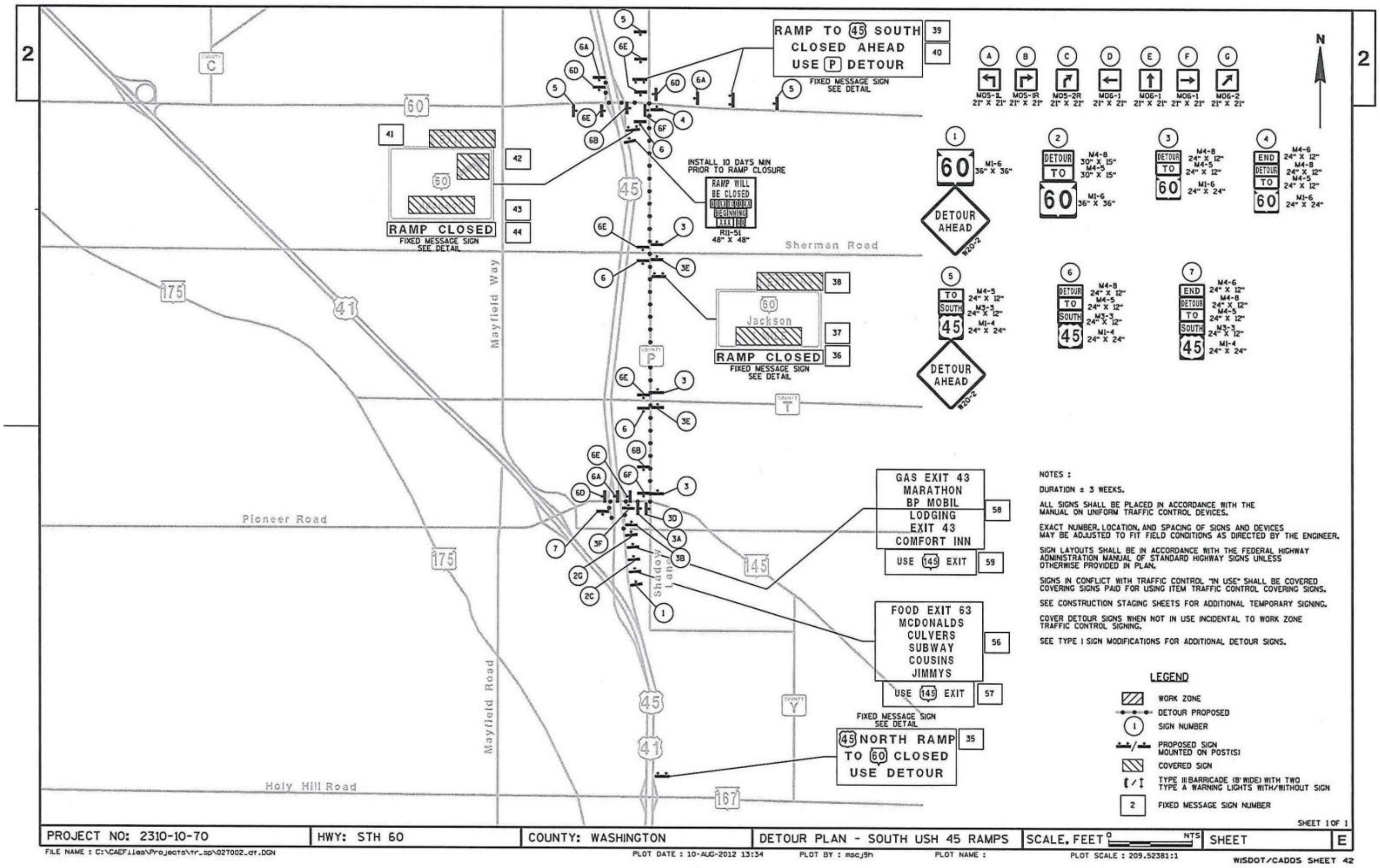
Projects that have previously approved SIS or Supplemental Traffic Generator Signs that have been temporarily removed during construction.

1. Temporary SIS Signs and Supplemental Traffic Generator signs **shall** only be allowed for approved SIS or Supplemental Traffic Generator signs that were removed as part of the improvement project (See Figure 1).
2. Temporary SIS Signs and Supplemental Traffic Generator signs **shall** be black on orange and contain no logos.
3. Temporary SIS Signs and Supplemental Traffic Generator signs **shall** be designed by WisDOT Bureau of Traffic Operations for all Regions, except SE. For SE Region projects, the signs **shall** be designed by the SE Region Traffic Operations. Sign details and installation details *should* be included as part of the improvement project plans.
4. Temporary SIS Signs and Supplemental Traffic Generator signs are typically paid for as part of the improvement project under the bid item, Traffic Control Signs Fixed Message.

Temporary Business Guidance Signs (signs not previously approved as SIS or Supplemental Traffic Generator signs).

1. Temporary directional signing for local businesses *may* be allowed in the highway right-of-way, at locations approved by the Project Manager.
2. Privately erected signs **shall** require an approved permit (see attached Temporary Business Guidance Signs Permit Application). Privately erected signs Temporary directional signing for local businesses **shall not** be allowed on freeways, expressways or at the exit ramp.

Figure 1. Example of Temporary SIS Signs for Improvement Projects



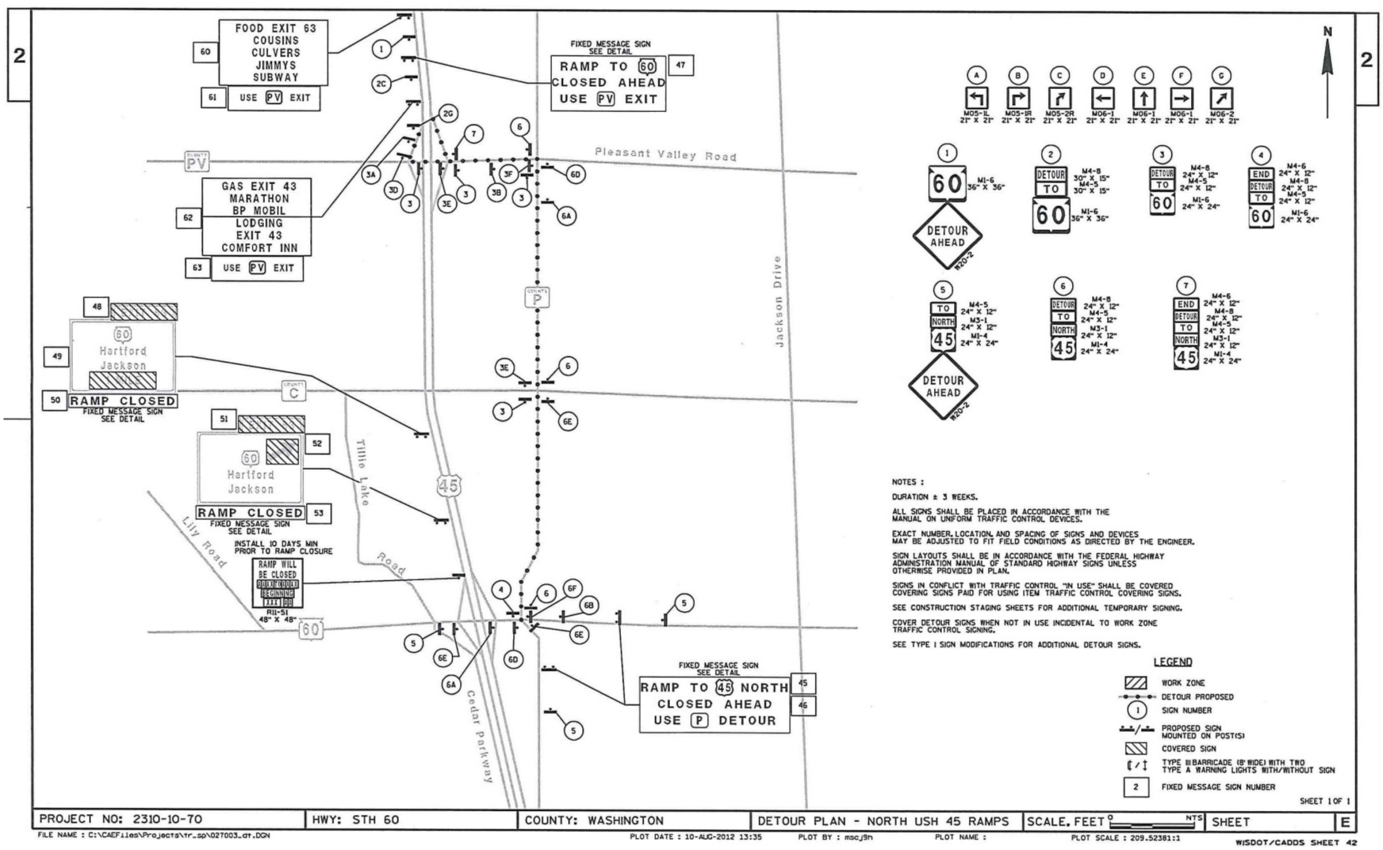


Figure 2. Temporary Business Guidance Signs Permit Application

APPLICATION – PERMIT TO INSTALL TEMPORARY BUSINESS SIGN(S)
On Highway Right-of-Way during Improvement Project

Wisconsin Department of Transportation
DT1932 6/2014

Applicant Name
Business or Activity – Address, City, State and Zip Code
(Area Code) Telephone
Type of Business or Activity
Sign Location(s) – Number and Placement to be coordinated with Project Engineer

On what highway?	At or approaching intersection with what highway?
1. On:	At:
2. On:	At:
3. On:	At:
4. On:	At:
5. On:	At:
6. On:	At:
Remarks:	

Two drawings MUST be attached: *One drawing must show the proposed sign design(s) and dimensions and the other must show the proposed sign location(s).*

I apply for permission to install and maintain temporary directional signs at the locations listed and in conformance with the guidelines attached to this application. I agree to comply with these guidelines and will remove all signs upon completion of the project, or when directed by the project engineer. I understand that signs may be removed without notice if they do not comply with the attached guidelines, do not match the attached drawings or do not comply with any additional conditions stated on or attached to the permit.

X ______________________ (Applicant Signature)

X ______________________ (Approved by Project Manager) (Date – m/d/yyyy)

X ______________________ (Maintaining Authority – *if sign location is not on STH)*

Project I.D.:

Guidelines for Installation of Temporary Business Guidance Signs On Improvement Projects

WisDOT may allow the placement of temporary directional signs in the highway right-of-way at locations approved by the Project Engineer. Privately erected signs require an approved permit (see attached permit form) and will not be allowed on the mainline of freeways or expressways. Signs with generic messages not containing individual business names (e.g., Access to Downtown) should be given consideration. Typical locations for generic message signs may include endpoints of the construction project or detour and sideroads approaching the project.

The following guidelines apply to privately erected signs along conventional highways (non-freeway/ non-expressway) or along offramps near the project:

1. The signs will not obstruct the view of, interfere with, or be attached to official traffic control devices such as signs and barricades, or obstruct the view of drivers entering or traveling on the highway. Signs shall be placed to allow at least 6 feet of clearance from edge of gravel shoulder to edge of sign, or at least 2 feet from back of curb to edge of sign. Signs shall be placed as near the right-of-way line as possible and shall not be placed in the median of divided highways.
2. Where several neighboring businesses are affected, every effort shall be made to identify these businesses on common signs. In the interest of legibility and not creating undue distraction to drivers, it may be necessary to identify businesses by their general location, e.g., “Main Street Businesses”, “Downtown Businesses”, or “City Business District”, rather than by individual business names. Use the phrase “Access To” instead of “Open To” on signs to clarify that although access is provided to businesses, the roadway is still closed to through traffic. Signs for an individual business may not be greater than 3' high by 3' wide. If multiple businesses are combined on a single sign, that sign may not be greater than 4' high by 8' wide.
3. If access to the business(s) will be through the closed portion of the highway under construction, one directional sign at the beginning of the detour, from each direction, will be allowed. Additional “trailblazers” may be necessary to guide traffic along the closed portion of the road, as approved by the Project Engineer.
4. If access to the business(s) will be via a road connecting the detour route to the closed portion of the highway, one sign will be allowed in each direction on the detour at the point where a motorist must leave the detour. Additional “trailblazers” may be necessary to guide traffic along the local road system after leaving the detour route. These signs must be approved by the Project Engineer and the local road’s maintaining authority.
5. For uniformity and readability, the lettering should be black block style letters on a white background and shall conform to the following size requirements: 4" high for posted speeds less than 45 mph; 6" high for posted speeds 45 mph or greater. Business logos may be used as an alternative to word messages but maximum allowable logo size is 4 square feet.
6. Sign supports shall be of FHWA approved breakaway materials, i.e., 4" x 4" wood posts, or smaller, as appropriate to the size and weight of the sign. It is the responsibility of the sign installer to contact Diggers’ Hotline at 1-800-242-8511 prior to installation. When it is not possible to mount the signs on post supports, use portable mounts approved by the Project Engineer. Business signs shall not be placed on any devices that are part of the official traffic control for the project.

The following guidelines apply along freeway/expressway mainline:

- No privately erected signs will be allowed on mainline freeways/expressways.

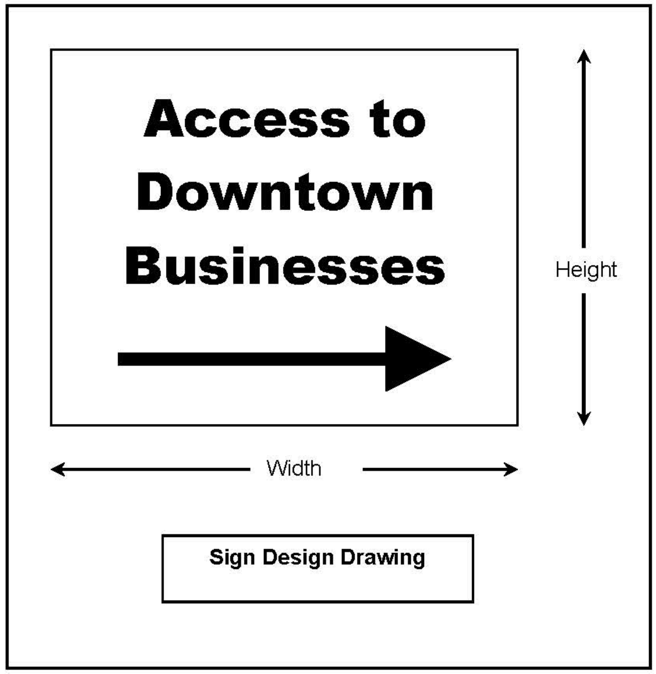
General Coordination and Permit Conditions for Privately Erected Signs

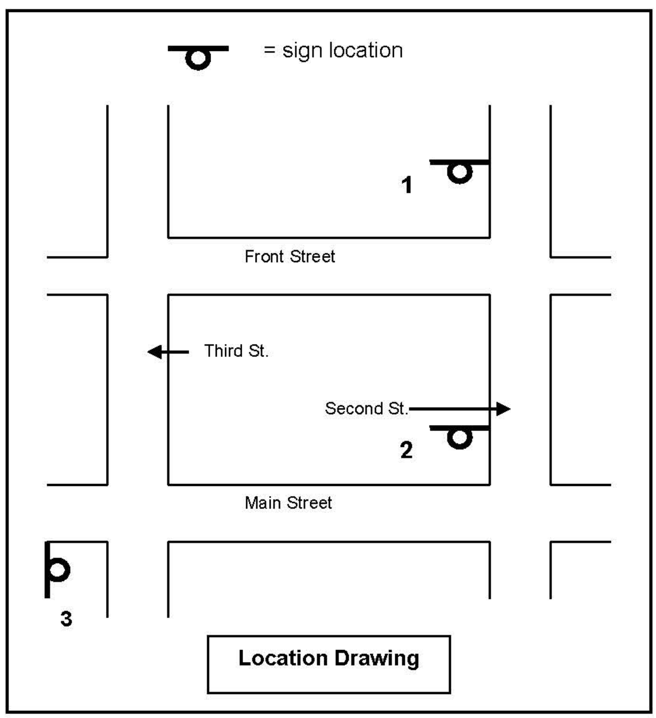
The Project Engineer will coordinate the design and placement of the signs with the owner, and will grant approval. All approved signs, their design and locations, will be documented on the permit form attached to these guidelines. A copy of the permit shall be delivered to the Project Engineer, and the maintaining authority in the case of local roads. The approved signs will be erected and removed at the expense of the applicant.

If non-complying signs or signs with potential to cause safety problems are located on a project, the Project Engineer will notify the business identified on the sign. Such signs not removed or corrected immediately will be removed by the department or its representatives and the cost billed to the sign owner.

All temporary signs must be removed by the applicant within 48 hours following restoration of normal traffic patterns. Such signs not removed after 48 hours will be removed by the department or its representatives and the cost billed to the sign owner.

Examples of Sign Permit Drawings:





2-15-11 Transition, Two to Four Lanes — June 2005

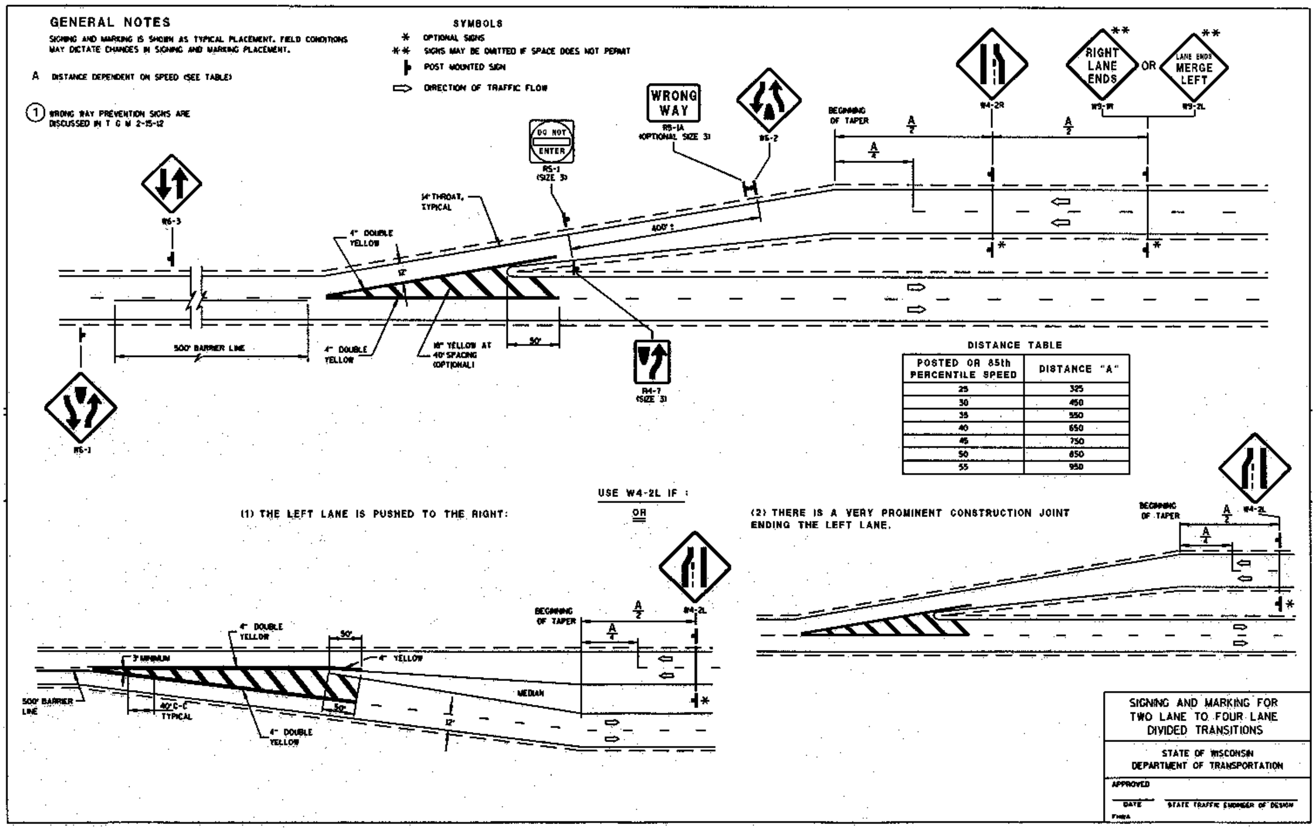
GUIDANCE

Figure 1 portrays recommended pavement markings and signing for typical transitions of two-lane highways to divided highways.

The main feature of the pavement markings is the formation of a large “V,” which will give continuous guidance to the left of the driver leaving the divided section.

The choice between using a W4-2R or L has been debated and has arguments on both sides. The illustration provides an acceptable signing choice in the absence of any other determinant factors.

Figure 1. Marking and Signing for Two-Lane to Four-Lane Divided Transitions



2-15-12 Wrong Way Prevention — November 2015

PURPOSE

Prevention of wrong way movement is a concern wherever an entire roadway is dedicated to one-way traffic. Wrong-way prevention signing consists of the appropriate use and placement of Turn Prohibition signs, Keep Right signs, DO NOT ENTER signs, WRONG WAY signs, ONE WAY signs, and Divided Highway Crossing signs.

The need for wrong way prevention signing in any situation is determined by the complexity of the situation requiring positive guidance and the consequence of error. The following guidance and details are intended to define the typical amount of signing for the various applications.

APPLICATIONS

<u>DIVIDED HIGHWAY WITH WIDE MEDIAN intersection with TWO-WAY CROSS STREET</u> (See Figure 1)

This typical signing plan *should* be sufficient for most intersections of this type.

The MUTCD Section 2B.37 and Figure 2B-12 allows the single installation of DO NOT ENTER and WRONG WAY SIGNS. Where the median width is 30 feet or greater, the signs *should* be installed on the median side.

<u>DIVIDED HIGHWAY WITH NARROW MEDIAN intersection with TWO-WAY CROSS STREET</u> (See Figure 2)

This typical signing plan *should* be sufficient for most intersections of this type. Additional needs *may* be met by installing additional signs as shown in MUTCD Figure 2B-15.

The MUTCD Section 2B.37 and Figure 2B-12 to allow the single installation of DO NOT ENTER and WRONG WAY SIGNS. Where the median width is less than 30', the signs *should* be installed on the outer side.

<u>DIVIDED HIGHWAY WITH WIDE MEDIAN intersection with INTERCHANGE RAMPS</u> (See Figure 3)

This typical signing plan *should* be sufficient for most intersections of this type. It combines the typical signing requirements from **Figure 1** with the Standards, Guidance and Options in the MUTCD Section 2B.41 and Figure 2B.18, except that the Turn Prohibition signs are designated optional. This is consistent with the last Option paragraph in the MUTCD Section 2B.18.

DIVIDED HIGHWAY WITH NARROW MEDIAN intersection with INTERCHANGE RAMPS (See Figure 4)

This typical signing plan *should* be sufficient for most intersections of this type. It combines the typical signing requirements from **Figure 2** with the Standards, Guidance and Options in the MUTCD Section 2B.41 and Figure 2B.18, except that the Turn Prohibition signs are designated optional. This is consistent with the second to last Option paragraph in the MUTCD Section 2B.18.

TWO-WAY UNDIVIDED HIGHWAY intersection with INTERCHANGE RAMPS (See Figure 5)

This typical signing plan *should* be sufficient for most intersections of this type. It reflects the Standards, Guidance and Options in the MUTCD Section 2B.41 and Figure 2B.18, except that the Turn Prohibition signs are designated optional. This is consistent with the second to last Option paragraph in the MUTCD Section 2B.18.

TRANSITION FROM TWO-WAY UNDIVIDED HIGHWAY TO DIVIDED HIGHWAY (See Figure 6)

This typical signing plan *should* be sufficient to prevent wrong-way movements in these transition areas. TEOpS 2-15-11 illustrates the overall signing and pavement marking requirements in greater detail.

DIVIDED HIGHWAY WITH INTERSECTING SIDEROAD (See Figures 7 and 8)

These typical signing plans *should* be sufficient for most side roads of these types. Additional needs *may* be met by installing additional signs as shown in the MUTCD Figure 2B-15.

The MUTCD Section 2B.37 and Figure 2B-12 allows for the single installation of the DO NOT ENTER and WRONG WAY signs. Where the median width is less than 30', the signs *should* be installed on the outer side.

DIVIDED HIGHWAY WITH NARROW OR WIDE MEDIAN DRIVEWAY (See Figures 9, 10 ,11, 12 and 13)

These typical signing plans *should* be sufficient for most driveways of these types. Additional needs *may* be met by installing additional signs as shown in the MUTCD Figure 2B-15.

The MUTCD Section 2B.37 and Figure 2B-12 allows for the single installation of the DO NOT ENTER and WRONG WAY signs. Where the median width is less than 30', the signs *should* be installed on the outer side.

ROUNDABOUTS (See Figure 14)

This typical signing plan *should* be sufficient for the prevention of wrong way movements on roundabouts with single and multiple approach lanes and interchange off-ramps.

DIVIDED HIGHWAY WITH SIGNALIZED WIDE MEDIAN INTERSECTION (See Figure 16)

This typical signing plan *should* be sufficient for most intersections of this type.

The MUTCD Section 2B.37 and Figure 2B-12 allows the single installation of DO NOT ENTER and WRONG WAY SIGNS. Where the median width is 30 feet or greater, the signs *should* be installed on the median side.

DIVIDED HIGHWAY WITH SIGNALIZED NARROW MEDAN INTERSECTION (See Figure 17)

This typical signing plan *should* be sufficient for most intersections of this type. Additional needs *may* be met by installing additional signs as shown in MUTCD Figure 2B-16.

The MUTCD Section 2B.37 and Figure 2B-12 to allow the single installation of DO NOT ENTER and WRONG WAY SIGNS. Where the median width is less than 30', the signs *should* be installed on the outer side.

POLICY

At approaches to multi-lane roadways with median widths less than 30', the R6-1 ONE WAY sign **shall** be installed at the near right installation above the STOP or YIELD sign. At approaches to multi-lane roadways with median widths 30' or greater, two R6-1 ONE WAY signs **shall** be installed back to back at the near right installation above the STOP or Yield sign. The R6-1 ONE WAY sign **shall** be used at "T" intersections with divided highways or above the roundabout directional arrow (R6-4b) sign.

At divided highways with wide medians that have a STOP or Yield sign in the median, a R6-1 ONE WAY sign **shall** be installed back to back above the STOP or Yield sign (See Figure 15).

The R6-2 ONE WAY sign **shall** be used for all other locations on the STH system.

The DO NOT ENTER sign **shall** be installed where it does not obscure the outline or shape of STOP or YIELD signs. If space does not permit, it is permissible to trim the DO NOT ENTER sign into an octagon shape, however the preference is to install the DO NOT ENTER sign on a separate post, next to the STOP sign.

GUIDELINES

Short divided sections with low traffic volumes and a posted speed of 40 mph or less *may* not need the DO NOT ENTER and WRONG WAY signs.

An urban boulevard with frequent cross streets and median openings *should* not need repeated DO NOT ENTER and WRONG WAY signs.

A history of wrong way movements and/or related crashes *may* warrant further measures. If visibility of the far roadway from the side street or ramp is obscured by geometrics or cross section, additional ONE WAY signs *may* be necessary and positioned as shown in the MUTCD Figure 2B-15.

Highway lighting *may* be a solution to visibility problems, eliminating the need for extra signing.

Pavement marking arrows *may* be used to supplement signing and reinforce the wrong way prevention message, especially on exit ramps.

Freeway ramps *may* warrant additional signing and marking strategies to help prevent wrong way movements. The following strategies *may* be used at freeway ramp locations that have exhibited problems with wrong way drivers entering the freeway:

1. Upsizing of DO NOT ENTER and WRONG WAY signs
2. Stop bars and type 4 pavement marking arrows
3. Dotted pavement marking line extensions through the intersection

The following strategies *may* be used in addition to the ones above or on their own. All of the following strategies are optional, and **shall** only be used at side by side ramp locations that have exhibited problems with wrong way drivers entering the freeway:

1. Additional WRONG WAY signs mounted below the DO NOT ENTER signs at a 3 foot mounting height as measured vertically from the bottom of the sign to the top of the near edge of pavement.
2. Reflective strips on WRONG WAY and DO NOT ENTER sign posts. These strips **shall** be 2 inches wide, composed of red Type H sheeting on 0.040 inch sheet aluminum, and **shall** run from the bottom of the sign to within 2 feet above the edge of pavement.
3. A FREEWAY ENTRANCE sign placed at the entrance to the on ramp
4. Dynamic (flashing) WRONG WAY signs

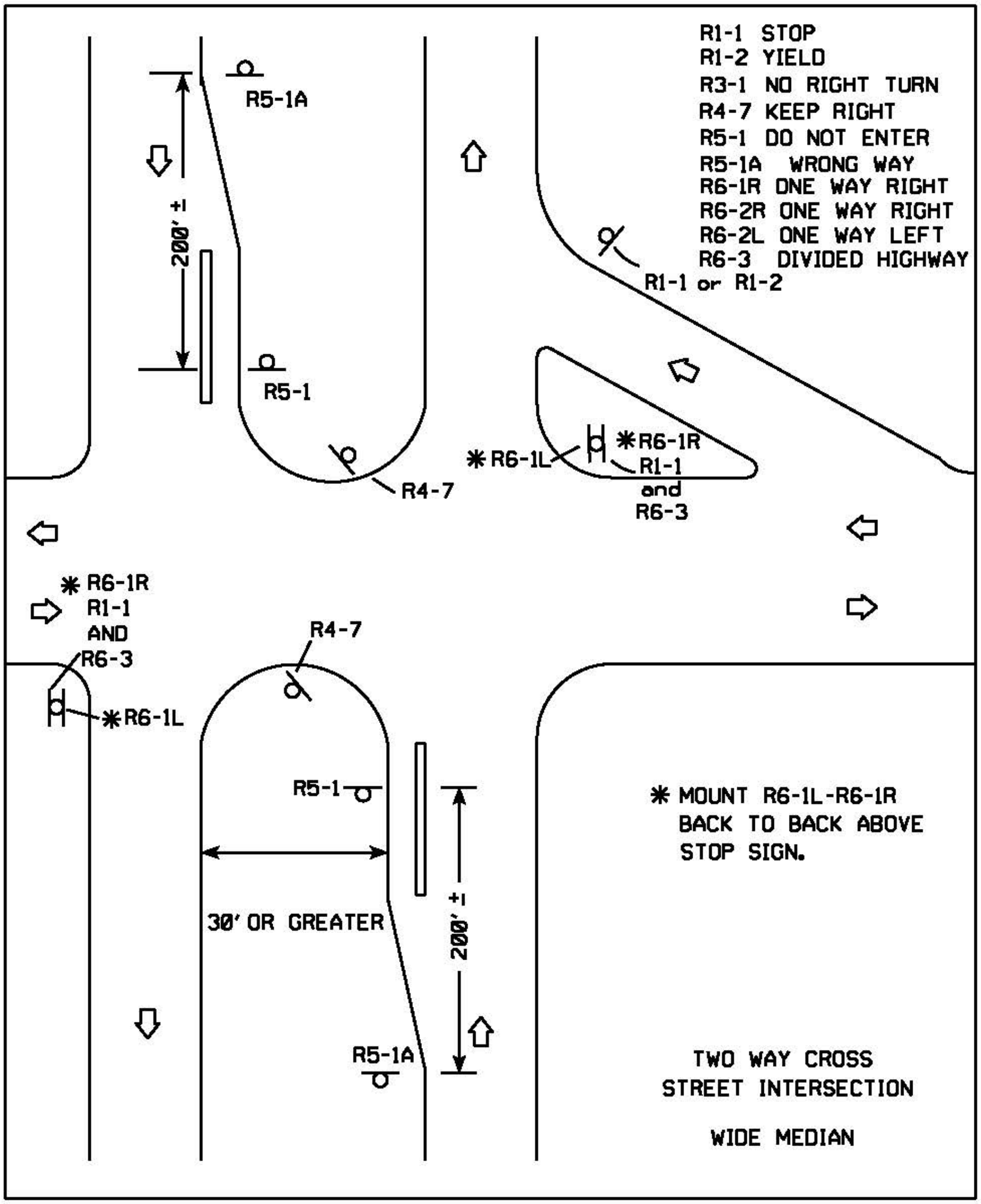


FIG. 1 WRONG WAY SIGNING RELATIVE TO DIVIDED HIGHWAY.

NOTE: SIGNING IS SHOWN AS TYPICAL SIGN PLACEMENT.
FIELD CONDITIONS MAY DICTATE CHANGES IN
SIGN PLACEMENT.

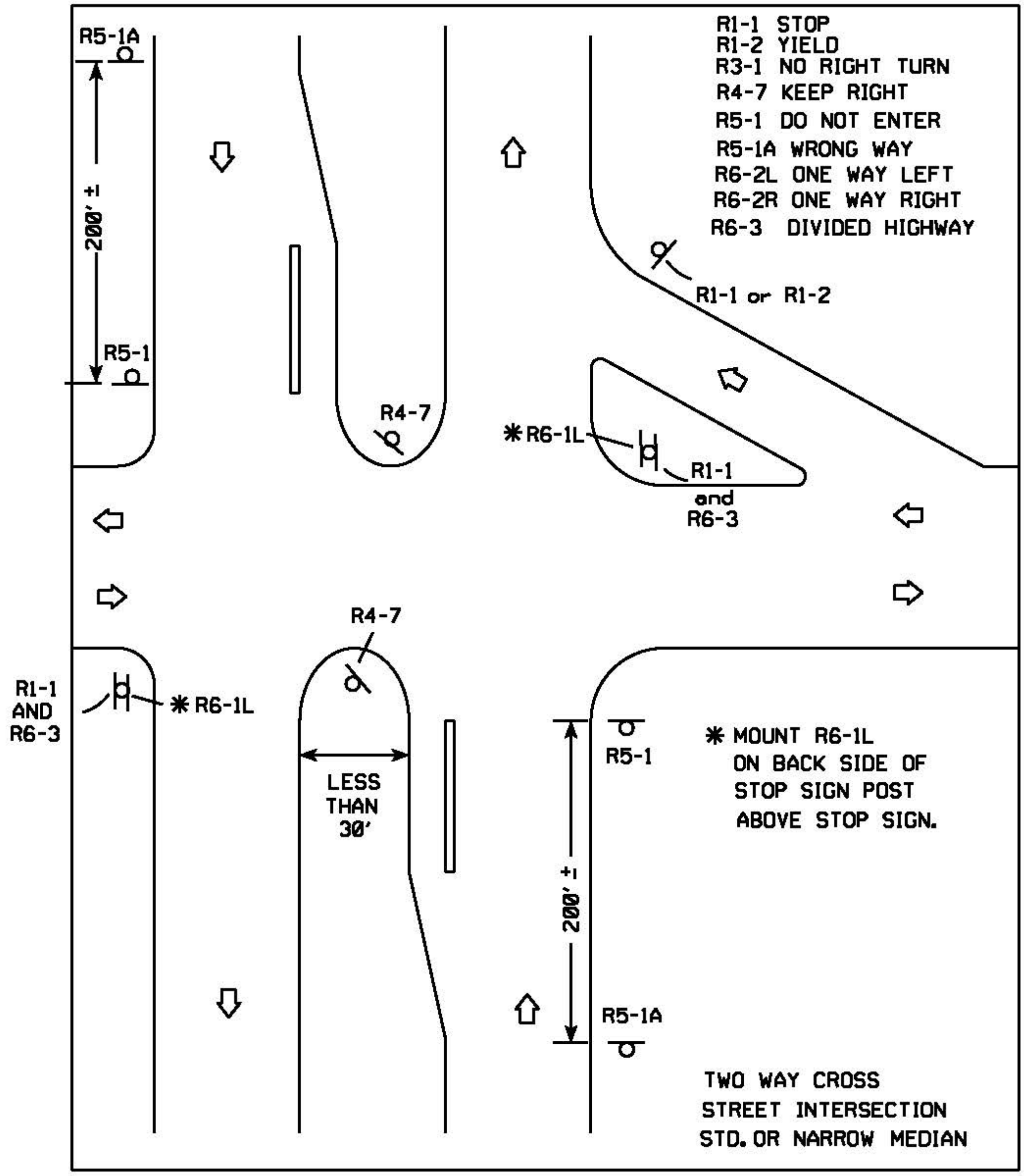


FIG. 2 WRONG WAY SIGNING RELATIVE TO DIVIDED HIGHWAY.

NOTE: SIGNING IS SHOWN AS TYPICAL SIGN PLACEMENT.
FIELD CONDITIONS MAY DICTATE CHANGES IN
SIGN PLACEMENT.

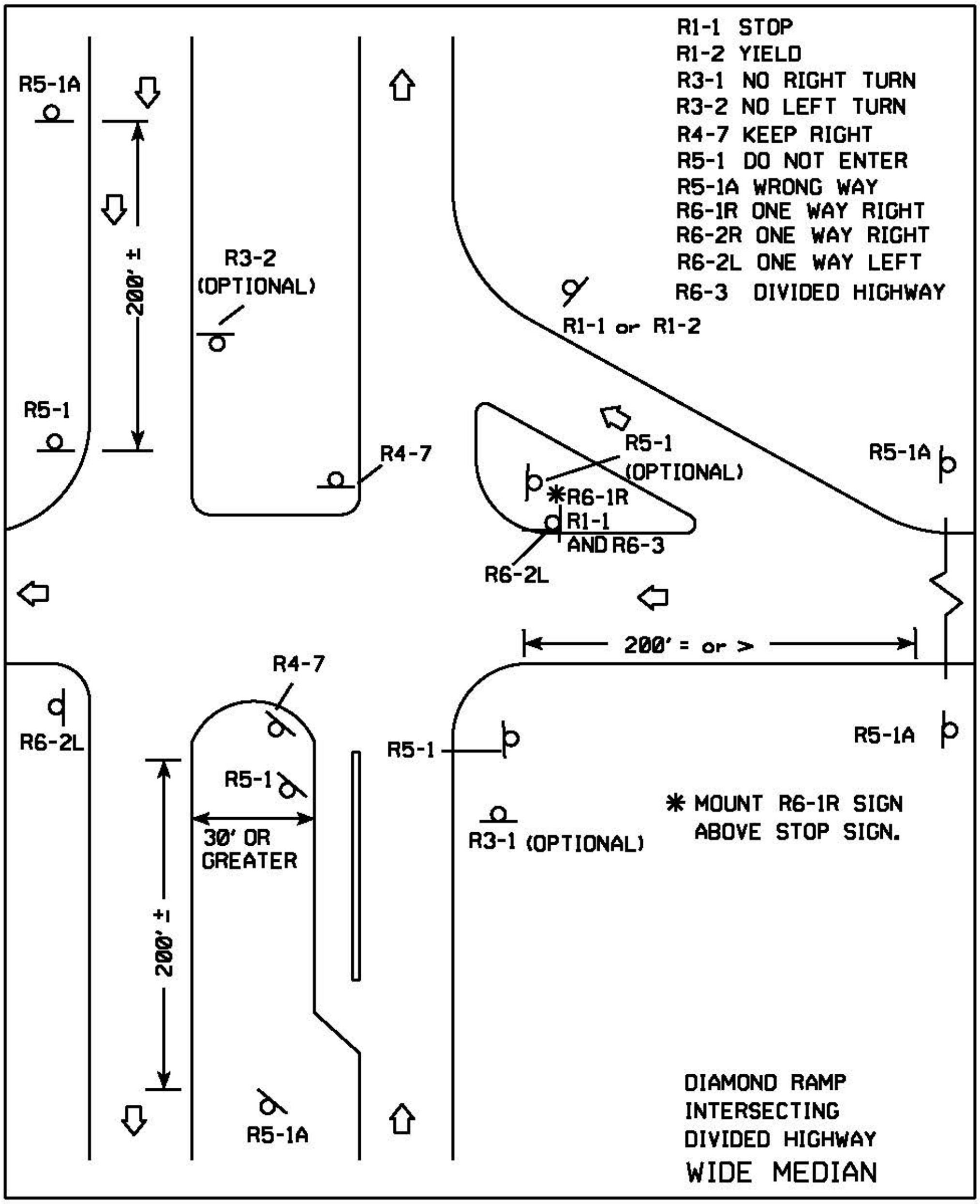


FIG. 3 WRONG WAY SIGNING RELATIVE TO RAMP.

NOTE: SIGNING IS SHOWN AS TYPICAL SIGN PLACEMENT. FIELD CONDITIONS MAY DICTATE CHANGES IN SIGN PLACEMENT.

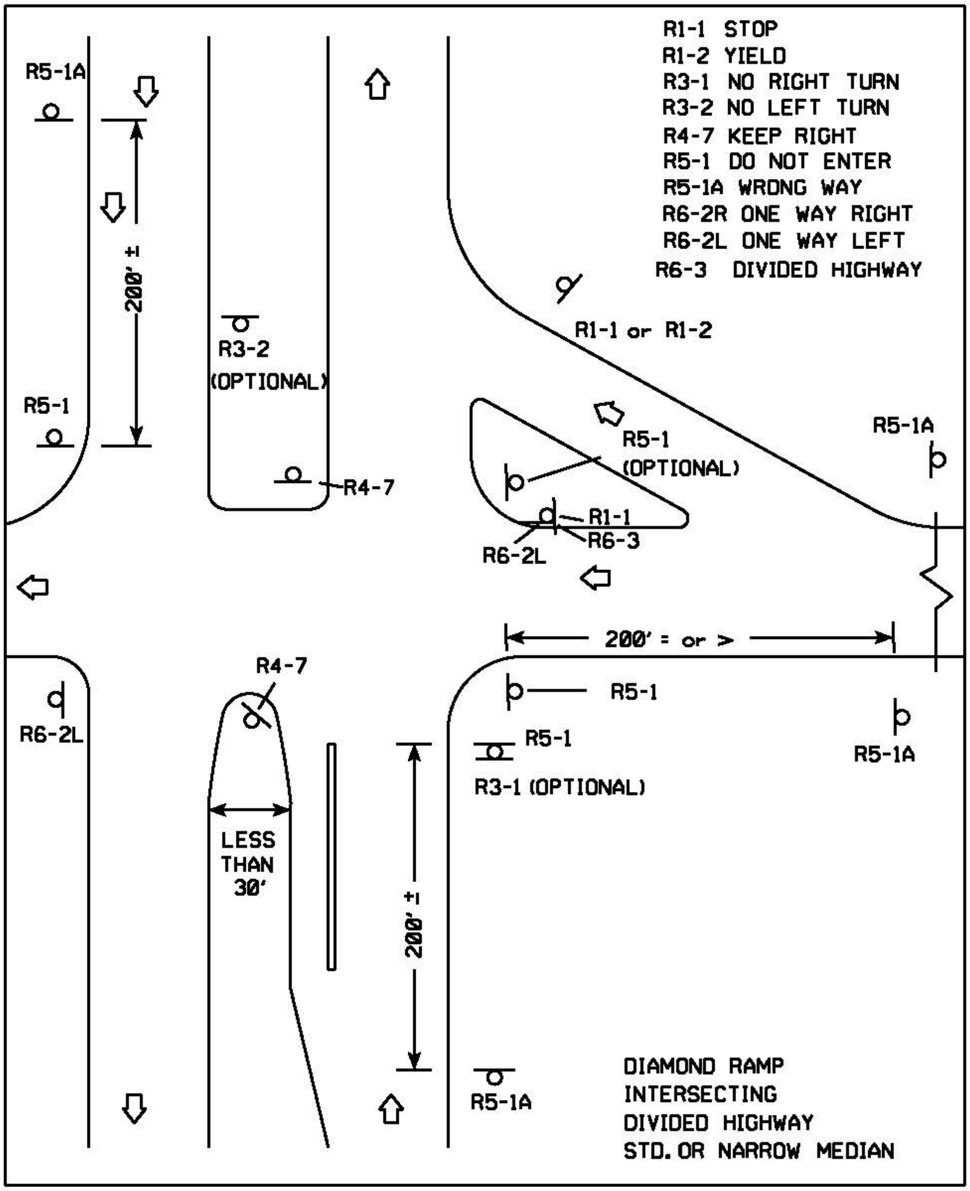


FIG. 4 WRONG WAY SIGNING RELATIVE TO RAMP.

NOTE: SIGNING IS SHOWN AS TYPICAL SIGN PLACEMENT. FIELD CONDITIONS MAY DICTATE CHANGES IN SIGN PLACEMENT.

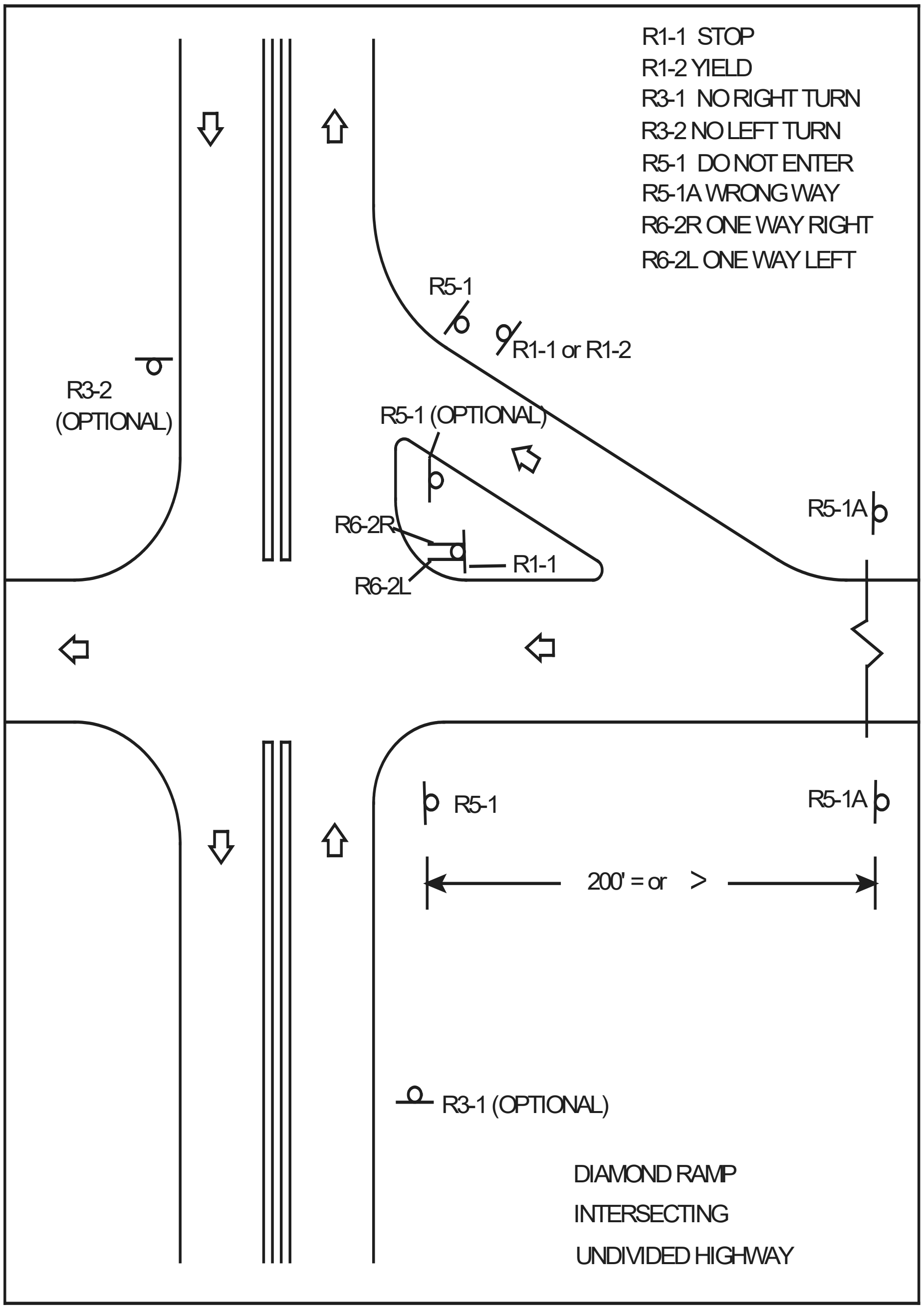


FIG. 5 WRONG WAY SIGNING RELATIVE TO RAMP.

NOTE: SIGNING IS SHOWN AS TYPICAL SIGN PLACEMENT. FIELD CONDITIONS MAY DICTATE CHANGES IN SIGN PLACEMENT.

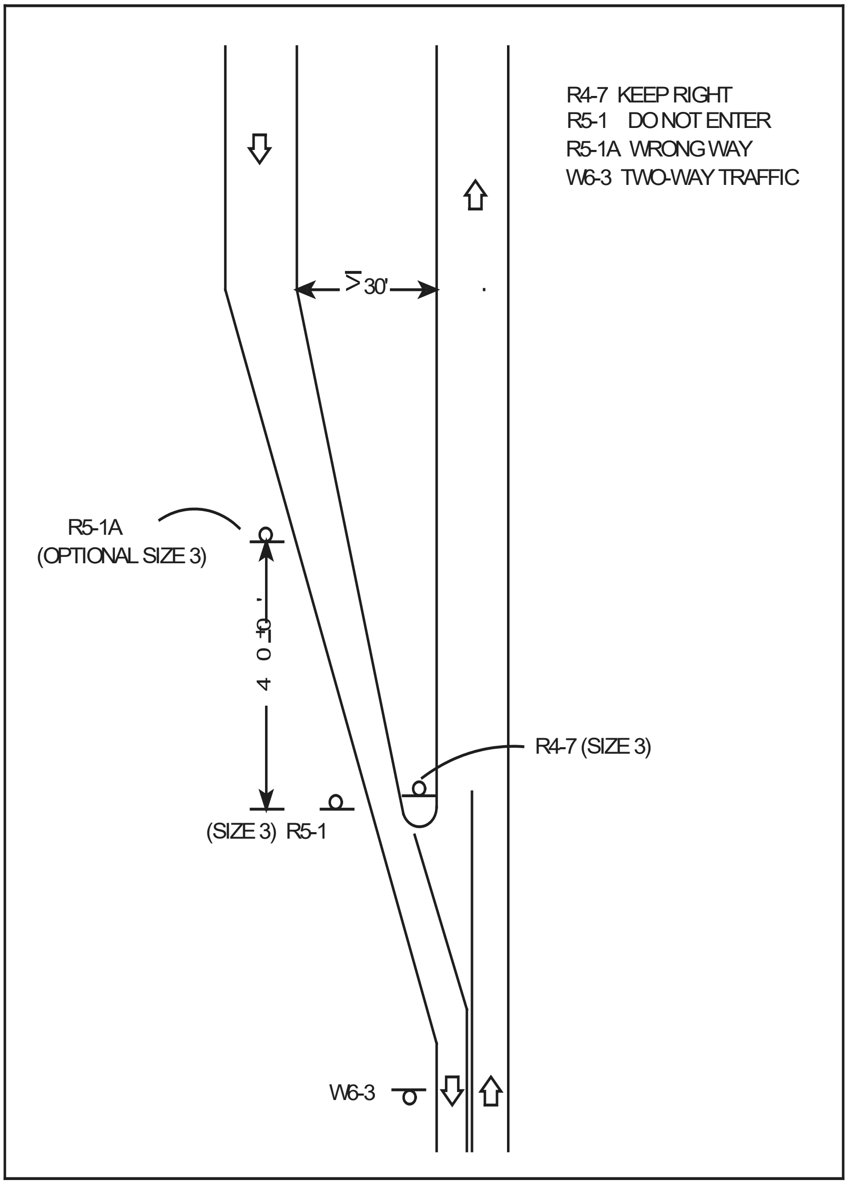


FIG. 6 TRANSITION FROM TWO-WAY UNDIVDED HIGHWAY TO DIVIDED HIGHWA

NOTE: SIGNING IS SHOWN AS TYPICAL SIGN PLACEMENT.
FIELD CONDITIONS MAY DICTATE CHANGES IN
SIGN PLACEMENT.

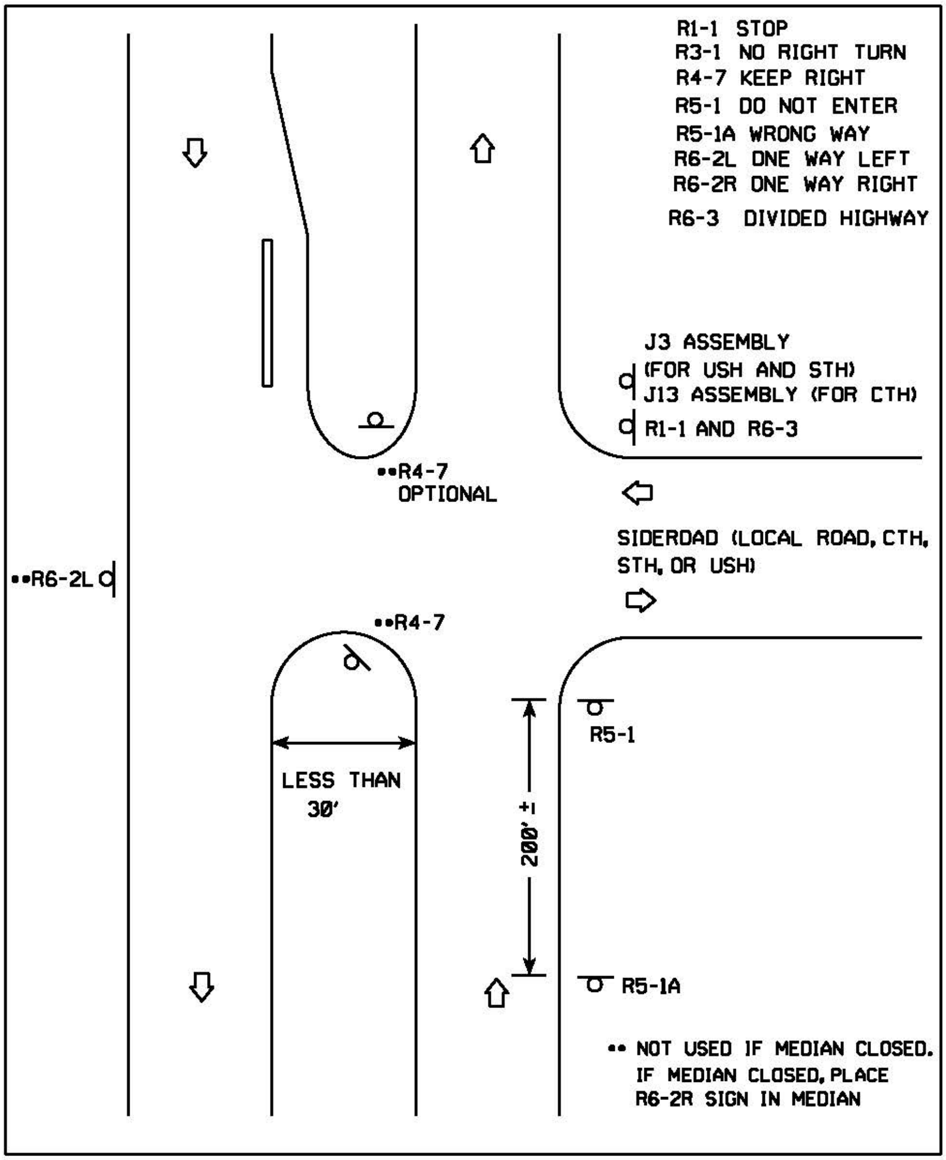


FIG. 7 WRONG WAY SIGNING RELATIVE TO DIVIDED HIGHWAY.

NOTE: SIGNING IS SHOWN AS TYPICAL SIGN PLACEMENT.
FIELD CONDITIONS MAY DICTATE CHANGES IN
SIGN PLACEMENT.

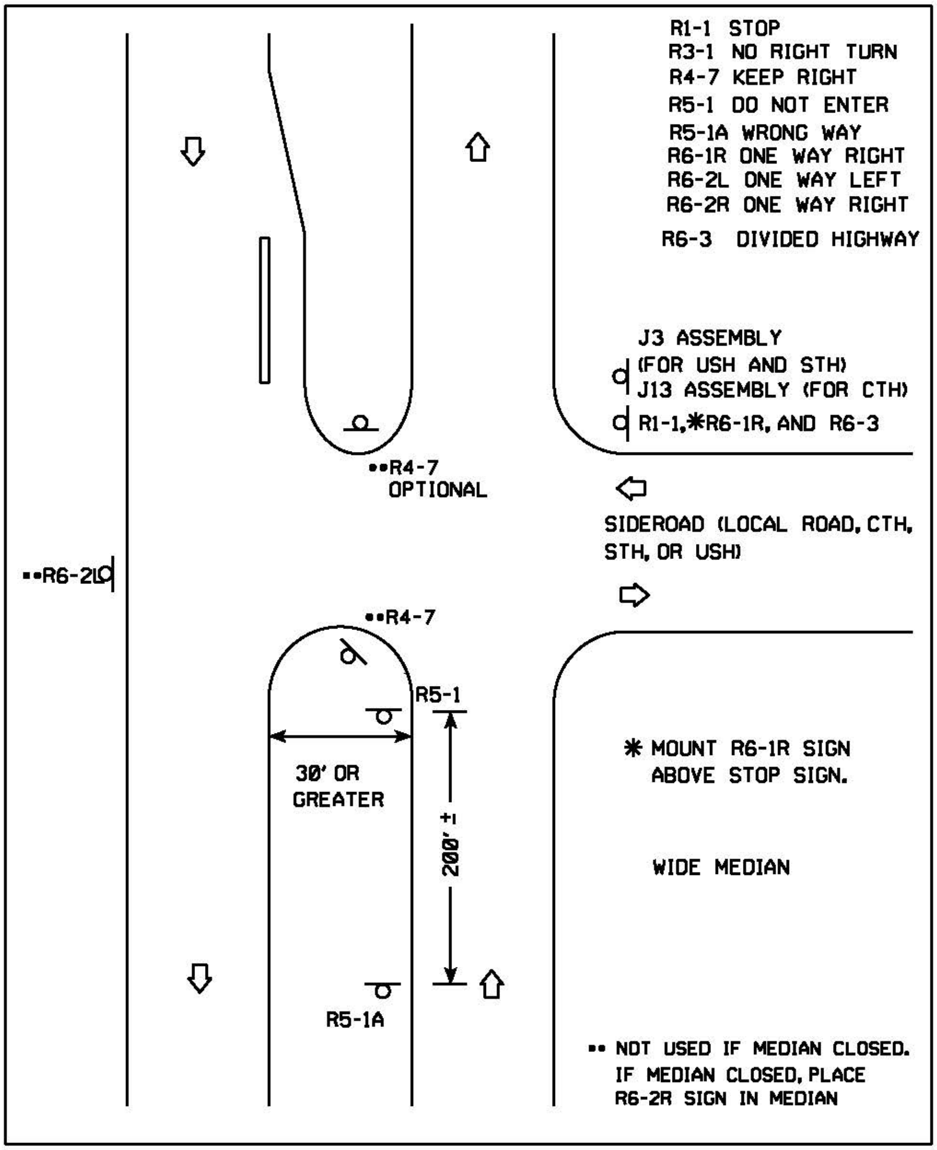


FIG. 8 WRONG WAY SIGNING RELATIVE TO DIVIDED HIGHWAY.

NOTE: SIGNING IS SHOWN AS TYPICAL SIGN PLACEMENT.
FIELD CONDITIONS MAY DICTATE CHANGES IN
SIGN PLACEMENT.

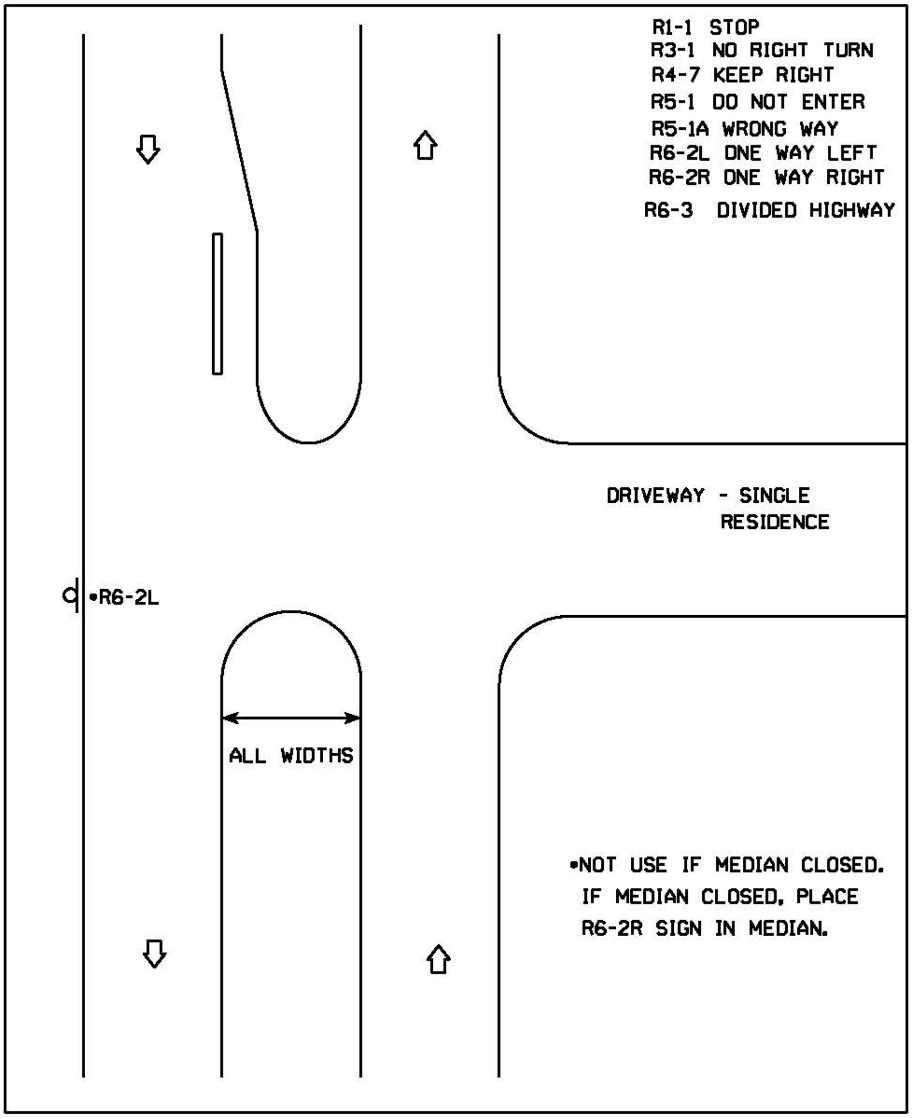


FIG. 9 WRONG WAY SIGNING RELATIVE TO DIVIDED HIGHWAY.

NOTE: SIGNING IS SHOWN AS TYPICAL SIGN PLACEMENT. FIELD CONDITIONS MAY DICTATE CHANGES IN SIGN PLACEMENT.

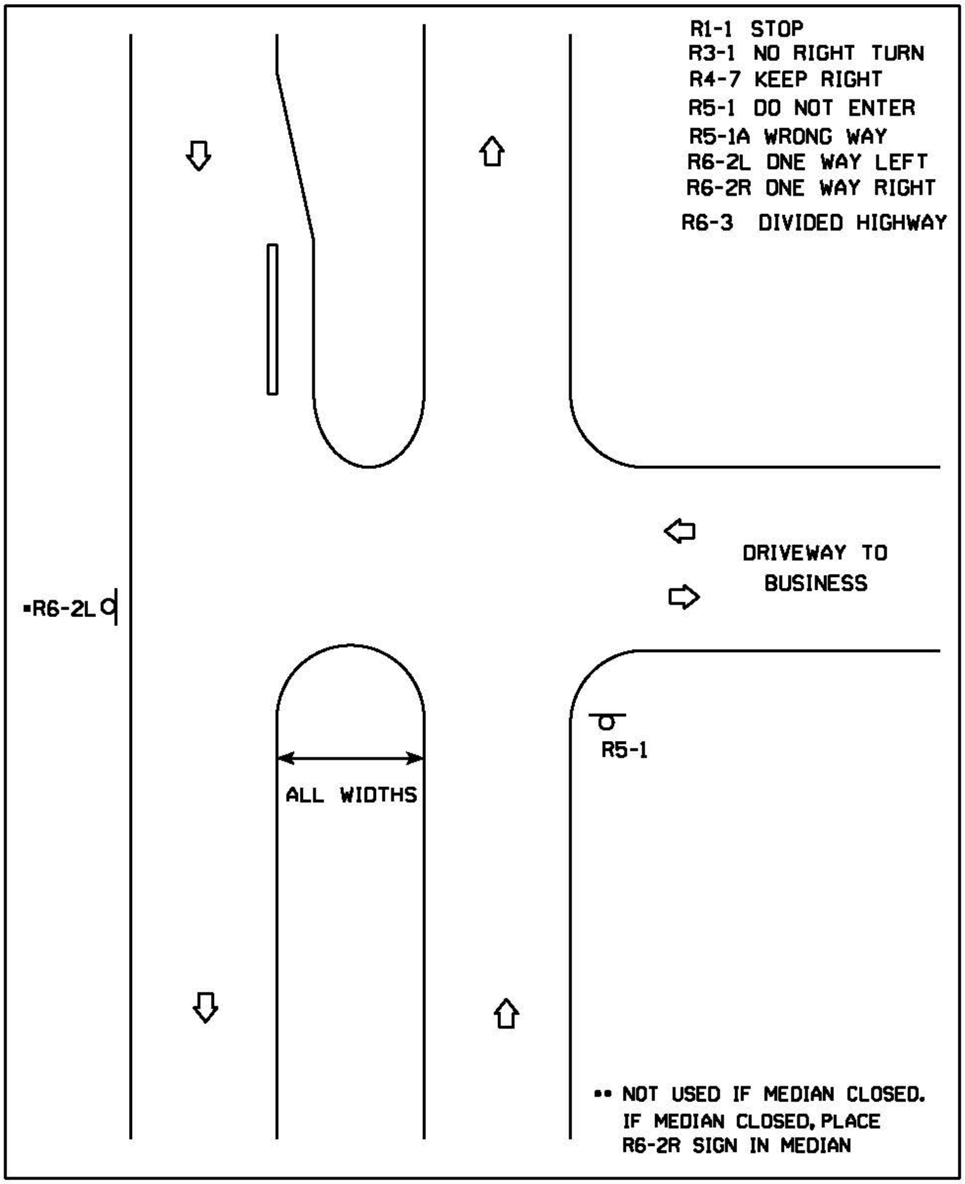


FIG. 10 WRONG WAY SIGNING RELATIVE TO DIVIDED HIGHWAY.

NOTE: SIGNING IS SHOWN AS TYPICAL SIGN PLACEMENT. FIELD CONDITIONS MAY DICTATE CHANGES IN SIGN PLACEMENT.

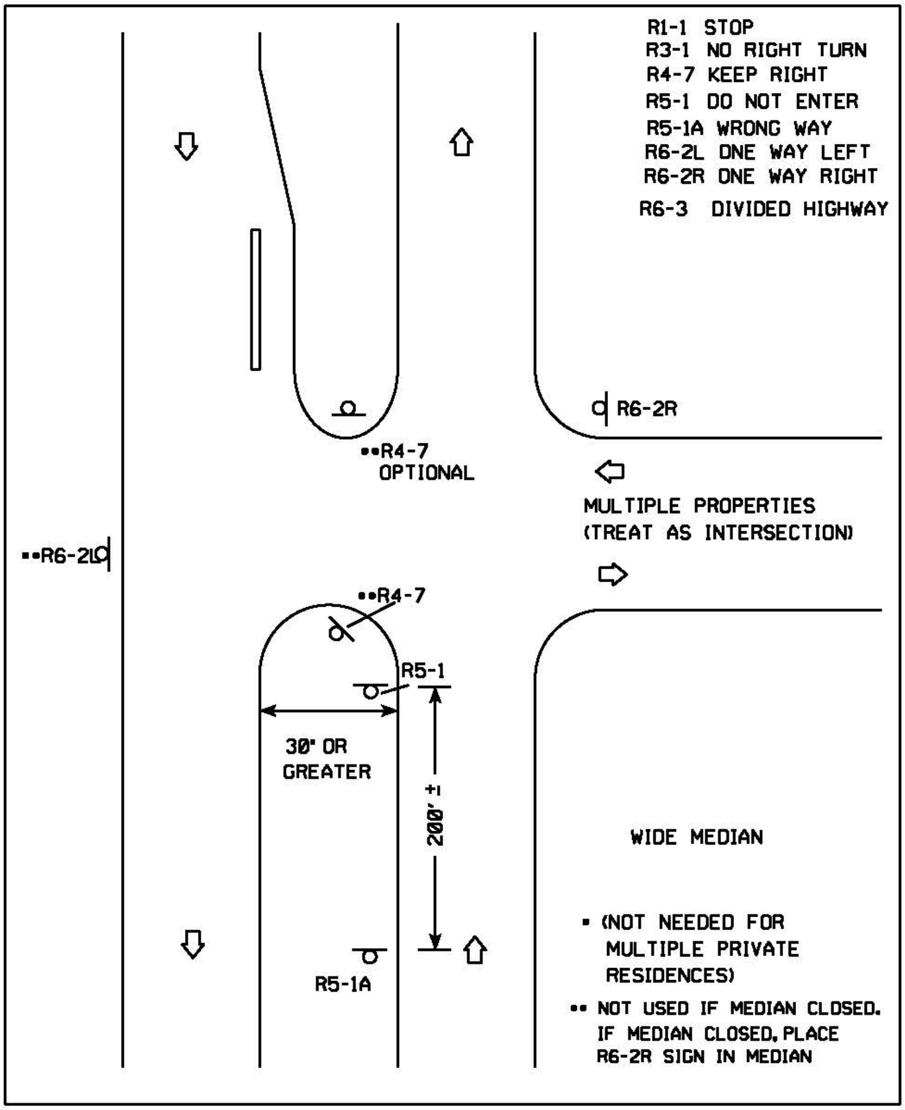


FIG. 11 WRONG WAY SIGNING RELATIVE TO DIVIDED HIGHWAY.

NOTE: SIGNING IS SHOWN AS TYPICAL SIGN PLACEMENT. FIELD CONDITIONS MAY DICTATE CHANGES IN SIGN PLACEMENT.

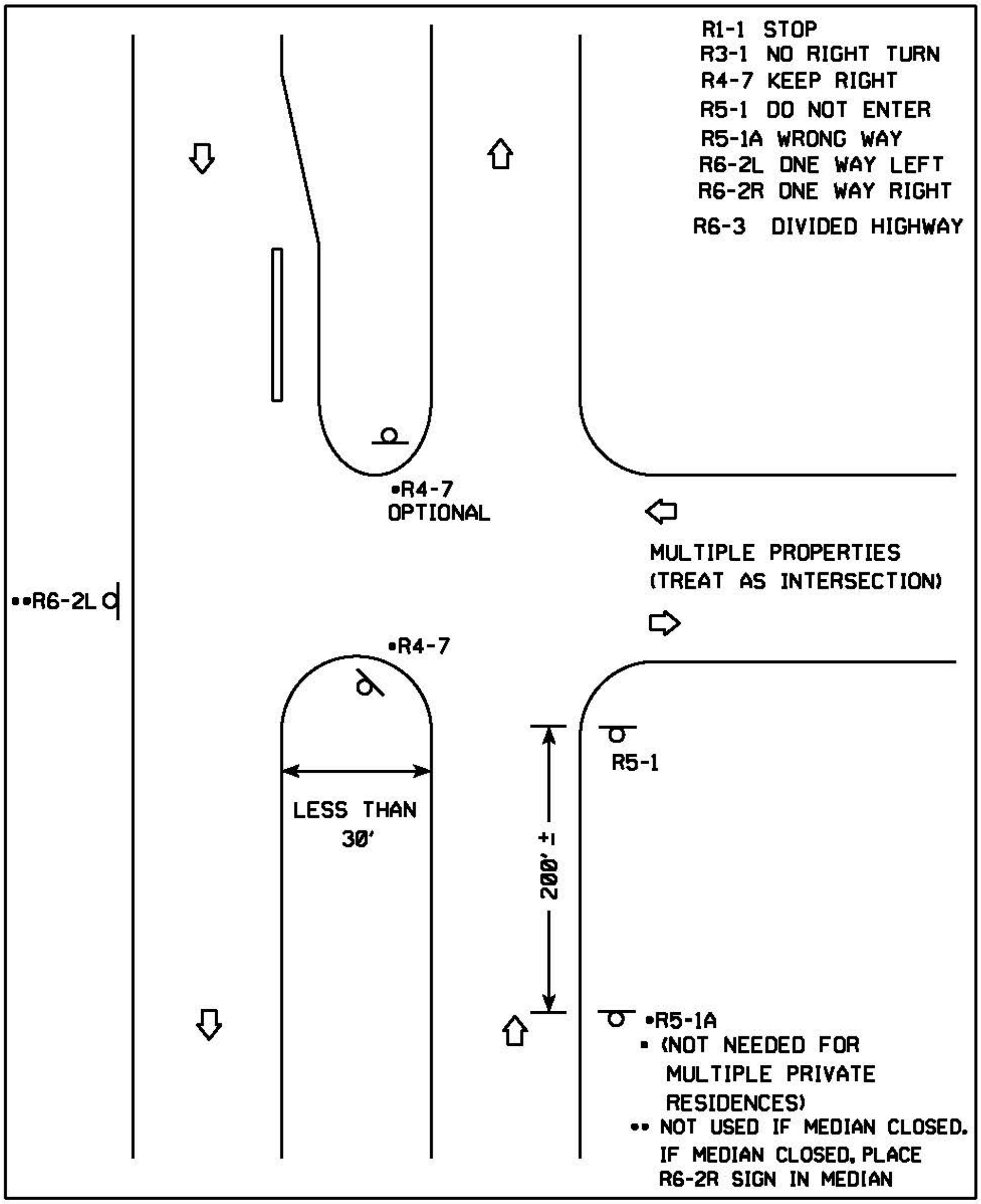


FIG. 12 WRONG WAY SIGNING RELATIVE TO DIVIDED HIGHWAY.

NOTE: SIGNING IS SHOWN AS TYPICAL SIGN PLACEMENT. FIELD CONDITIONS MAY DICTATE CHANGES IN SIGN PLACEMENT.

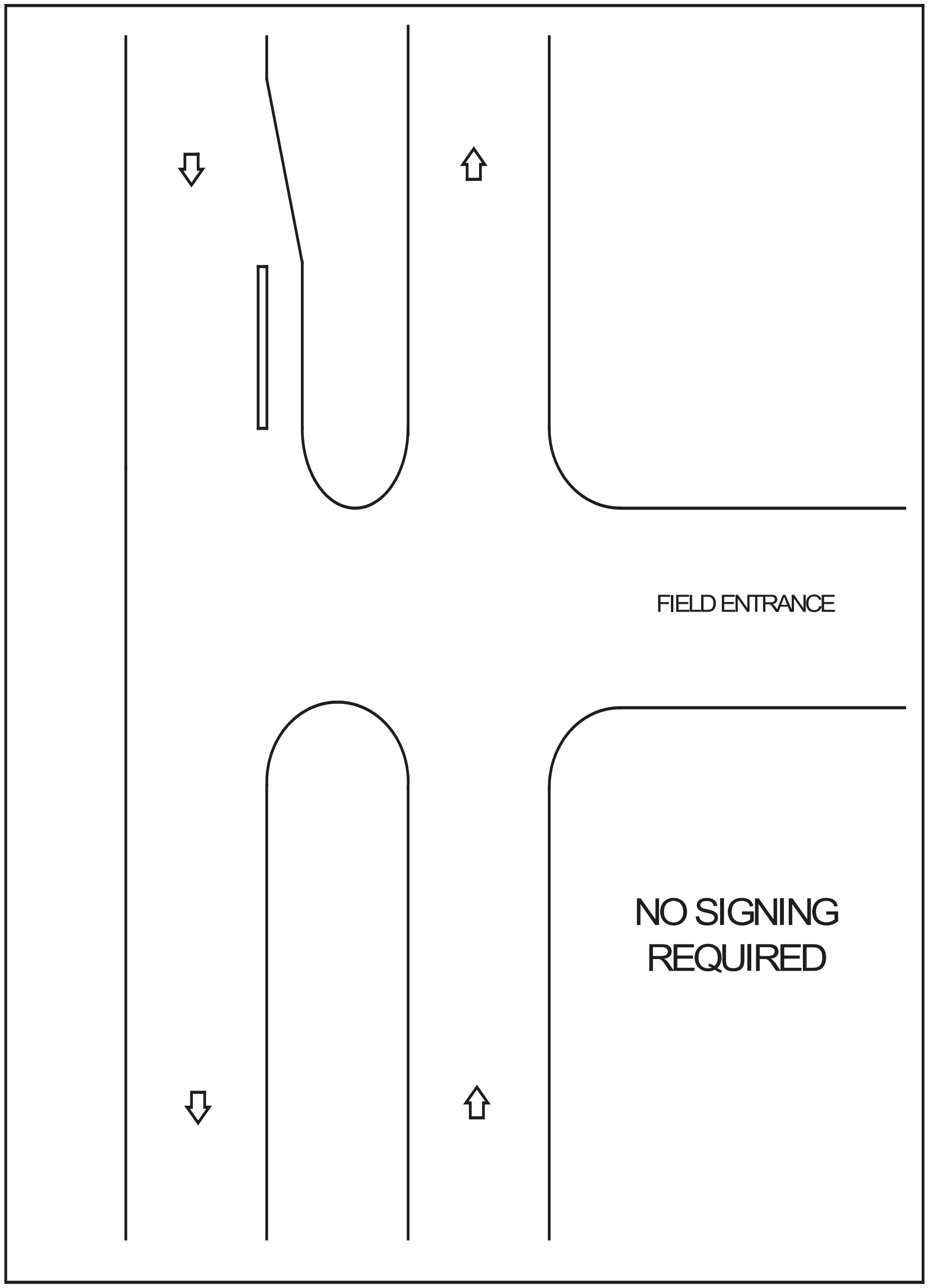


FIG. 13 WRONG WAY SIGNING RELATIVE TO DIVIDED HIGHWAY.

NOTE: SIGNING IS SHOWN AS TYPICAL SIGN PLACEMENT. FIELD CONDITIONS MAY DICTATE CHANGES IN SIGN PLACEMENT.

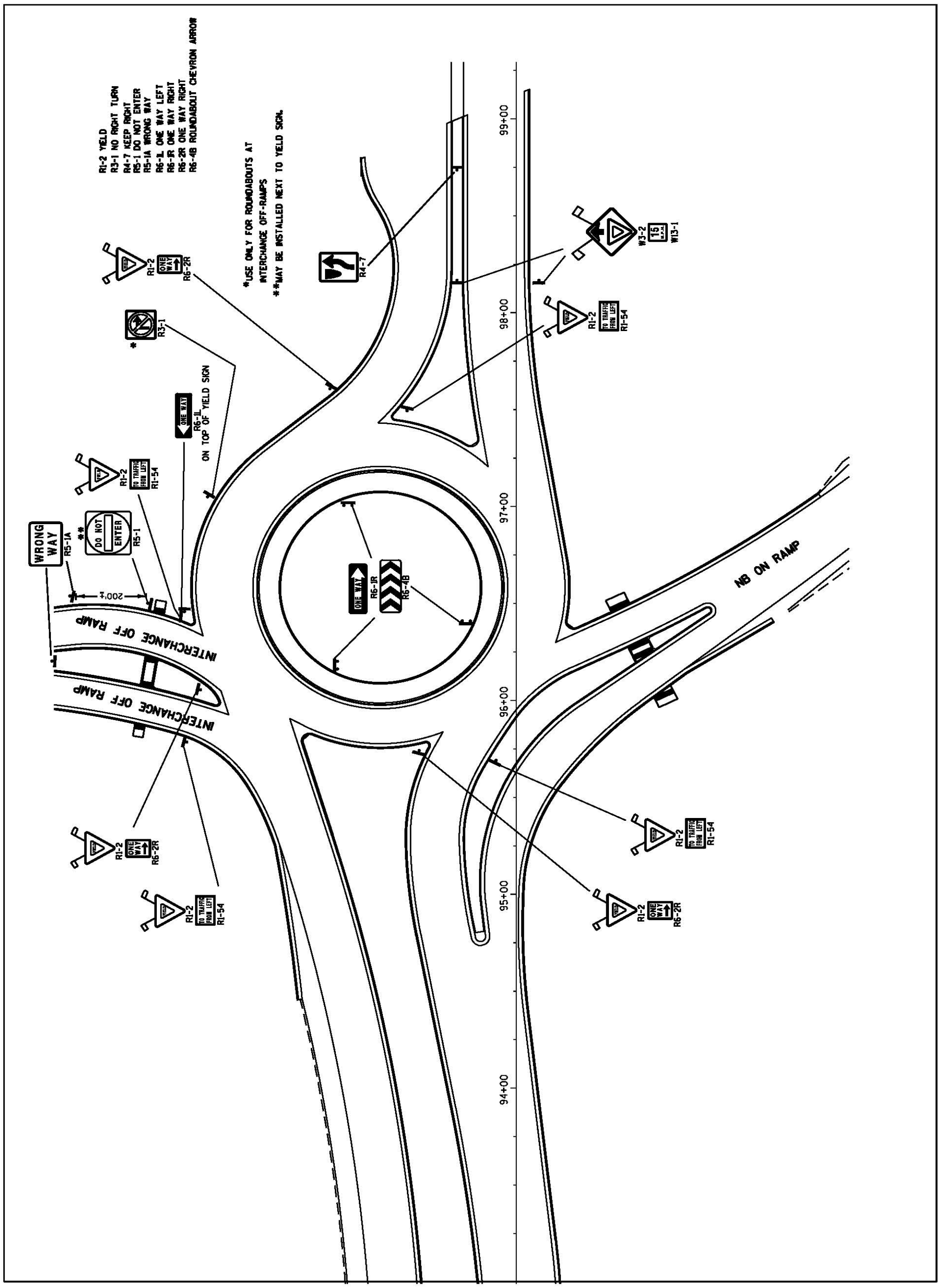


FIG. 14 WRONG WAY SIGNING RELATIVE TO ROUNDABOUT

NOTE: SIGNING IS SHOWN AS TYPICAL SIGN PLACEMENT. FIELD CONDITIONS MAY DICTATE CHANGES IN SIGN PLACEMENT

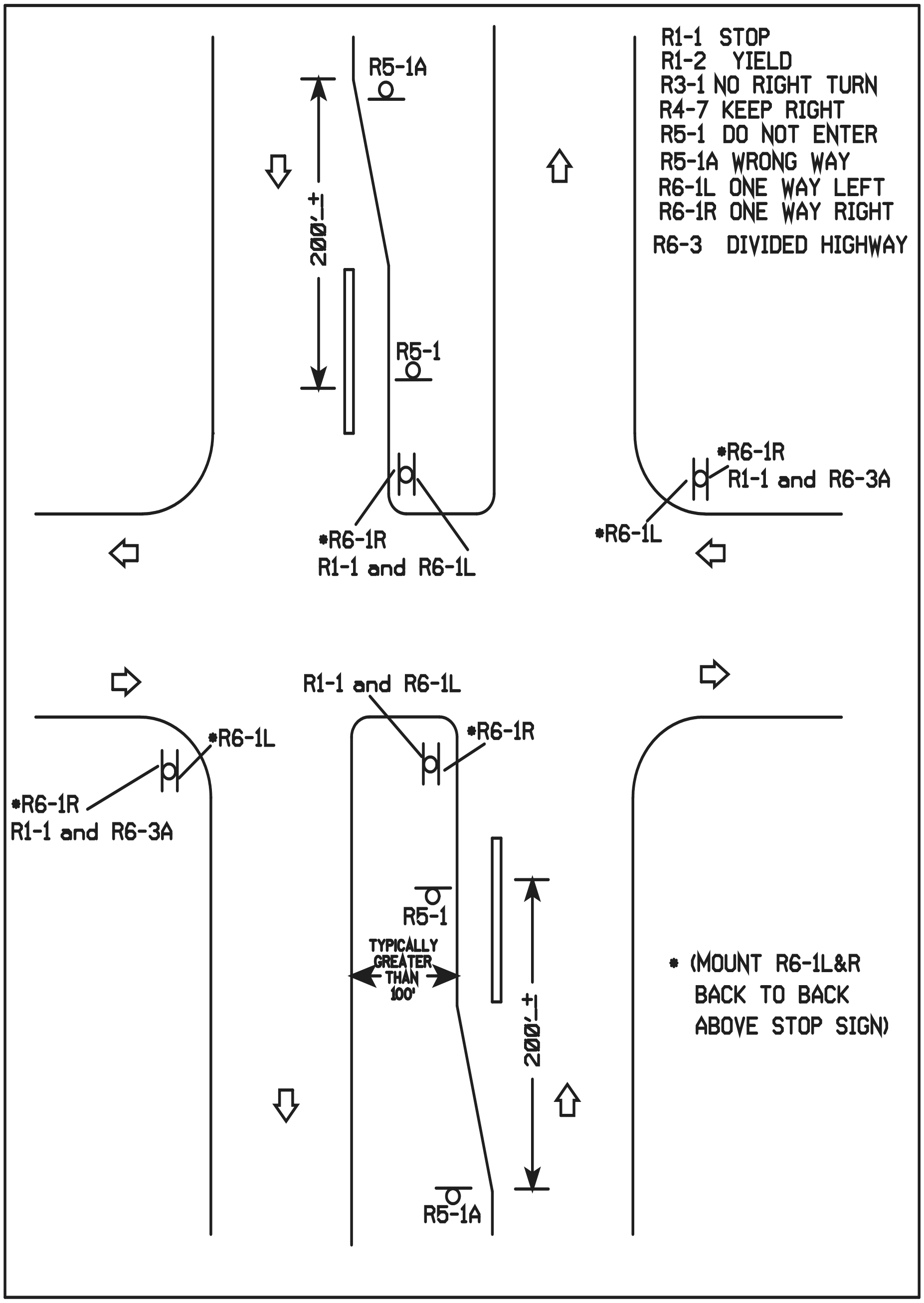


FIG. 15 WRONG WAY SIGNING RELATIVE TO DIVIDED HIGHWAY.

(WIDE MEDIAN WITH STOP OR YIELD SIGN IN MEDIAN)

NOTE: SIGNING IS SHOWN AS TYPICAL SIGN PLACEMENT. FIELD CONDITIONS MAY DICTATE CHANGES IN SIGN PLACEMENT.

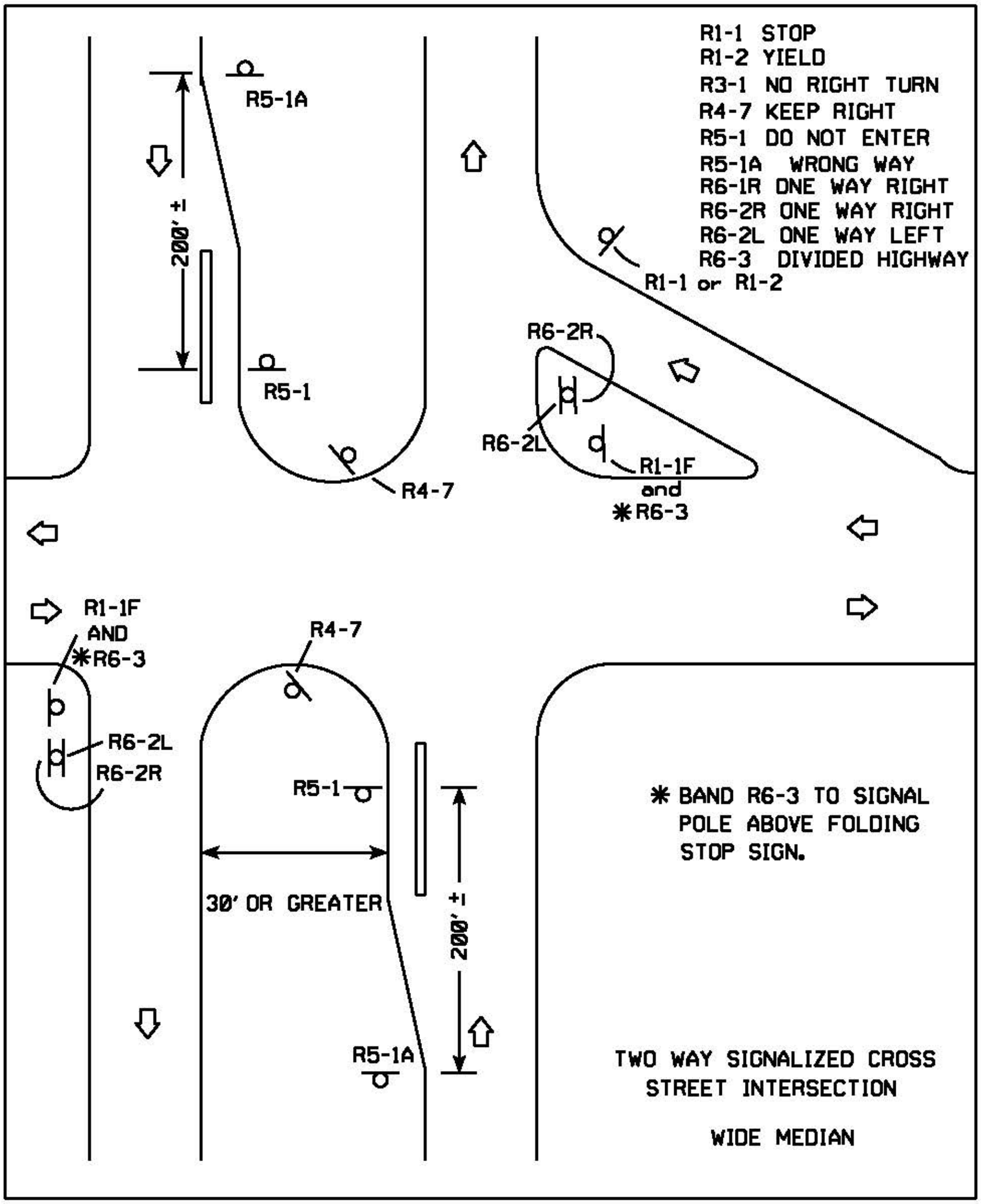


FIG. 16 WRONG WAY SIGNING RELATIVE TO DIVIDED HIGHWAY.

NOTE: SIGNING IS SHOWN AS TYPICAL SIGN PLACEMENT. FIELD CONDITIONS MAY DICTATE CHANGES IN SIGN PLACEMENT.

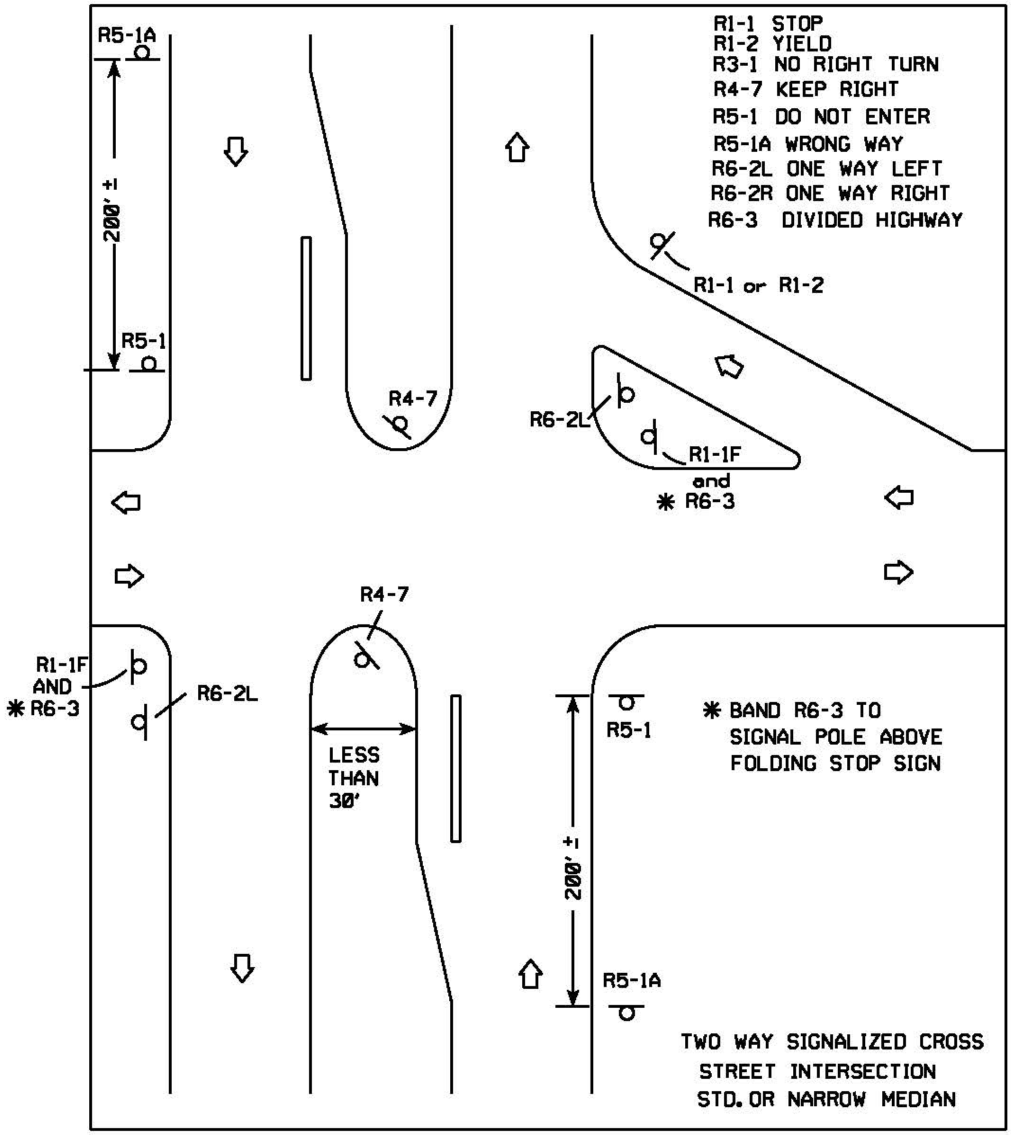


FIG. 17 WRONG WAY SIGNING RELATIVE TO DIVIDED HIGHWAY.

NOTE: SIGNING IS SHOWN AS TYPICAL SIGN PLACEMENT. FIELD CONDITIONS MAY DICTATE CHANGES IN SIGN PLACEMENT.

2-15-15 Recreational Trail Signing — January 2015

PURPOSE

This policy provides guidance for the installation of guide signs to direct traffic to major access points for public recreational trails. This policy does not address warning signs that *may* apply to locations where the recreational trail crosses a highway.

DEFINITION

Freeways are defined as divided arterial highway facilities that have full controlled access, by means of grade separation at interchanges only.

Expressways are defined as divided arterial highway facilities that have partial control of access and generally with grade separations at major intersections.

Conventional highways are defined as either divided or undivided roadway facilities that have no control of access with grade separations at intersections. These highways can be two-lane or multilane facilities.

POLICY

The following criteria **shall** apply for a trail to be eligible for signing on WisDOT-maintained roadways:

1. Public recreational trails owned and/or managed by the state government **shall** be the only trails that qualify for signing on freeways.
2. Public recreational trails owned and/or managed by the state or county government, or by a multi-state agency or commissions **shall** be the only trails that qualify for signing on expressways.
3. Public recreational trails owned and/or managed by the state or county government, by a multi-state agency or commission, or by a city, village, or township *may* be signed for on conventional highways.
4. All trailblazing signing off the State Trunk Highway system **shall** be in place prior to the installation of any signs on the State Trunk Highway system.
5. The trail **shall** be constructed and maintained to Wisconsin DNR standards, with an improved surface of compacted aggregate or better and be open year round. National Trails, as established by Congress, on the National Trails System with a natural surface *may* qualify for signing, provided the access points to be signed meet all other applicable criteria, including off-street parking facilities.
6. Evidence of poor trail maintenance or inadequate or poor trailblazing signage will be cause to remove any existing signs from the State Trunk Highway system.
7. The message on the signs *should* read “XX State Trail” for state owned trails and “XX Trail” for county, regional, city, village or township trails. The signs **shall** be composed of white lettering on a brown background.
8. For all roadways, only the trail termini will be signed. Intermediate access points *may* qualify for signing. The intermediate access points **shall** be spaced a minimum of 15 miles. A maximum of 2 signs **shall** be installed, one in each direction of travel, for each trail access point to be signed. For freeways and expressways, a directional sign (D1 sign) **shall** be placed on the freeway/expressway ramp to lead to the trail access.
9. Trail termini and intermediate access points *should* have the following amenities:
   a. Public restrooms or toilets on freeways and expressways, but are optional on conventional highways
   b. Public, off-street paved or gravel parking facilities
   c. Trail information
10. Where trail access points from two different trails have the same point of access from the State Trunk Highway, both trail names **shall** be identified on the same sign.
11. These signs **shall** be placed at the closest State Trunk Highway intersections to the trail termini. Trailblazing signing from a conventional State Trunk Highway to another conventional State Trunk Highway will not be allowed.
12. For freeways, expressways, and conventional highways, trail access points **shall** be no more than 5 miles from the nearest exit or State Trunk Highway.
13. The cost for fabrication, installation, and maintenance of any recreational trail signing **shall** be the responsibility of the trail owner or managing organization or agency. WisDOT **shall** coordinate the fabrication, installation, and maintenance of all signs on State Trunk Highways, including ramps, and **shall** be reimbursed for all costs. Installation of signs *may* be performed by WisDOT forces or by permit/letter.

2-15-16 ATV Route Signing — November 2015

PURPOSE

Section 23.33(1)(c) Wisconsin Statute defines an all-terrain vehicle (ATV) route as a highway or sidewalk designated for use by ATV operators by the governmental agency having jurisdiction as authorized under this section. In addition, s. 23.33(11)(am)(3) allows ATV operation on non-interstate highway bridges 1,000 feet in length or less by ordinance of the county and the municipality in which the bridge is located, regardless of jurisdiction.

At some locations on state trunk highway right of way, local agencies *may* erect signing for the purpose of directing and controlling ATV trail operations. This is permissible unless there is some problem generated by the existence of ATVs at specific locations. Signing for ATV trails and routes is described in Administrative Code NR 64.12 and also described with typical applications illustrated in WDNR's "Trail Signing Handbook", 2012. A copy of this book *should* be kept in each traffic section. This policy will clarify that handbook with regards to ATV use on WisDOT maintained highways.

DEFINITIONS

ATV crossing: A location where an ATV route or trail crosses, but does not run along, a highway.

ATV route: Any roadway or sidewalk properly designated for use by ATV operations per s. 23.33.

ATV trail: A marked corridor on public property or on private lands subject to public easement or lease, designated for use by all-terrain vehicle operators by the governmental agency having jurisdiction, but excluding roadways of highways except those roadways that are seasonally not maintained for motor vehicle traffic.

POLICY

ATV crossing warning signs:

1. ATV crossing warning signs (W11-50) are shown routinely in the WDNR Trail Signing Handbook. On state maintained highways, these signs **shall** only be installed by WisDOT, and only where warranted due to sight conditions, per the table in Section 2C.46 of the MUTCD.
2. WisDOT will assume the installation and maintenance costs for any ATV Trail crossing warning signs installed on the state highway system.

ATV Route guide signs and arrows:

The following policy criteria **shall** be used when ATV Route guide signs are requested from municipalities:

1. ATV Route signs (D11-10) **shall** be installed immediately downstream from where an ATV Route turns onto a State or US Highway. From a safety standpoint, it is desirable to keep ATVs on the shoulder; however, this *may* cause shoulder rutting issues, especially in locations where ATVs will tend to straddle the paved shoulder/gravel shoulder transition. For this reason, it *may* be desirable to supplement the initial D11-10 signs with "STAY ON PAVEMENT" (R4-55) or "STAY ON SHOULDER" (R4-55-S) signs, mounted directly below the D11-10 sign. Region maintenance *should* be consulted to determine if these signs are necessary. A second D11-10 sign **shall** be installed where the ATV Route turns off of the State or US Highway. This sign **shall** be supplemented with an appropriate M7 series arrow.
2. It *should* be noted that the WDNR Trail Signing Handbook shows a 6" x 12" "directional arrow" above a 6" x 6" ATV symbol sign at locations where the ATV route ends at an ATV trail. This combination of sign **shall not** be installed along ATV routes on State or US Highways. This "directional arrow" sign mimics the design of standard large one-direction (night) arrows. As ATV users will be using some or all of the traffic lane, these signs will be installed at the same offset and mounting height as other traffic signs. This could lead to motorist confusion. ATV routes on State or US Highways ending at ATV trails **shall** utilize the D11-10/M7 sign combinations.
3. The county or local municipality **shall** be required to obtain a permit (see TEOpS 2-15-3) for these signs from the WisDOT Region Traffic Engineer. The written request *should* contain:
    a. A copy of both the municipal and county ordinances
    b. A map showing the ATV Route

   The Region Traffic Engineer *should* contact Bureau of Highway Maintenance (BHM), State ROW Permits Engineer, to ensure that the county and municipal ordinances have been reviewed by WisDOT and WDNR. Signs **shall not** be erected until the ordinances are legally in effect. The current BHM contact is Bob Fasick, (608) 266-3438.
4. WisDOT will set up a Professional and Technical Project ID to charge costs to and will coordinate manufacture and installation of the signs. All costs for the installation and maintenance of ATV Route signs **shall** be billed to the county or local municipality. For county requested signs, the Sales to Others process *may* be utilized in lieu of the P&T process.
5. All ATV Route signs, auxiliary arrows and plaques, and ATV crossing signs on State or US Highways

shall be installed on WisDOT standard breakaway supports. Mounting height and offset **shall** follow sign plate A4-3.

Other comments on the WDNR Trail Signing Handbook:

1. Any and all responsibility for signing along trail, off of the state highway, is local, including installation and maintenance.
2. Regarding illustrations in the book:
    a. Warning signs on the trail when visible from the highway *should* be the minimum size specified.
    b. Orange markers on the right-of-way would usually be unnecessary except to mark a turn.
    c. STOP signs are shown too close to the highway. They *should* be back of the snowplowing range, at least 20' from the pavement and desirably more.
    d. STOP signs *should* be parallel to the highway, and the trail approaching the highway *should* be aligned to be as near to a right angle as possible.
3. On page 14 of the handbook: If requested WisDOT will install and maintain guide signs for trail head parking lots. The signs *should* contain the word "Parking".
4. Trail sign posts on the right of way installed by local agencies **shall** meet the same small support safety standards as those erected by WisDOT.
5. Trail signs **shall not** be attached to any of WisDOT's signposts.

ADDITIONAL INFORMATION

BHM has developed a comprehensive policy on ATV routes and Trails that is available at HMM 09-10-11.

2-15-20 Cemetery Signing — April 2022

PURPOSE

This policy provides guidance for the permitting of signs on WisDOT-maintained roadways directing road users to certain cemeteries. These guidelines apply to conventional highways, expressways, and freeways.

DEFINITIONS

Freeways are defined as divided arterial highway facilities that have full controlled access, by means of grade separation at interchanges only.

Expressways are defined as divided arterial highway facilities that have partial control of access and generally with grade separations at major intersections.

Conventional highways are defined as either divided or undivided roadway facilities that have no control of access with grade separations at intersections. These highways can be two-lane or multi-lane.

POLICY

The following criteria **shall** apply for a cemetery to be eligible for signing on WisDOT maintained roadways:

1. Only veterans' cemeteries that are exclusively for veterans and that are owned and/or managed by the state or national Department of Veterans Affairs are eligible to be permitted for signing under this policy. The primary function of the facility **shall** be a cemetery. Presently, the Northern Wisconsin Veterans Memorial Cemetery in Spooner, the Southern Wisconsin Veterans Memorial Cemetery near Union Grove, and the Northwoods National Cemetery in Harshaw are the only three veterans cemeteries that qualify for signage under this policy.
2. All other cemeteries **shall** not be signed on WisDOT maintained roadways.
3. Signing from one conventional State Trunk Highway to another conventional State Trunk Highway will not be allowed. Any necessary signing off of the State Trunk Highway system **shall** be in place prior to the installation of any signs on the State Trunk Highway system.
4. The signs **shall** be white message on green background.
5. On conventional highways, signs *should* be erected a minimum of 500 feet in advance of the intersection or cemetery entrance.

6. On freeways and expressways, signs *should* be erected within one mile in advance of the exit ramp or side road. Destination signs (D1-1 signs) **shall** be erected at or near the end of the exit ramp or side road approach.
7. For freeways, expressways, and conventional highways, the cemetery **shall** be no more than 5 miles from the nearest exit or State Trunk Highway.
8. The cost for fabrication, installation, and maintenance of this signing **shall** be the responsibility of the cemetery owner or managing organization or agency. WisDOT **shall** coordinate the fabrication, installation, and maintenance of all signs on State Trunk Highways, including ramps, and **shall** be reimbursed for all costs.

2-15-30 Hydrant Signing November 2015

PURPOSE

Coordination with fire departments has indicated problems with limited identification of fire hydrant locations from the freeway or expressway. This is especially important in areas where the view of fire hydrants from the highway is obstructed. It has been learned that response to freeway or expressway fires can be a two-squad operation. There is response time to the freeway or expressway fire scene, and there is response time to fire hydrants off of the highway right-of-way. The freeway or expressway response crew must coordinate location and hook-up to the hydrant. When location of the hydrant is uncertain, time is lost. The purpose of this guideline is to establish criteria on the usage of fire hydrant location signs and sign identification blades along noise walls.

DEFINITIONS

Freeways are defined as divided arterial highway facilities that have <u>full</u> controlled access, by means of grade separation at interchanges only.

Expressways are defined as divided arterial highway facilities that have <u>partial</u> control of access and generally with grade separations at major intersections.

POLICY

The placement of hydrant signs is most critical where the vision of the fire hydrant or local street from the highway (freeway or expressway) is restricted. Sounds walls are an excellent example of where vision is completely restricted. Topography of landscape *may* also hinder vision. It is the intent of the Department to install hydrant signs that satisfy the following conditions:

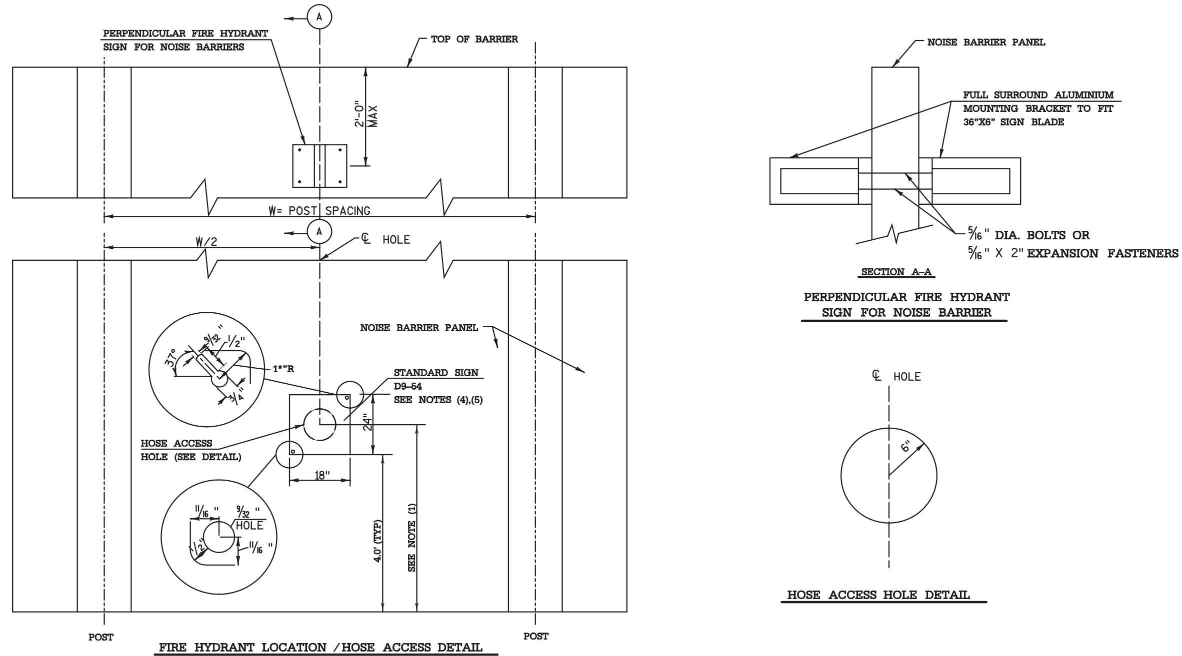
1. At all sound wall installations where the wall creates a visual and physical barrier between the roadway and the hydrant.
2. At locations where topography or landscape create a visual or physical barrier between the highway and the hydrant, the hydrant signs *should* be mounted either on posts or the right-of-way fence on the highway side.
3. At locations where crash experience is above average, and expeditious response is advantageous.
4. At locations where fire hose standpipes have been installed. Signs *should* be mounted on posts near the standpipe access joint.
5. The local fire department or fire district **shall** pay for all costs of the sign, sign blade and all mounting hardware. This includes the costs for initial installation and long-term maintenance. The Department *may* pay for the initial installation provided they are part of a project.

SIGN INSTALLATION

1. The hydrant sign (D9-54 sign) **shall** be placed, with movable capability, over the fire hose access hole (See Figure 1).
2. A two-sided sign blade (D9-54A sign) with blue Type H Reflective sheeting **shall** be placed on all new sound wall installations. Existing sound wall installations without the two-sided blade *should* be retrofitted with the blade as opportunities allow. The sign blade *should* be placed near the top of the sound wall on the highway side, above the fire hose access hole (See Figure 1).

Standard sign plate D9-54 (See Figure 2) has been developed for hydrant signs (See attached sign plate detail). The sign is white on green, containing a fire hydrant symbol and the approximate numerical address of the fire hydrant.

It is strongly encouraged that contact is made with the fire department jurisdictions responding to the freeway or expressway to verify the numerical address of the hydrant.

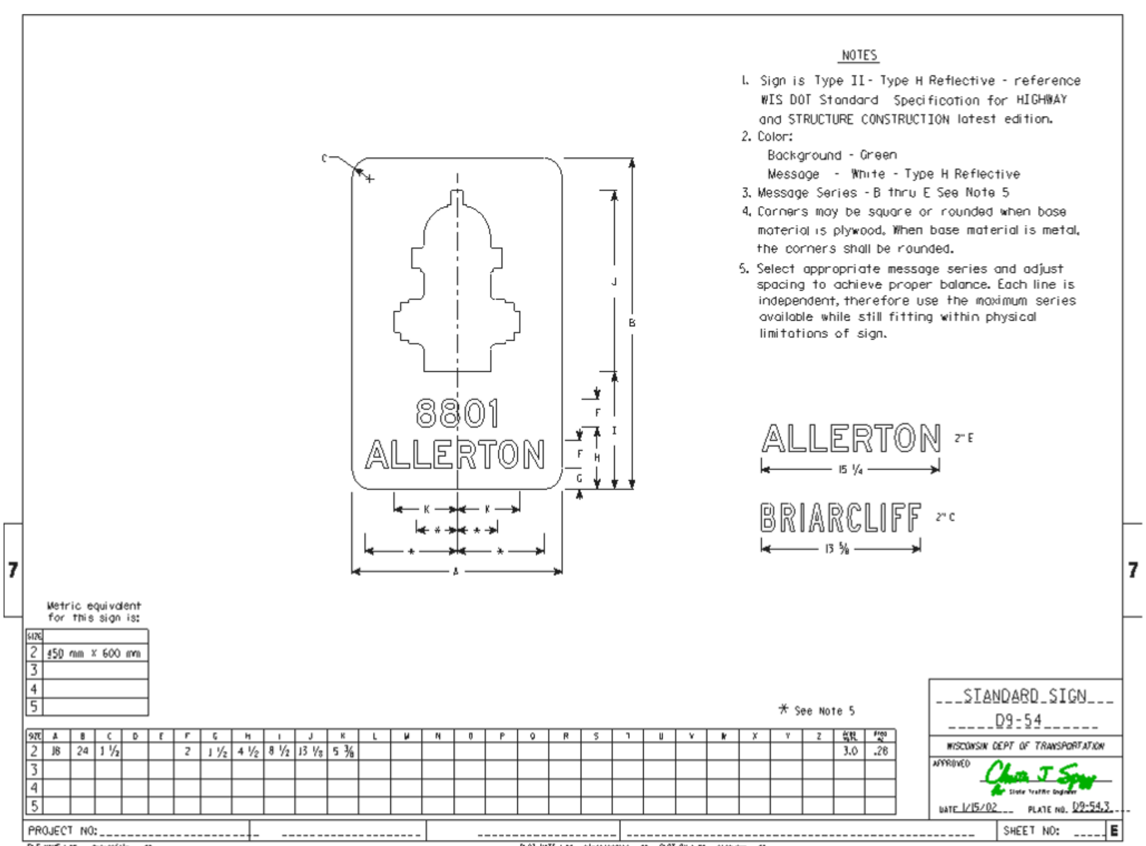


NOTES:

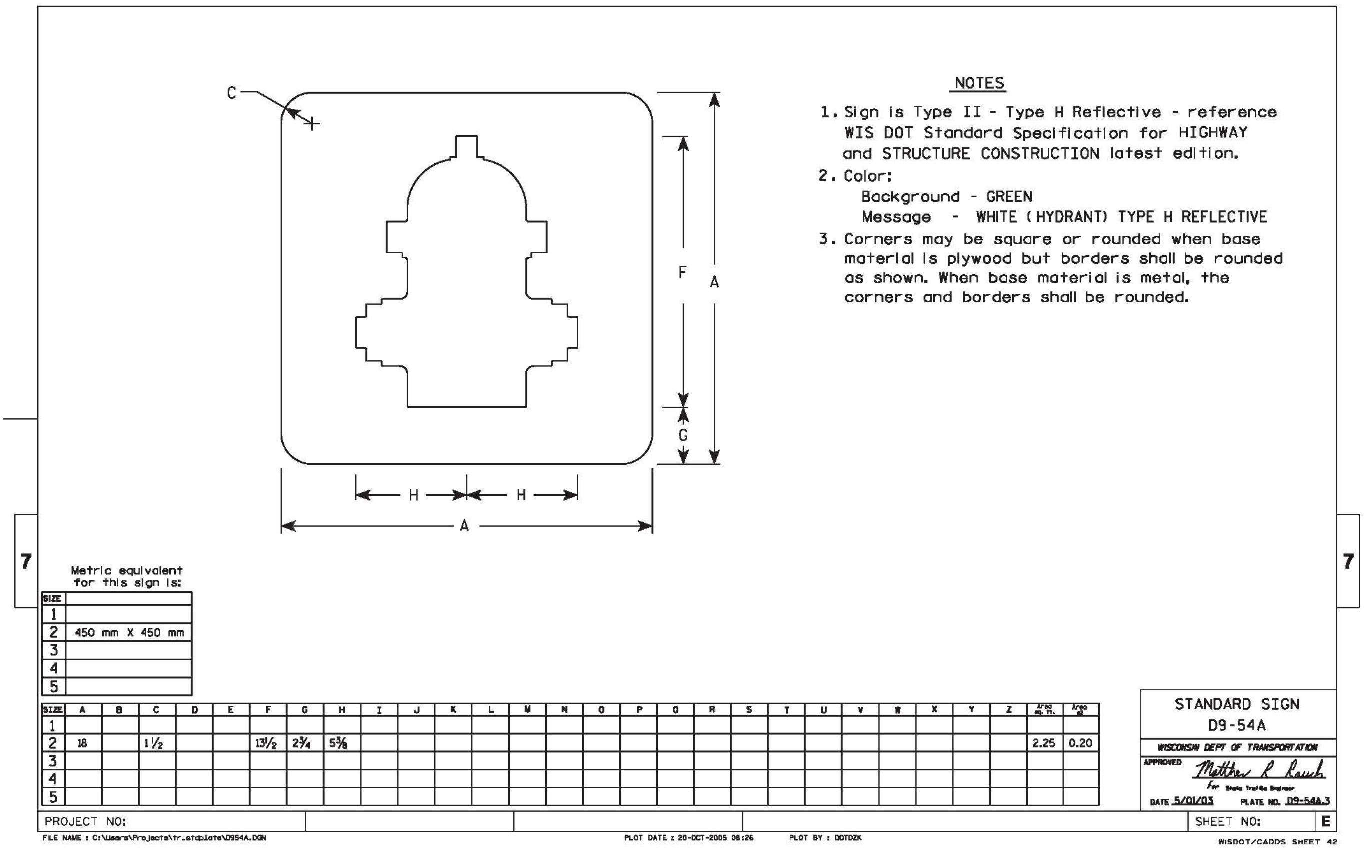
1. STANDARD SIGNS D9-54 WILL BE FURNISHED BY THE CONTRACTOR. SEE PLAN.

2. THREE STANDARD SIGNS D9-54 TO BE FURNISHED PER STATION. ONE SIGN SHALL BE INSTALLED ON EACH SIDE OF THE BARRIER. ONE ADDITIONAL SIGN TO BE INSTALLED ON FENCE AT R/W LINE WITH MESSAGE FACING AWAY FROM FREEWAY.

3. ADDITIONAL FIRE HYDRANT SIGNS SHALL BE ATTACHED TO THE NOISE BARRIER PANEL NEAR THE TOP OF THE BARRIER. SEE DETAIL ABOVE, PAID FOR UNDER "PERPENDICULAR FIRE HYDRANT SIGN FOR NOISE BARRIERS". SEE SPECIAL PROVISIONS.



SIZE	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	SQ. FT.	
2	18	24	1 1/2			2	1 1/2	4 1/2	8 1/2	13 1/8	5 3/8																3.0	.28
3																												
4																												
5																												



2-15-31 Signing for Low Inlets Along Barrier Walls — March 2011

PURPOSE

County maintenance personnel, first responders, and WisDOT maintenance staff have indicated problems with identification of low inlets along freeway barrier walls. There could be times that the inlets are covered with snow, ice or other debris that makes location difficult. Clogged inlets can present potential traffic safety issues and efficient, rapid location of them is very essential.

FHWA has indicated that a sign used for marking such inlets would not be considered an official traffic sign. Technically, the sign would not be in the line of sight or directed to passing motorists.

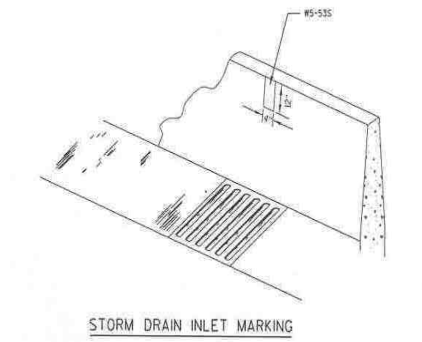
This policy governs the design and placement of signing for low inlets along freeway barrier walls.

POLICY

The sign used for the identification of low inlets along barrier walls is the green object marker (W5-53S) sign. This sign *may* be used, provided the following criteria are met:

1. The request to use the signs **shall** be coordinated with both the WisDOT Region Maintenance Engineer and Traffic Engineer.
2. The signs **shall** be installed on the face of the barrier, near the top to prevent covering by snow. See Figure 1 for typical installation detail.
3. Signs are paid for under the bid item: Signs Reflective Type II.
4. The signs **shall** be manufactured on 0.040” thick aluminum and fastened to the concrete wall with an adhesive with 1 ½” concrete anchor screws at each corner.
5. Replacement signs for maintenance **shall** be obtained through WisDOT.

Figure 1. Typical Installation of Storm Drain Inlet Marking



2-15-36 Distance Signs, D2-Series and Post-Interstate E8-Series — February 2018

PURPOSE

The purpose of this policy is to provide guidance for the use of Distance signs on State Highways under Department of Transportation jurisdiction. This policy guidance will address the selection of destinations, consistent determination of appropriate distances, sign design, and typical Distance sign placement.

General guidance on selection of destinations can be found in the MUTCD Sections 2D.37 and 2E.35. Specific guidance on the selection of destination cities can be found in TEOpS 2-15-5.

Guidance on the location of Distance signs is found in MUTCD Sections 2D.38 and 2E.39.

This policy does not apply to Interchange Sequence signs, which are addressed in MUTCD Section 2E.36.

B. Definitions

Distance Signs are defined as guide signs displaying a sequence of one to three destinations ahead with the distance to reach those destinations.

Freeways are defined as divided highways with fully controlled access at interchanges only. Interstate Highways are freeways with the interstate route designation.

Expressways are defined as divided highways with partially controlled access by a combination of interchanges, at-grade intersections, and driveways.

Conventional Highways are defined as streets or roads other than freeways or expressways. They *may* be divided or undivided, two-lane or multi-lane, and access is available at intersections and driveways.

National Control Cities are Chicago, Milwaukee, Beloit, Rockford, Janesville, Madison, Wisconsin Dells, La Crosse, Albert Lea, Eau Claire, St. Paul, Sheboygan, and Green Bay.

Regional Control Cities are defined as

1. Urban areas in Wisconsin or within 60 miles of the state line with a population in the most recent decennial census of 30,000 or more,
2. Other communities, such as Sturgeon Bay, Woodruff, Minocqua, and Lake Geneva, which are approved by the State Traffic Engineer based on their character as widely known tourism destinations, and
3. Urban areas on or north of Highway 64 with a population exceeding 3500, and urban areas south of Highway 64 with a population exceeding 10,000.

Major Crossroads or Side Roads, in most cases, *should* be state highways, but *may* be a county highway or local arterial serving a nearby community.

POLICY

General Guidance

1. The combination Destination Direction and Distance signs, such as is designated D1-1a. D1-2a, or D1-3a in MUTCD, **shall not** be used on state highways.
2. Unincorporated communities **shall not** be displayed on Distance signs unless the community is

designated a Regional Control City.

3. Traffic generator supplemental sign destinations **shall not** be displayed on Distance signs.
4. The sign design format for distance signs **shall** use upper and lower case letters.
5. The letter sizes **shall** be appropriate for the highway class; minimum 6-inch/4½-inch on conventional highways and minimum 8-inch/6-inch on expressways and freeways.

The selection of destinations **shall** be solely for the purpose of guidance and information for the non-local state highway driver, and **shall not** be used to promote communities, facilities, or preferential routes.

The first line of the sign **shall** designate the next selected "destination" in the direction of travel. If used, a second line of the sign *may* designate the second, or an interim, destination of importance in the direction of travel. The bottom line **shall** designate a National Control City or Regional Control City or the last incorporated city or village of the greatest significance, in that order of priority.

Distances **shall** be rounded up or down, as appropriate, to display the even mile.

Specific Guidance – Conventional Highways

The first destination on a Distance sign on a conventional state highway **shall** display either the next incorporated community (city or village), or the next major crossroad or side road, whichever is deemed the most beneficial information for the driver.

If used, the second line of the Distance sign *may* display the second major crossroad or a subsequent incorporated community served by the state highway. Selection of the community *may* be guided by use of the comparative population and distance formula in TEOpS 2-15-5. Selection *may* also be varied on successive Distance signs to display alternative communities served by the route.

The bottom line of a Distance sign on a state highway **shall** designate a National Control City or Regional Control City or the last incorporated city or village of the greatest significance, in that order of priority. The bottom line control city *should* be the same on all successive Distance signs along the route until that city is reached.

If the conventional state highway does not enter the corporate limits of a community, the community **shall not** be displayed on the Distance sign, but *may* appear on a Direction sign (D1-series) at the appropriate location.

Distances to a crossroad **shall** be rounded to the nearest even mile.

Distances to a community *may* be measured differently depending on the size of the community and how the state highway passes through it.

1. If the community is not very large and the highway serves the central business district, the distance *should* be measured to that "downtown" area and *may* be rounded down.
2. If the highway does not serve the downtown, the distance *may* be measured to the municipal limits or a major crossroad within the municipal limits and *may* be rounded up.
3. If the city is large, the distance *may* be measured to a major crossroad or municipal feature within the city limits.

Distance signs *should* be installed downstream from rural interchanges and STH/USH intersections, following the J4 and R2-1 signs. Distance signs are typically not installed within incorporated city or village limits. A distance sign *should* be installed where a conventional highway exits the limits of the last contiguous incorporated city or village, across from the I2-3. Distance signs *should not* be installed where the highway leaves an unincorporated community, unless the community is designated a Regional Control City.

Specific Guidance – Expressways

The first destination on a Distance sign on an expressway **shall** display either the next incorporated community (city or village), or the next major crossroad or interchange, whichever is deemed the most beneficial information for the driver.

If used, the second line of the Distance sign *may* display the second major crossroad or interchange or a subsequent incorporated community served by the state expressway. Selection of the community *may* be guided by use of the comparative population and distance formula in TEOpS 2-15-5. Selection *may* also be varied on successive Distance signs to display alternative communities served by the route.

The bottom line of a Distance sign on an expressway **shall** designate a National Control City or Regional

Control City or the last incorporated city or village of the greatest significance, in that order of priority. The bottom line control city *should* be the same on all successive Distance signs along the route until that city is reached.

If the state expressway does not enter the corporate limits of a community, the community **shall not** be displayed on the Distance sign, but *may* appear on a Direction sign (D1-series) or Exit sign (E1- or E4-series) at the appropriate location.

Distances to a crossroad or interchange **shall** include the exit ramp and **shall** be rounded to the nearest even mile.

Distances to a community *may* be measured differently depending on the size of the community and how the state expressway passes through it.

1. If the community is not very large and the highway serves the central business district, the distance *should* be measured to that "downtown" area and *may* be rounded down.
2. If the highway does not serve the downtown, the distance *may* be measured to the municipal limits or an interchange or major crossroad within the municipal limits and *may* be rounded up.
3. If the city is large, the distance *may* be measured to an interchange or major crossroad or municipal feature within the city limits.

Distance signs should be installed downstream from rural interchanges and STH/USH intersections, following the J4 and R2-1 signs. At interchanges, a Distance sign *should* be installed on the mainline downstream from the on-ramp, after the J4 and R2-1. Where multiple interchanges serve the same community, a Distance sign *should* only be installed after the last interchange serving that community. Where less than 3 miles exists between the on-ramp taper point and the next off-ramp theoretical gore, the Distance sign *may* be omitted.

Specific Guidance – Freeways

The first destination on a Distance sign on a freeway **shall** display either the next interchange, or the next incorporated community (city or village), whichever is deemed the most beneficial information for the driver.

If used, the second line of the Distance sign *may* display the second interchange or a subsequent incorporated community served by the freeway. Selection of the community *may* be guided by use of the comparative population and distance formula in TEOpS 2-15-5. Selection *may* also be varied on successive Distance signs to display alternative communities served by the route.

The bottom line of a Distance sign on a freeway **shall** designate a National Control City or Regional Control City or the last incorporated city or village of the greatest significance, in that order of priority. The bottom line control city *should* be the same on all successive Distance signs along the route until that city is reached.

If the freeway does not enter or pass within one mile of the corporate limits of a community, the community **shall not** be displayed on the Distance sign, but *may* appear on an Exit sign (E1- or E4- or E9-series) at the appropriate location.

If the freeway does pass within one mile of the corporate limits of a community, the community *may* be displayed on the Distance sign, and *may* appear on an Exit sign (E1- or E4- or E9-series) at the appropriate location.

Distances to an interchange **shall** include the exit ramp to the crossroad and **shall** be rounded to the nearest even mile.

Distances to a community *may* be measured differently depending on the size of the community and how the freeway serves it.

1. If the community is not very large and the freeway serves the central business district, the distance *should* be measured to a "downtown" interchange and *may* be rounded down.
2. If the freeway does not serve the downtown, the distance *may* be measured to the municipal limits or a major interchange within the municipal limits and *may* be rounded up.
3. If the city is large, the distance *may* be measured to a major interchange or municipal feature within the city limits.

At interchanges, a Distance sign *should* be installed on the mainline downstream from the on-ramp, after the J4 and R2-1. Where multiple interchanges serve the same community, a Distance sign *should* only be installed after the last interchange serving that community. Where less than 3 miles exists between the on-ramp taper point and the next off-ramp theoretical gore, the Distance sign *may* be omitted.

2-15-51 Routine Sign Replacement Criteria June 2025

PURPOSE

Over time the visual characteristics of signs deteriorate as a result of weather, age and ultraviolet radiation, resulting in reduced legibility performance day and/or night. As a result, signs have to be changed periodically as part of a routine sign replacement. There are a number of mechanisms to accomplish the replacement of signs on the WisDOT system. Often questions arise as to when signs *should* be changed, who *should* change the signs and what criteria *should* be used in determining replacement. Therefore, it is necessary to have clear, consistent guidelines for the routine replacement of signs on state highways.

FEDERAL HIGHWAYS MINIMUM SIGN RETROREFLECTIVITY VALUES

Section 2A.08 of the MUTCD requires all units of government to use an assessment or management method that is designed to maintain the retroreflectivity of signs at or above the levels prescribed in the MUTCD Table 2A-3. To maintain compliance with the minimum sign retroreflectivity values in the MUTCD, WisDOT utilizes the following approved assessment and management methods:

1. Blanket Replacement. All signs in an area/corridor are replaced at specified intervals. This commonly takes place during improvement projects.
2. Expected Sign Life. Age of the sign is tracked and the sign is replaced when it meets its expected life. Current WisDOT expected sign life period is 12 years.
3. Control Signs. Replacement of signs in the field is based on the performance of a sample of control signs. The data from the control signs can provide engineering support to the Expected Sign Life method. Over time the Expected Sign Life replacement cycle *may* be revised based on data from the Control Signs test deck, which is located at the Madison Sign Shop yard.

DETAILED SIGN REPLACEMENT POLICY

General Sign Replacement due to age/condition of sign

1. The Department's Traffic Operations Asset Management System (TOAMS) **shall** be used to track inventory data on signs that include manufacture date of sign, sign sheeting code and condition of sign.
2. Sign date and sheeting code tags **shall** be placed on the upper right corner on the back of Type II signs by the sign manufacturer or contractor. Type I signs **shall** have the sign date and sheeting code tag placed on the lower right corner on the back of the sign. The WisDOT Bureau of Traffic Operations (BTO) Sign Shop provides all date and sheeting code tags to sign manufacturers and contractors.
3. In general, signs *should* be replaced on a twelve-year cycle, based upon the corridor replacement program, established by the Bureau of Traffic Operations.
4. In general, signs needed for let projects will not be supplied through the BTO Sign Shop. The exception to this would be if there is an unexpected lack of signs by the contractor that *may* otherwise cause a delay in the completion of the project or needed for safety or operational issues. Detailed guidance is given below on the sign replacement criteria for let projects.
5. For Type II signs not installed in projects, County Highway Departments, through Traffic Maintenance Agreements, will handle the installation and maintenance.
6. WisDOT **shall** provide all signs to the County Highway Departments. There are statewide procurement contracts to handle this. Counties **shall not** furnish signs, other than TODS or TRANS 200 arrow boards that are covered by other policies.
7. Routine Type I sign replacements, that are not part of an improvement project, are to be performed by the annual statewide Let Contract. The statewide open-end signing contractor *should* only be used for knock-down repairs and replacements of Type I signs, Type I or Type II Supplemental Traffic Generator sign installations or for safety or operational issues where the county cannot get to the site in the timeframe needed.
8. Any signs or posts that are damaged, illegible, leaning, not in proper orientation to the roadway *should* be repaired or replaced as soon as opportunities permit.

Sign Replacement Due to Changes in Sign Standards

1. Signs no longer meeting mounting height, size, message, letter size or sheeting material criteria *may* be

replaced through the following methods:

   a. Let Project or refurbishment project in the area.
   b. Knockdown, storm or vandalism damage that would cause the sign and/or posts to be replaced.
   c. Utilization of 12-year corridor replacement plan.

2. Examples of signs not meeting standards would include:
   a. Too low of mounting height.
   b. Too close to roadway.
   c. Wrong size sign used for roadway.
   d. Wrong letter size used on sign.
   e. Signs containing Engineer Grade sheeting.
   f. Change of Standard in the MUTCD resulting in a compliance period.
   g. Change of Signing Policy in the Traffic Engineering, Operations & Safety Manual.
3. If there is a safety issue/concern due to a sign not conforming to standards, the sign **shall** be replaced or removed as soon as practical. An example would be a restriction of motorist visibility due to an improper mounting height.
4. Analysis of intersection crash data *may* be used to help determine if sign standards attributed to any safety issues.
5. The methods of sign replacement *should* be followed as explained in the <u>General Sign Replacement due to age/condition of sign</u> part of this policy.

<u>Sign Replacement as part of Let Projects</u>

Below are guidelines that **shall** *should* be followed to help determine if replacement of signs on a let project is feasible.

Type I signs

1. Per Department policy, type I guide signs should be replaced in qualifying improvement projects.

   Exceptions to this policy include:
   - It is not required to replace Type I signs on non-pavement-preservation preventive maintenance projects (see [FDM 3-5-5]), and
   - It is not required to replace Type I signs on Group 3 pavement-preservation preventive maintenance projects (see [FDM 3-5-5], work consists of milling, rut filling, seal coating, micro-surfacing and crack filling projects) because:
   - When Group 3 pavement strategies are applied early in the pavement life cycle, most signing should still be in good condition.
   - The work can easily exceed 10% of the project, i.e., it would not meet the requirement for incidental construction.

   Exceptions to replacement of overhead mounted Type I guide signs can also be made if there is another improvement project programmed or scheduled on the same roadway segment within the next five years. Any signs not conforming to WisDOT and MUTCD policies shall be replaced in the improvement project. Any exceptions to replacement of Type I signs shall be coordinated with the Region Signing Engineer or Region Traffic Engineering Supervisor.
2. Galvanized steel I-beams *should* only be replaced if Type I sign is not at the proper offset (30 foot desirable / 17.5 foot minimum from edge line to edge of sign) or if the new Type I sign is larger. All corten steel I-beams and bases **shall** be replaced.
3. Steel I-beams and bases that are re-used *should* have the base bolts replaced by utilizing bid item 635.0300 (Sign Supports Replacing Base Connection Bolts).

Type II signs

1. In general, per Department policy, the replacement of Type II signs will be handled through maintenance as part of a 12-year corridor replacement schedule. However, there are situations that will require Type II signs to be placed in improvement projects that include:
   - Project is on a new alignment.
   - Projects that are installing new signs, signs that are not currently at the needed locations, e.g. changing intersection control or adding chevrons.
   - Updating or adding signs that were not there before, e.g. population, street name signs, overhead signs.
   - Placing no passing zone signs after the roadway has been re-spotted.
2. Projects that require removal, stockpiling and re-installation of Type II signs and posts will use the bid items of Moving Signs Type II and Moving Small Sign Supports.
3. Designers should include an undistributed quantity of posts (10% of existing) to account for the replacement of any posts that are rotted, warped, too short or get damaged during the removal/re-installation.
4. The designer should consult with the Region Signing Engineer or Region Sign Program Supervisor to confirm the use of improvement projects for the installation of Type II signs.

2-15-52 Maintenance of Signs and Sign Post Designs — March 2020

PURPOSE

This policy establishes maintenance responsibility for signs and sign post designs on state trunk highways and crossroads intersecting state maintained highways, either by at-grade intersections or service interchanges. In addition, roundabouts often times add complexity for the responsibility of sign maintenance, especially for local and county roadway approaches. DOT improvement projects often include signs that are installed on county highways and local roads. Because the local unit did not install the signs, there are often questions about the responsibility for maintenance, and many of these signs are left to deteriorate. On several occasions the local unit requests a special type of signpost to be used on state maintained highways through their community. As a result, questions arise as to what type of signposts are acceptable, who would maintain the posts and potential liability issues. Therefore, it is necessary to have clear, consistent guidelines for the maintenance of signing, and designs of signposts, on state maintained highways and at locations of local crossroads intersecting state maintained highways.

SIGN MAINTENANCE POLICY

WisDOT is responsible for maintenance of permanent signs on all state trunk highways. As part of its responsibility, WisDOT *may* contract for services to accomplish the maintenance and *may* require that others fund the costs, for example costs of supplemental traffic generator signs, as approved in TEOpS 2-15-3.

Should WisDOT allow a local unit of government to erect or maintain any signing, a permit in the form of a letter **shall** be signed by a representative of the local unit of government and the Region's Traffic Supervisor.

In addition, WisDOT is responsible for maintenance of certain other permanent signs on connecting roadways, local streets and business highways described below. It *should* be noted that this policy is not all-inclusive.

Intersecting and Interchanging Roadways (excluding roundabouts)

1. On local public roadways intersecting state maintained highways, WisDOT will maintain the STOP sign and directional assembly (J3 or J13 assembly), adjacent to the STOP sign.
2. On county roadways intersecting state maintained highways, WisDOT will maintain the STOP sign and directional assembly (J3 or J13 assembly), adjacent to the STOP sign.
3. On local and county roadway interchanges with state maintained highways, between the junction assembly (J1 sign) and the ramp, WisDOT will maintain the route markers and destination signs (D1 signs), including the junction assembly.
4. On local and county roadway interchanges with state maintained highways, between ramp to ramp, WisDOT will maintain all signs. An exception to this would be a special agreement with the local unit of government/county or if WisDOT would not have jurisdiction of the intersecting roadway.
5. On state and U.S. highway interchanges with state maintained highways, WisDOT will maintain all the

signs.

6. All advanced signing on local and county roads that intersect state maintained highways **shall** be the responsibility of the county/local unit of government to maintain, regardless of who installed it originally.
7. WisDOT will not maintain street name signs at the intersection.
8. For blinker stop signs and blinker stop ahead signs, refer to the separate policy for criteria and permits.

Roundabouts

1. On all roundabouts with at least one WisDOT maintained approach roadway, WisDOT will maintain, at a minimum, the following signs:
    a. Chevron bank (R6-4b)
    b. One Way signs (R6-1R and R6-2R)
    c. Yield signs (R1-2)
    d. To Traffic From Left Plaque (R1-54)
    e. Splitter island signs (J-3 or D1 series)
2. On state trunk highway approaches, including interchange ramps, WisDOT will maintain all signs, including overhead sign supports (See Figure 2).

    On county and local road approaches, in addition to the Yield sign (R1-2), To Traffic From Left Plaque (R1-54) and One Way sign (R6-2R), WisDOT will also maintain any overhead guide signs that have an Interstate, U.S. or State highway shield on them, including their associated overhead sign support(s) (See Figures 3A and 3B). The county and/or local unit of government would maintain all other signs and associated sign structures on their approaches, including overhead regulatory lane control signs and the ground mounted map sign (D1-62 sign).
3. For roundabouts on Connecting State Highways, WisDOT will maintain any overhead guide signs that have an Interstate, U.S. or State highway shield on them, including their associated overhead sign support(s). For any overhead guide signs that exclusively contain business route signing, the local unit of government would maintain the sign and associated overhead sign support. WisDOT will also maintain any splitter island signs that have a U.S. or State route shield (J-3 or D1 series) and any U.S. or State reassurance marker (J4 series). All other signs in the roundabout on connecting highways **shall** be maintained by the local unit of government.
4. For roundabouts with county highway and/or local road approaches, it is recommended that early in the design process, a Maintenance Agreement be developed. By having the Maintenance Agreement developed early in the design process, the county or local unit of government will clearly have knowledge of what they are to maintain.

    Some particular items that *should* be included in the Maintenance Agreement would include:
    a. Specific signs that WisDOT would maintain and what the locals/county would maintain. This would also include signposts.
    b. Specific overhead sign supports (if any), that WisDOT would maintain and what the locals would maintain.
    c. Recommended inspection frequencies for overhead sign supports that the locals would maintain.

Connecting Highways and Local Streets

1. On connecting highways WisDOT maintains only route markers and trailblazer assemblies, including overhead guide signs that contain interstate, U.S. and State route shields and their associated overhead sign supports or sign bridges. For any overhead guide signs that exclusively contain business route signing, the local unit of government would maintain the sign and associated overhead sign support.
2. On local streets, upon coordination with the local unit of government, WisDOT would maintain only those trailblazer assemblies that are installed and/or approved by WisDOT.

Business Route Signing

1. For business routes located on state maintained highways, WisDOT will install and maintain all route

markers.

2. When business routes of state highways are marked over county highways, local streets or highways, WisDOT *may* initially install route markers, but will not be responsible for their maintenance. The installation and maintenance of all other signs **shall** be the responsibility of the local unit of government.
3. Expanded guidance on the usage of business route signing is included in TEOpS 2-4-19.1.

SIGN POST DESIGN POLICY ON STATE MAINTAINED ROADWAYS

1. On state maintained roadways, 4”x6” wood posts and 2”x2” square steel posts are typically used for sign posts. Municipalities *may* be allowed to install signs on customized posts. The municipality **shall** pay for the cost of the customized posts.
2. Any customized posts allowed **shall** be NCHRP 350 or MASH crash compliant. The municipality **shall** provide WisDOT a copy of the certification letter from the Federal Highway Administration.
3. A permit for non-standard sign supports **shall** be filled out by the municipality and signed by the City/Village Engineer or Director of Public Works or Official Governmental Representative and, upon approval, the WisDOT Region Traffic Operations Engineer. A sample Application/Permit form is shown in Figure 4.
4. Municipalities *may* be allowed to paint the posts a neutral color that does not detract from the face of the sign. Acceptable neutral colors are black, brown or dark green.
5. Red, white and orange colors **shall not** be used for signposts. A yellow color *may* only be used if the color is to mark a truck route. The municipality **shall** be required to have a local ordinance in place before painting the posts.
6. For any painted sign posts requiring replacement by WisDOT, the municipality will be responsible for re-painting signposts. Any customized signposts requiring immediate replacement by WisDOT will be replaced with 2”x2” square steel posts or 4”x6” wood posts. The municipality *may* later replace the DOT installed post with a NCHRP 350 or MASH crash compliant customized post at their cost.
7. Municipalities **shall not** paint the backside of the signs.
8. Signs installed on customized sign posts **shall** meet WisDOT/MUTCD design and size standards. WisDOT **shall** provide the municipality with all state-owned signs to be installed on customized sign posts. WisDOT *may* require the municipality to replace signs due to age or damage of signs or changes to sign design standards. WisDOT reserves the right to replace existing signs on customized posts owned by the municipality.
9. Sign installation and placement **shall** be to WisDOT standards. See Standard Sign Plates A4-3 and A4-4 for sign mounting height and lateral offset.
10. Existing customized posts on state maintained highways which are not NCHRP 350 or MASH crash compliant **shall** be replaced immediately with 2”x2” square steel posts, or 4”x6” wood posts. The municipality *may* later replace the DOT installed post with a NCHRP 350 or MASH crash compliant customized post at their cost.
11. Wood 4”x6” posts **shall** have 1 ½” diameter breakaway holes drilled into the 6-inch face of the post, (see figure 1). Breakaway holes are not required in 4”x6” wood posts if the post is mounted behind beam guard or concrete barrier.

Figure 1. Interchange Roundabout

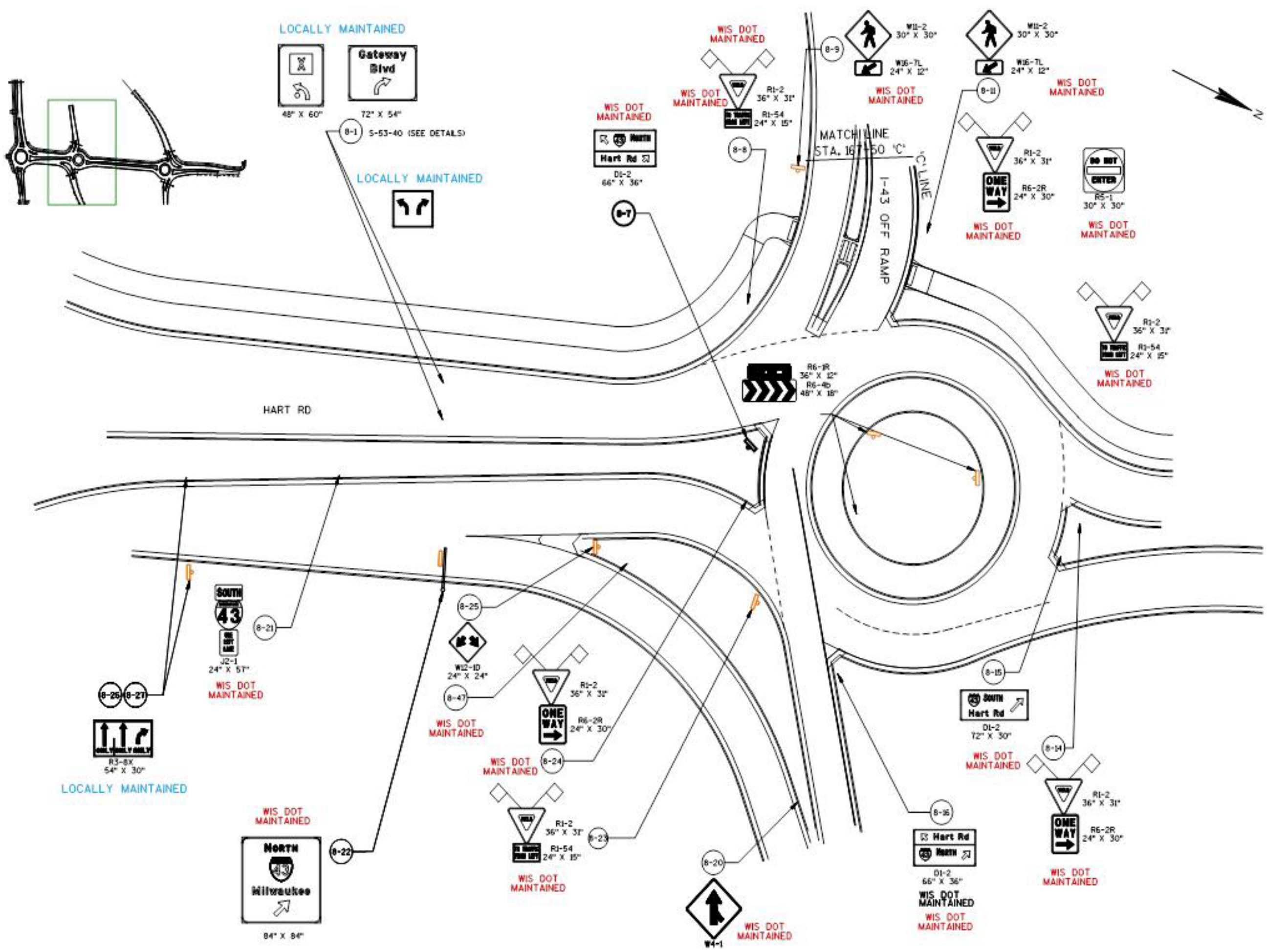


Figure 2A. County Highway / State Highway Roundabout
(Signing for local roads is the same as County Highway signing)

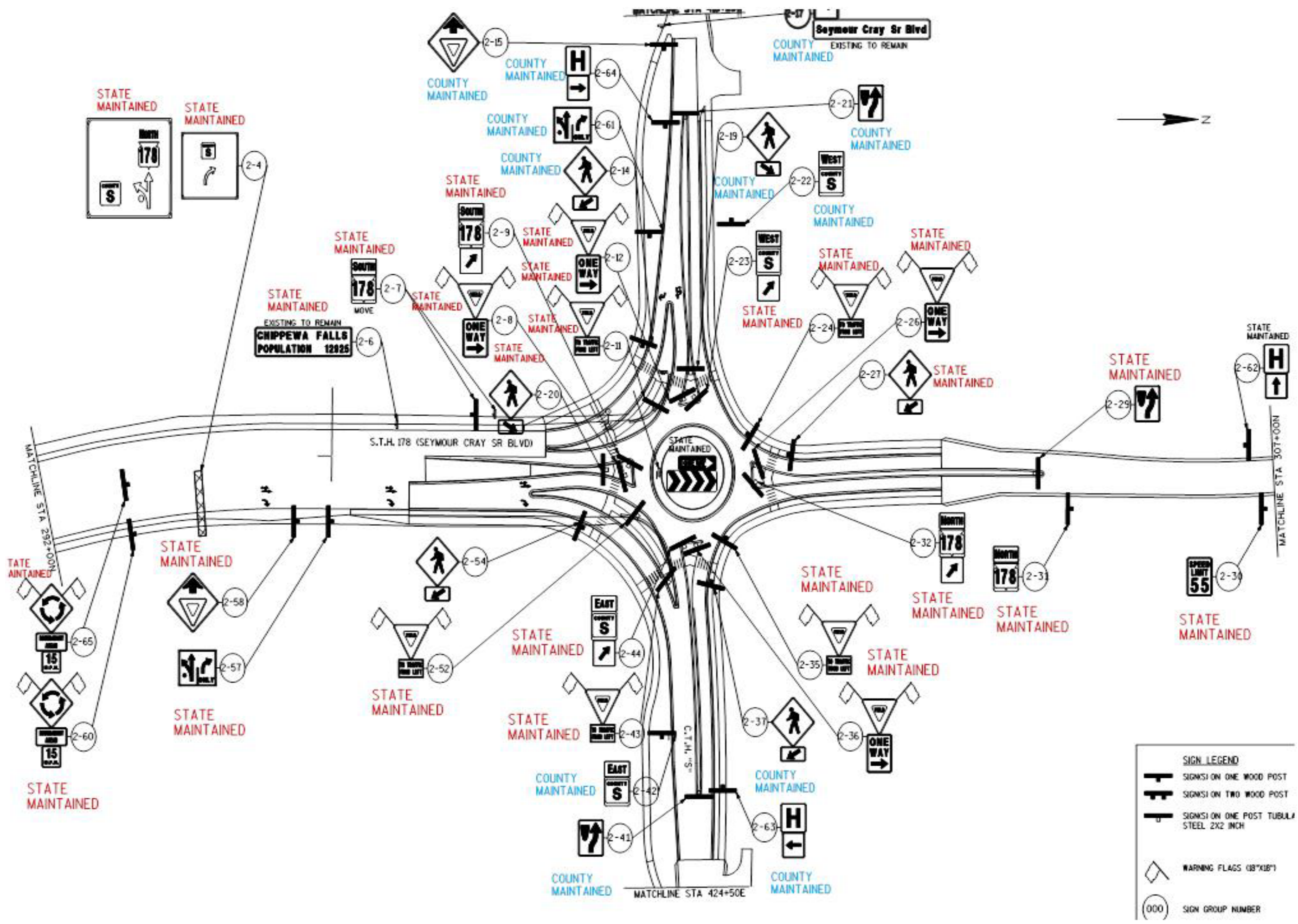


Figure 2B. County Highway / State Highway Roundabout
(Signing for local roads is the same as County Highway signing)

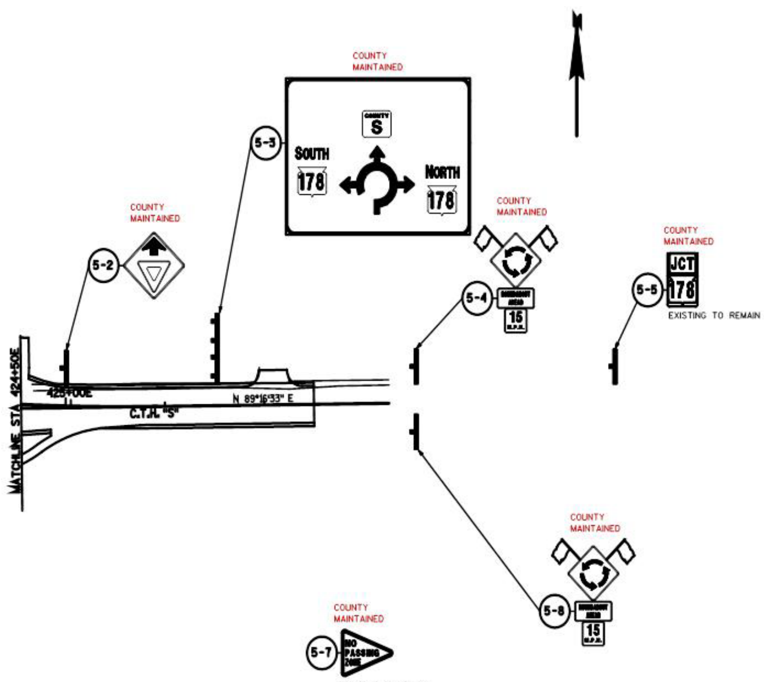


Figure 3. Custom Sign/Post Installation Permit

APPLICATION/PERMIT FOR CUSTOM SIGN POSTS

Wisconsin Department of Transportation
7/2014

When approved, this permit documents the terms and conditions or use by the municipality for installation and/or maintenance of custom sign posts on highways under the jurisdiction of the Wisconsin Department of Transportation. The applicant must obtain this approved permit prior to installation of custom sign posts.

Submit the completed application to the WisDOT Regional Office that has maintenance jurisdiction of the state trunk highway in the county where the posts will be located. A single application may be made for all installations along a continuous segment of highway.

Applicant (City, Village, Town):	County:
Mailing Address:	Area Code-Telephone Number:
	Email Address or FAX Number:
Highway (STH/USH):	Local Street Name of STH/USH:
Installation Limits: From:	To:
Installation Type ☐ Improvement Project Agreement – Project ID: ☐ Installation by Permit – Permit to Work on Highway Right-of-Way (WisDOT form DT1812) required	
Locations:	Items to Install:

Page 1 of 3

Installation Conditions

1. Terms and conditions of this application/permit shall be in conformance with WisDOT Traffic Guidelines Manual Policy 2-15-52 *Maintenance of Signs and Sign Post Designs*. By entering into this agreement, the Municipality agrees to the terms and cost arrangements in this policy document.
2. For permit requests or sign replacement, WisDOT shall furnish all standard state-owned signs to the municipality for installation on custom posts. For let project installations, the custom posts will be installed as part of construction let plans as non-participating item.
3. All custom sign posts shall be NCHRP 350 or MASH crash compliant. A copy of the certification letter from the Federal Highway Administration shall be attached to this application for each manufacturer's model and style of custom post used.
4. Replacement of custom posts from a different manufacturer or model shall require a new permit/application.
5. The applicant shall retain a copy of this permit and supporting documentation for future reference.
6. Custom post details shall be attached to this application. Region Traffic Operations Engineer shall approve final post design.
7. Region Traffic Operations Engineer shall approve final sign locations. For Improvement Project Agreements, these locations shall be included on the final construction plans.
8. The municipality shall be responsible for costs for removal should future highway projects require the removal of the custom posts.
9. Sign installation and placement shall be to Wisconsin Manual of Uniform Traffic Control Devices and WisDOT standards.
10. This application shall be signed by the City/Village Engineer or the Director of Public Works or Official Governmental Representative.

X

Authorized Representative | Date

Print Name | Title

Approved for the Wisconsin Department of Transportation

Permit Number = Region (NC,NE,NW,SE,SW) – County Number – Permit Number in county

Permit Number

X

Region Traffic Operations Engineer | Date

Print Name | Area Code-Phone Number

Page 2 of 3

INDEMNIFICATION

The Applicant shall save and hold the State, its officers, employees, agents, and all private and governmental contractors and subcontractors with the State under Chapter 84 Wisconsin Statutes, harmless from actions of any nature whatsoever (including any by Applicant itself) which arise out of, or are connected with, or are claimed to arise out of or be connected with any of the work done by the Applicant, or the construction or maintenance of facilities by the Applicant, pursuant to this permit or any other permit issued by the State for location of property, lines or facilities on highway right-of-way, (1) while the Applicant is performing its work, or (2) while any of the Applicant's property, equipment, or personnel, are in or about such place or the vicinity thereof, or (3) while any property constructed, placed or operated by or on behalf of Applicant remains on the State's property or right-of-way pursuant to this permit or any other permit issued by the State for location of property, lines or facilities on highway right-of-way; including without limiting the generality of the foregoing, all liability, damages, loss, expense, claims, demands and actions on account of personal injury, death or property loss to the State, its officers, employees, agents, contractors, subcontractors or frequenters; to the Applicant, its employees, agents, contractors, subcontractors, or frequenters; or to any other persons, whether based upon, or claimed to be based upon, statutory (including, without limiting the generality of the foregoing, worker's compensation), contractual, tort, or whether or not caused or claimed to have been caused by active or inactive negligence or other breach of duty by the State, its officers, employees, agents, contractors, subcontractors or frequenters; Applicant, its employees, agents, contractors, subcontractors or frequenters; or any other person. Without limiting the generality of the foregoing, the liability, damage, loss, expense, claims, demands and actions indemnified against shall include all liability, damage, loss, expense, claims, demands and actions for damage to any property, lines or facilities placed by or on behalf of the Applicant pursuant to this permit or any other permit issued by the State for location of property, lines or facilities on highway right-of-way in the past or present, or that are located on any highway or State property or right-of-way with or without a permit issued by the State, for any loss of data, information, or material; for trademark, copyright or patent infringement; for unfair competition or infringement of personal or property rights of any kind whatever. The Applicant shall at its own expense investigate all such claims and demands, attend to their settlement or other disposition, defend all actions based thereon and pay all charges of attorneys and all other costs and expenses of any kind arising from any such liability, damage, loss, claims, demands and actions.

Any transfer, whether voluntary or involuntary, of ownership or control of any property constructed, placed or operated by or on behalf of the Applicant that remains on the State's property or right-of-way pursuant to this permit shall not release Applicant from any of the indemnification requirements of this permit, unless the State is notified of such transfer in writing. Any acceptance by any other person or entity, whether voluntary or involuntary, of ownership or control of any property constructed, placed or operated by or on behalf of the Applicant that remains on the State's property or right-of-way pursuant to this permit, shall include acceptance of all of the indemnification requirements of this permit by the other person or entity receiving ownership or control.

Notwithstanding the foregoing, a private contractor or subcontractor with the State under Chapter 84 Wisconsin Statutes, that fails to comply with sections 66.047 and 182.0175 Wisconsin Statutes (1985-1986), remains subject to the payment to the Applicant of the actual cost of repair of intentional or negligent damage by the contractor or subcontractor to any property, lines or facilities placed by or on behalf of the Applicant pursuant to this permit or any other permit issued by the State for location of property, lines or facilities on highway right-of-way, and remains subject to payment to the Applicant for losses due to personal injury or death resulting from negligence by the contractor or subcontractor.

Notwithstanding the foregoing, if the State, or its officers, employees and agents, fail to comply with sections 66.047 and 182.0175 Wisconsin Statutes (1985-1986), the State or its officers, employees and agents, remain subject to the payment to the Applicant of the actual cost of repair of willful and intentional damage by the State, or its officers, employees and agents, to any property, lines or facilities placed by or on behalf of the Applicant pursuant to this permit or any other permit issued by the State for location of property, lines or facilities on highway right-of-way, and remain subject to payment to the Applicant for losses due to personal injury or death resulting from negligence by the State, its officers, employees and agents.

No indemnification of private contractors or subcontractors with the State under Chapter 84 Wisconsin Statutes, shall apply in the event of willful and intentional damage by such private contractors or subcontractors to the property, lines and facilities of the Applicant located on the highway right-of-way pursuant to this permit or any other permit issued by the State for the location of property, lines or facilities on highway right-of-way.

2-15-53 New Bypass Signing January 2007

PURPOSE

Quite often, a highway bypass is constructed to divert traffic around a community, thus reducing traffic congestion and increasing traffic safety within the community. However, bypasses have the potential to experience more crashes than expected when designed, due primarily to several human factors issues. Even when designed to the proper geometrics, drivers *may not* be mentally prepared for the increased speed of traffic on the bypass and the quick decisions that need to be made, as a result of the increased speed. This has led to several angle type collisions, primarily at intersections.

In February 2006, FHWA prepared a report for WisDOT that outlines several enhancements that *should* be made to increase safety at bypasses. Several of these enhancements include signing improvements. This policy provides requirements and guidance to the proper usage of signs for new bypasses on state maintained highways.

DEFINITIONS

<u>Freeways</u> are defined as divided highways with fully controlled access at interchanges only. Interstate Highways are freeways with the interstate route designation.

<u>Expressways</u> are defined as divided highways with partially controlled access by a combination of interchanges, at-grade intersections, and driveways.

<u>Conventional Highways</u> are defined as streets or roads other than freeways or expressways. They *may* be divided or undivided, two-lane or multi-lane, and access is available at intersections and driveways.

A <u>Bypass</u> is defined as a new route that diverts traffic around a community and re-connects to the existing routes on the outskirts of the community (See Figure 1).

POLICY

<u>Sign Sizes</u>

1. For all bypasses, regulatory, warning and school signs **shall** be minimum size code 3.
2. Route assemblies *should* be minimum size code 2 for conventional highways and minimum size code 3 for four lane divided and expressway bypasses.
3. Advance crossroad name signs (M1-94 sign) **shall** be size code 3 (8” upper case / 6” lower case) for all conventional highway bypasses 45 mph and higher and all four lane and expressway bypasses. Advance crossroad name signs (M1-94 sign) *may* be size code 2 (6” upper case / 4 ½” lower case) for conventional highway bypasses, less than 45 mph.

<u>Regulatory Sign Installations</u>

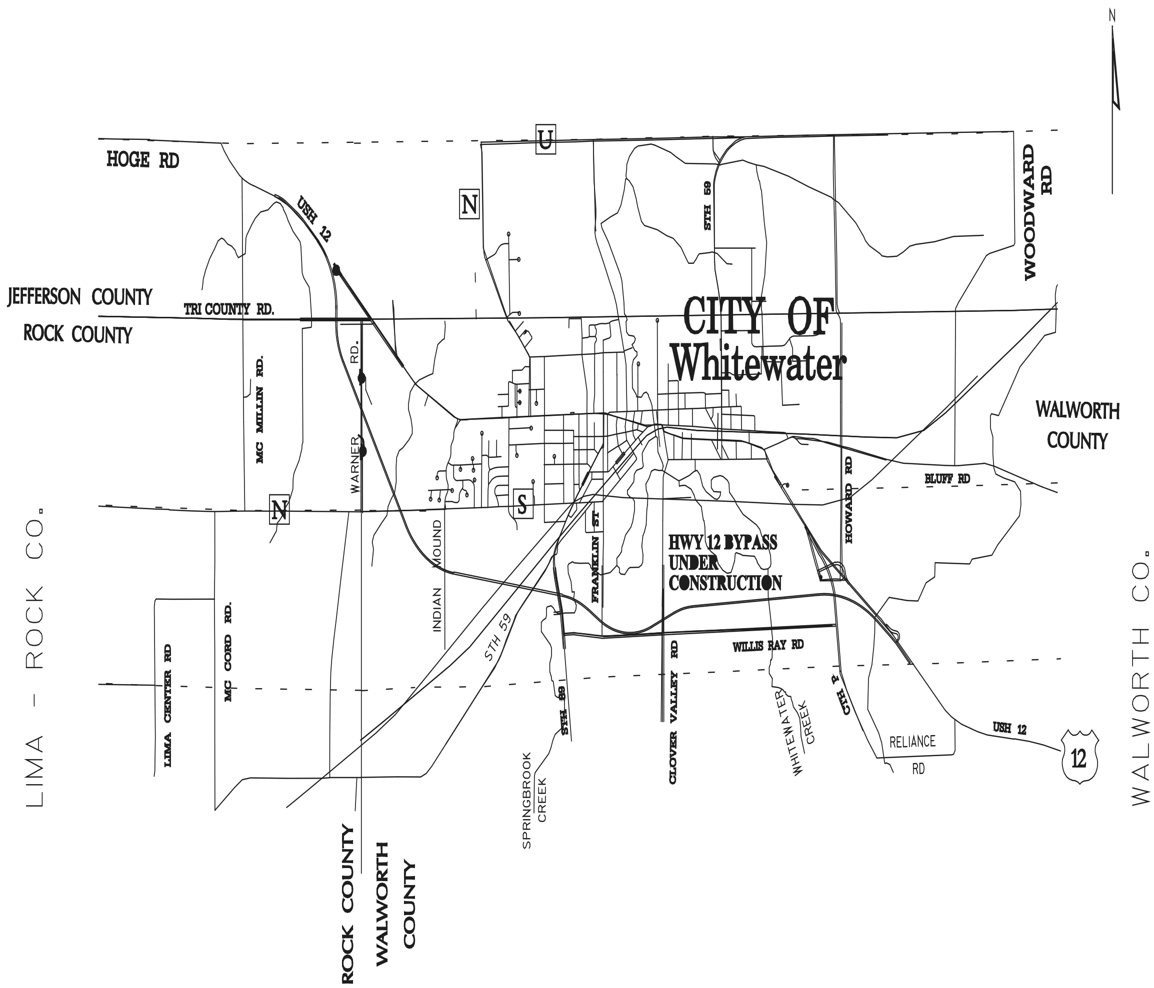
1. Double up STOP signs (R1-1 signs) at all side roads (right and left signs). 200’ minimum of centerline on the side road **shall** be used.
2. STOP signs (R1-1 signs) **shall** be installed in the pork chop islands or in the median island.
3. For median widths greater than 40’ (measured from median edge of travel lane to median edge of travel lane), STOP (R1-1 signs) or Yield (R1-2 signs) signs *should* be installed as appropriate at the second crossroad intersection (in the median) of a four-lane bypass. Typically for median widths 30’ or less, the Yield sign is used in the median to discourage any long trucks from hanging over into the adjacent travel lanes.
4. Cross Traffic Does Not Stop signs (R1-52C sign) **shall** be installed below all STOP signs (R1-1 sign) on both two lane and four lane bypasses. For four lane bypasses, the Cross Traffic Does Not Stop sign (R1-52C sign) *should* be placed below the Divided Highway sign (R6-3 or R6-3a sign).
5. The One-Way sign (R6-1 sign) **shall** be used for all divided bypasses. The R6-1 One-Way signs **shall** be placed above the STOP sign (R1-1 sign). Refer to TEOpS 2-15-12 (Wrong-Way Prevention) for additional criteria on Wrong Way signing.
6. Temporary orange warning flags *may* be added to all STOP signs (R1-1 sign). The flags *should* remain in place until the end of their useful life.
7. The Divided Highway Now Open – Use Proper Lane sign (R3-57 sign) *should* be installed 300–500 feet

in advance of the intersection on side roads for divided highway bypasses. The sign **shall** remain in place for up to a year and then removed.

Warning Sign Installations

1. Supplemental roadway name plaques below the crossroad warning signs (W2-1 and W2-2 signs) **shall not** be used. The crossroad warning sign and advanced crossroad name sign **shall** be on separate installations and spaced properly.
2. Crossroad warning signs *may* be installed at mainline intersections, regardless of sight distance issues.
3. STOP Ahead or Signal Ahead signs **shall** be used on all side roads, regardless of sight distance. STOP Ahead or Signal Ahead signs *may* be doubled up.
4. Temporary orange warning flags *may* be added to all STOP Ahead signs and Signal Ahead signs. The flags *should* remain in place until the end of their useful life.
5. The Two-Way Traffic warning sign (W6-3 sign) **shall** be used if a two-lane bypass is graded or paved for a four-lane capacity that could make it appear like a four lane highway. The Two-Way Traffic warning sign (W6-3 sign) *should* be placed after major intersecting side roads or at least at two mile intervals and *should not* be doubled up.

Figure 1. Sample of New Bypass Highway



2-15-55 Signing for Restricted Crossing U-Turns (RCUTs) May 2023

BACKGROUND

The usage of the Restricted Crossing U-Turn (RCUT), formerly referred to as a "J" turn intersection, has been a low cost intersection safety improvement method that was introduced in the early 1980's. A characterization of a RCUT intersection is the prohibition of left turn and through movements from side street approaches. Instead, these side street movements are accommodated by requiring drivers to make a right turn onto the main highway, and then make a U-turn at a median opening downstream. Left turns from the main roadway onto the sideroad *may* be allowed to remain at the existing sideroad intersection, or, in the case of a full median closure, *may* be executed by making a U-turn at the downstream median opening and then turning right onto the sideroad.

The Federal Highway Administration has indicated several advantages in the RCUT concept over grade-separated interchanges and at-grade intersections. Some of these advantages include increased safety, better operational issues, lower construction costs and less right-of-way impacts. Other states that have implemented the RCUT concept have seen significant safety benefits by eliminating the "far side" right angle crash.

PURPOSE

Currently the Federal MUTCD does not contain guidance on the signing of RCUT intersections. As the construction of RCUT intersections increases, it is critical to have a consistent signing practice for motorist expectations. The signing can be accomplished utilizing traditional regulatory, warning and guide signs outlines in the MUTCD.

Below are guidelines that *should* be followed for the signing of RCUT intersections:

GUIDELINES

The attached typical signing plans *should* be sufficient for most intersections of this type. The choice of using J-Panels only or a combination of J-Panels and diagrammatic signs is left to regional preference.

1. For routes that are not numbered or lettered, advance crossroad name signs **shall** be used.
2. On divided roadways with posted speeds of 45 mph or greater or inadequate sight distance, advanced warning signs WATCH FOR TURNING VEHICLES NEXT ½ MILE *may* be used as a warning to motorists for turning traffic.
3. TEOpS 2-15-12 **shall** be followed for placement of Wrong Way signing.

Figure 1a. Diagrammatic RCUT Signing

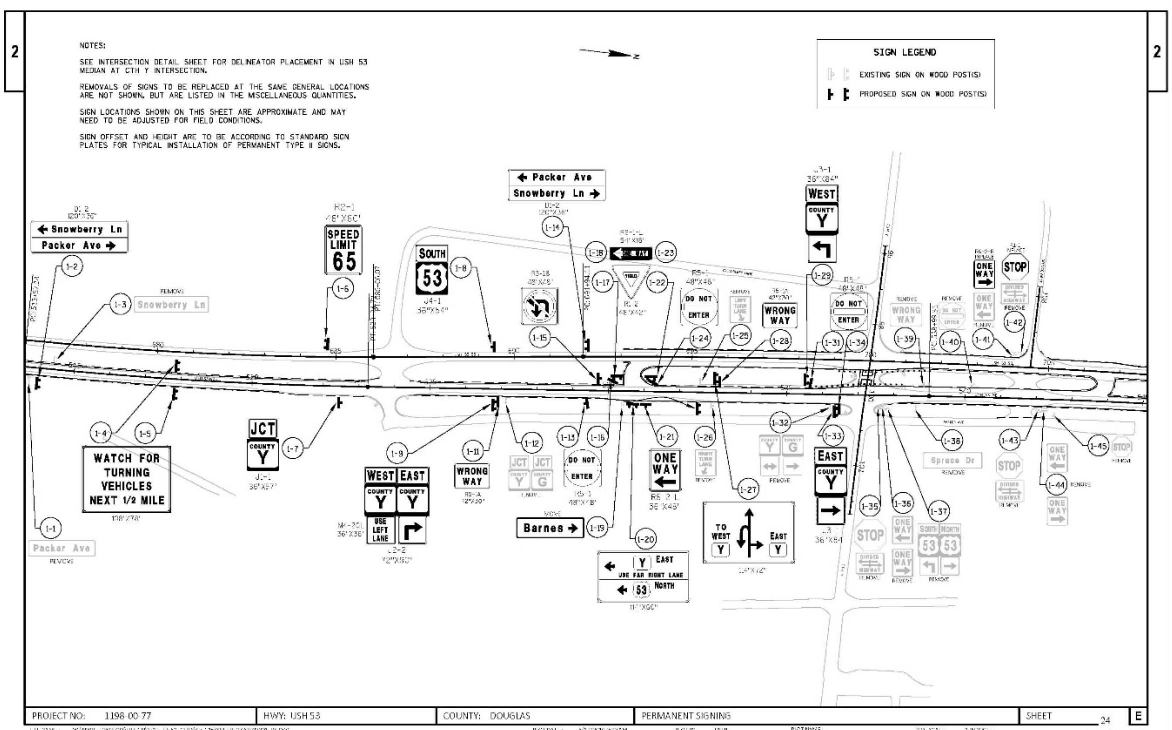


Figure 1b. Diagrammatic RCUT Signing

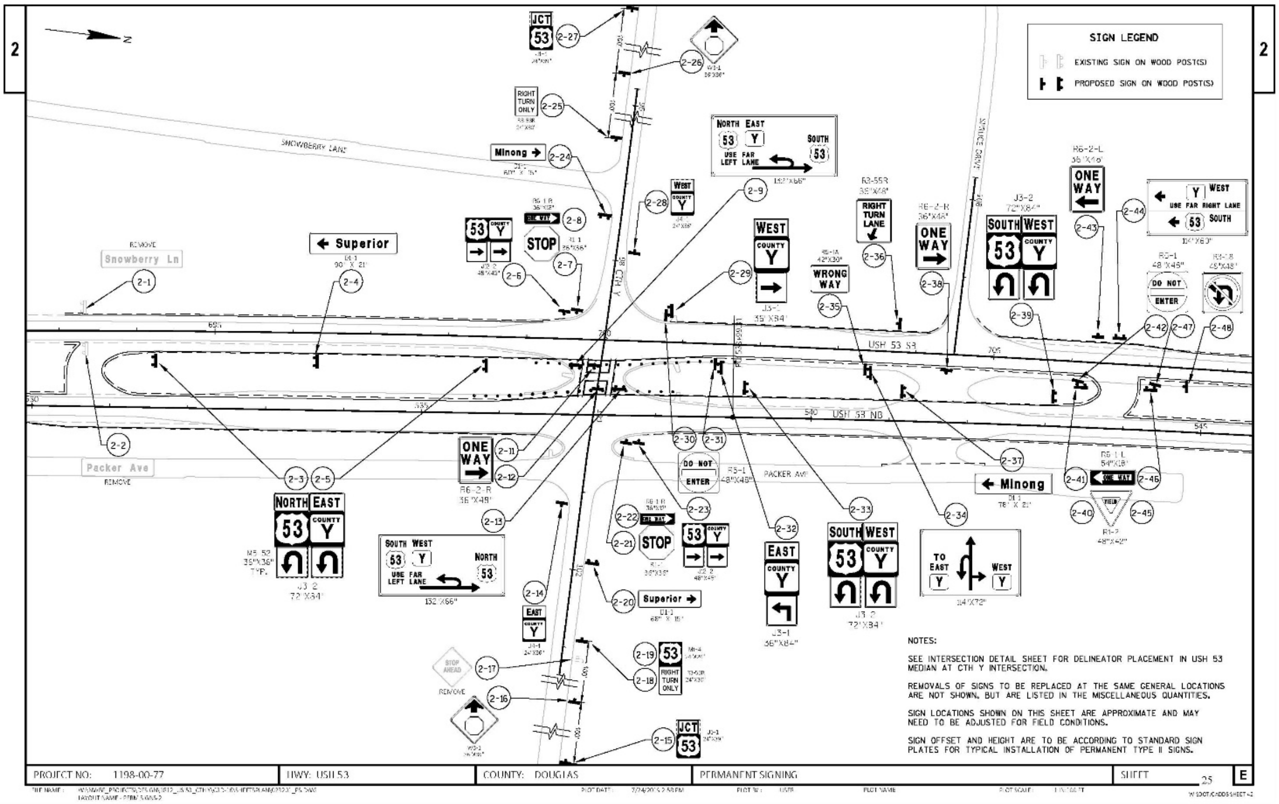


Figure 1c. Diagrammatic RCUT Signing

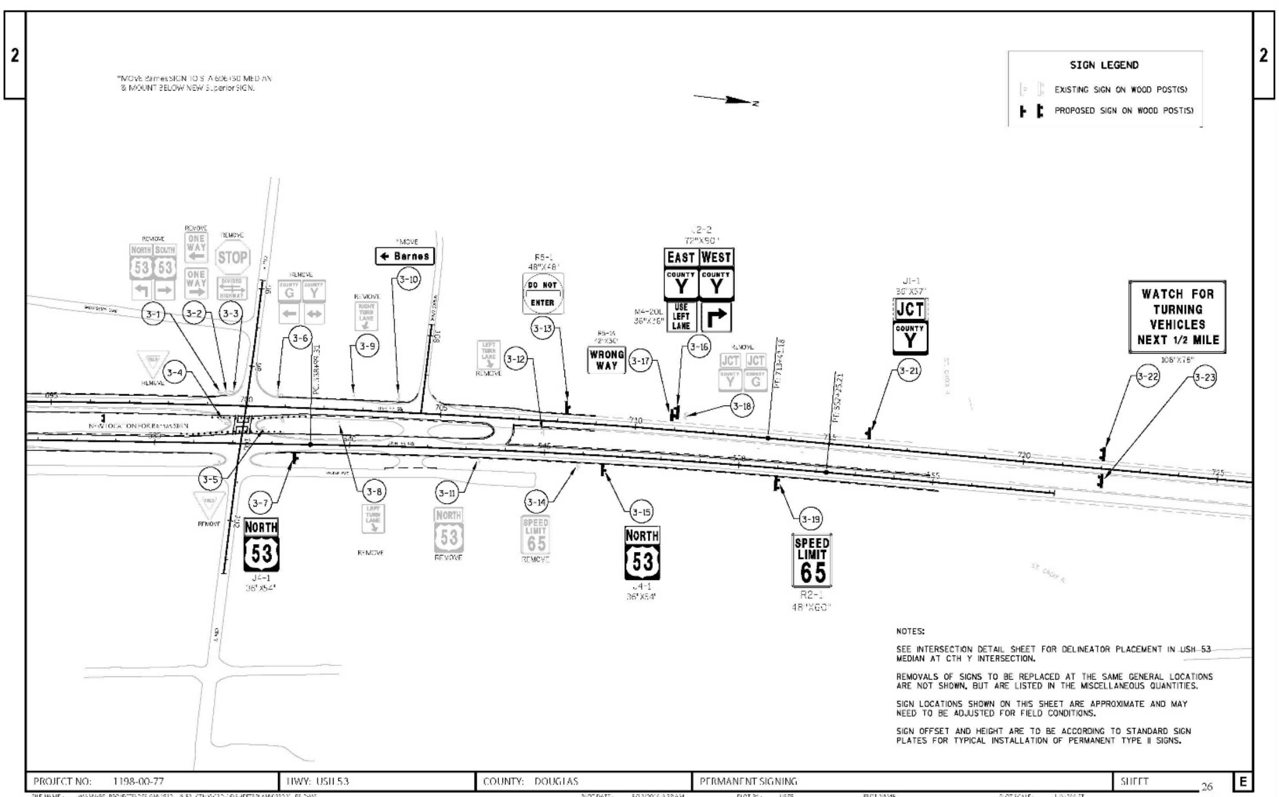


Figure 2. CTH-STH RCUT Signing Using J-Panels Only

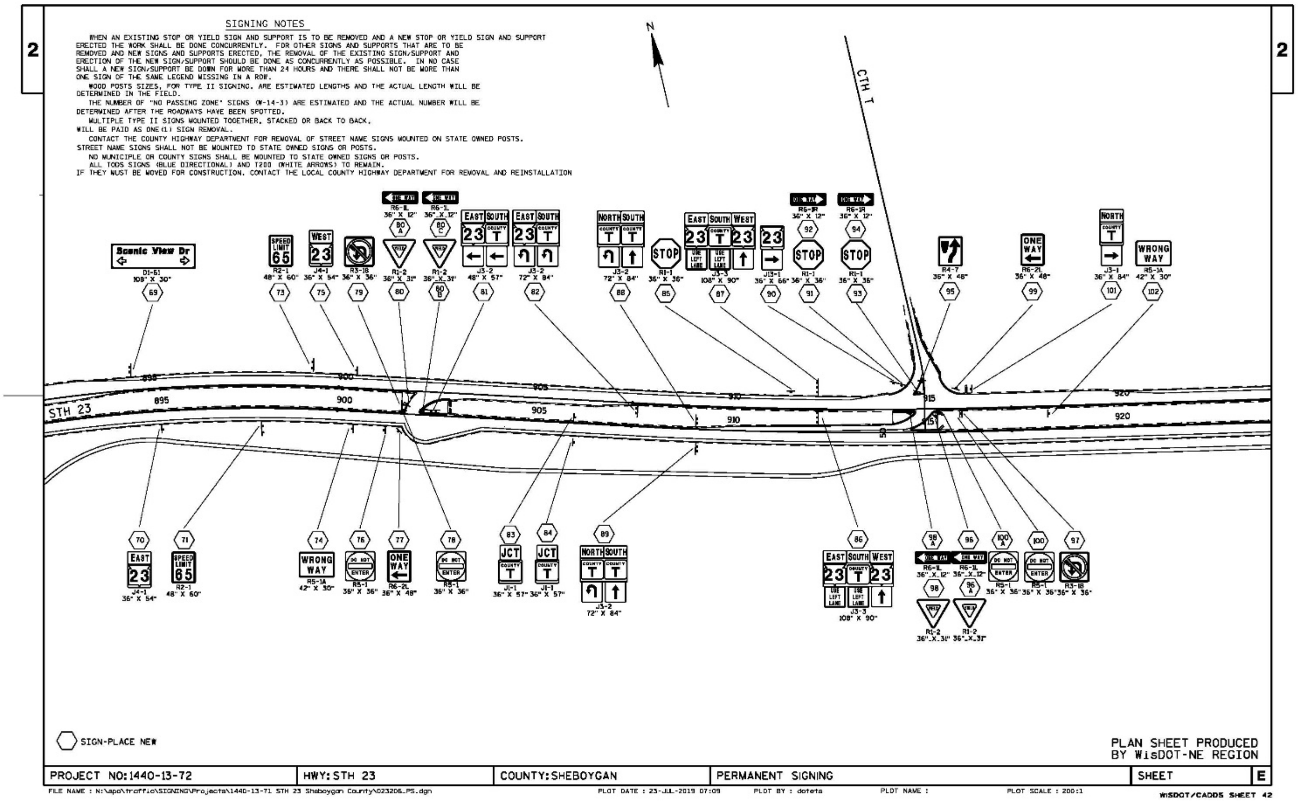


Figure 3a. Local-STH RCUT Signing Using J-Panels Only

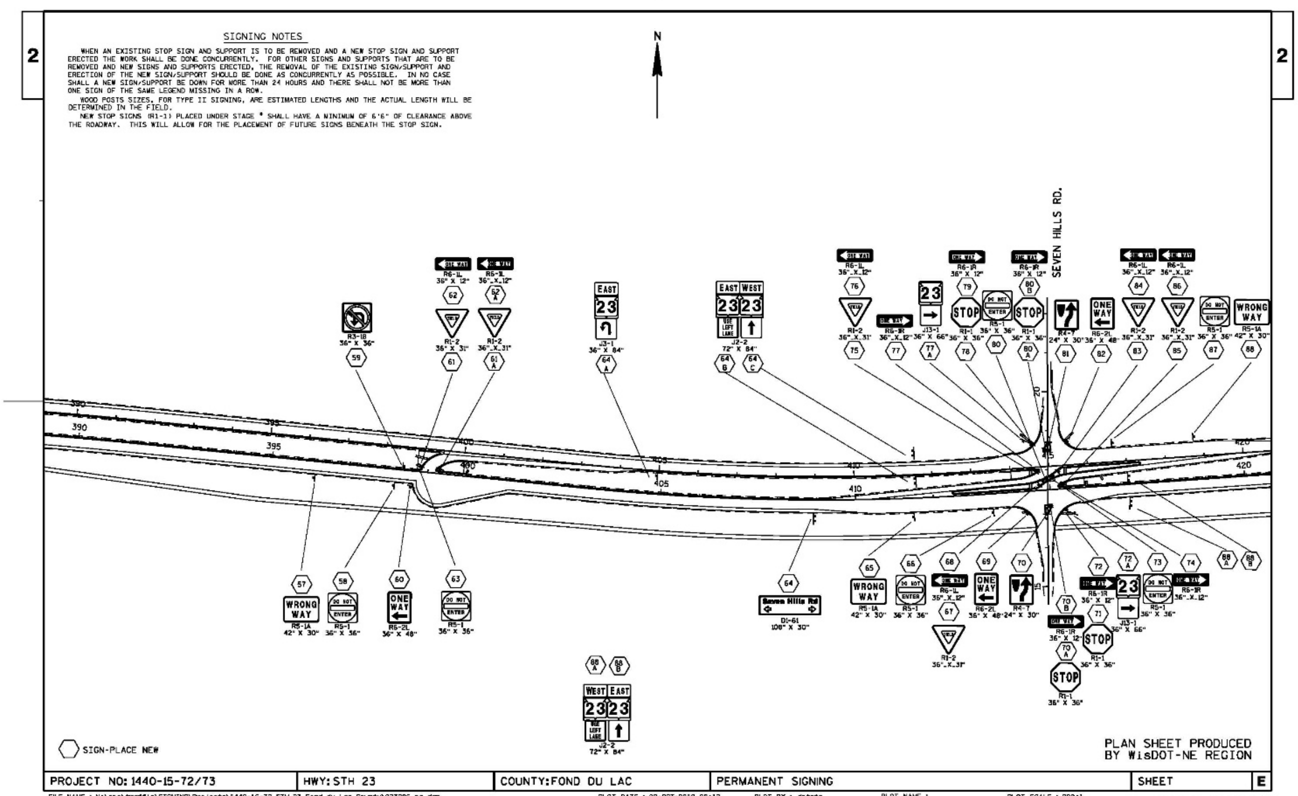
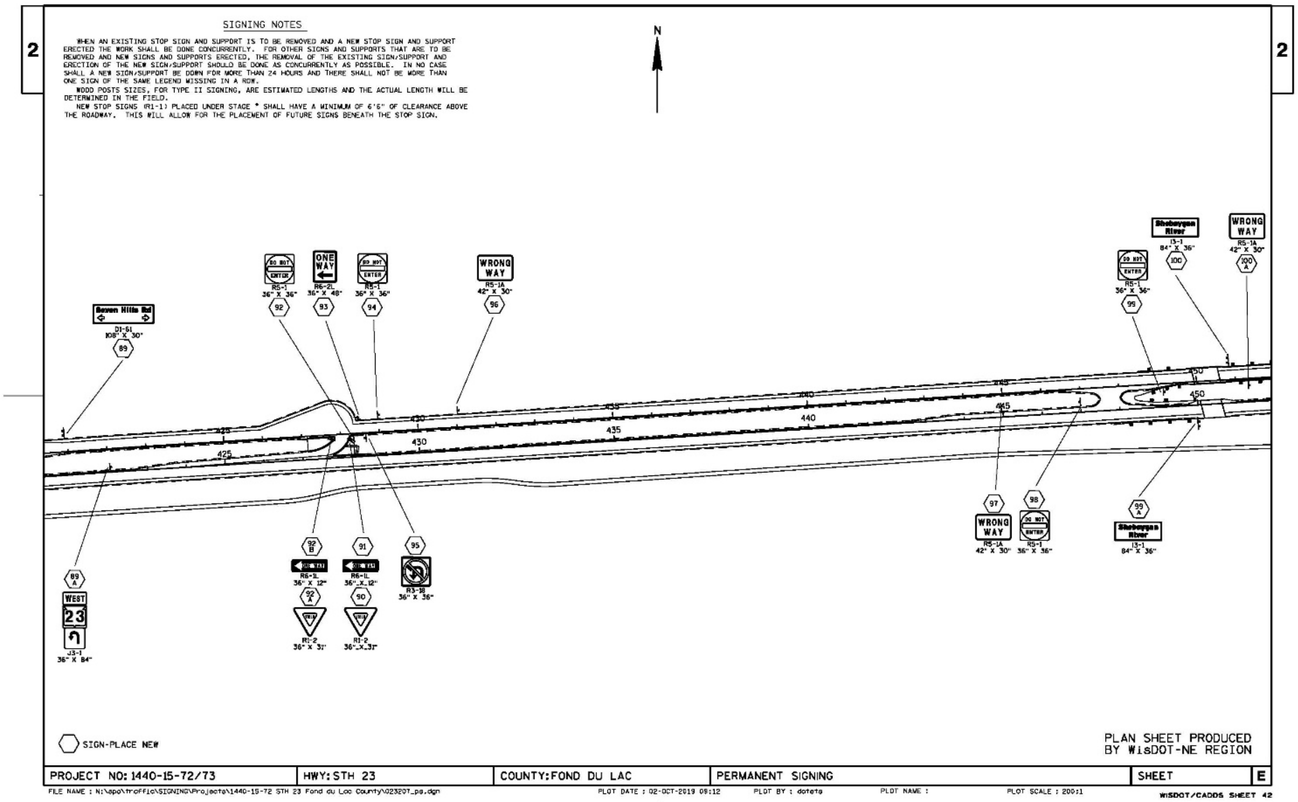


Figure 3b. Local-STH RCUT Signing Using J-Panels Only



2-15-56 Signing for Diverging Diamond Interchanges — January 2015

BACKGROUND

The usage of the Diverging Diamond Interchange (DDI) is a relatively new development in highway design in the United States. DDIs allow free-flow left turns from the crossroad to the freeway on-ramps. This is accomplished by crossing traffic on the crossroad from the right-hand side to the left-hand side through the interchange area.

Several advantages in the DDI concept over traditional diamond interchanges include increased safety, increased capacity of left turn movements, and less right-of-way impacts.

PURPOSE

Currently the Federal MUTCD does not contain guidance on the signing of DDIs. As the construction of DDIs increases, it is critical to have a consistent signing practice for motorist expectations. The signing can be accomplished utilizing traditional regulatory, warning and guide signs outlined in the MUTCD.

Below are guidelines that *should* be followed for the signing of DDIs:

GUIDELINES

The attached typical signing plans *should* be sufficient for most interchanges of this type. Figure 1 shows a DDI with the crossroad over the freeway, and Figure 2 shows a DDI with the freeway over the crossroad.

Field review of signing is critical before opening the DDI to traffic. Signing *should* be adjusted to ensure that wrong way prevention signs (Do Not Enter, No Left/Right/U-turns) are positioned to minimize the possibility of confusion for drivers.

<u>Single-lane Crossroad Approach to DDI</u>

1. The double reverse curve warning sign (W24-1) *should* be used on all approaches to DDIs. The W24-1 sign **shall** be used on approaches to DDIs with safe operating speed less than posted/statutory speed of the roadway.
2. R3-50A signs *should* be installed above all through lanes on the signal mast arms within the DDI.
3. TEOpS 2-15-12 **shall** be followed for placement of Wrong Way signing. Sign plate R3-4R (reverse no

U-turn) has been developed for use at the signals within the DDI.

4. TEOpS 2-4-44 *should* be followed for placement of guide signs.

Mulit-Lane Crossroad Approach to DDI

1. The double reverse curve warning sign (W24-1L) *should* be used on all approaches to DDIs. The W24-1L with an advisory speed sign (W13-1P) **shall** be used on approaches to DDIs with safe operating speed 10 mph or more less than posted/statutory speed of the roadway. When a W24-1 is used, an appropriate supplementary plaque ("All Lanes", "Left 2 Lanes", etc.) **shall** be placed below the W24-1L.
2. R3-50A signs **shall** be installed above all through lanes on the signal mast arms within the DDI.
3. TEOpS 2-15-12 **shall** be followed for placement of Wrong Way signing. Sign plate R3-4R (reverse no U-turn) has been developed for use at the signals within the DDI.
4. Approaching the DDI, advance overhead lane selection guide signs (E6 series) **shall** be used.
5. For DDIs with the crossroad over the freeway, J2 and D1-7x series signs *should* be used within the DDI. For DDIs with the freeway over the crossroad, overhead guide signs **shall** be used in place of the J2 series signs.
6. If overhead guide signs are used within the DDI, D1 or J3 series signs *may* be used at the on-ramp terminal within the DDI.

Figure 1.

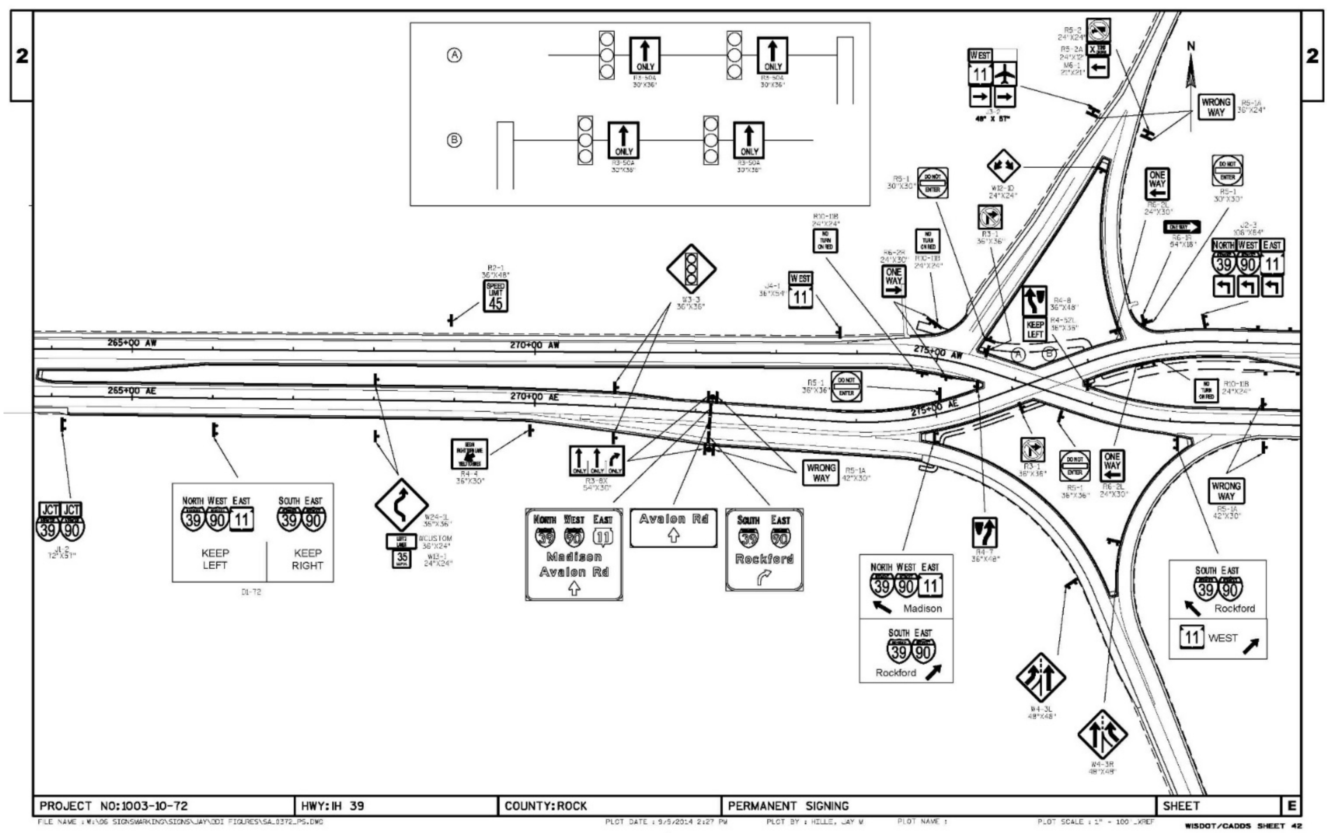


Figure 1. Continued

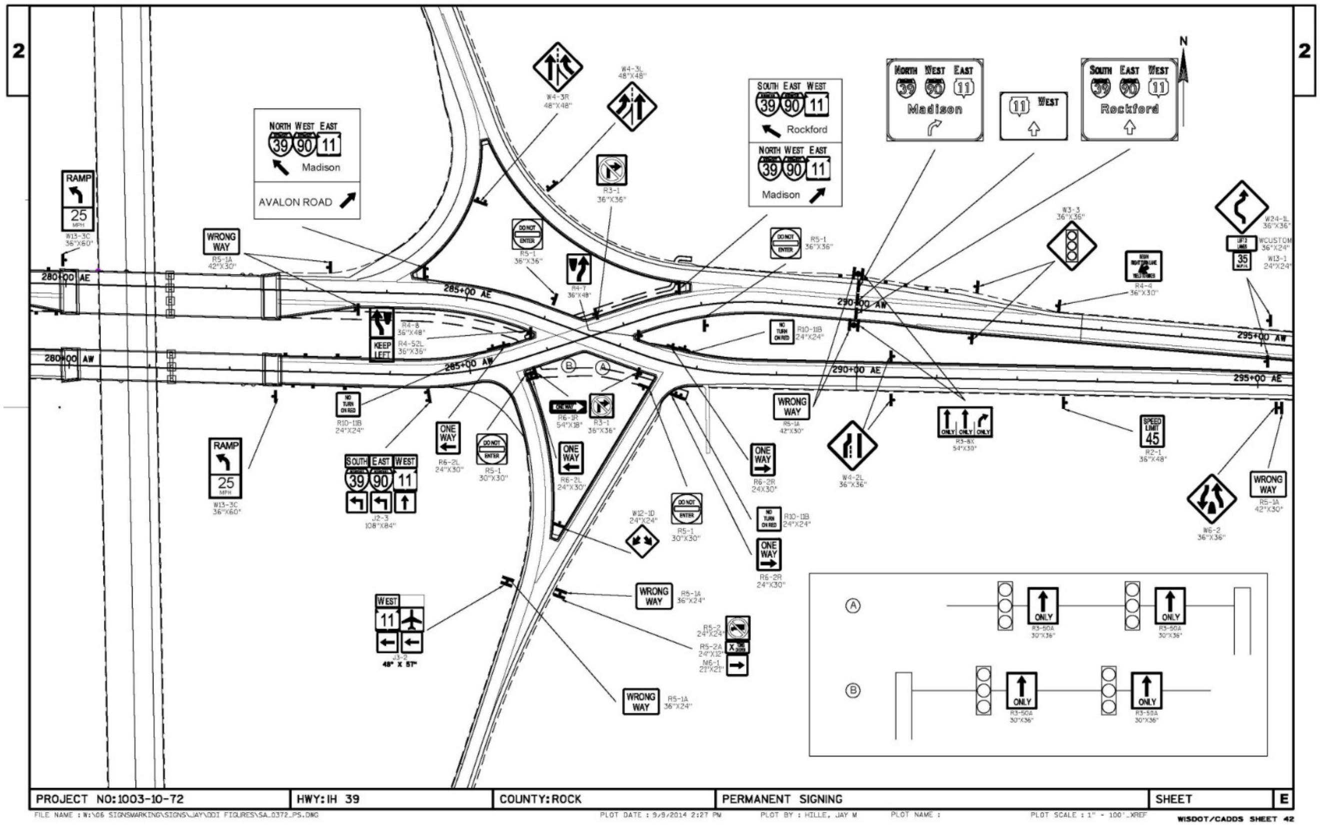


Figure 1. Continued

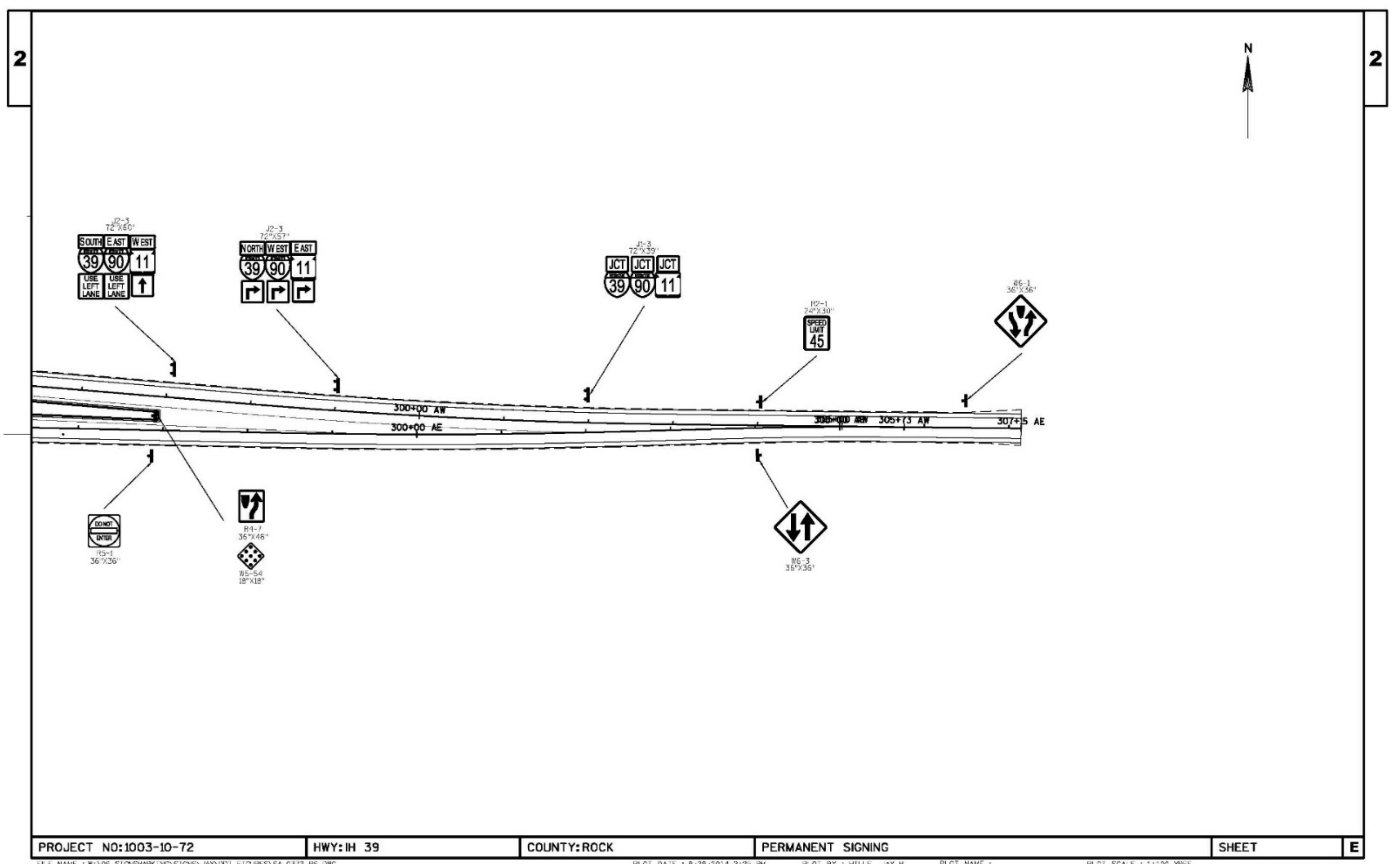


Figure 2.

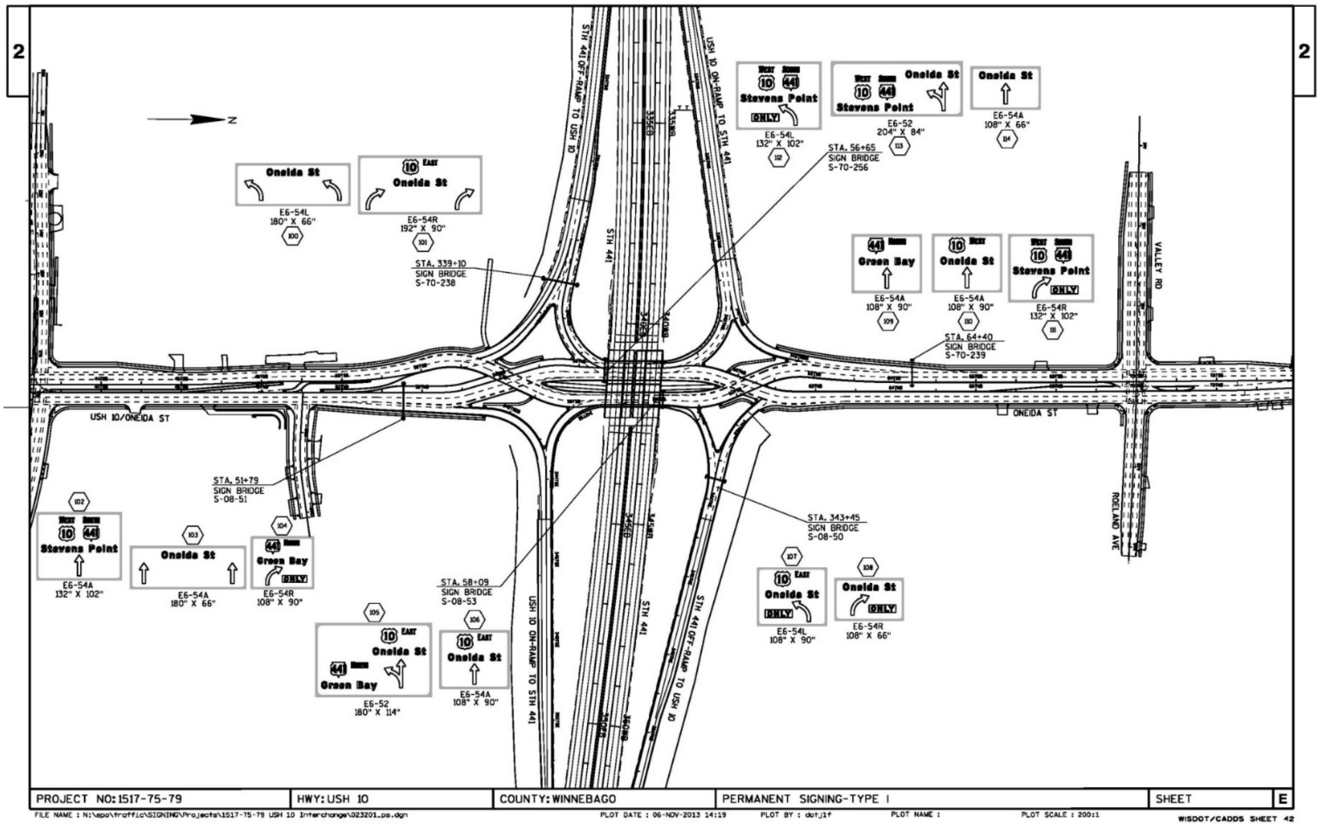


Figure 2. Continued

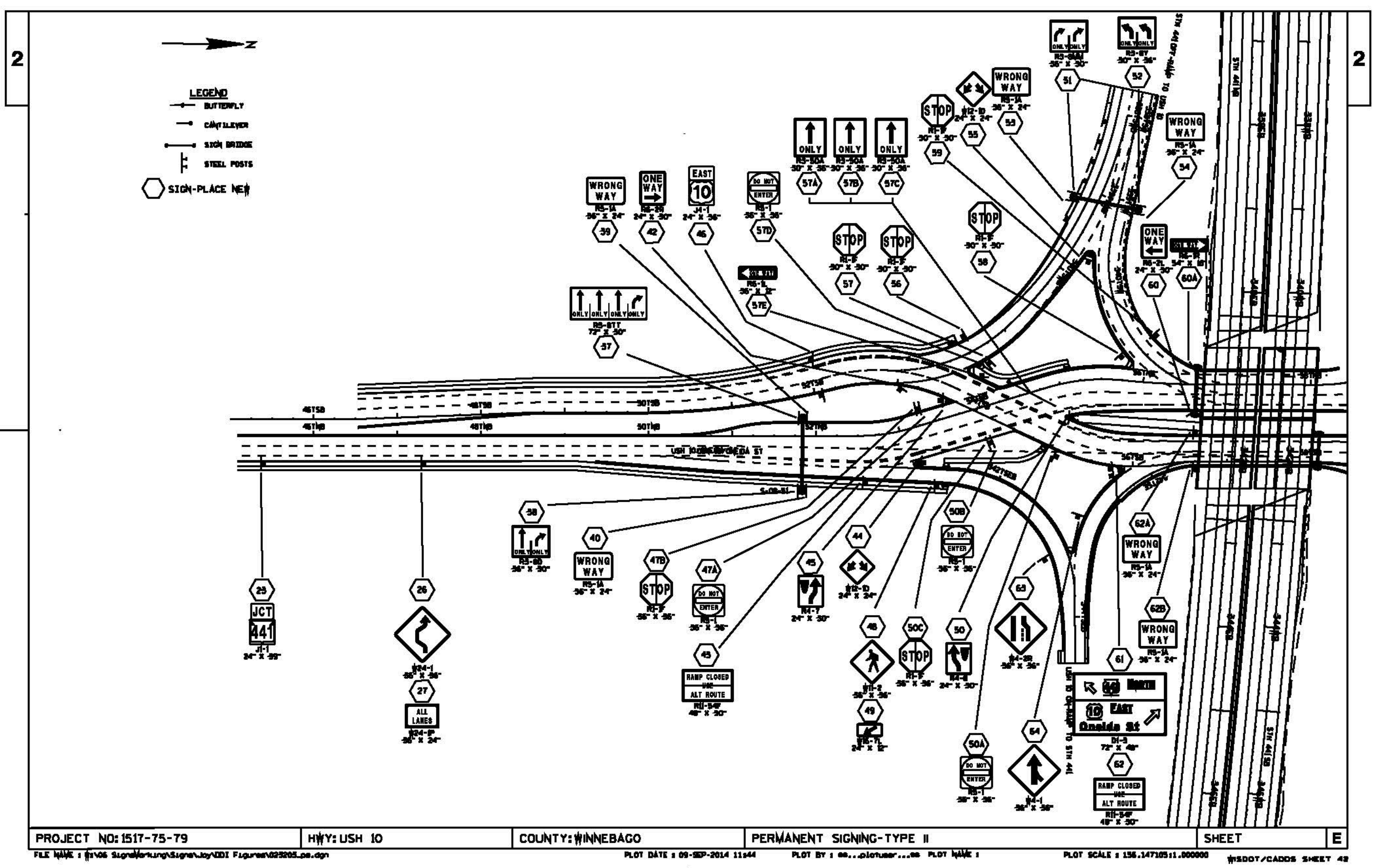
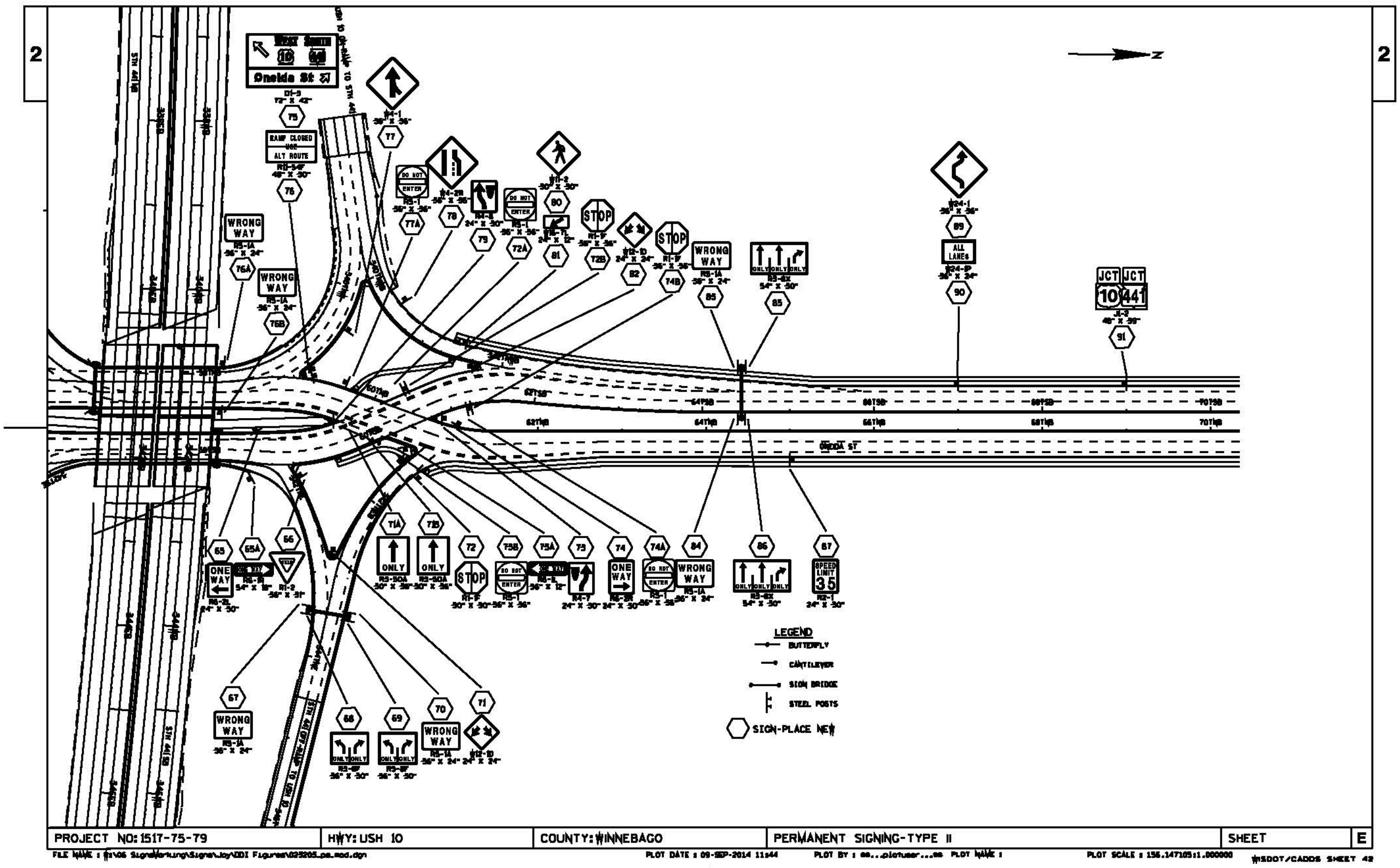


Figure 2. Continued



2-15-58 Specific Information Signs — February 2021

PURPOSE

The purpose of this policy is to provide consistent statewide direction for the permitted use of Specific Information Signs under Wisconsin Administrative Code Chapter Trans 200.06 and Wisconsin Statute 86.195.

The Specific Information Signs (SIS) have the business's logos on blue signs. These **shall** only be permitted on SIS highways.

DEFINITIONS

SIS Highway: SIS Highway *may* be a major highway, interstate, freeway, or expressway and are approved by the state legislature. In Trans 200.03, Chapter 86.195 contains all SIS approved highways. (https://docs.legis.wisconsin.gov/statutes/statutes/86/195/2)

POLICY

In addition, the following DOT qualifying considerations **shall** be met.

Gasoline

1. Businesses **shall** be open a minimum of 16 hours per day, seven days a week for freeways and expressways.
2. Businesses **shall** be open a minimum of 12 hours per day, seven days a week for other highways.
3. Businesses **shall** provide a restroom, drinking water, and a public telephone.
4. Businesses **shall** provide vehicle services including fuel, oil and water.
5. Businesses **shall** be within three miles of the exit. If there are no businesses in the same category within three miles of the exit, the maximum distance *may* be extended to 15 miles.

Food

1. Businesses **shall** be open five days per week from at least 10 a.m. to 7 p.m.
2. Businesses **shall** have licensing and approval where required.
3. Businesses **shall** have at least 50 percent of gross receipts from food and non-alcoholic beverages.
4. Businesses **shall** provide restrooms and a public telephone.
5. Businesses **shall** be within three miles of the exit. If there are no businesses in the same category within three miles of the exit, the maximum distance *may* be extended to 15 miles.

Lodging

1. Businesses **shall** have licensing and approval where required.
2. Businesses **shall** have adequate sleeping accommodations.
3. Businesses **shall** provide restrooms and a public telephone.
4. Businesses **shall** be within three miles of the exit. If there are no businesses in the same category within three miles of the exit, the maximum distance *may* be extended to 15 miles.

Camping

1. Businesses **shall** have licensing and approval where required.
2. Businesses **shall** have restrooms, drinking water, and a public telephone.
3. Businesses **shall** have adequate parking accommodations.
4. Businesses **shall** be within three miles of the exit. If there are no businesses in the category within three miles of the exit, the maximum distance *may* be extended to 15 miles.

Tourist Attractions

1. The primary purpose **shall** be to provide amusement, historical, cultural, or leisure activities to the public.
2. Businesses **shall** have regional significance and adequate parking accommodations.
3. Businesses **shall** be within 30 miles of the exit.
4. Businesses **shall** be open a minimum of 8 hours per day, 5 days per week, for at least 3 consecutive months.
5. Applications **shall** be sent to BTO and forwarded onto the Advisory Council for approval.

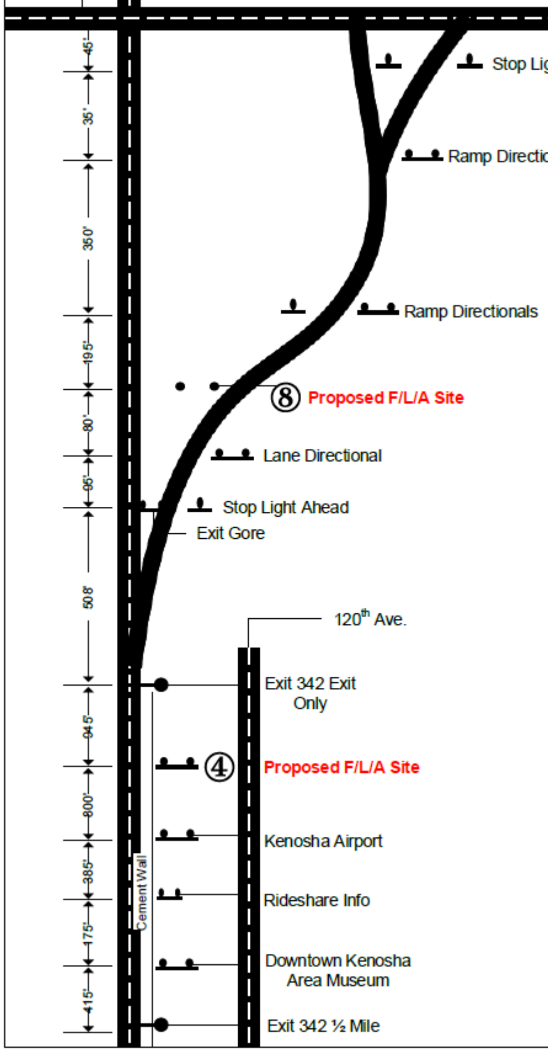
Installation of Specific Information Signs
Contact Interstate Logos for an application.
4918 Triangle St.
McFarland, WI 53558
(844) 496-9163 or (608) 579-1570
www.wisconsin.interstatelogos.com

Improvement Projects

- Site Plans **shall** be requested from Wisconsin Logos (see attached example below).
- Project contractors **shall not** perform work on SIS signs.
- STSP 638-010 **shall** be included in projects with SIS signs.

Wisconsin
SITE PLAN

ROUTE: 94
EXIT: 342
CROSSROAD: STH 158
DIRECTION: W/B
COUNTY: Kenosha
DATE: 9/9/14



WISDOT SITE PLAN APPROVAL

FIELD INSPECTOR ____________________ DATE ____________

Project ID # ____________________ DATE ____________

NOTES

Site ④ located behind wall. Access from service road.

Install site ⑧ on existing wood posts on left side of ramp.

GENERAL NOTE: An approved site plan by the WisDOT constitutes permission for Interstate Logos to perform the work shown on the site plan. A copy of the approved site plan must be at the site where work is being performed.

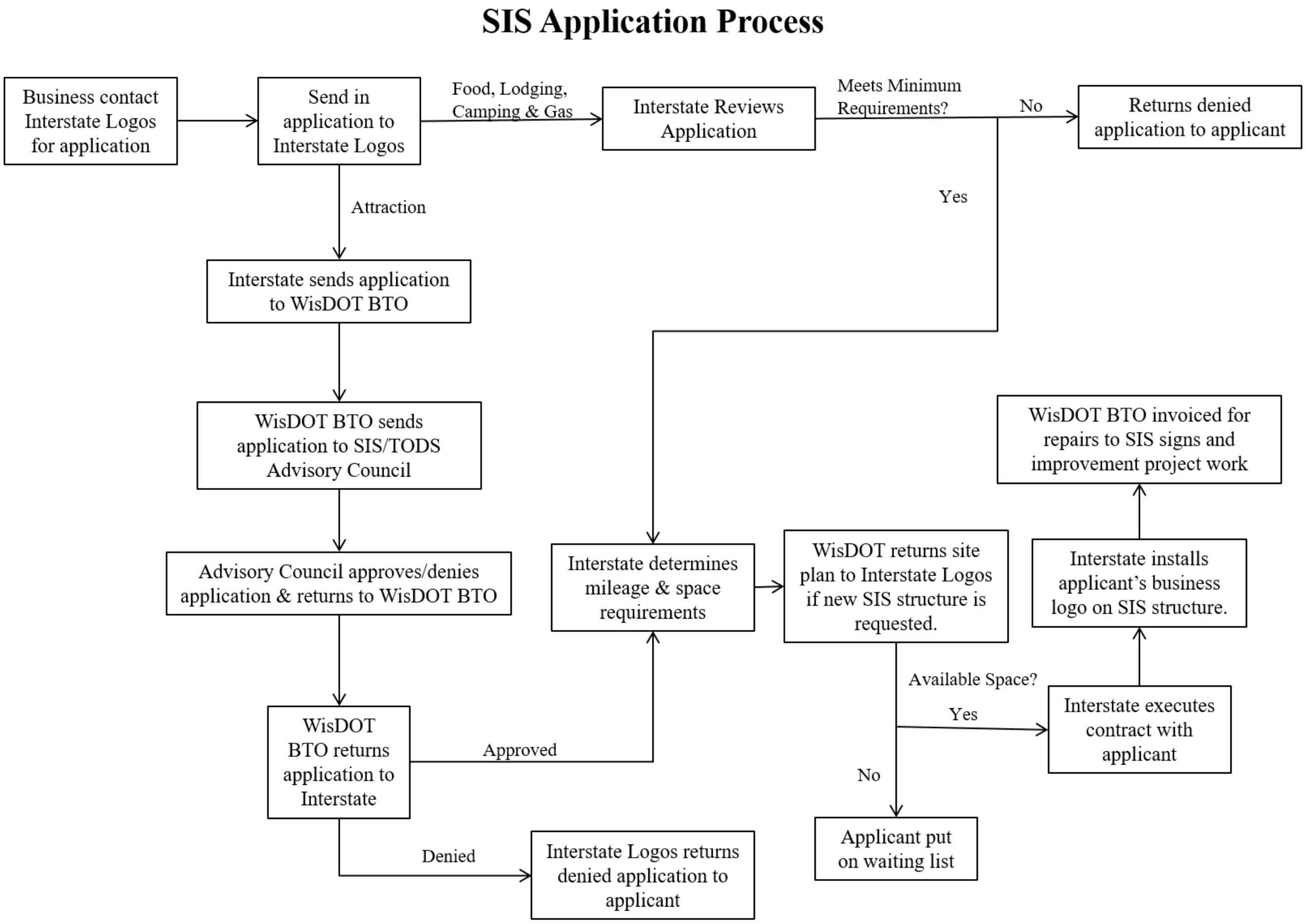
RAMP SIGNS

SITE #	OFFSET	NEW SIZE	NEW SUPPORTS	NEW QTY.
⑧	15'	5'x5'	Wood	2
⑦				
⑥				
⑤				

MAINLINE SIGNS

SITE #	OFFSET	NEW SIZE	NEW SUPPORTS	NEW QTY.
④	10'	15'x12'	Steel	2
③				
②				
①				

The flow chart below describes the application process to obtain a SIS sign.



2-15-59 Tourist Oriented Directional Signs — March 2023

PURPOSE

The purpose of this policy is to provide consistent statewide direction for the permitted use of Tourist Oriented Directional Signs under Wisconsin Administrative Code Chapter Trans 200.08 and the Wisconsin Statute 86.196.

The Tourist Oriented Directional Signs (TODS) are white on blue signs. They are not permitted on SIS-designated highways, at the intersection of two state roadways, or inside federal urban areas.

The application/permit form DT1864 incorporates Trans 200.08 and Statute 86.196 and specifies complete guidance on the use of these signs.

DEFINITIONS

SIS Highway: Specific Information Sign highways can be found in TEOpS 2-15-58.

Federal Urban Area: Federal urban areas are defined as "Urban Federal Aid Systems" with populations of 5,000-49,000.

Urban Areas: Urban areas are defined as urban boundaries with populations of 50,000 or greater.

GUIDANCE

The following businesses are qualified for a TODS sign under the gas, food, lodging, or camping categories.

Bed and Breakfast	Campground
Hotel	Motel
RV Park	Resort
Restaurant	Service Station
Coffee Shops	

The following table provides a list of facilities which, if open and available to the public, *may be* eligible for a TODS attraction sign.

American Indian Craft	Amusement Park
Antique Shop	Art Gallery
Bait and Tackle Shop	Beach (privately owned)
Bicycle Rental	Boat Tour
Boat/Canoe Rental	Brewery (with tours)
Candy Store (Primary Business)	Cave (with tours0
Cheese Factory Shop (Primary Business)	Farm Tour
Ferry	Fish Farm
Game Farm (open to Public)	Golf Course
Hot Air Balloon Rides	Museum
Orchard	Park
Petting Zoo	Pick-Your-Own Fruits and Vegetables
Rafting/Tubing Business	Sausage Factory Shop (primary business)
Ski Resort/Hill	Stable
Tree Nursery	Wildlife Refuge
Winery (with tour)	Zoo
Botanical Gardens	Fairgrounds
Water Park	Casino/Bingo

The following table proves a list of facilities which are *not* eligible for TODS attraction signs.

Tennis Court	Fireworks
Book Store	Go-Kart Track
Taxidermy Shop	Grotto
Car Rental	Health Club
Swimming Pool/Natatorium	Hobby Shop
Civic Center	Ice Rink/Arena
Conservation Area	Movie Theater
Outlet Mall	Religious Shrine
Sports Arena/Stadium	

POLICY

TODS signs are intended for use in rural or outlying urban areas. They **shall not** be installed at intersections inside Federal Urban or Urban Area boundaries, or for businesses located inside Federal Urban or Urban Area boundaries.

In addition, the following DOT qualifying considerations **shall** be met.

1. Name changes **shall** require cancellation of the old sign and issuance of a new permit.
2. Only the name of the facility and mileage **shall** be allowed on the signs. Additional sign features, such as vacancy, hours of operation or products offered **shall not** be allowed on the sign or on an attached plaque or board.
3. If a conventional highway facility qualifies for signs in more than one category (TODS, SIS, Trans 200 Guidance or Supplemental Guide sign), only one category will be allowed in each direction.
4. If outdoor advertising signs for the facility are within 1,000 feet of the intersection or entrance, guidance signs **shall not** be permitted.
5. Businesses **shall** be within five miles of the intersection and have direct access to the State or U.S. Highway. If the business is not located directly on the crossroad off the State or U.S. Highway, additional supplemental signs *may* be required.
6. Businesses **shall** have no illegal outdoor advertising signs.

Category specific information:

Gasoline

1. Businesses **shall** have fuel, oil, and water available.
2. Businesses **shall** be open a minimum of twelve hours per day, seven days a week if located on a conventional roadway. Businesses located on an expressway **shall** be open a minimum of sixteen hours per day, seven days a week.
3. Businesses **shall** provide a restroom, drinking water, and a public telephone.

Food

1. Businesses **shall** have licensing or approval, where required.
2. Businesses **shall** be open five days per week from at least 10 a.m. to 7 p.m.
3. Businesses **shall** have at least 50 percent of gross receipts from food and non-alcoholic beverages.
4. Businesses **shall** provide a restroom, drinking water, and a public telephone

Lodging

1. Businesses **shall** have licensing or approval, where required.
2. Businesses **shall** have adequate sleeping accommodations.
3. Businesses **shall** have parking accommodations.
4. Businesses **shall** provide restrooms, drinking water, and a public telephone.

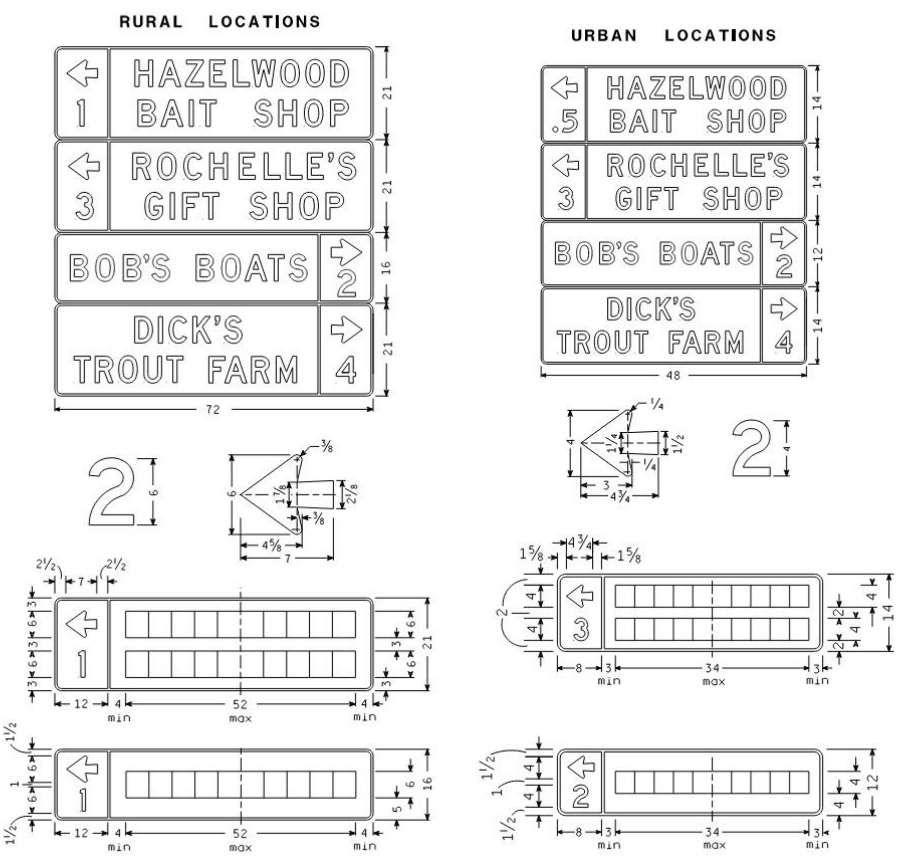
Camping

1. Businesses **shall** have licensing or approval, where required.
2. Businesses **shall** have adequate parking accommodations.
3. Businesses **shall** provide restrooms, drinking water, and a public telephone.

Tourist Attractions

1. Businesses **shall** have licensing or approval, where required.
2. Businesses **shall** be open at least eight hours per day, five days a week for at least three consecutive months.
3. Businesses **shall** provide restrooms and drinking water
4. Businesses **shall** have significant interest to the traveling public, as approved by the Advisory Council.

Figure 1. Standard Plate for TODS signs



As shown on Figure 1 of the Standard Sign Plate E10-82, the sign message **shall** consist of 4 or 6 inch white lettering on type H reflective blue background. Letter sizes and spacing **shall** conform to the standards in the FHWA Standard Highway Signs manual. Overall sign sizes used **shall** conform to the dimensions as shown on the Standard Sign Plate E10-82. Base material is aluminum, with rounded corners. A half inch white border with a 1 ½" radius shall be placed around the sign.

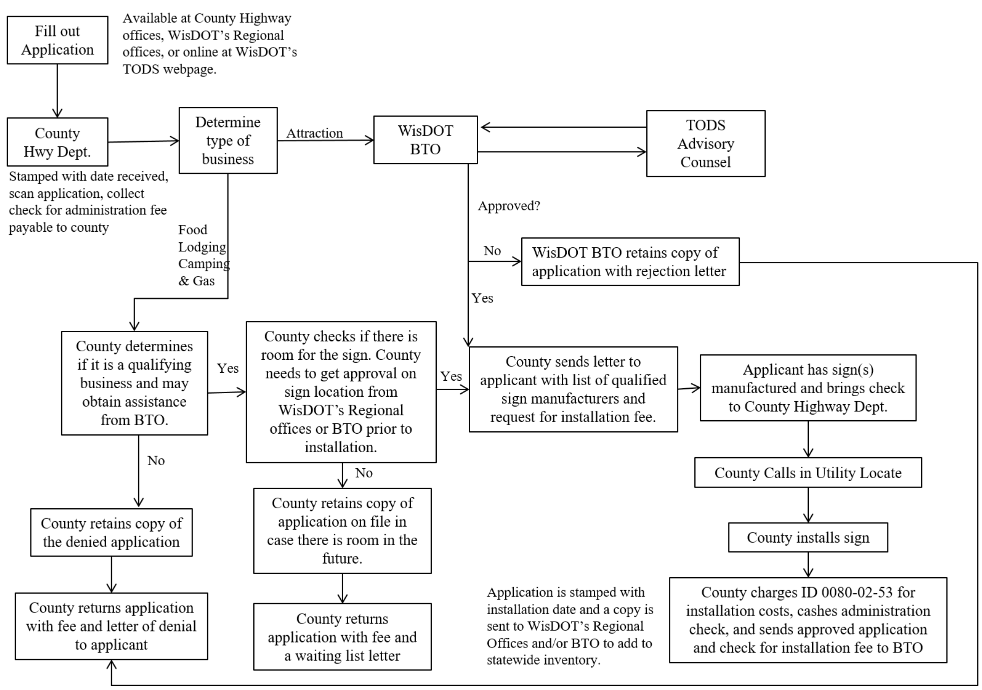
The WisDOT Region office reserves the right to remove non-conforming signs from the highway right-of-way. The owner *may* contact the WisDOT Region office to pick up any signs that have been removed. Upon pickup of the removed signs, the sign owner **shall** be responsible for sign removal costs.

Installation of Tourist Oriented Directional Signs by Counties

1. Businesses **shall** drop off or submit a completed DT1864 form with a check payable to the county for the $100/sign for administration fee. If approved, businesses are required to pay the administration fee every 5 years based on the installation date.
2. All applications **shall** be forwarded to Casey Amans (casey.amans@dot.wi.gov) to verify the location is outside federal urban area boundaries.
3. Once approved, the business *may* have the sign manufactured from one of the businesses on the Qualified Manufacturer list. Signs **shall** be made to state standards.
4. The business **shall** bring in the sign(s), along with a check for $250 per sign payable to the Wisconsin Department of Transportation for the installation fees. These checks *should* be sent to: Wisconsin Department of Transportation, attn: Casey Amans, 3609 Pierstorff St. Madison, WI 53704.
5. Signs **shall** be mounted on 4" x 6" treated posts.
6. For removal and/or installation of signs on existing posts, the removal/installation fees are $100 per sign. Checks *should* be sent to: Wisconsin Department of Transportation, attn: Casey Amans, 3609 Pierstorff St. Madison, WI 53704.
7. All county costs for TODS repairs and installations **shall** be charged to the 0080-02-53 project ID. The county *should* ensure the business submits the appropriate repair/installation fees due to WisDOT.
8. The county *should* only repair damaged TODS when directed to do so by the sign owner. Every repair requires the business to cover the appropriate costs. If the business elects not to repair the sign, the county *may* remove it. If the business wants their sign(s), removal fees would apply.
9. Any existing white arrow boards for the business **shall** be removed before a TODS sign is installed

The application process for a TODS sign is shown below in the Figure 2.

Figure 2. TODS Application Process



TOURIST ORIENTED DIRECTIONAL SIGN (TODS) APPLICATION/PERMIT

Wisconsin Department of Transportation
DT1864 12/2020 s. 86.196 Wis. Stats., Ch. Trans. 200.08 Wis. Admin. Code

INSTRUCTIONS:

1. Complete both sides of the application. PLEASE PRINT CLEARLY.
2. Prepare a check for $100 per sign for the administrative fees. The check is to be made payable to the county in which the requested sign(s) would be located.
3. Staple the check to the upper left corner of this application.
4. Send the application and check to the County Highway Commissioner. The application will be reviewed, and the county will contact you with the results. If the application is denied, the check will be returned.

Make Check Payable To:

Mail To:

NAME of Business/Service/Activity:

Street Address, City, State, ZIP Code:

Business/Service/Activity Category for which TODS are Requested *(Check ONE)*:
☐ Gas ☐ Food ☐ Lodging ☐ Camping ☐ Tourist Attraction

Amenities Available at the Business/Service/Activity:
☐ Restrooms ☐ Parking ☐ Drinking Water ☐ Telephone

Period Business/Service/Activity Operates:
☐ Open All Year ☐ Seasonal Operation

If Seasonal Operation, Open Each Year:
From (month/day): To (month/day):

Hours of Operation:	OPEN	CLOSE
Monday	☐ a.m. ☐ p.m.	☐ a.m. ☐ p.m.
Tuesday	☐ a.m. ☐ p.m.	☐ a.m. ☐ p.m.
Wednesday	☐ a.m. ☐ p.m.	☐ a.m. ☐ p.m.
Thursday	☐ a.m. ☐ p.m.	☐ a.m. ☐ p.m.
Friday	☐ a.m. ☐ p.m.	☐ a.m. ☐ p.m.
Saturday	☐ a.m. ☐ p.m.	☐ a.m. ☐ p.m.
Sunday	☐ a.m. ☐ p.m.	☐ a.m. ☐ p.m.

Special Rule for the **ATTRACTION** Category:
If you are applying for TODS under the ATTRACTION category, the following information is ***required***:
Number of Visitors per Year: (*5,000 Minimum Annual Attendance)

Special Rule for the **FOOD** Category:
If you are applying for TODS under the FOOD category, the following information is ***required***:

☐ Yes ☐ No 1. Do you serve 2 meals per day?
☐ Yes ☐ No 2. Are at least 50% of your gross annual receipts for food and nonalcoholic beverages?

Sign Conflicts:

☐ Yes ☐ No 1. Do you have a "White Arrow Board" sign (Ch. Trans 200.03, Wis. Admin. Code) at the intersection of the proposed TODS locations?
☐ Yes ☐ No 2. Do you have an outdoor advertising sign, which is not in accordance with s.84.30 Wis. Stats. or Ch. Trans. 201 Wis. Admin. Code?
☐ Yes ☐ No 3. Do you have permitted outdoor advertising signs within 1,000 feet of the proposed TODS locations?

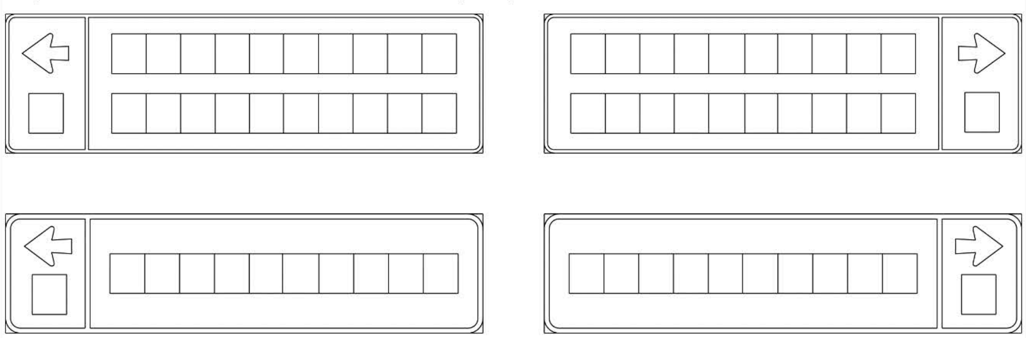
Number of Signs:

☐ One new TODS (Administrative fee is $100 payable to the county)

☐ Two new TODS (Administrative fee is $200 payable to the county)

☐ Replace or Repair Existing TODS (Installation fee is $100/sign if sign only, $250/sign if replacing sign and/or posts, payable to WisDOT)

Proposed Sign Wording:
Fill in the name and the distance from the intersection to the business/service/activity for each TODS requested. Limit the name to one character or space per box.



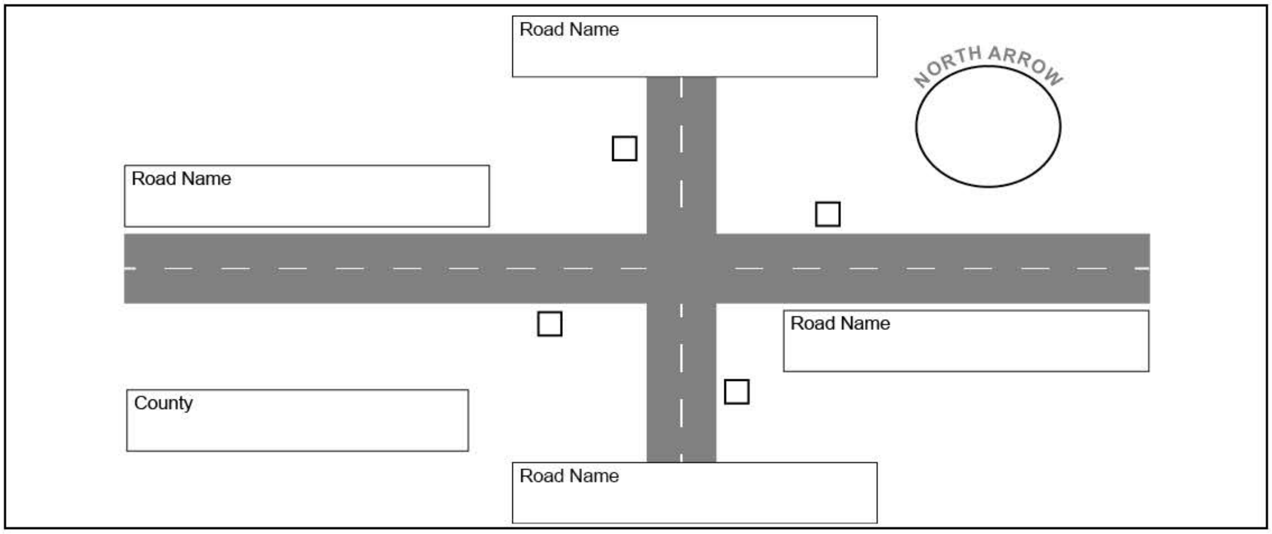
Page **1** of **2**

TOURIST ORIENTED DIRECTIONAL SIGN (TODS) APPLICATION/PERMIT *(continued)*

Wisconsin Department of Transportation   DT1864

PROPOSED SIGN LOCATION INSTRUCTIONS:

1. Label the intersecting roads.
2. Place an arrow in the circle pointing to the North.
3. Check (X) one or two of the boxes ☐ corresponding to the proposed sign location(s). TODS are only permitted on U.S. or State Highways. They must direct motorists to businesses/services/activities that are located on County Highways or Town Roads.
4. Place an O (circle) at the approximate location of your business.
5. Write the name of the county in the lower left corner.
6. Write in any additional details or comments that would be helpful in determining the proposed sign location. (Optional)



CERTIFICATION:

I, the applicant, certify that the statements contained on this application/permit are true and correct, and that the business identified is conducted in conformity to all laws applicable to nondiscrimination, and that discrimination is not exercised in regard to race, religion, color, sex, sexual orientation, or national origin. I understand that in addition to the attached administration fee, I am responsible for the manufacturing and installation costs for the proposed sign(s). I understand that this permit is revocable, and that it is subject to renewal every five years. I further understand that if my business is a seasonal operation, I am responsible for notifying the county prior to closing and re-opening, and that a "CLOSED" plaque will be placed on my sign when my business is closed for the season.

Applicant Name (First, MI, Last)

(Area Code) Telephone Number

X ______________________ (Applicant Signature)   ______________ (Date – m/d/yyyy)

APPROVAL – APPROVED BY WISCONSIN DEPARTMENT OF TRANSPORTATION OR AUTHORIZED AGENT:

Subject to present and continuing compliance by the applicant with all requirements of s.86.196 Wis. Stats. and Chapter Trans. 200.08 Wisconsin Administrative Code, a permit is granted for the TODS sign(s) described. This permit expires on the five-year anniversary date of the installation of the TODS sign panel.

X ______________________ (WisDOT Region Traffic Engineer)   ______________ (Date – m/d/yyyy)   X ______________________ (WisDOT Bureau of Traffic Operations or Authorized Agent)   ______________ (Date – m/d/yyyy)

DENIAL – DENIED BY WISCONSIN OF DEPARTMENT OF TRANSPORTATION OR AUTHORIZED AGENT:

X ______________________ (WisDOT Bureau of Traffic Operations or Authorized Agent)   ______________ (Date – m/d/yyyy)   Reason:

— For WisDOT Use ONLY —					
SIGN SIZE	PERMIT NUMBER		INSTALLATION DATE		
☐ RURAL (72") ☐ URBAN (48")	County	Number	Month	Day	Year

Page **2** of **2**

2-15-60 Trans 200 Guidance Signing (White Arrow Boards) February 2021

PURPOSE

The purpose of this policy is to provide consistent statewide direction for the permitted use of guidance signs under Wisconsin Administrative Code Chapter Trans 200.

These narrow horizontal signs are only permitted on conventional state highways or expressway approaches to at-grade intersections. As prescribed in subsection Trans 200.03, these signs *may* be permitted to direct to:

- resorts,
- hotels,
- places of public entertainment or instruction,
- any place of religious worship,
- any county institution,
- any scientific experiment location for the furtherance of agriculture or other science or art.

The term “entertainment” in this case does not include nightclubs, taverns, or similar establishments.

Trans 200.03, this policy, and the Application/Permit Form DT1903 specify complete guidance on the use of these signs.

DEFINITIONS

Freeways are defined as divided highways with fully controlled access at interchanges only. Interstate Highways are freeways with the interstate route designation.

Expressways are defined as divided highways with partially controlled access by a combination of interchanges, at-grade intersections, and driveways.

Conventional Highways are defined as streets or roads other than freeways or expressways. They *may* be divided or undivided, two-lane or multi-lane, and access is available at intersections and driveways.

GUIDANCE

The following table provides a list of facilities which, if open and available to the public, *may* be eligible for a White Arrow Board permit.

MAY BE ELIGIBLE

TYPE OF FACILITY	QUALIFYING CONSIDERATIONS
Agricultural experiment	
Animal shelters	*May* be permitted for County Institutions only.
Athletic fields, facilities	*May* be permitted for facilities that do not qualify for supplemental signing, and community wayfinder signing is not available.
Aviation Flight School	
Cabins, Cottages	For rental periods less than 30 days
Camps, religious or youth	
Campgrounds, RV Parks	Privately owned with rental periods less than 30 days.
Churches	
Condominiums	Only if part of a resort, for rental periods less than 30 days
Convention Center	*May* be permitted for facilities that do not qualify for supplemental signing, and community wayfinder signing is not available.
Country Clubs	Only when open to the public
County Healthcare Facilities	
Cruises, Boat	
Environmental Center	
Event Centers	*May* be permitted if open to the public and for multi-purpose use, including weddings, community gatherings, conferences, etc. Venues that offer wedding services only *should not* be permitted.
Exhibition, Exposition Center	*May* be permitted for facilities that do not qualify for supplemental signing, and community wayfinder signing is not available.
Golf Courses	Only when open to the public
Horseback Riding	Only when open to the public
Hotel, Motel, Bed & Breakfast	*May* be permitted as a substitute for “Lodging” category where SIS or TODS is not permitted.
Humane Society Shelter	*May* be permitted for County Institutions only.
Libraries	
Marinas	

Museums and historic sites	*May* be permitted for facilities that do not qualify for supplemental signing, and community wayfinder signing is not available.
Recreational facilities	Facilities open to the public for recreational activities including ATV parks; amusement parks; archery ranges; boat, kayak or canoe launches, tours or rental facilities; bowling alleys; casinos; caves; concert venues; curling venues; disc golf courses, fishing piers; go-cart tracks, hanggliding; horseshoe facilities; ice skating rinks; paintball facilities; playgrounds; riding stables; rock climbing; shooting ranges; skate parks; skydiving facilities; sledding hills; splash parks; swimming pools; tour providers (airplane helicopter, tram, boat, walking); volleyball courts; waterski or wake board shows; waterparks.
Religious Worship Facilities	
Research Facilities	
Resorts	For rental periods less than 30 days
Restaurants, Supper Clubs	*May* be permitted as a substitute for “Food” category where SIS or TODS is not permitted.
Schools	
Scientific Experiments	
Seminaries	Only if it contains a public place of worship.
Shooting Ranges, Gun Clubs	Gun clubs **shall** be open to the public as shooting ranges. See types of shooting ranges under Qualifying Considerations for Recreational Facilities.
Theaters	Live entertainment only
Trails - Recreation, Nature, Skiing, Biking, Hiking, Snowshoeing, Snowmobiling, ATV or other vehicle trails	Directing to trailhead access with parking.
Train rides	*May* be permitted as a substitute for “Attractions” category where SIS or TODS is not permitted.
Wildlife Refuges	To instructional centers only
Zoo	*May* be permitted for facilities that do not qualify for supplemental signing, and community wayfinder signing is not available.

The following table provides a list of facilities which are **not eligible** for a White Arrow Board permit. As a general class, all retail or wholesale sales or service establishments **shall not** be approved for White Arrow Board.

NOT ELIGIBLE

Agricultural Farms	Berry Patches	Cranberry Marshes	Tree Farms
	Tree, Plant Nurseries	Produce Stands	Greenhouses
Air Traffic Control			
Animal Hospitals			
Animal Ranches	Game Farms		
Apartments	Buildings	Complexes	
Artists	Art Dealers	Artist Studios	
Auto Repair	Auto Body Repair		
Barber, Beauty Shops			
Builders, Contractors	Carpenters	Electricians	Landscapers
	Painters	Plumbers	Tree Service
Bus Terminals			
Cemeteries		(see TEOpS 2-15-3 & 2-15-20 re: Veterans Cemeteries)	
Clinics			
Crafts supplies, outlets			
Dance Halls			
Factories			
Freight Terminals			
Government Offices			
Halfway Houses			
Health Clubs			
Highway Departments	Maintenance Facilities		
Historic Neighborhoods			
Hospitals			
Jails			
Kennels			
Lakes	Landings		

Malls, Shopping Centers			
Mental Health Facilities (except County)			
Mobile Home Parks			
Movie Theaters			
Nursing Homes, Assisted Living, Private			
Office Buildings			
Pharmacies			
Post Offices			
Power Plants	Utilities		
Private Clubs			
Realtors			
Recycling Station			
Rehabilitation Centers (except County)			
Residences			
Retirement Facilities (except County)			
Sales, Retail or Wholesale		Antique Dealers	Auto Dealerships
	Bait & Tackle Shops	Grocery Stores	Hardware Stores
	Home Furnishings	Home Improvements	Liquor Stores
	Lumber Dealers	Materials Suppliers	Mobile Home Sales
Storage Units			
Subdivisions			
Taverns	Bars	Pubs	Taps
Taxidermists			
TV & Radio Stations			
UW Extension Offices			
Veterans Memorials			

POLICY

White Arrow Boards are intended for use in rural or outlying urban areas. They *should not* be installed in dense urban areas due to sidewalks, terraces, and right of way constraints.

In addition, the following DOT qualifying considerations **shall** be met.

1. The facility **shall** be open to the public.
2. Lodging facilities **shall** have three or more units that **shall** be available for less than 30-day rental periods.
3. Signs *may* only be permitted on the state highway(s) nearest the facility:
   a. Directing to the facility's entrance off the state highway, or
   b. Directing to the facility's entrance on a local or county road.

Signs directing to facilities beyond other state, US, or Interstate highways **shall not** be permitted.

4. Guidance signing **shall not** be permitted on the right of way at the entrance to a facility if there is sufficient sight distance in which to identify the activity, facility or other type of signing at the entrance. This applies both to businesses that front the roadway and also to those not fronting the roadway, but are visible from the roadway. Minimum visibility distances, based on the posted speed, are found in the following table from MUTCD Section 2C.36.
5. Businesses **shall** have the appropriate operating licenses to receive, maintain, or renew a permit.
6. Name changes **shall** require cancellation of the old and issuance of a new permit.
7. Only the name of the facility **shall** be allowed for guidance. Additional sign features, such as vacancy, hours of operation or products offered **shall not** be allowed on the sign or on an attached plaque or board.

Posted Speed	Minimum Visibility Distance
25 mph	280 ft
30 mph	335 ft
35 mph	390 ft
40 mph	445 ft
45 mph	500 ft
50 mph	555 ft
55 mph	610 ft
60 mph	665 ft
65 mph	720 ft

8. If a conventional highway facility qualifies for signs in more than one category (TODS, SIS, White Arrow Boards or Supplemental Guide sign), only one category will be allowed. In this case, the White Arrow Boards *should* be discouraged because it is not retroreflective.
9. If outdoor advertising signs for the facility are within 1,000 feet of the intersection or entrance, guidance signs **shall not** be permitted.
10. No more than one arrow board for a facility **shall** be permitted on a state highway in each direction.
11. Guidance sign assemblies **shall** be limited to a maximum of six arrow boards. Signs utilizing the Standard Sign Plate E10-83A alternate two-line design should count as two.
12. There *may* be a maximum of two guidance sign assemblies per intersection approach in the same direction.

As shown on Figure 1 of the DT1903 form and on the Standard Sign Plate E10-83, the sign **shall** be a non-reflective white arrow, on a non-reflective black rectangular background with rounded corners, consisting of 4 ½ inch black block lettering. Base material is aluminum. Letter sizes and spacing **shall** conform to the standards in the FHWA Standard Highway sign manual. Overall sign sizes used **shall** conform to the dimensions as shown on Figure 1 of the DT1903 form.

An alternate two-line design, as shown on Standard Sign Plate E10-83A, is available for facilities requiring additional lettering. If the alternate two-line design is utilized, the sign **shall** be for a single facility only and **shall** otherwise conform to the same standards as the E10-83 design. When approved for use, the WisDOT Region **should** provide the facility the E10-83A standard sign plate for manufacturing purposes. In most scenarios, the standard E10-83 design **should** be preferred.

The WisDOT Region office reserves the right to remove non-conforming signs from the highway right-of-way. The owner *may* contact the WisDOT Region office to pick up any signs that have been removed. Upon pickup of the removed signs, the sign owner **shall** be responsible for sign removal costs.

Upon approval as a qualifying facility, the region *may* issue the permit Form DT1903, "AUTHORITY TO ERECT DIRECTIONAL SIGNS ON THE STATE HIGHWAY SYSTEM APPLICATION". There is no permit fee. Installation **shall** be by the requestor's choice of a WisDOT approved signing contractor or county signing crew in accordance with Department signing standards as detailed on Figure 2 of the DT1903 form. All costs of sign manufacturing, installation, maintenance, and modification of assemblies **shall** be the responsibility of the requestor(s).

<u>Installation of White Arrow Board Signing by Counties</u>

1. Upon approval, the permittee will be provided a list of qualified manufacturers that they may contact to make the signs. All manufacturing costs are the responsibility of the approved business. In addition to the qualified manufacturers, the permittee may also contact the county to inquire about manufacturing the signs (some counties will offer that service). If the county makes the signs, the county should invoice the approved business for the manufacturing costs.
2. Installation costs shall be $250 per sign if new posts are needed. All signs shall be installed on 4x6 treated wood posts. For removal and/or installation of signs on existing posts, the removal/installation fee shall be $100 per sign.
3. The permittee shall provide a check for installation fees payable to: Wisconsin Department of Transportation, and it should be sent to Wisconsin Department of Transportation, Attn: Casey Amans, 3609 Pierstorff St, Madison, WI 53704. The permittee should be advised to either drop the check off at the county or WisDOT Regional offices, who will forward the check to the department, or mail it directly to the above address.
4. The county should only repair damaged white arrow boards when directed to do so by the sign owner. Every repair or replacement requires the permittee to cover the associated installation costs (see costs in step #2).
5. The county shall charge their costs to install or repair white arrow boards to Project ID: 0080-02-63. The county should ensure that the business submits the appropriate repair/installation fees due to WisDOT.

APPLICATION TO ERECT WHITE ARROWBOARD SIGNS ON THE STATE HIGHWAY SYSTEM

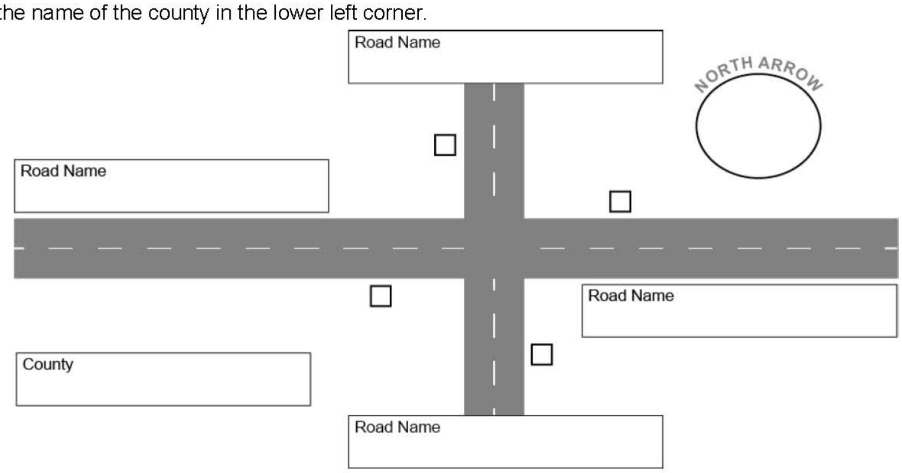
Wisconsin Department of Transportation
DT1903 3/2021

Submit completed application to Wisconsin Department of Transportation Regional Office

NAME of Business/Service/Activity:			
Street:	City:	State:	ZIP Code:
Email Address:	(Area Code) Telephone Number:		

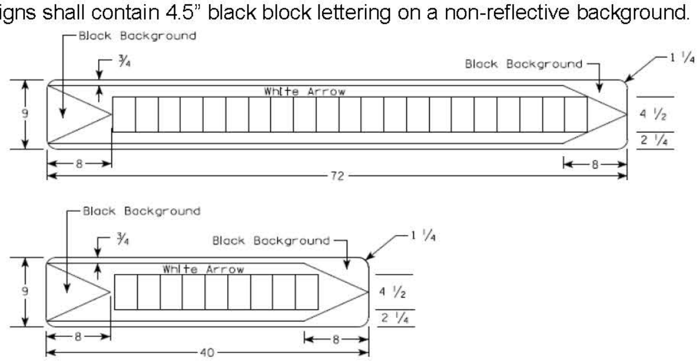
Proposed Sign Location Instructions:

1. Label the intersecting roads.
2. Place an arrow in the circle pointing to the North.
3. Check (X) one or two of the boxes ☐ corresponding to the proposed sign location(s).
4. Write the name of the county in the lower left corner.



Proposed Sign Wording:

Figure 1: Fill in the name of the business. Limit the name to one character or space per box. Signs shall contain 4.5" black block lettering on a non-reflective background.



Number of Signs (select one):

◯ 1 Sign

◯ 2 Signs

Signs placed on (select one):

◯ New Posts

◯ Existing Posts

***Installation Fees**:

- $250/sign with new 4x6 posts
- $100/sign with existing posts
- Payable to WisDOT

I apply for authority to erect and maintain guidance signs at the locations listed on this application. I certify and agree that these signs will conform to the approved design of the Wisconsin Department of Transportation and that I will comply with all the regulations under which authority these signs may be erected. I acknowledge that I would be responsible for the manufacturing and installation costs of the requested sign(s), and I certify that I will comply with the attached administrative codes and figures.

X

Applicant Signature | Date (m/d/yy)

X

WisDOT Region Signature | Date (m/d/yy)

☐ **APPROVED** ☐ **DENIED – Reason:**

APPLICATION TO ERECT WHITE ARROWBOARD SIGNS ON THE STATE HIGHWAY SYSTEM

(continued)

Wisconsin Department of Transportation DT1903

Sign Erection Regulations

Extracted from Chapter Trans 200, Wisconsin Administrative Code

Trans 200.02 Authority for the erection of signs.

1. The Department of Transportation or its authorized representatives in the case of the marked routes of state trunk highways, and local authorities with respect to highways under their exclusive jurisdiction, may place and maintain such traffic signs and signals as they deem necessary to warn, guide, inform, and regulate traffic, and also such signs and signals as are expressly permitted or required by the statutes or by these regulations, subject, however, to such limitations and restrictions as are contained in the statutes and these regulations.

2. The Department of Transportation with respect to the state trunk highway system, and local authorities with respect to highways under their jurisdiction, may erect or permit any department of the federal, state or local government to erect such standard signs as the Department of Transportation or local authorities deem necessary to inform and warn the public of federal or state laws, local ordinances and lawful regulations by any such department.

Trans 200.03 Guidance signs for resorts, hotels, county institutions, etc.

1. Any person or persons conducting a summer or winter resort, hotel, or any place of public entertainment or instruction, or any place of religious worship, or persons having charge of any county institution or of any scientific experiment for the furtherance of agriculture or other science or art may be permitted to erect guidance signs of a type approved by the Department subject to the conditions contained in this section.

2. No guidance sign may be permitted on freeways, including the national system of interstate highways.

3. Only where such institution or business location is removed from the state trunk highway system may such guidance signs be erected.

4. Such guidance signs may be erected at only two intersections of the state trunk highway system with county highways or town roads, and at such intersections of county or town highways as are deemed necessary by the local authorities having jurisdiction over those highways.

5. One sign of an approved size and shape may be erected at the entrance to any of the enumerated institutions or businesses.

6. No person may be permitted to erect or maintain a guidance sign on a highway if that person has any advertising in the vicinity of the intersection where the guidance sign is proposed to be erected or has a business sign under 200.06 on the same highway.

7. All guidance signs erected on any public highway shall be of a type and design approved by the Department. No flashing, illuminated, or reflecting signs or installation shall be permitted.

8. No guidance sign may be erected upon state trunk highway right of way at an intersection with the state trunk highway system until the location and manner of erection of the have the written approval of the Department. No guidance sign may be erected on the right of way of a county and town highway until the location and manner of erection of the sign have the written approval of the local authorities having jurisdiction over the said highway.

9. All guidance signs and their supports shall be maintained in good condition. **Signs or installations not satisfactorily maintained shall be removed by the officers in charge of the maintenance of the highway.**

Trans 200.04 Prohibited signs and signals.

1. No person may erect, cause to be erected, permit to be erected or maintain any advertising, warning, route, guide, information, or regulatory sign or signal within the limits of any highway except as authorized in sections 200.02, 200.03, 200.05 or 200.06.

2. No person may place or maintain nor may any public authority permit upon any highway any official traffic control device bearing thereon any commercial advertising except as authorized in 200.06.

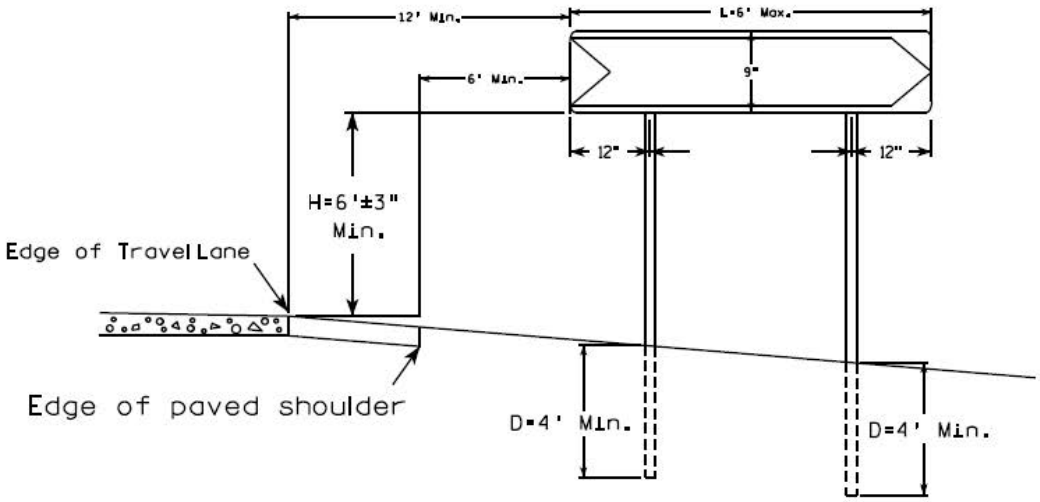
APPLICATION TO ERECT WHITE ARROWBOARD SIGNS ON THE STATE HIGHWAY SYSTEM

(continued)

Wisconsin Department of Transportation DT1903

Figure 2. Typical Installation Detail for Arrow Board Signs

(Supplement to form DT1903)



<u>Sign Installation Requirements for Permittees & Counties:</u>

1. Upon approval, the permittee shall be responsible for having the signs manufactured to state specifications (a non-reflective white arrow, on a non-reflective black rectangular background with rounded corners, consisting of 4 ½ inch black block lettering). A list of qualified manufacturers will be provided, from which the permittee can choose to have the signs manufactured (the permittee shall be responsible for all manufacturing costs).

2. After the signs are manufactured, the permittee is to drop them off at the county (some qualified manufacturers may ship signs directly to the county). Once received, the county will install the sign(s) at the approved location(s). Counties shall charge their installation costs to Project ID: 0080-02-63.

3. The permittee shall submit payment for the installation fees to cover the county's costs. **Costs are $100/sign if installed on existing posts, or $250/sign if new 4x6 posts are needed.** Checks shall be made to: Wisconsin Department of Transportation, and should be sent to Wisconsin Department of Transportation, Attn: Casey Amans, 3609 Pierstorff St, Madison, WI 53704. It is recommended the permittee drop off the check when delivering the signs to the county (the county will forward it to WisDOT), or it can be mailed directly to the above address.

4. Signs are to be mounted per dimensions shown above and are to project approximately 1 inch above the top of the post.

5. Sign posts are to be treated **4x6 wood suitable for ground contact** (4x4 wood posts shall <u>not</u> be used).

6. Signs less than 4 feet in length may be mounted on a single post; all other dimensions shown above apply.

7. If multiple signs are "stacked" on the same posts, all signs are to be the same length. In this case, the minimum mounting height shall be 5'3" for rural areas. <u>Sign assemblies shall be limited to a maximum of six signs</u>.

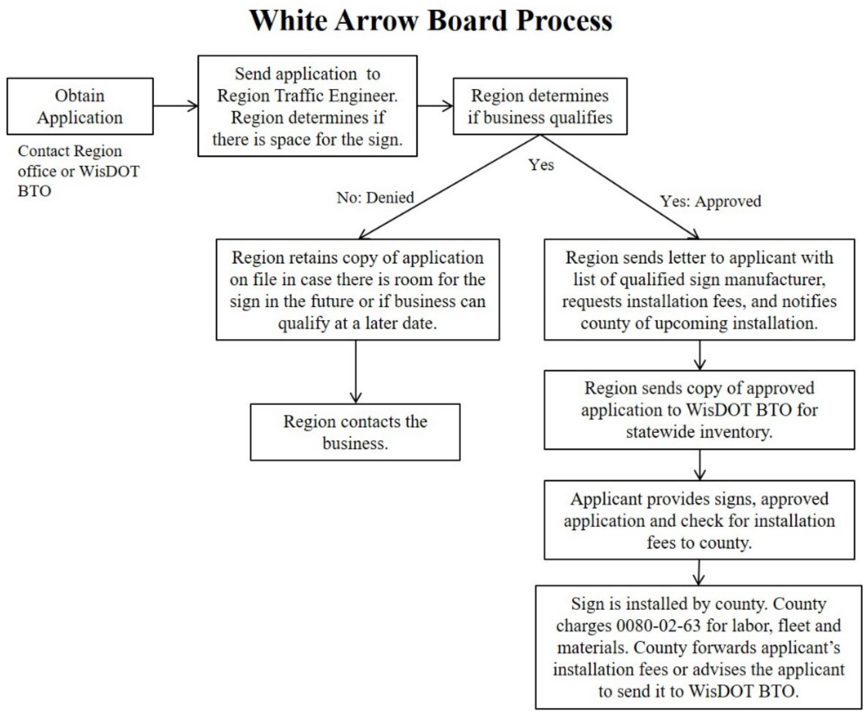
8. There may be a <u>maximum of two guidance sign assemblies per intersection approach in the same direction</u> (Maximum of total 12 signs, no more than 6 signs on each assembly). If a sign is approved at an intersection that already has two full assemblies, do not install and notify the WisDOT Region as soon as possible.

9. Contact Diggers Hotline prior to any excavation.

10. Signs are to be white arrows on a black, rectangular background with rounded corners (new design as of March 2021, replaced the traditional cut-out arrow design). Base material is aluminum. Do not install any signs that have reflective sheeting.

11. **All repair and replacement costs are the responsibility of the permittee.** If an existing sign is damaged or worn, the county should only repair or replace it with the permittee's approval. If a sign is repaired or replaced, the permittee shall be responsible for all manufacturing costs and the associated installation costs (same costs as noted in #3, payable to Wisconsin Department of Transportation). If the permittee elects not to repair a damaged sign, the county should remove it.

The flow chart below describes the application process for a White Arrow Board.



2-15-61 Signing and Marking Maintenance of Roadside Facilities — February 2017

PURPOSE

In addition to the roadways maintained by the Department, there are several types of ancillary facilities that are either constructed or maintained by the Department. This includes rest areas, SWEFs, waysides, park & ride lots, etc. These facilities *may* be maintained either by the Department, or by county or municipal forces via signed agreements. In the past, the maintenance of signs and pavement markings for these facilities has been inconsistent, due to lack of guidance as to how they *should* be maintained. This policy will clarify which signs and pavement markings are to be maintained by the Department, and how this maintenance **shall** be funded.

POLICY

Rest Areas

All rest area signing and pavement marking **shall** be maintained by the Department. All signs along the mainline highway **shall** be paid for either under the standard county RMA Project ID (00XX-01-65) or the appropriate improvement project. In addition, all signing along the exit ramp, up to and including the R8-74 (Cars, Trucks, Trailers, etc.) sign, and all signs along the entrance ramp beginning with the R1-2 (Yield) sign, **shall** also be paid for either under the standard county RMA Project ID or the appropriate improvement project. These signs **shall** be replaced as part of the normal sign replacement cycle.

All sign and pavement marking replacement within the rest area, between the R8-74 sign and the R1-2 sign, **shall** be paid for under the Rest Area maintenance Project ID, which will be provided by the Bureau of Highway Maintenance. These signs and pavement markings **shall** be maintained by the department, and *should* be replaced on the normal replacement cycle. The Region **shall** coordinate with BHM before replacing any signs or pavement markings within rest areas.

Waysides

All wayside signing and pavement marking **shall** be maintained by the Department. All signs along the mainline highway **shall** be paid for either under the standard county RMA Project ID or the appropriate improvement project. This includes any regulatory signs (R1-1, R5-1, R6-2, etc.) located at the wayside driveway. These signs **shall** be replaced as part of the normal sign replacement cycle.

All sign and pavement marking replacement within the wayside **shall** be paid for under the Wayside maintenance Project ID, which will be provided by the Bureau of Highway Maintenance. These signs and pavement markings **shall** be maintained by the department and *should* be replaced on the normal replacement cycle. The Region **shall** coordinate with BHM before replacing any signs or pavement markings.

<u>SWEFs (Safety and Weight Enforcement Facilities)</u>

All SWEF signing **shall** be maintained by the Department. All signs and pavement markings along the mainline highway **shall** be paid for either under the standard county RMA Project ID or appropriate improvement project. The signs and pavement markings **shall** be replaced as part of the normal replacement cycle.

All sign and pavement marking replacement within the SWEF **shall** be paid for under the appropriate maintenance Project ID for that SWEF, which will be provided by the Bureau of Highway Maintenance. These signs **shall** be maintained by the department and *should* be replaced on the normal replacement cycle. The Region **shall** coordinate with BHM before replacing any signs or pavement markings.

<u>Park & Rides</u>

The Department has several Park & Ride lots that were constructed under WisDOT LET projects, but that are maintained by either the county or municipality via signed agreement. The Region *should* read these agreements to verify which signs the Department is responsible for. This *may* include off-system directional (D4-series) signs. These signs **shall** be paid for either under the standard county RMA Project ID or the appropriate improvement project and **shall** be replaced as part of the normal sign replacement cycle.

The Department also has several Park & Ride lots that do not have any such maintenance agreements. For these lots, all signs and pavement markings **shall** be maintained by the Department. These signs and pavement markings **shall** be paid for under the standard county RMA Project ID, and **shall** be replaced as part of the normal replacement cycle.

2-15-62 Memorial Signing — February 2020

PURPOSE

The state legislature will occasionally adopt an act memorializing a highway or bridge. Once signed into law, these acts will direct the department to erect signage to inform motorists of the memorialization. This policy will establish the requirements, design, and installation practices for memorial signing.

DEFINITIONS

State Trunk Highway System: All Interstate, US, and State numbered highways, except for any connecting highway limits.

Memorial Bridge: A bridge on the state trunk highway system that has been designated in Chapter 84 of the Wisconsin State Statutes as a memorial.

Memorial Highway: A section of state trunk highway that has been designated in Chapter 84 of the Wisconsin State Statues as a memorial.

POLICY

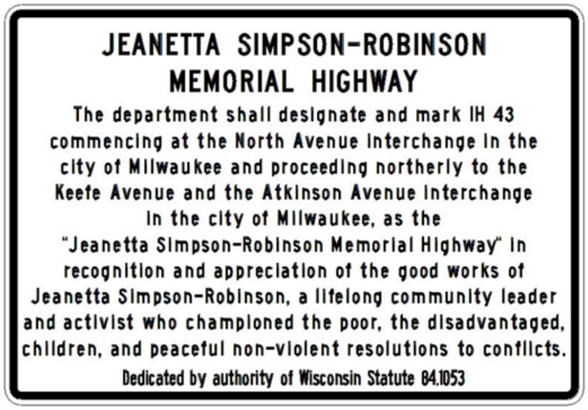
Memorial signing **shall** only be installed for highways or bridges designated as memorial highways or memorial bridges in Chapter 84 of the Wisconsin State Statues. All requirements listed in the designating statute **shall** apply.

<u>Memorial Highways</u>

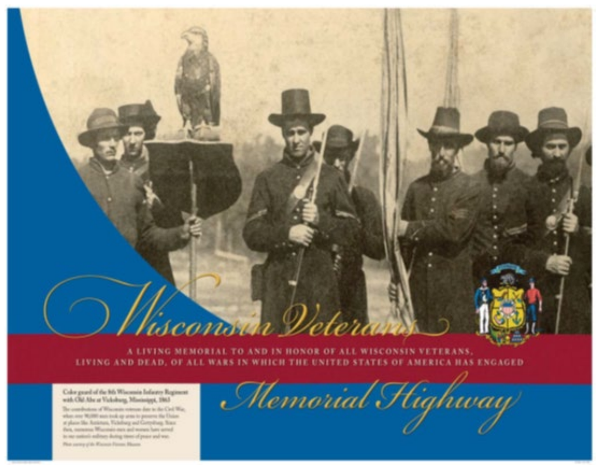
Per WisMUTCD Section 2M.10, memorial signs *should not* appear on or along a highway. Therefore, these signs **shall not** be installed along state trunk highways where they are visible to vehicles operating along the highway. Rest areas, scenic overlooks, parks, and municipal buildings are potential locations for these signs. The requesting, party **shall** work with the owners of any potential sites on an agreement for installation. The site chosen *should* be located along the designated section of highway, and *should* have ample free parking, to allow motorists a proper viewing experience. Two signs *may* be installed, one near each end of the designated section of highway.

There are two options for off right-of-way memorial highway signing:

> *Option 1 -* The sign *may* have black lettering on a white background, and would list the name of the memorial highway, as designated by statute. It would also contain the text of paragraph (1) of the statute and include the statute number. An example of this sign option is shown below.



Option 2 - The sign *may* be a multi-colored interpretive sign with a choice of wording and design. The interpretive sign could be installed in a covered display case with a 45-degree orientation to the viewer. The Bureau of Traffic Operations would work with the requesting group(s) to develop a sign design. An example of this sign option is shown below.



<u>Memorial Bridges</u>

Because the installation of memorial bridge signs off the main roadway is not practical, these signs **shall** be installed along the highway, one at each end of the bridge. For one-way bridges, only one sign **shall** be installed.

The sign **shall** have white lettering on a brown background, and will list the name of the memorial bridge, as designated by statute. For bridges over roadways, the name of the roadway *should* be listed below the memorial bridge designation, in white letters on a green background. For bridges over waterways, if the waterway qualifies for signage under TEOpS 2-4-55, the name of the waterway **shall** be listed below the memorial bridge designation, in white letters on a green background. For all other bridges, the memorial bridge designation **shall** be the only information included on the sign.

2-20-10 Sign Delivery Process **August 2016**

PURPOSE

Most signs (with the exception of Type I Signs) are delivered from the Traffic Operations Central Sign Shop in Madison to a distribution county utilizing the Badger State Industries (BSI) delivery system. Shorter lead times for sign delivery are available, however the sign cost(s) will increase.

The Bureau of Traffic Operations maintains all of the sign costs in the WorkDirector database. These costs are for the normal delivery period of each type of sign.

The Sign Delivery Calendar will be produced and sent to the Regions annually. Copies of this calendar can be obtained from the Bureau of Traffic Operations Traffic Design Unit (DOTBTOSignOrders@dot.wi.gov).

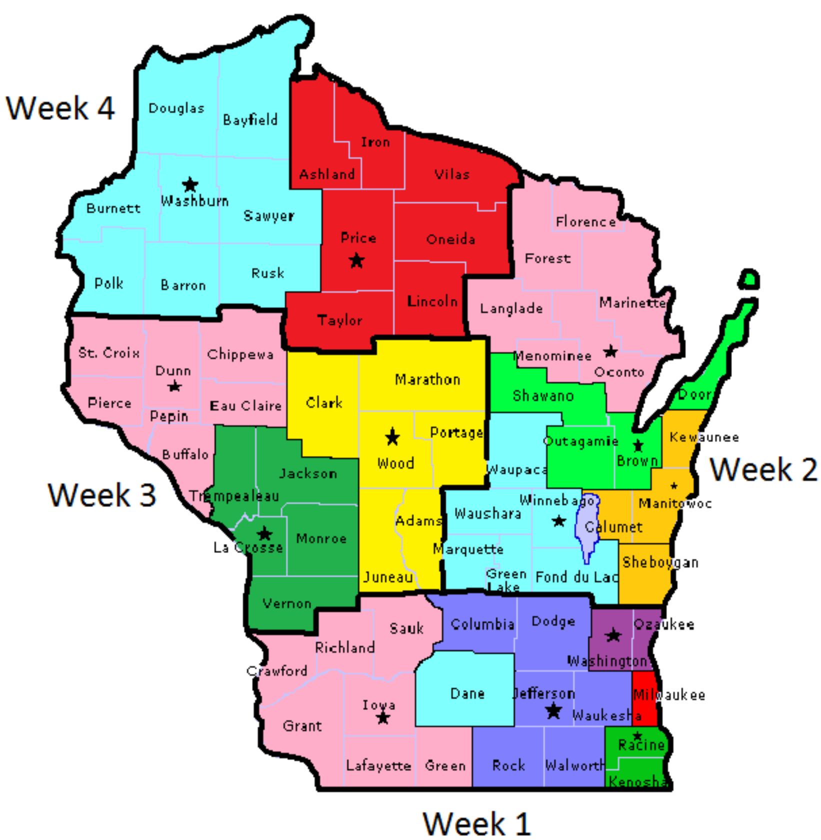
PROCESS

The BSI delivery process consists of a four-week cycle.

The requestor will need to allow the proper lead time for a sign delivery. The lead times differ on the vendor contracts for each sign type. Please keep these times in mind when ordering signs. These lead times are subject to change upon renewal of vendor sign contracts. The Regional Sign Shops will be notified of any changes in vendor lead times.

IMPORTANT: Remember to add 14 calendar days to these lead dates to allow the Bureau of Traffic Operations to process the sign order. That time is needed to check the requisition, prepare a sign detail (if necessary), get the requisition entered on a vendor order and send the purchase order to the vendor.

Sign Distribution Counties



Requirements of BSI Sign Delivery Contract

Below is a summary of the provisions contained in the BSI sign delivery contract.

1. Aluminum signs are normally banded together and secured on pallets.
2. Signs not on pallets are on red carts. Typical lengths of these signs are 8 to 10 feet but may be as long as 16 feet.
3. Each Sign Shop **shall** have an individual available to assist in the unloading procedure.
4. Deliveries will normally be made on Thursday of each week. Revisions to the delivery schedule by BSI must be approved by the Sign Distribution County BSI must notify the Distribution County of changes in the delivery schedule 48 hours prior to the delivery. In addition, the contacts at each Sign Shop **shall** be notified 48hours in advance by BSI as to the arrival time of each delivery.
5. For County contact information please contact DOTBTOSignOrders@dot.wi.gov
6. BSI will also return signs from the county to the Central Office Sign Shop in Madison.
7. BSI will pick up and haul scrap aluminum signs from the counties.
8. BSI is responsible for damages to signs that are shipped and returned.

2-20-15 Sign Evaluation Form for Regions — July 2012

PURPOSE

All roadway signs for the department are now manufactured by outside vendors. In an effort to consistently maintain the high quality of signs expected by the department, a procedure has been developed that will monitor the performance of vendors and track potential problem patterns. The intent of the procedure is for Bureau of Traffic Operations to have written documentation to discuss and resolve any problems with vendors.

This procedure has also been established to give the region sign shops guidance on the steps to take when faced with poor-quality signs from vendors.

POLICY

The attached form describes the procedure that the region sign shops *should* follow when poor quality signs have been delivered to them. This procedure on this attached form *should* be followed and the form filled out and attached to every sign returned for poor quality.

Not all “defects” noted on the form will necessitate the sign to be returned.

SIGN EVALUATION FORM

Date__________

Region # ______

WorkDirector Requisition No._____

Requisition Line No.____

Instructions: The Region Sign Shops should follow the procedure outlined on this form and fill out the following information when returning signs that have been manufactured poorly by a vendor. It is important to fill out this evaluation form for any defective signs received so that Central Office can monitor vendor performance and have written documentation to discuss problems with vendors.

Step 1: Once the Region Sign Shop receives a poorly manufactured sign, they should notify the Central Sign Shop (608) 246-3270 of the problems either verbally or by email. Central Sign Shop will then inform appropriate vendor of the problem(s).

Step 2: ***Demountable Copy Signs:*** Since demountable copy signs are shipped directly to the Region Sign Shops, any defective demountable copy signs will be picked up from the Region Sign Shop directly by the vendor. After the Region has contacted Central Sign Shop, in step 1, Central Sign Shop will contact the vendor and have them pick up the sign from the Region Sign Shop. The vendor, after receiving notice from Central Sign Shop, will have five (5) working days to pick up the sign from the Region Sign Shop, repair or replace the sign, and ship the sign back to the Region Sign Shop. The Region Sign Shop should attach a completed sign evaluation form with the returned sign and should also send a copy of the evaluation form to Central Sign Shop for record keeping.

All Other Signs: Since signs other than demountable copy signs are shipped to the Region Sign Shops via Badger State Industries (BSI), any defective signs will be sent back to Central Sign Shop at the Central Sign Shop via the BSI sign delivery truck. After the Region has contacted Central Sign Shop, in step 1, Central Sign Shop will contact the vendor and they will have five (5) working days to re-fabricate the sign and have it delivered to the

Central Sign Shop in Madison. This process can take place before the Region ships the sign back to Madison via the BSI delivery truck. After the re-fabricated sign is delivered by the vendor to Central Sign Shop, Central Sign Shop will place the sign on the next scheduled delivery to the Region. The Region Sign Shop should attach a completed sign evaluation form with the returned sign and should also send a copy of the evaluation form to Central Sign Shop for record keeping.

Problems with Sign(s)

(place an "x" next to each deficiency and make comments, if necessary)

Sign Base Material

Sample

___Incorrect Material ___Incorrect Thickness ___Mounting Holes Incorrectly Located
___Bent/Warped ___Corners Incorrect ___Wrong Size Sign
___Rough Edges ___Uneven Sawcuts

Other Deficiencies/Additional Comments______________________
____
____
____

Sign Face Material

___Incorrect Material(s) ___Peeling From Sign ___Air Bubbles in Sheeting
___Sheeting Recovered ___Wrong Color ___Inconsistency in Colors
___Missing Manufacturing Date Sticker on Back ___Missing WisDOT ID Sticker on Front

Other Deficiencies/Additional Comments______________________
____
____
____

Sign Message Material

___Incorrect Material ___Incorrect Letter Spacing ___Message Crooked on Sign
___Incorrect Letter Series ___Incorrect Location ___Inconsistency in Colors
___Message Cut Poorly ___Message Peeling or Not Applied According to WisDOT Standards

Other Deficiencies/Additional Comments______________________
____
____
____

Traffic Engineering, Operations, & Safety Manual

Chapter 2 Signing
Section 25 Field Crew Guidance

2-25-1 Field Crew Guidance and Contacts — March 2020

PURPOSE

This subject was developed to provide guidance to improvement project inspectors as well as Department and County field and maintenance crews for the installation, service and maintenance of all types of highway signs on the State Highway network. The goal for this is to install signs to provide a safe, understandable and efficient system of guidance to the motoring public.

These guidelines are intended to provide a framework of policies and practices for the systematic reporting and handling of signing installation and replacement or sign repair activities done by others under the direction of the Wisconsin Department of Transportation through its Regions. It is inherent these guidelines promote safety of the motorist, safety for the improvement and maintenance crews and standardization of practices toward uniform application and appearance statewide.

Improvement project crews and maintenance crews will perform their operations in accordance with the Wisconsin Manual on Uniform Traffic Control Devices, Traffic Engineering, Operations & Safety Manual and other Department policies as referenced within.

The Department recognizes these guidelines *may* require adjustments and revision as they are implemented.

SIGN TYPES

There are two types of signs that are installed and maintained for the DOT:

- Type I signs are on an extruded aluminum base material, typically mounted on steel I-beams.
- Type II signs consist of direct applied message sheet aluminum base material, typically mounted on wood or steel posts.

SIGN CLASSIFICATIONS

Regulatory signs give notice of traffic laws and convey the rules of the road. Regulatory signs typically have a red or white background. Examples are stop signs, speed limit signs, wrong way signs, etc.

Warning signs alert the attention of the driver to special conditions on or adjacent to a roadway that *may* require an important driving decision or action. Warning signs typically have a fluorescent yellow background. Examples include curve warning signs, no passing zone signs, stop ahead signs etc.

School signs are used to alert the motorist to school locations and the posted school speed limit. School Signs typically have a fluorescent yellow/green background.

Guide signs are directional and informational. They are used to direct the motorist to their destination and to inform them about various service facilities and other points of interest along the highway. Guide Signs typically have a green background, and directional assemblies are typically black on white background or white on blue background.

Recreational signs are informative for the traveling public not familiar to an area to get to their destination. Recreational Signs typically have a brown background. Examples are historical marker signs and boat landing signs.

Tourist information signs are informative signs used to guide motorists to service type areas. Tourist Informational Signs typically have a blue background. Examples of these signs are TODS.

STORAGE & HANDLING OF SIGNS

Signs **shall** be shipped with the sign face protected either by cardboard or slip-sheeting paper taped to the sign. Signs **shall** be stored vertically on edge.

Signs that *may* be stored at County shops:

- Mandatory (max of 6)
  - Stop Signs (30x30 and 36x36)
  - Yield (36x31)

Signs **shall not** be stored at the Region except those necessary for the electricians. Scrap aluminum signs **shall** be returned to the Distribution County. The Distribution County will return all scrap aluminum signs to BSI.

SIGN VERIFICATION

Check all signs in against the sign shipper received at the time of delivery. Call and/or email you region rep or BTO Shop Coordinator(DOTBTOSignOrders@dot.wi.gov) with any questions.

a. Acceptable Abbreviations

Highway	Hwy	Circle	Cir	Lane	Ln
Parkway	Pkwy	Road	Rd	Trail	Tr
Boulevard	Blvd	Street	St	Court	Ct
Avenue	Ave	Place	Pl	Drive	Dr
Terrace	Ter				

b. Arrow Abbreviations

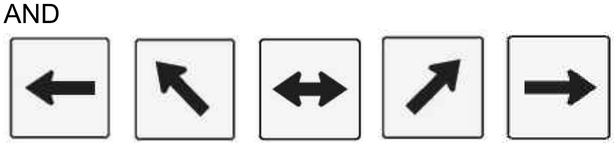
Left Arrow		[LA]	Right Arrow		[RA]
Tilt Left Arrow		[TL]	Tilt Right Arrow		[TR]
Up Arrow		[UA]	Double Arrow		[DBA]
Down Left Arrow		[DL]	Down Right Arrow		[DR]
Left Turn Arrow		[LT]	Right Turn Arrow		[RT]
Left Bent Arrow		[LB]	Right Bent Arrow		[RB]
Ahead & Left Arrow		[U/LA]	Ahead & Right Arrow		[U/RA]
Left and Tilt Right		[LA/TR]	Tilt Left and Right		[TL/RA]
Ahead and Tilt Left		[UA/TL]	Ahead and Tilt Right		[UA/TR]
Tilt Down Left and TR		[DL/TR]	TL and Tilt Down Right		[TL/DR]

c. J-panels

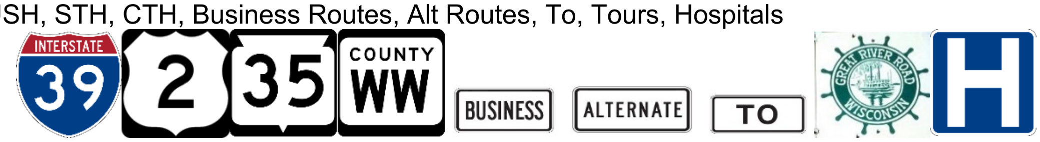
How to organize J-panels (Refer to A2-1s for the correct codes):

1. Direction of arrow:

AND



2. IH, USH, STH, CTH, Business Routes, Alt Routes, To, Tours, Hospitals



Number (lowest number first)

INSTALLING SIGNS

County Maintenance Agreements

Counties will be given corridors of the signs and/or posts needing replacement from the Region. For locations of new signs the work order will be provided by a Regional contact, the area then will be staked by the DOT. Crews **shall** contact Digger's Hotline prior to digging. Crews need to check to make sure sign is facing in the proper direction for traffic and at proper heights, offsets and use of proper mounting hardware.

The scheduling of the sign replacements shall be completed within 75-days of receiving the sign or July 1st whichever comes later. The region does have discretion to extend this time based on a very high numbers of signs or post replacements.

A detailed breakdown of county costs including county labor, equipment, number of signs, and number of posts **shall** be shown on all invoices.

The following signing activities can be classified into the following county maintenance agreements (XX denotes county unless otherwise noted):

1	Adams	25	Iowa	49	Portage
2	Ashland	26	Iron	50	Price
3	Barron	27	Jackson	51	Racine
4	Bayfield	28	Jefferson	52	Richland
5	Brown	29	Juneau	53	Rock
6	Buffalo	30	Kenosha	54	Rusk
7	Burnett	31	Kewaunee	55	Sawyer
8	Calumet	32	La Crosse	56	Sauk
9	Chippewa	33	Lafayette	57	St. Croix
10	Clark	34	Langlade	58	Shawano
11	Columbia	35	Lincoln	59	Sheboygan
12	Crawford	36	Manitowoc	60	Taylor
13	Dane	37	Marathon	61	Trempealeau
14	Dodge	38	Marinette	62	Vernon
15	Door	39	Marquette	63	Vilas
16	Douglas	40	Milwaukee	64	Walworth
17	Dunn	41	Monroe	65	Washburn
18	Eau Claire	42	Oconto	66	Washington
19	Florence	43	Oneida	67	Waukesha
20	Fond du Lac	44	Outagamie	68	Waupaca
21	Forest	45	Ozaukee	69	Waushara
22	Grant	46	Pepin	70	Winnebago
23	Green	47	Pierce	71	Wood
24	Green Lake	48	Polk	73	Menominee

Activity Code 081 for Permanent Sign Repair and 085 Temporary/Emergency Sign Repair

- RMA 00XX-01-61 Damaged signs **without** a break ticket and Adopt a Highway
- Damage Claim 0077-0x-00 Damage signs **with** break ticket (X designates the number for your region)
    1. Madison
    2. Waukesha
    3. Green Bay
    4. Wisconsin Rapids
    5. La Crosse
    6. Eau Claire
    7. Rhinelander
    8. Superior
- 0080-02-63 White Arrowboards*
- 0080-02-53 TODS Signing*
- 0080-02-61 Ski Area Signing

Activity Code 086 Permanent Sign Replacement

- TMA A project number will be provided though MPM
- DMA 00XX-58-22 Discretionary Maintenance Agreements

*For White Arrowboards and TODS signs the County *should* collect the checks made payable to the Wisconsin Department of Transportation and send the checks to: Wisconsin Department of Transportation, Attn: Casey Amans, 3609 Pierstorff St, Madison, WI 53704. The County *should* only repair damaged White Arrowboards or TODS signs when directed to do so by the sign owner.

Improvement/Refurbishment Projects

A listing of signs may be provided by the Signing Coordinator to the designer to be included in the construction project plan. The listing *should* identify location on respective improvement project in both directions of travel. A special ID is set up for all improvement projects.

FIELD OPERATIONS

WisDOT **shall** provide all permanent signs. It **shall** be the responsibility of the County to provide all necessary posts and mounting hardware for installation of the signs, unless other arrangements have been made with the Region. All aluminum signs removed are the property of the DOT and arrangements **shall** be made for the delivery of signs back to the Central Office Sign Shop. Signs **shall** be returned banded on pallets or on red carts. Any signs put on a cart for transport back to Madison **shall** be placed so the back of the sign is against the metal toprotect the face of the sign from further damage.

Routine Maintenance Sign Installation Activities

1. Patrol

Crews generally have a daily work plan, which establishes the route to be traveled each day. Knockdown temporary repairs will be the responsibility of the Counties. **NO CREW SHALL LEAVE THE SITE OF A DOWNED STOP OR YIELD SIGN, A TEMPORARY OR PERMANENT REPAIR SHALL BE MADE IMMEDIATELY.**

Field and maintenance crews *should* be watchful for and report findings to Regional Signing Coordinator and/or CO Sign Shop:

- missing signs
- signs showing face material failures,
- obsolete signs or signs which are not needed
- vandalized signs or posts (defaced, gunshot or broken)
- maintenance or contractor damaged signs or posts
- bent or leaning posts
- correctness of installation (height, offset, location, visibility, plumbness)
- sign meets WMUTCD specifications

2. Installing Signs

Signs are attached to the posts using lag bolts or machine bolts. Signs are to be mounted so as to project 1" to 1-1/2” above the top of the post. All signs **shall** have a nylon washer used under the metal washer to reduce damage caused by the twisting of the sheeting under the pressure of tightening the bolts (See Sign Plate A4-8). Do not over tighten bolts.

Standard signs are fabricated using sheet aluminum. Aluminum signs are usually pre-drilled with mounting holes. Aluminum signs 78” or more in width **shall** have channel steel stringers installed.

Ensure that post is set to the correct depth (see Sign Plate A4-2 through A4-4). Once the post is placed in the hole check to see that the sign is the proper height and the sign is square with the roadway, facing the proper direction for traffic the sign is intended. The posts **shall** be back filled with suitable materials, and tamped in place, using 6" layers while keeping the post plumb. It is recommended that a level be used in this process.

When attaching the sign to the post it is important to keep the sign square on the post. Attach the bolt to the top of the sign first. Then square the sign on to the post before attaching the lower bolt. Predrilling of the post while squaring the sign is recommended.

Breakaway holes **shall** be drilled on all 4”x 6” wood posts (see Sign Plate A4-11). The breakaway holes do not need to be drilled if the posts are located behind a concrete barrier or guardrail.

PRIORITY OF ACTION FOR KNOCKDOWNS

1. STOP and YIELD Signs.

These signs are the most important signs. If a STOP or YIELD sign is reported down it is to be considered life threatening and extreme steps **shall** be taken to get it back up, even if it means using temporary supports. This includes overtime, nighttime, weekends and holidays. Whatever is necessary to get the sign back up as quickly as possible **shall** be done. A temporary repair **shall** be made immediately, and a permanent repair **shall** be made within 10 working days, or as agreed upon with Regional Traffic Section.

2. Regulatory, Warning and School Signs.

   Second priority goes to Regulatory, Warning and School Signs. These signs, when reported damaged or knocked down, require prompt scheduling of repairs. Signs that are recognized as being critical to motorist safety are those that require the motorist to be alert to a specific change in the road or a potential hazard. Temporary repair **shall** be made immediately, during normal business hours.

3. Guide Signs, Recreational & Tourist Signs

   Guide, recreational, and tourist signs are directional and informational type signs. They are less critical with respect to scheduling damage repairs. Temporary repairs are not necessary for these types of signs.

   All signs that have been damaged *should* be replaced, contact your Region Sign Coordinator for these signs. All temporary sign repairs **shall** be a WisDOT approved sign post..

DETOUR AND CONSTRUCTION SIGNING

The majority of detours are planned and will be done by contract. Small and emergency type detours performed by the counties need to be in accordance with the WMUTCD. The Department will provide signs for these detours.

REPORTING SYSTEMS

Repair Records for Accidents/Broken Posts and Signs are to be filled out and sent to the Regional shops monthly or as agreed upon with your Region.

Annual Sign and Post Replacement List will be given to the Counties. As the County completes the work, they **shall** send an updated copy of the list to the Regional.

The Regions *may* periodically provide the Counties with a new sign and post work order. These forms need to be filled out and sent to the Region upon completion.

Any counties with repair charges for vehicle damage with accident claim tag numbers **shall** fill out the County Charges Worksheet form DT 1785 and send it to the Region as soon as practical. Forms can be obtained from your Regional Signing Coordinator.

Knockdown and Repair Report is a way to record incoming calls for knockdowns or repairs and Diggers Hotline ticket information on a single form. This form is provided for your convenience and does not need to be returned to the Regional Sign Shop.

REQUIRED NUMBER OF POSTS

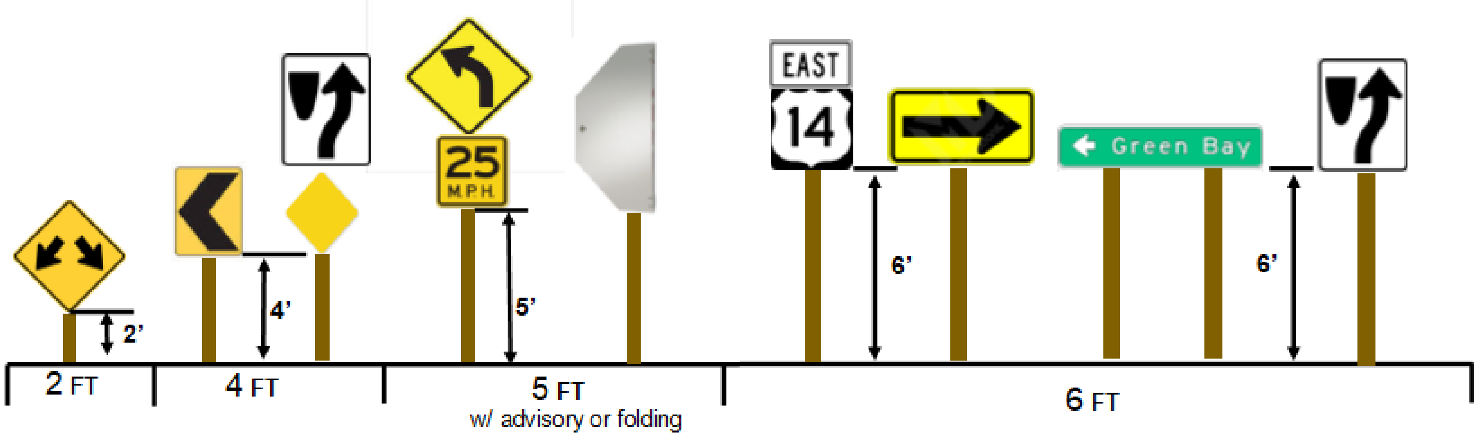
4x6 Wood Posts		
Number of Posts	**Length (Rectangle/Square)**	**Comments**
1	L ≤ 48"	
2	48" < L ≤ 108"	
3	108" < L ≤ 144"	Posts spacing **shall** be > 3.5'

4x6 Wood Posts	
Number of Posts	**Diamond**
1	24", 30", 36"
2	48"

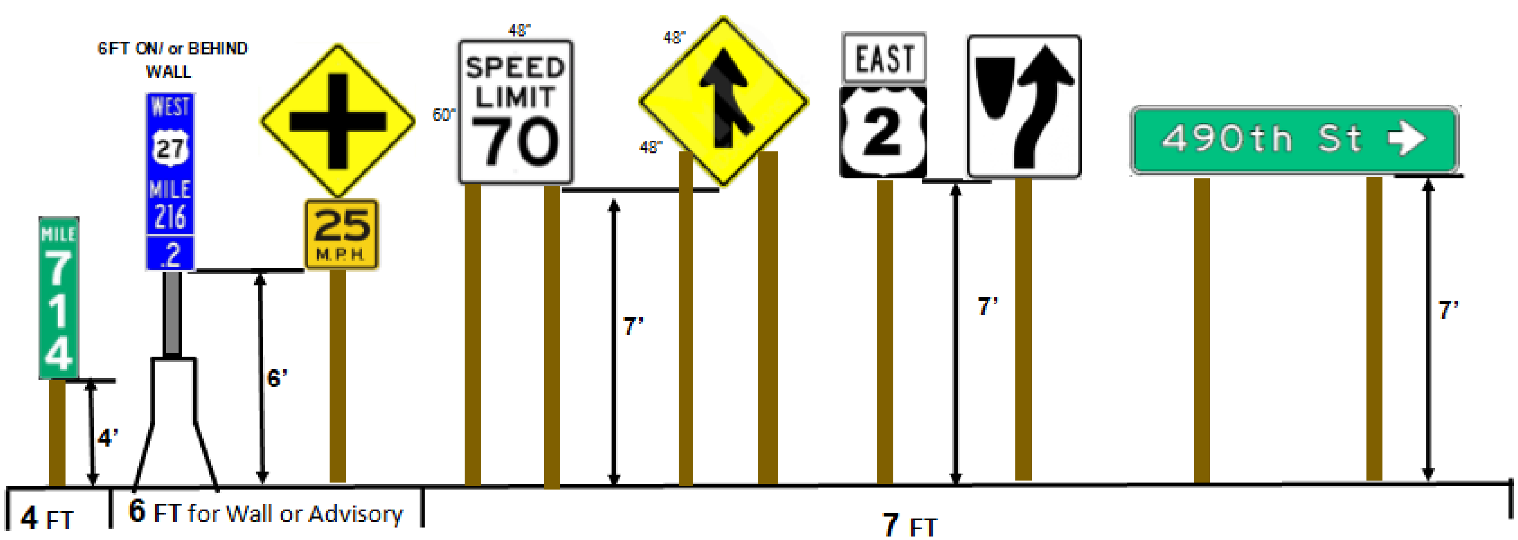
2x2 Square Steel Posts	
Number of Posts	**Area (ft^2)**
1	≤9
2	9<x≤18
3	18<x≤27

STANDARD INSTALLATION

Standard Installation for Rural Highways

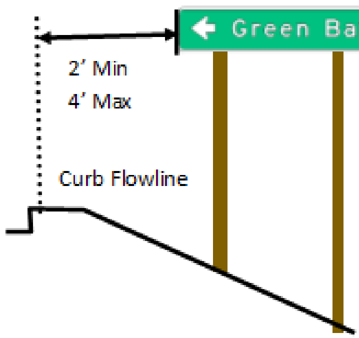


Standard Installation for Freeways , Expressways & Urban Highways

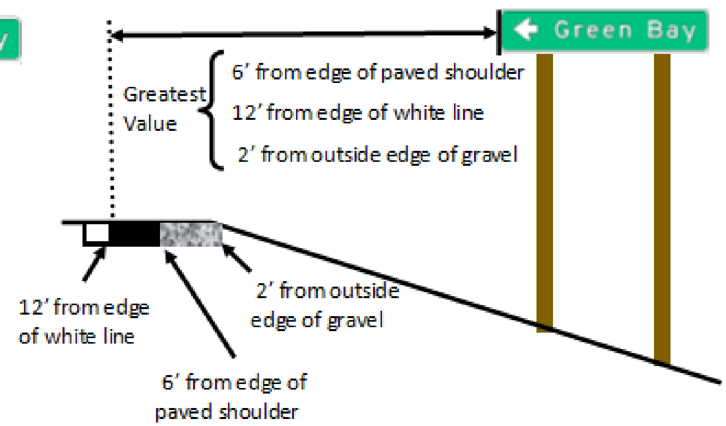


ALL heights are measured from top of pavement not the ground.

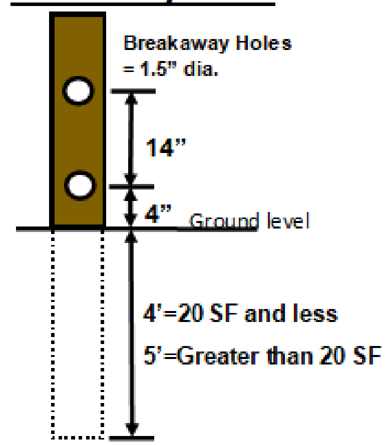
Urban Area



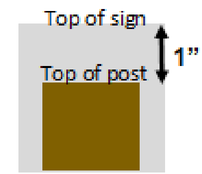
Rural Area



Breakaway Holes

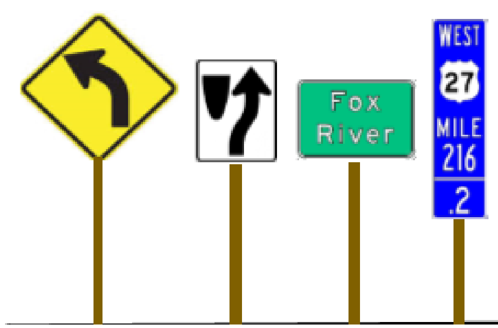


Mounting Signs To Post



No Stringers: ≤72"
72" Stringers: 78", 84" or 90" Signs
90" Stringers: 96", 102" or 108" Signs
108" Stringers: 114", 120" or 126" Signs
126" Stringers: 132", 138" or 144" Signs

1 4x6 Post



24"/30"/36" Diamonds
AND
Width ≤ 48"

2 4x6 Post

48" Diamonds
AND
48" < width ≤ 108"

3 4x6 Posts

width > 108"
Minimum of 42" between posts on center

EXAMPLES OF CORRECT VS. INCORRECT INSTALLATIONS

<table>
<tr><th>Incorrect</th><th>Correct</th></tr>
<tr><td>
</td><td>
</td></tr>
<tr><td>
</td><td>
</td></tr>
<tr><td>
</td><td>
</td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td>
</td><td>
</td></tr>
<tr><td></td><td></td></tr>
</table>

CONTACTS

DOT Contacts			
Region	**Contact Person**	**Number**	**Email**
WisDOT CO Sign Shop 3609 Pierstorff St Madison, WI 53704	Jon Eldridge Casey Amans Ryan Mayer	608-246-3270 608-245-5344 608-246-5408 608-246-3810	jonathan.eldridge@dot.wi.gov dotbtosignorders@dot.wi.gov casey.amans@dot.wi.gov ryan.mayer@dot.wi.gov
SW Region- La Crosse 3550 Mormon Coulee Rd. La Crosse, WI 54601	Eric Glindinning Kory Keppel	608-785-9909 608-792-6204	Eric.glindinning@dot.wi.gov kory.keppel@dot.wi.gov
SW Region- Madison 3601 Pierstorff St Madison, WI 53704	Jeff Holloway Timm Punzel	608-246-3268 608-246-5352	jeffrey.holloway@dot.wi.gov timm.punzel@dot.wi.gov
SE Region- West Allis 935 S. 60th St. West Allis, WI 53214	Chuck Saldivar Bree Johns-Konkol	414-750-1682 414-266-1171	chuck.saldivar@dot.wi.gov bree.johnskonkol@dot.wi.gov
NE Region- Green Bay 944 Vander Perren Way Green Bay, WI 54304	Tom Tilleman Mark Janke	920-492-4135 920-492-5981	thomas.tilleman@dot.wi.gov mark.janke@dot.wi.gov
NC Region- Wis Rapids 2841 Industrial St Wis Rapids, WI 54495	Al Smith Tyler Meyer	715-421-8364 715-421-8075	alan.smith@dot.wi.gov tyler.myers@dot.wi.gov
NC Region- Rhinelander Hanson Lake Rd Rhinelander, WI 54501	Al Smith Tyler Meyer	715-421-8364 715-421-8075	alan.smith@dot.wi.gov tyler.myers@dot.wi.gov
NW Region- Spooner W7102 Green Valley Rd Spooner, WI 54801	Steven Allard Gary Eisold	715-577-1259 715-450-9093	steven.allard@dot.wi.gov gary.eisold@dot.wi.gov
NW Region- Eau Claire 5009 USH 53 South Eau Claire, WI 54701	Steven Allard Gary Eisold	715-577-1259 715-450-9093	steven.allard@dot.wi.gov gary.eisold@dot.wi.gov

Sign Distribution County Contacts			
County	**Contact Person**	**Number**	**Email**
Iowa 1215 N. Bequette St. Dodgeville, WI 53533	Randy Sudmeier	608-574-2936	randy.sudmeier1@iowacounty.org
Jefferson 1425 S. Wisconsin Drive Jefferson, WI 53549	Tyson Barns	920-674-7390 920-723-7269	TysonB@jeffersoncountywi.gov
Washington 900 Lang St. West Bend, WI 53090	Tim Pfeifer Kevin Schweizer	262-335-4440 262-483-3079 262-335-5027	tim.pfeifer@co.washington.wi.us Kevin.schweizer@washington.wi.us
Milwaukee 10190 West Watertown Plank Rd Wauwatosa, WI 53226	Douglas Decker	414-333-3291	douglas.decker@milwaukeecounty.wi.gov
Racine 14200 Washington Ave. Sturtevant, WI	David Prott	262-534-6400	david.prott@goRacine.org
Winnebago 901 W. CTH Y Oshkosh, WI 54903	Chuck Griedl	920-232-1718 920-420-9412	c.griedl@co.winnebago.wi.us
Manitowoc 3500 STH 310 Manitowoc, WI 54220	Greg Grotegut Ryan Drumm Fritz Emme	920-683-4345 920-323-5520 920-683-4351 920-683-4347 920-323-6513	Gregorygrotegut@co.manitowoc.wi.us Ryandrumm@co.manitowoc.wi.us Fritzemme@co.manitowoc.wi.us
Brown 2198 Glendale Ave Green Bay, WI 54303	Dave Delvaux Andrew Sell	920-662-2176 920-662-2174	Delvaux_DJ@co.brown.wi.us sell_al@co.brown.wi.us
Oconto 202 Van Dyke St Oconto, WI 54153	Vanessa Peters	920-834-6885	vanessa.peters@co.oconto.wi.us
La Crosse 301 Carlson Rd. West Salem, WI 54669	Ron Brueggen Keith Pack	608-792-8053 608-421-8875	rbrueggen@lacrossecounty.org kback@lacrossecounty.org
Dunn 3303 USH 12 E Menomonie, WI 54751	John Sworski Dustin Binder	715-308-3430 715-556-2293	jsworski@co.dunn.wi.us dbinde@co.dunn.wi.us
Wood 555 17th Ave Wisconsin Rapids, WI	Brandon Dammann Barry Hamm	715-421-9039 715-424-7408 715-213-0856	bdammann@co.wood.wi.us bhamm@co.wood.wi.us
Washburn 1600 CTH H Spooner, WI 54801	Steve Flach	715-635-4459 715-635-4480	sflach@co.washburn.wi.us
Price 704 N Lake Ave Phillips, WI 54555	Chuck Fisher Joe Baratka	715-339-2355	chuck.fischer@co.price.wi.us joe.baratka@co.price.wi.us

Sign Distribution Counties

2-25-2 Field Crew Safety and Training May 2017

PERSONAL SAFETY

All Department of Transportation (DOT) personnel **and** any personnel working for the state are required to follow the safety policies stated in the DOT Transportation Administrative Manual (TAM). DOT, county, and contractor personnel **shall** wear:

- Eye Protection: (TAM SD 36)
  - Safety glasses with attached shields
- Foot Protection: Steel-toe boot or shoe (TAM SD30)
- Protective Headgear: (TAM SD 51)
  - Hard hat
- High Visibility Safety Apparel: (TAM SD 57)
  - Reflectorized Safety Vest at all times on or along the roadway
  - Reflectorized Safety Pants during nighttime hours.

Hazard Warning Information - Treated Wood Management (See Exhibit 5)

(Material Safety Data Sheets *should* be requested from the wood post vendor)

EMPLOYEE RECOMMENDED TRAINING

All agencies doing work for the DOT *should* make sure their employees are properly trained in the following areas:

1. Field Operations Awareness
2. Shop Tools
3. Major Equipment Operations
4. Utilities Locate. Call Diggers Hotline 811
5. Retraining
6. Vehicle Safety and Inspection

WORK AREA TRAFFIC CONTROL

All traffic control **shall** be in compliance with the WMUTCD and Departmental policies. See Standard detail drawings.

Vehicles used in highway signing operations **shall** be equipped with at least two (2) yellow, high intensity rotating beacons, clearly visible from the front, rear and both sides of the vehicle. These beacons **shall** be placed as high as possible on each vehicle. Vehicles **shall** have all warning lights operating when stopped, or moving slowly along any highway. Warning lights **SHALL NOT** be displayed while the vehicle is traveling at highway speeds or when traveling between jobs.

When conditions are less than ideal, additional advance warning signs or devices *should* be added to the traffic control layouts. In some cases, the work *should* be deferred until the conditions are more favorable.

All lane closures on two lane roadways require flagging of traffic as well as advance signing and cone placement in the work area. Remember that all flaggers **shall** use stop/slow paddles.

An encroachment into a lane of traffic *may* require cones and/or flagging. The amount of encroachment, the volume and speed of passing vehicles will determine traffic control measures required. For example, a cone *may* be sufficient to mark the point where an outrigger makes contact with the pavement outside the overall width of the truck.

PUBLIC SAFETY

Workers **shall** park vehicles off the road as far as practical. Care *should* be taken to not block the vision of existing traffic control devices such as stop signs and signals. Work activities *should* be performed with an assumption the motorist does not know what the workers are going to do.

UTILITIES

<u>Utility Locates.</u> Diggers Hotline (811) **shall** be called and located before any work is performed. They *should* be given at least a 3 working day notice.

The following is a five-point plan for utility locates before digging in the highway right-of-way, which covers the routine steps required by Diggers Hotline:

1. Prepare a plan or work location sketch or drawing. Indicate a 25 foot radius around the stake or lath for "MARKING INSTRUCTIONS" for Diggers Hotline.
2. At each locate site, mark with a stake or by painting the pavement or shoulder of the highway. White or pink are the approved colors for ribbons, flags or paint when marking sign locations for utility locates.
3. Identify the exact location by measuring the distance from the nearest intersecting street or highway. Indicate which side of the highway the locate is on.
4. Contact Diggers Hotline to request the area to be located. Retain ticket number for a minimum of six years after work is completed.
5. Investigate the possibility of other utilities having services at the locate site.

<u>Utility Damage Procedure.</u> Damage prevention is the ultimate goal. As stated above it is essential to get clearance from utilities before doing any digging.

- ❑ BEFORE YOU DIG, CONFIRM UTILITIES HAVE BEEN LOCATED

IF UTILITY DAMAGE OCCURS:

- ❑ CALL THE UTILITY FROM A SAFE LOCATION AS SOON AS POSSIBLE.
- ❑ CLEAR AREA IF NECESSARY.
- ❑ EXTINGUISH ALL FIRE SOURCES; BE MINDFUL OF LOSS OF LIFE.
- ❑ NOTIFY EMERGENCY SERVICES (IF NECESSARY).
- ❑ NOTIFY SUPERVISOR.
- ❑ BE AVAILABLE ON OR NEAR THE SITE UNTIL REPAIR CREW ARRIVES.

MAJOR EQUIPMENT OPERATIONS

It is recommended that field operations that involve digger derricks or bucket trucks will NOT be performed with fewer than two crew persons on the job site.

HAVING A UTILITY LOCATE CLEARANCE DOESN'T NECESSARILY MEAN ALL DANGER HAS BEEN REMOVED.

Derrick operators must be aware of overhead lines to be certain the boom or its attachments remain the required distance away from the overhead lines.

ACRONYMS & DESCRIPTIONS
HMA - Hot Mix Asphalt
MSDS - Material Safety Data Sheets
PCC - Portland Cement Concrete
PMC - Pavement Marking Coordinator
TMA - Traffic Maintenance Agreement
Type H Sheeting - Prismatic High Intensity
Type F Sheeting - Prismatic High Intensity Fluorescent Sheeting

3-2-1 Longline Marking — December 2024

GENERAL

The purpose of this policy is to provide specific guidance for the uniform application of long line markings on State Highways under DOT jurisdiction. The WISMUTCD Section 3B contains further guidance on longline markings.

Centerline Markings

Centerline markings **shall** be a 6" wide yellow line. Dashed lines **shall** be 12.5' long with a 37.5' gap.

Centerlines markings **shall** be marked on:
- All highways under DOT jurisdiction
- Through all intersections with local roads on two-lane state highways.
- On undivided multilane highway with a double yellow line

Centerline markings **shall not** be marked through:
- Intersections where the state highway is more than two lanes
- Intersections where Interstate, US, or State Highways intersect
- Signalized intersections
- All way stop
- Intersections with opposing left turn lanes.
- Stop lines or marked crosswalks.

Further information on centerline markings are located in Section 3B.01 of the WISMUTCD.

Edge line Markings

The WISMUTCD Section 3B.06, describes edge line markings in more detail. Edge line markings **shall** be a 6" white line on the edge of the roadway except the left most edge line on a divided highway **shall** be yellow.

Edge line markings **shall:**
- Continue through all driveways (commercial or private) except major commercial driveways (big box stores, etc.) with a full width turn lane.
- Be used on freeways and expressways
- Be used on rural arterial roads with a traveling width of at least 20 feet and an ADT > 6,000 vehicles per day

Edge line markings **shall not** continue through**:**
- Intersecting roadways with two lanes or more
- Intersections where Interstate, US, or State Highways intersect
- Intersections with opposing left turn lanes
- Signalized intersections
- Stop controlled intersections
- Commercial driveways meeting intersection design standards with full width paved turn lanes.

Edge lines *should* be used in urban areas or semi urban areas that do not have curb and gutter as required in WISMUTCD Section 3B.07. Edge lines *should* be used in urban areas where a single paved width is 16 ft or greater.

Edge Lines Adjacent To Urban Curb & Gutter Sections

POSTED SPEED	IS THERE CONTINUOUS LIGHTING?	
	YES	NO
≤ 30 mph	No	Optional
35 mph or 40 mph	Optional	Recommended
≥ 45 mph	Recommended	Required

Lane Line Markings

Lane lines **shall** be marked to delineate traffic traveling in the same direction. Lane lines **shall** be a 6" wide white line that is 12.5' long with a 37.5' gap between lines. Lane lines **shall** be marked on all state highways under DOT jurisdiction. Lane lines **shall** be marked through minor intersections and major T-intersections on the state highways.

Dotted Lane Lines

According to the WISMUTCD Section 3B.04, a dotted line (3' line, 9' gap) *maybe* used as a substitute lane line or a continuation of an edgeline. This line **shall** be 6" wide and **shall** be used to separate a through lane that continues beyond an intersection or interchange from an adjacent lane under the following conditions:

- A deceleration or acceleration lane
- A through lane that becomes a mandatory turn or exit lane (SDD 15C31 sheet b)
- Auxiliary lane
- Tapered Exit and On Ramps (SDD 15C31 sheet a)
- Parallel Exit (Deceleration) Ramps (SDD 15C 31 sheet b)

Dotted Lines

Dotted lines "cat tracks" **shall** be added to provide guidance through intersections where the edge of the traveled lane is unclear. A dotted line *may* extend through an uncontrolled movement of a state highway intersection with another highway. If these lines are used through an intersection they **shall** be 2' lines with a 6' gap and the same width as the line that is being extended see in SDD 15C8 sheet c. Dotted lines "cat tracks" **shall** be installed when there are multiple left turn lanes and at side by side ramps..

Channelizing Lines

Channelizing lines **shall** be white and 10" in width. Channelizing lines **shall** be used in the following locations:

- In advance of an exit ramps or intersections to distinguish a lane. (3 foot line with a 9 foot gap) SDD 15C8.
- In advance of freeway route splits with dedicated lanes.
- To separate a through lane that continues beyond an intersection from an adjacent auxiliary lane between two intersections SDD 15C8.
- Exit gore markings **shall** extend fifty feet past the unpaved neutral area and 300 feet to begin the gore line, as shown on SDD 15C31.
- Entrance gore marking **shall** follow SDD 15C31.
- To separate turn lane and through movements.
- To separate dual turn lanes.

Channelizing markings **shall not** be marked through:

- Signalized intersections.
- Intersections at a 4 way stop.
- Stop lines or marked crosswalks.

Dotted Extension Lines

Dotted extension lines **shall** be used at roundabouts at a 2' line with a 2' gap. Dotted extension lines are 18" in width. Refer to FDM 11-26-35 and SDD 15C22 for more guidance on placement. WisDOT will maintain all dotted extension lines at a state maintained roundabout.

Bike Lane

If bike lanes are marked, they are typically at least 5 ft wide, and a minimum of 4 feet from a longitudinal joint. Use a 5 foot width at 45 mph or higher. Refer to SDD 15C29 in the FDM. The words "BIKE LANE" or the bike symbol *maybe* used to delineate the bike lane. Signing *may* also be used to supplement the marking. The DT2500 form **shall** be completed to permit locals to install/maintain bike lanes and the DT2137 form **shall** be completed to permit the locals to install/maintain Shared Lane Markings.

The usage of green pavement marking for bike lanes or bike boxes **shall not** be allowed on state maintained roadways unless locals install and maintain the markings.

3-2-2 No-Passing Zone Standards — March 2021

GENERAL

No-passing zones are marked and signed on state-maintained highways to indicate where a driver cannot safely complete a passing maneuver under normal light and weather conditions. Passing Zones allow the driver to make a decision based on rules of the road and circumstances, such as oncoming traffic, reduced visibility due to fog, low light, rain or smoke, turning traffic, or vehicles entering from side roads or driveways. **No-passing zones *should not* be marked to eliminate all possible conflicts.**

However, certain conditions warrant short zones or no-passing zone extensions. Although sufficient sight distance *may* be present at these locations, the passing operation is not appropriate under state law or for safety reasons as documented in an engineering study.

Wisconsin Statute 346.10 allows passing another vehicle at a rural (non-business regional, non-residential regional) intersection, unless the intersection is designated by signals, stop signs, yield signs, or warning signs. Routinely marking zones through minor intersections and/or driveways would significantly reduce legal passing areas available to the driver, increasing non-compliance and unsafe passing in less favorable locations where adequate sight distance *may not* be available.

SIGHT DISTANCE

Each Region has a No-Passing Zone Sight Distance Map or spreadsheet listing the sight distance criteria on on state-maintained highways. Typical sight distances are shown in the following table, but other criteria such as ADT or geometrics *may* change or alter those requirements.

Table 1. Sight Distance

Posted Speed Limit	No-Passing Zone Sight Distance		Minimum Distance Between Zones	
(MPH)	(mile)	(feet)	(mile)	(feet)
25-30	0.10	528	0.10	528
35-40	0.13	686	0.10	528
45-50	0.16	845	0.13	686
55	0.21*	1,110*	0.15	792

* When authorized by the designated Regional Signing/Marking Engineer, the 55 MPH No-Passing Zone, sight distance ***may* be increased from 0.21 to 0.26 miles** on certain higher volume highway segments, due to higher frequency of crashes and/or a demonstrated history of excessive speeding above the posted limit.

REQUIRED EQUIPMENT

1. Use two vehicles that provide a target on the lead vehicle 42 inches above the roadway. The observer's eye in the trailing vehicle **shall** be 42 inches above the roadway. Whatever type of target is used, it **shall** have a sharp cutoff when it disappears and appears.
2. A Distance Measuring Instrument (DMI) **shall** be used and **shall** have an accuracy of at least 10 feet per mile. The DMI **shall** decrease the measured distance when the vehicle backs up.
3. Two-Way communication equipment is required for the two vehicles.
4. At a minimum, a full-width flashing yellow light bar with 360-degree visibility **shall** be used. Additional signs and flashing lights on the vehicles are recommended.

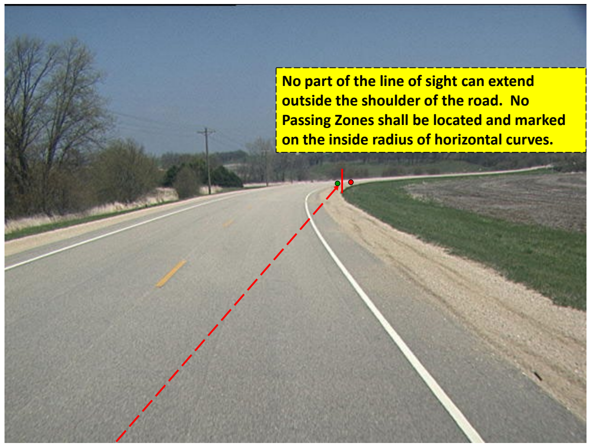
CRITERIA FOR LOCATING AND MARKING NO PASSING ZONES

- Prior to beginning work on locating no passing zones, the project engineer or Region Signing/Marking Engineer **shall** be contacted to determine if there are any special no-passing zones to mark under the contract.
- Follow the no passing zone sight distance shown in Table 1.
- The termini of no-passing zones **shall** be established to an accuracy of +/- 50 feet (0.01 mile).
- When the distance between two successive no-passing zones is less than the minimum distance shown in Table 1, connect the two zones.
- For roadways with speed limit changes, the proper no-passing zone sight distance in Table 1 **shall** be maintained.
    - Posted speed limit is increasing:

      When the lead vehicle reaches the increased speed sign, the trail vehicle would back up until the appropriate no-passing zone sight distance is achieved.
    - Posted speed limit is decreasing:

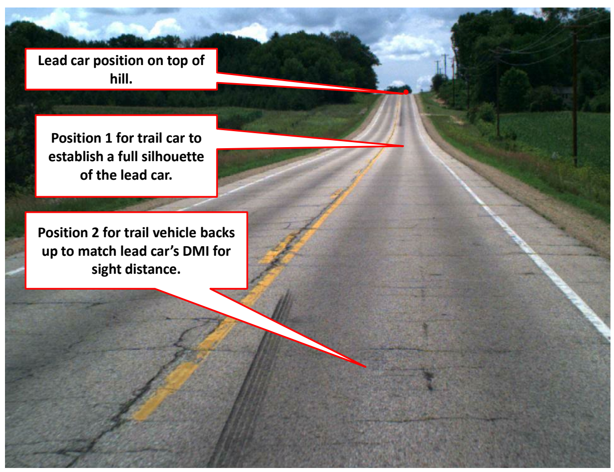
      When the trail vehicle reaches the decreased regulatory speed sign, the lead vehicle would back up until the appropriate no-passing zone sight distance is achieved.
- On horizontal curves, no part of the line of sight **shall** extend outside the shoulder (see Figure 1). No passing zones **shall** be located and marked on the inside radius of horizontal curves. If the horizontal curve requires a No Passing Zone, the starts and ends of the zones **shall** be recorded in the cardinal direction.

Figure 1. Horizontal Curve



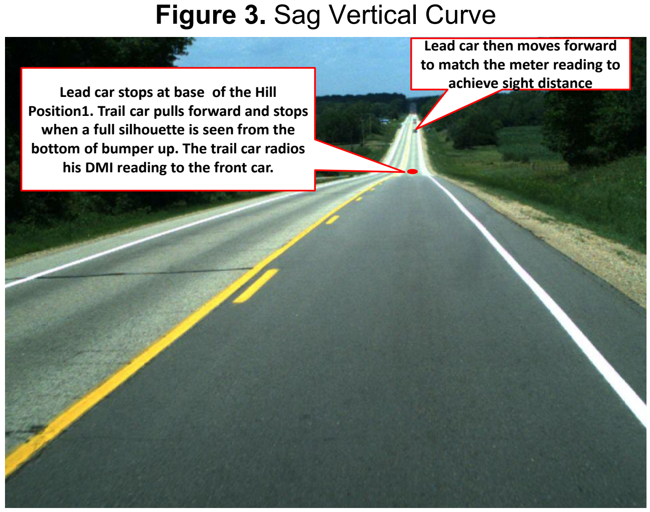
- On vertical curves, whenever the target light disappears from sight, the crew **shall** check for blind spots. For a crest vertical curve, if the target light on the lead vehicle goes out of sight, the trail vehicle parks at the base of the hill. The lead vehicle **shall** back up to reveal a full silhouette of the rear of the car (from the bottom of the bumper up). Once the trail vehicle sees the full silhouette of the lead vehicle, the trail vehicle **shall** back up to establish the sight distance between the 2 vehicles before marking the roadway (see Figure 2).

Figure 2. Crest Vertical Curve



- For sag vertical curves, if the target on the lead vehicle goes out, the lead vehicle **shall** stop at the base of the hill or in the sag. The trail vehicle **shall** pull forward until they see a full silhouette of the lead vehicle. Once the trail vehicle sees the full silhouette of the lead vehicle, the lead vehicle **shall** pull forward to establish the sight distance between the 2 vehicles before marking the roadway (see Figure 3).

Figure 3. Sag Vertical Curve



- If the no passing zone is less than 500 feet in length, the zone **shall** be extended to 500 feet by lengthening the zone at its beginning in each traffic direction.
- The correctness of no-passing zones leading into and out of the project limits **shall** be checked. Ensure that the minimum distance between zones and the sight distance are checked.

MARKING MATERIAL

The beginning and end of all no-passing zones **shall** be marked on the roadway with T's and dots. T's and X's **shall** be 12" X 12" and 2" stroke. Dots **shall** be 3" - 4" in diameter. Use white spray paint (for asphalt) and black spray paint (for concrete) that will be readily visible after one year of application.

RECORDING OF NO PASSING ZONES

Use DT2124 to record the No Passing Zones. Include the following data on the No Passing Zone Log Sheets:

- Log all starts and ends in miles to the nearest 1/100th of a mile.
- The beginning and ending of both no-passing zone line in the cardinal direction.
- The sight distance and speed criteria for each zone.
- The location of landmarks (intersecting U.S., State and County trunk highways, bypass lanes, truck climbing lanes, passing lanes, county boundary lines, railroad crossings, and starts and ends of bridges).

NO-PASSING BARRIER LINE CRITERIA

1. No-passing barrier lines, 500 feet in length, **shall** be marked on an undivided STH approach in the following intersection situations:
   - The STH traffic is controlled by a stop sign.
   - The intersection with the STH is controlled by a signal.
   - The intersection with the STH is controlled by a roundabout.
   - At a T-intersection with a standard bypass lane that allows vehicles proceeding straight to pass to the right of a left turning vehicle without leaving the paved portion of the highway as per SDD 15C8-b, a 500-foot barrier line **shall** be installed prior to the start of the bypass taper.
2. A no-passing barrier line **shall** be marked in the following non-intersection situations:
   - In advance of a divided highway illustrated on SDD 15C21.
   - In advance of a painted median island illustrated SDD 15C18.
   - Bridges having a width less than 24 feet shown on SDD 15C6.
   - Railroad grade crossings shown on SDD 15C9.
   - Passing/Truck Climbing Lanes illustrated on the SDD 15C8-c and SDD 15C8-d, A bypass lane for an intersection is **not** considered a passing lane under this guideline.
   - Any stretch of undivided 4 lane roadways **shall** have the opposing lanes designated by a double yellow barrier line for its entire length and start the barrier lines of 500 feet before the approaches to this section.

SPECIAL NO PASSING BARRIER LINES

The specific characteristics and factors leading to the increase or decrease of the No-Passing Zone sight distance from the DOT 55 MPH standard of 0.21 mile, *should* be documented in the Region. If there is a justified special zone, the traffic engineer **shall** give the crew locating no passing zones specific directions as to where barrier lines are to be placed. Special zones *may* include:.

- Any intersection justified by an engineering study, appropriate reasons include a crash history related to passing maneuvers or demonstrated operational problems. illustrated on the SDD 15C8-13b
- In low speed urban areas, double yellow barrier lines *may* be placed when justified by an engineering study. Criteria for the engineering study include curb and gutter, reduced speed, parking allowed, poor stopping sight distance, closely spaced driveways or intersections, and high pedestrian volumes. The double yellow lines *should* be installed from the start of the curb and gutter to the end of curb and gutter through the urban area. When urban double yellow lines are used, 500-foot barrier lines **shall** be placed on the approaches to this special layout, unless a longer no-passing zone takes precedence.
- At a T-intersection that allows vehicles proceeding ahead to legally pass to the right of a left turning vehicle without leaving the paved portion of the roadway, a 500-foot barrier line prior to the start of the bypass taper will be optional based on engineering judgment.

SIGNING

A No-Passing Zone pennant sign (W14-3) **shall** be installed as required in TEOpS 2-3-38, supplementing zones established under this guideline. This sign **shall** be placed no more than 50 feet from the start of the no-passing barrier line unless it's impossible due to location on a bridge deck or other exception.

3-2-3 Special Marking — April 2023

GENERAL

Special pavement markings consist of arrows, symbols, words, stop lines, crosswalks, diagonals, and aerial/vascar enforcement markings. These markings *may* be used to supplement signing. When used, they **shall** conform to the requirements in Section 3B of the WISMUTCD and the following guidelines.

POLICY

Most special markings **shall** be white and reflective.

Arrows

In general, arrows are used to supplement signing. There are 3 main types of arrows that WisDOT uses:

1. *Lane Control Arrows*
   - To supplement signing for complicated lane assignments and turn lanes. For mandatory turn lanes, the installation of arrows are required, per SDD 15C8 sheet b
2. *Wrong Way Arrows (Type 4)*
   - On any freeway off-ramp with high crash rates or unusual or poor geometrics.
   - Intersections or ramps with demonstrated problems of wrong way driving.
3. Lane Drop Arrows (Type 5)
   - On any lane drop with high crash rates.

Use SDD 15C7 sheet c and d for the size and shapes of these markings.

Words

Words currently allowed by WisDOT can be found on SDD 15C7 sheets a and b All words *should* be used at a site with a documented safety problem and discussed with the regional traffic engineer.

- The word, "ONLY", *may* only be used with singular Type 1 or Type 2 lane use arrows. The word, "ONLY", **shall not** be used in a two-way left turn lane.
- The word, "SCHOOL", either single or dual lane marking, **shall** only be used when one of the following criteria applies:
  - In advance of a marked crosswalk, which is typically monitored by a school crossing guard.
  - At a mid-block or uncontrolled intersection. The requestor **shall** be responsible for maintenance of the "SCHOOL" marking in combination with the crosswalk marking. This **shall** be documented on the application/permit form, DT2136 and the crosswalks policy under the "Type of Crosswalk Marking, Other". The required detail **shall** comply with SDD 15C7.
  - *Should not* be installed in a parking lane.
- "BIKE LANE" **shall** only be used with a signed bike lane.
- "YIELD" *may* only be used at roundabouts where there is a documented safety issue.
- The word, "OK", **shall not** be used on any state maintained highways.

Symbols

Symbols **shall** conform to the SDD15C7 sheet a and **shall** only be used when the following criteria applies:

- At a site with a documented safety problem.
- Supplement to regulatory signage.
- At the discretion of the regional traffic engineer.

Chevron/Diagonal Markings

Chevron/Diagonal markings provide added emphasis to the neutral area where driving is discouraged. Chevron markings *may* be applied at gores., refer to the FDM SDD 15C 31 sheet a and b. Yellow diagonal markings *may* be used in medians, refer to SDD 15C18 and SDD 15C21.

Stop Lines .

Stop lines indicate where vehicles are required to stop at intersections. Stop lines are not required at all intersections, but *may* be desired if:

- An approach to a signalized intersection where detection is installed and stopping at a certain point *may* enhance the operation.
- Intersection approaches with unusual geometrics such as large skew angles or non-symmetric approaches.
- Complex multilane approaches.
- An approach to an intersection with the STOP sign installed well in advance of the desired stopping point because of curb radii.
- In advance of a marked or unmarked crosswalk with significant pedestrian volumes.

For placement of stop lines refer to SDD 15C33. If the stop lines are required by the department, the Department will maintain the markings. All other stop lines and crosswalks *may* be marked by contract at the request of the municipality with the understanding that the local agency assumes responsibility for the maintenance.

Crosswalks

Crosswalks mark the path at which pedestrians *should* cross the roadway by delineating paths on approaches to and within signalized intersections, and on approaches to other intersections where traffic stops. As a secondary purpose, crosswalk markings *may* also serve to alert drivers of a pedestrian crossing point without signal or stop control. At non-intersection locations, crosswalk markings legally establish the crosswalk.

The Department policy for installation of crosswalks is as follows:

- Crosswalk markings *should* be installed at signalized intersections where pedestrian signal indications are present and at locations where there is a signed school crossing.
- Crosswalk markings *should not* be installed at non-intersection, mid-block locations or urban locations where posted speed limits are 45 MPH or more, unless traffic controls (all-way stop, signal, roundabout) or crossing enhancements (curb bump outs, median divider island, etc.) are present.
- Non-intersection crosswalk markings **shall not** be permitted at rural locations with a posted speed limit of 45 MPH or more. Exceptions *may* include trail crossings where advance warning signs are present.
- A permit for crosswalk markings *should not* be approved if a sidewalk or trail approach and/or ADA-compliant curb ramps (where there is curb) do not currently exist or are planned outside the roadway limits on both sides of the crosswalk approach. Per approval of the Region Traffic Engineer, the local government *may* be permitted to maintain existing crosswalk markings without sidewalk and/or ADA-compliant curb ramps as long as the local unit of government agrees to become compliant with the next highway project (regardless of sidewalk or curb work) or local sidewalk project.
- A permit for crosswalk markings **shall not** be approved unless parking is prohibited within 15 feet of the near limits of the crosswalk, as referenced in Wisconsin State Statute 346.53(5).

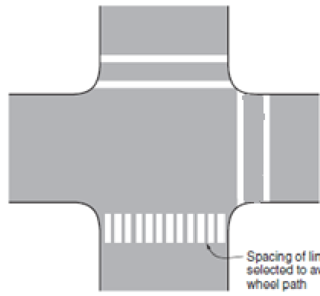
Crosswalk Type Selection

There are 2 types of crosswalks that WisDOT allows as shown in Figure 3B-19 of the WISMUTCD

- Two 6” Transverse Lines at all intersections
  - Preferred method due to:
    - Reduced maintenance cost

        - Less marking area to become slippery and cause problems
        - Reserve ladder bar for the areas with safety issues
- 24” Ladder Pattern
    - Midblock crossings
    - Multi-lane roundabouts where there is a high presence of pedestrians during peak hours or a demonstrated operational or safety issue. Consult the Region Traffic Engineer and Bike/Ped Coordinator for concurrence.
    - High pedestrian volumes
    - Locations with identified safety issues or risks

Figure 3B-19. Examples of Crosswalk Markings



Crosswalk markings *should* be placed as nearly perpendicular as possible to the direction of travel on the roadway. The following form needs to be completed to permit a municipality to install and maintain a crosswalk DT2136. A signed copy of the permit **shall** be sent to the local unit of government and a copy **shall** be filed in the Region office. Block pattern crosswalks are paid for by linear feet of each block.

Special Marking Treatments for Crosswalks

FHWA has published an official WISMUTCD Ruling, dated August 15, 2013 that allows subdued-colored aesthetic pavement treatments between legally marked transverse crosswalk lines. However, the following criteria **shall** apply:

- The colored pavement treatment **shall not** be made of retroreflective material.
- Transverse crosswalk lines **shall** delineate the edges of the crosswalk and **shal**l be 2-6” white transverse lines.
- Examples of acceptable aesthetic pavement treatments include brick lattice patterns, paving bricks, paving stones, cobbles or other types of paving. All treatments cannot impede wheelchair pedestrians.
- Examples of acceptable colors for aesthetic pavement treatments are red, rust, brown, burgundy, clay, tan or similar earth tone equivalents.

Funding

Funding for new crosswalk markings, replacement of existing crosswalk markings or new and replacement colored pavement treatments, is entirely the responsibility of the local government permittee except as follows:

- As part of a highway improvement (new or altered pavement surface) project:
    - Funding of the initial installation and/or colored pavement treatments *may* be included in the project cost without local participation or as outlined in FDM Section 11-3.
    - Routine maintenance of the crosswalk markings between successive improvement projects **shall** be entirely the responsibility of the permittee.
- At signalized intersections with pedestrian signals and at roundabouts:
    - Regions have discretion to maintain the crosswalk marking where sidewalks and ADA compliant ramps are present.

If the local unit of government desires any marking beyond the standard transverse 6” wide lines, the extra cost and maintenance of the marking or colored pavement is borne by the local unit of government.

Aerial Enforcement and Vascar Enforcement Bars

Aerial and Vascar Enforcement Bars are transverse markings placed on the roadway to assist law enforcement agencies in the enforcement of speed regulations. These markings are a series of two to five bars with a center-to-center spacing of 660 ft. and **shall** conform to the SDD15C14.

- Aerial –These lines are utilized by airplane to determine vehicle speeds from the air.

- VASCAR (Visual Average Speed Computer and Recorder) – These lines are utilized at ground locations for speed monitoring and verification of distance traveled.

Wisconsin State Patrol is the authority on these markings in cooperation with the Division of Transportation System Development to determine the quantity and locations of these markings for the use on state trunk system. Wisconsin State Patrol will notify the Regional traffic office for new locations that are needed or those that need to be remarked. Actual marking of the lines will be done by the Special Marking Contractor as the work schedule permits. A representative of State Patrol **shall** mark the locations of the lines with a small paint stripe prior to placing markings. A car can be provided by State Patrol for Traffic Control during the marking process, if the project engineer deems it necessary.

Parking on State Highways

Parking on State Highways is not encouraged due to the impacts on traffic flow, safety, highway operations, and maintenance. Parking on State Highways is only allowed when a municipality agrees to establish **and** maintain the parking lanes.

This policy is consistent with provisions of Section 86.32(4) of the Wisconsin State Statutes for connecting highways, section 3B.19 of the Wisconsin MUTCD, MUTCD Part 8, and FDM Chapter 17.The Region, after Regional Traffic Engineer review, *may* issue a permit or sign an agreement with local municipalities to allow the marking of parking spaces on the state highway. Installation and marking of parking spaces *may* appear in contracts for state highway work after a project agreement with local cost participation is finalized. Parking space **shall** follow SDD 15C36.

Parking Restrictions

Yellow curb markings *may* be installed on state highways to restrict parking. Yellow curb markings **shall** be accompanied by No Parking Signs or covered in State Statute 346. WisDOT will not pay for or maintain these markings.

Corrugated Median

Corrugated medians are used to delineate the raised section of a median. If the raised part of the median is separating opposing directions of traffic it *should* be painted in a set of double yellow solid lines on both sides of the median and the raised part of the median *may* be painted in yellow. If the raised part of the median is separating traffic in the same direction of traffic a double set of while solid lines **shall** be used and the raised part of the median *may* be painted in white.

Railroad markings

Railroad markings **shall** follow SDD 15c9 and include the RR, X and 3 stop bars. The RR is set before the X to reduce the amount of wear on the marking from traffic. Railroad insurance is required if you are painting any part of the railroad marking.

Outfall markings

Outfall markings are white 8” x 8” Epoxy squares. Follow SDD 8d15 for placement.

3-2-4 Island Marking — March 2019

PURPOSE

This policy explains the concept of how islands **shall** be marked consistent with WISMUTCD Section 3B.23

POLICY

Channelizing lines **shall** be placed upstream and adjacent to islands. The color of the pavement marking adjacent to the island **shall** be indicative of the function of the island.

- If an island separates traffic flowing in the same direction, such as a right or left turn island, the pavement markings along the island *may* be left unmarked. If marked it **shall** be white.
- If an island separates opposing traffic, such as a median island, the pavement markings **shall** be yellow.

Channelizing lines *may* be extended to address a demonstrated problem.

Refer to SDD 15C18 and 15C27 for details on how to mark a Turn Lane Island, Median, and Corrugated Median

3-2-11 Raised Pavement Markers March 2017

PURPOSE

Raised pavement markers are used to either supplement or substitute longitudinal pavement markings. These retroreflective units are either placed on top of or embedded into the pavement. Section 3B.11 to 3B.14 of the WISMUTCD covers the installation of raised pavement markers, and Section 6F.79 covers temporary raised pavement markers. This policy will clarify application of raised pavement markers on WisDOT maintained roadways.

POLICY

The color of the raised pavement markers **shall** match the color of the line that they supplement or substitute.

Plowable raised pavement markers **shall not** be used on state-maintained roadways. Existing plowable raised pavement markers **shall not** be covered over during a resurface project and **shall** be removed, prior to resurfacing the roadway.

<u>Temporary Raised Pavement Markers, Type I (Pucks)</u>

Temporary Raised Pavement Markers Type I *may* be used in construction zones to supplement pavement marking through shifting tapers. If used in shifting tapers within construction zones, temporary raised pavement markers **shall** remain in place until the traffic staging changes. They **shall** be placed every 50 feet.

<u>Temporary Raised Pavement Markers, Type II (Tabs)</u>

Temporary Raised Pavement Markers Type II **shall** be used to substitute pavement markings which are completely covered. Permanent markings **shall** be installed within 14 days of the marking being obliterated.

On undivided roadways, W8-12 “NO CENTER LINE” signs **shall** be used to warn motorists of a roadway without any centerline until temporary or permanent markings are installed. These signs **shall** be placed at the beginning of the project, at two-mile intervals throughout the project, and at locations where traffic enters the project area from intersections with state trunk and county trunk highways.

On undivided roadways, prior to the existing marking being obliterated, the locations of the existing pavement markings, including no passing zones, **shall** be documented. In addition, prior to the existing marking being obliterated, the R4-1 DO NOT PASS sign **shall** be installed at the beginning of the no passing zones. Additional R4-1 DO NOT PASS signs **shall** be installed within any no-passing zone that continues beyond an intersection with a state or county trunk highway or that exceeds one mile in length. The R4-2 PASS WITH CARE sign **shall** be installed at the downstream end of the no passing zones. Once the permanent pavement marking has been re-established, the R4-1 and R4-2 signs **shall** be removed.

If the above signs are in place for less than seven continuous days and nights, rollup signs and stands *may* be used in lieu of post mounted signs.

Same-day pavement marking *may* be used in lieu of using Temporary Raised Pavement Markers, Type II.

The standard application of Temporary Raised Pavement Markers, Type II **shall** be installed as shown on Standard Detail Drawing 15C34.

3-4-1 Maintenance of Markings

December 2024

PURPOSE

The purpose of this policy is to provide guidance for the maintenance responsibility of pavement markings on state maintained roadways as to what markings the State will maintain and what the local municipality will maintain.

POLICY

The State **will** maintain:

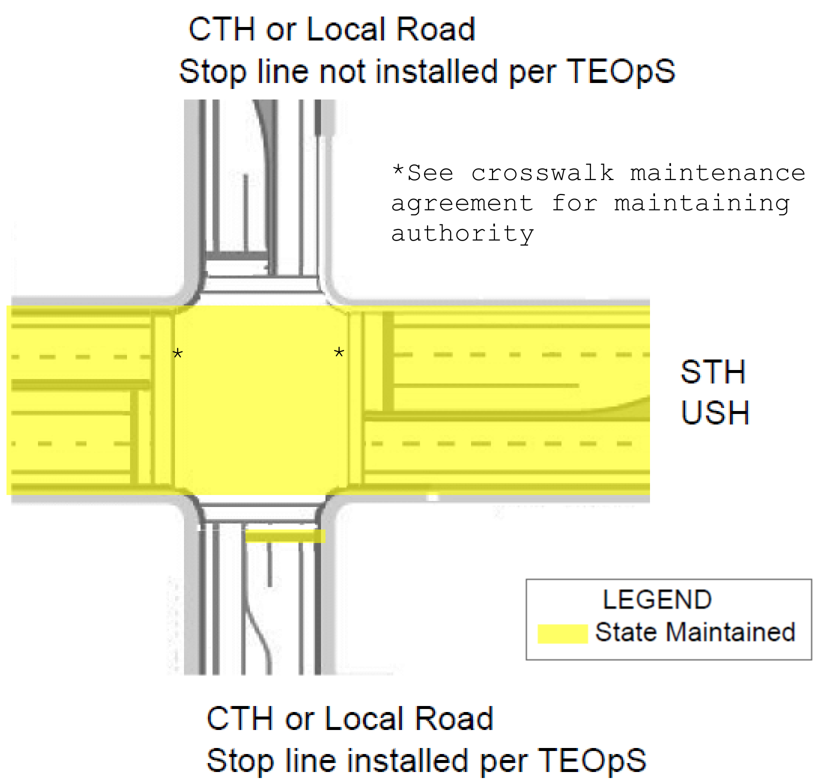
- All markings on STH, USH, or IH except for permitted markings.
- All markings within a roundabout including island gores.
- Stop lines if they meet the requirements in TEOpS 3-2-3.
- Rest areas and weigh stations.

The State **will not** maintain:

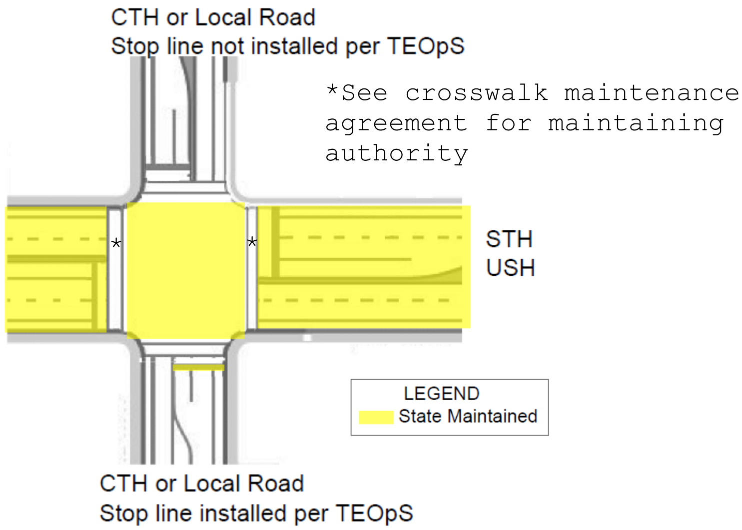
- Edge lines/centerlines on local roads and connecting highways, including non-state approaches to a roundabout.
- Crosswalks and special markings on local roads and connecting highways.
- Permitted markings on state highways.
- Shared use path markings and bike lane symbols.

Some examples are shown below.

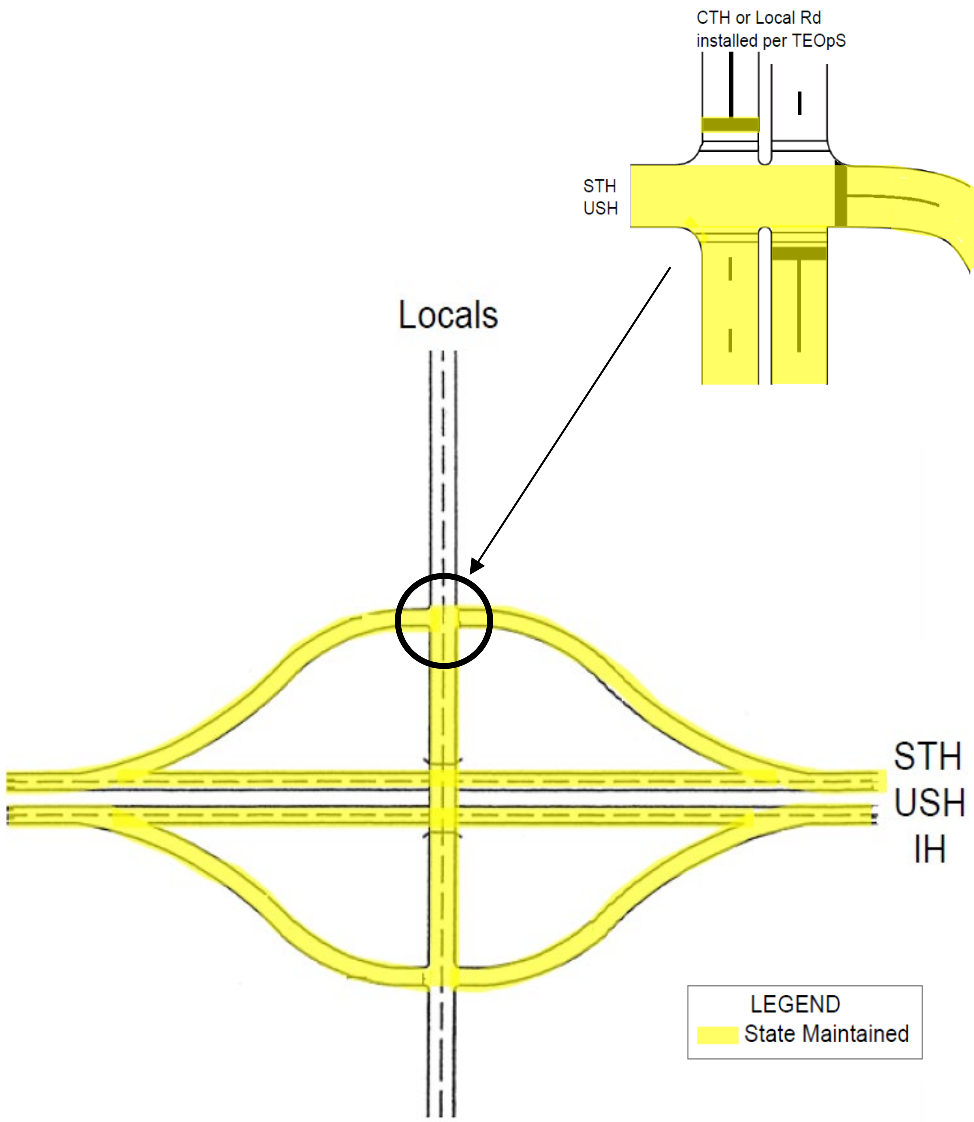
Signalized Intersections



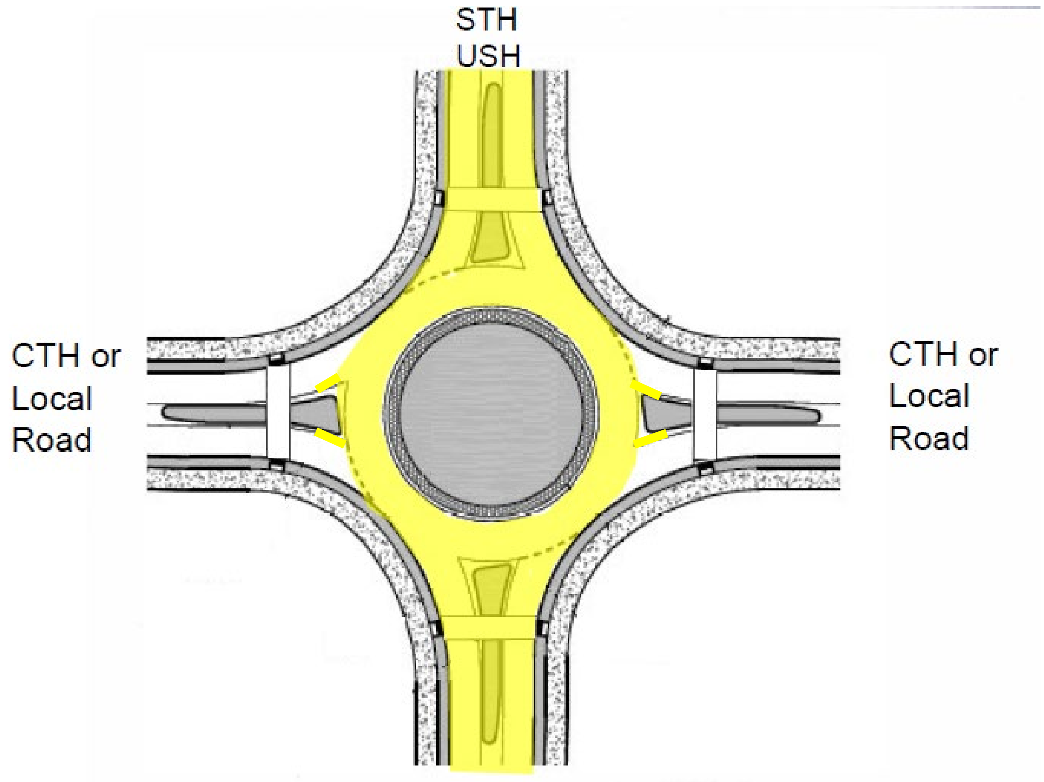
Non-Signalized Intersections

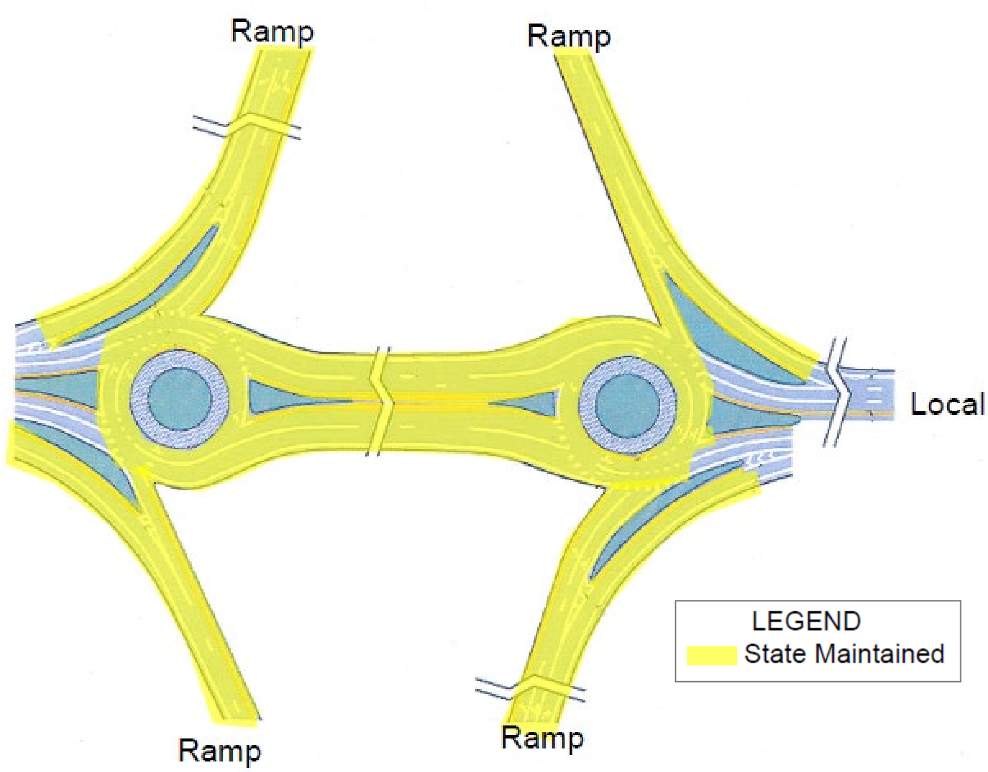


Interchange Ramps

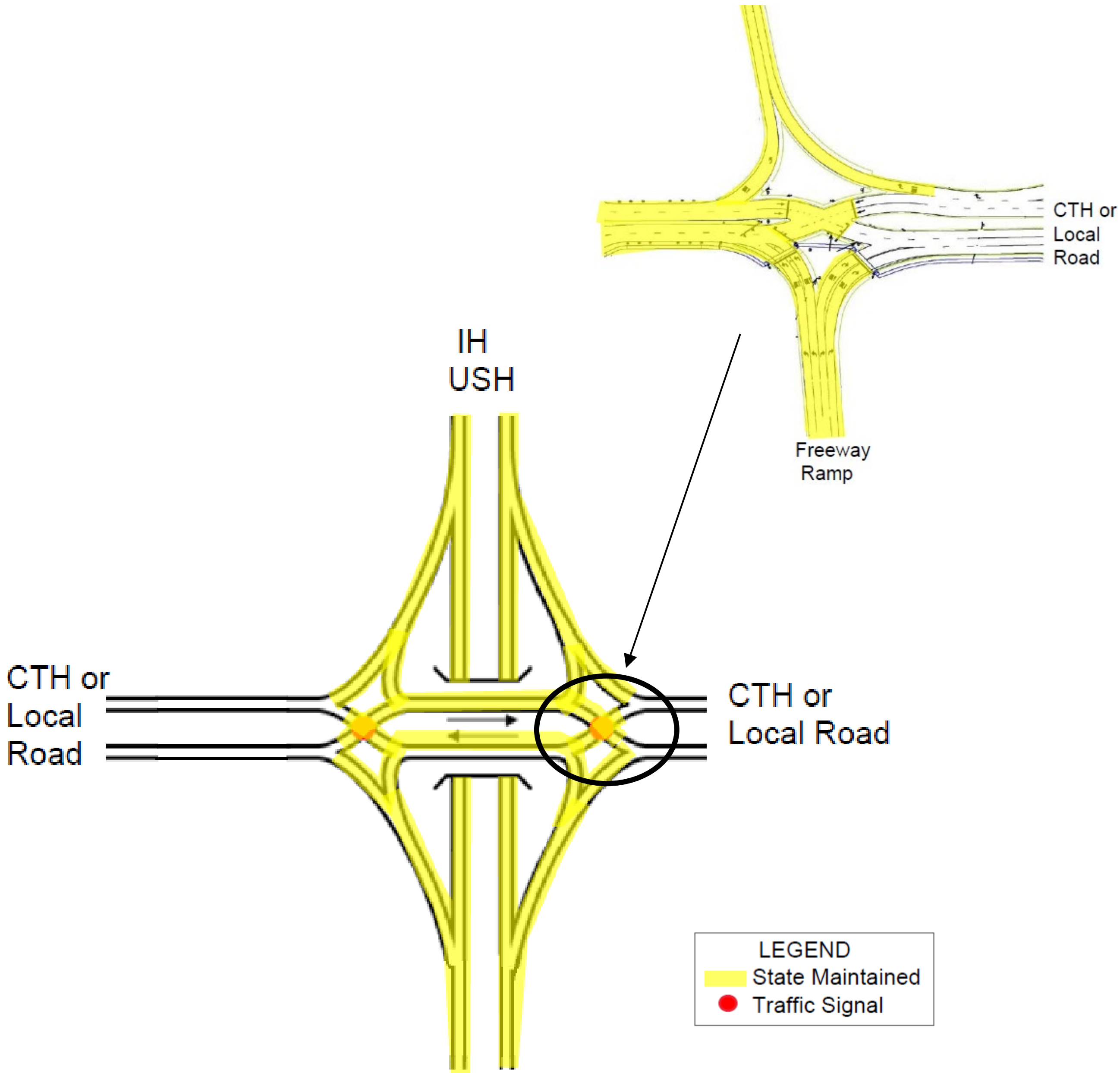


Roundabouts





Diverging Diamond Interchange



3-6-1 Delineators — October 2017

GENERAL

Delineators are reflective devices, mounted in a series along the side of a highway providing guidance by indicating the alignment at night and/or under adverse weather conditions.

The 2009 Manual on Uniform Traffic Control Devices (MUTCD) Part 3F addresses the use of delineators. Additional guidance is given in Part 5E and 6F and Facilities Development Manual.

POLICY—FREEWAYS AND EXPRESSWAYS

Locations

Delineators **shall** be used on unlighted freeways and expressways and *may* be used if they are continuously lit. Delineators *should not* be installed on the left side unless there are operational problems or high crash experience. Delineators also *should not* be used behind barrier wall or guardrail. They are to be installed as part of the barrier wall or guardrail.

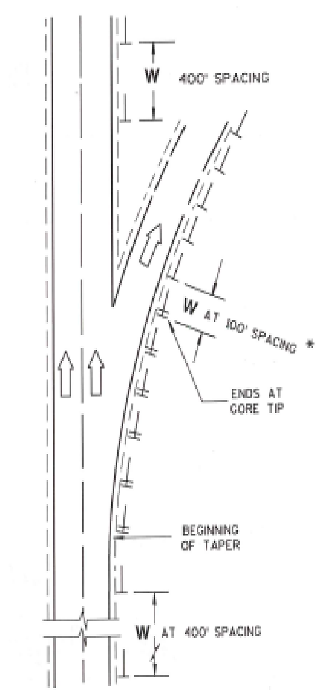
Delineators **shall** only be used on conventional highways if there are crash or operational issues, as documented by an engineering study and approved by the Regional Traffic Engineer. Delineators **shall not** be installed along the left side of any roadway having bi-directional traffic. Chevrons are the recommended choice of treatment for the left side of roadway and guidance on the usage of chevrons can be found in TEOpS 2-3-10.

Size and Color

The color of delineator **shall** match the color of the pavement marking line being supplemented. Delineator dimensions are shown in SDD 15A2 through 15A7.

Longitudinal Spacing

Delineators are to be placed at 100' center-to-center spacing on ramps and 400' center-to-center spacing on mainline. If they are interrupted, then they *may* be moved in either direction up to 25' for ramps and 100' for mainline. A minimum of 3 delineators is required.



Offset Distance

Delineators **shall** be placed at a constant distance from the edge of shoulder for the length of the installation, typically 4 feet. If a barrier wall or parapet is present place the delineators on the wall.

Transition Areas

Engineering judgment **shall** be used to adjust the longitudinal and offset spacing in any transition area. Consideration must be given to the function of providing guidance of the roadway alignment and as an aide for night driving.

3-10-1 Pavement Marking Material Selection Policy — December 2024

PURPOSE

Uniformity in the application of pavement markings materials on state highways is very important because it will provide for consistency of motorist expectations, which can enhance traffic safety. Consistency of application will result in the most efficient usage of dollars (both for projects and maintenance) for pavement markings. In turn, this will lead to a sustainable pavement marking program that will provide effective pavement markings to address the needs of motorists at the most economical cost.

This policy provides direction on what types of pavement marking materials are used on the different types of roadways.

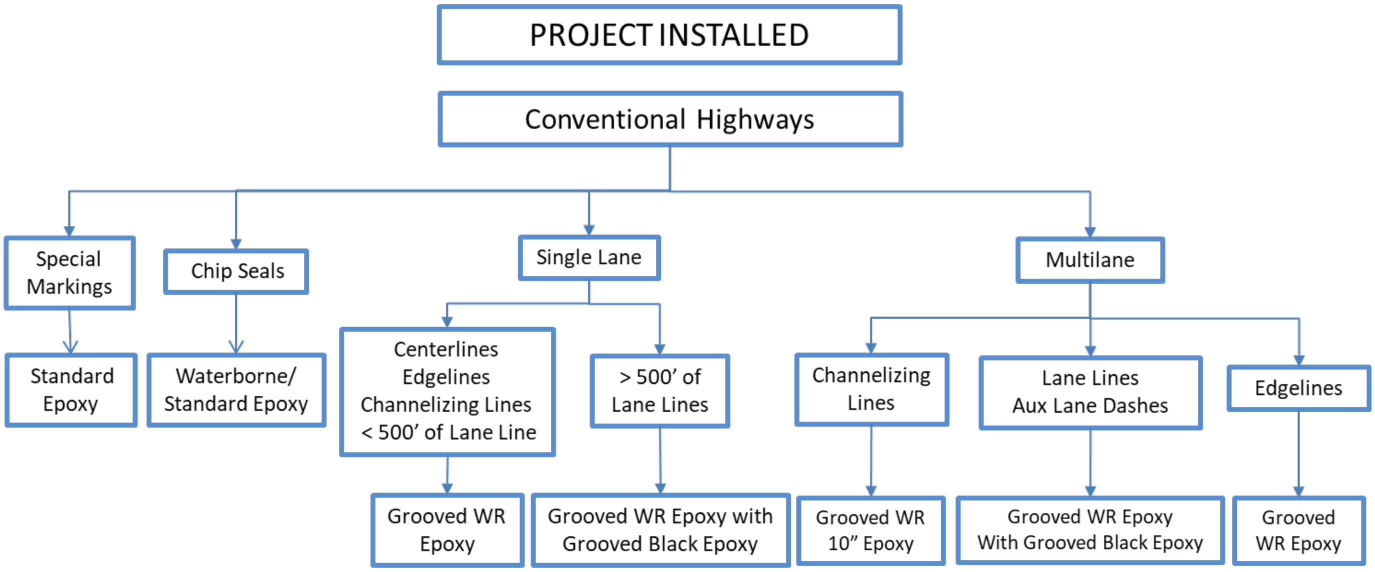
It is recognized that there *may* be times where unique situations could necessitate a deviation from this policy. Unique locations or non-standard markings **shall** be discussed with the Regional Traffic Signing and Marking Engineer prior to including such markings in contract plans.

Any pavement marking material usage requests that are not on the Department's Approved Products List **shall** be reviewed and approved by the Bureau of Traffic Operations prior to usage. Any shortages of pavement marking materials or vendors requesting usage of new products **shall** be referred to the Bureau of Traffic Operations.

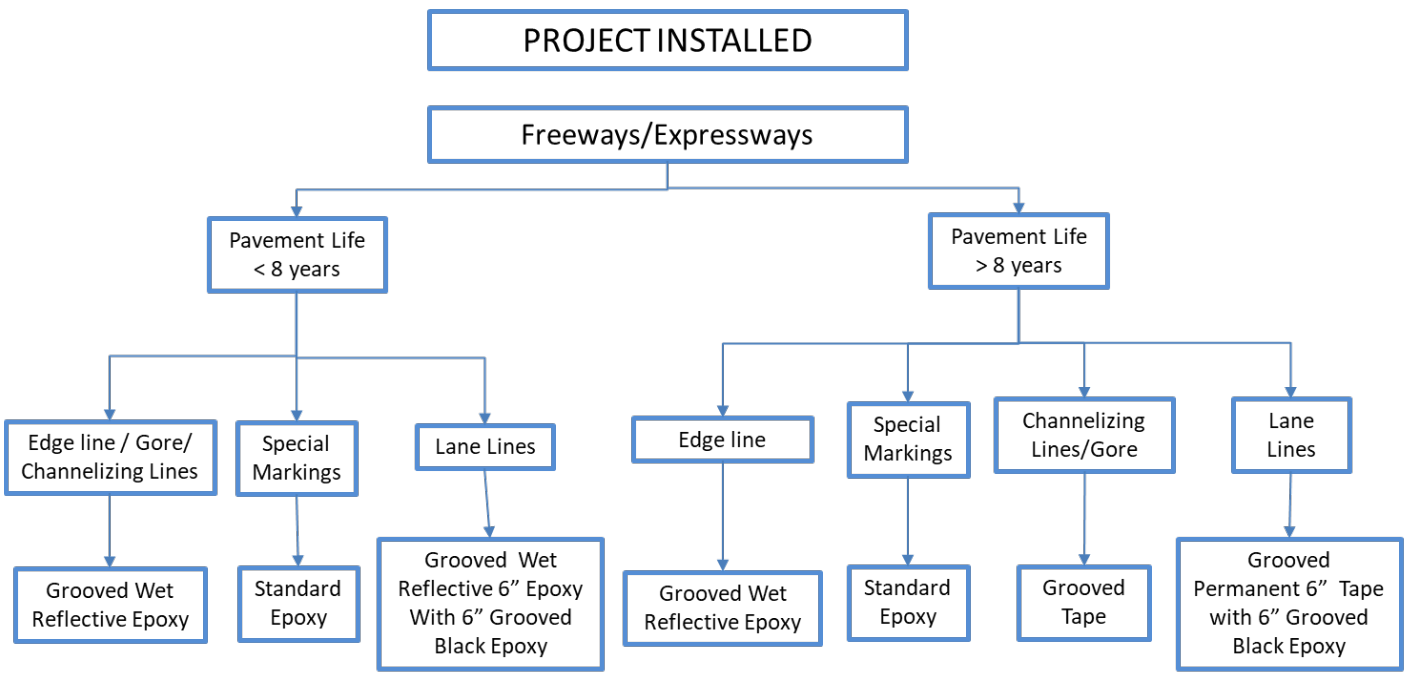
POLICY

The type of pavement marking material used on state highways is provided below in the flow charts. The flow charts are for project installed pavement markings and maintenance installed pavement markings. These charts **shall** be utilized when making the decision to select the proper pavement marking material for the roadway.

- When utilizing the flow charts, the following criteria **shall** be kept in mind: If a contrast epoxy product already exists, retrace only the white portion of the epoxy unless the black aggregate is visually missing.
- Grooved Wet Reflective Epoxy **shall** only be remarked in kind if an existing groove has maintained adequate depth.
- If preformed thermoplastic is present, remove preformed thermoplastic markings and replace with a product listed on the associated flow chart. Retracing preformed thermoplastic is **NOT** permitted.
- If tape is present and still bonding, retrace marking with a product listed on the flow chart product. However, if the tape product is failing, remove tape and replace with epoxy.



On local and connecting highway projects consult with maintaining authority for product selection.



On local and connecting highway projects consult with maintaining authority for product selection.

3-10-2 Pavement Marking Replacement Criteria — December 2024

PURPOSE

Over time the visual characteristics of pavement markings deteriorate as a result of age, traffic wear, snow plowing and ultraviolet radiation, resulting in reduced visibility. As a result, pavement markings have to be replaced as part of a routine pavement marking replacement. Often questions arise as to when pavement markings *should* be changed, who *should* replace the pavement marking, and what criteria *should* be used in determining replacement. Therefore, it is necessary to have clear, consistent guidelines for the replacement of pavement markings on state highways.

FEDERAL HIGHWAYS MINIMUM PAVEMENT MARKING RETROREFLECTIVITY VALUES

Section 3A.03 of the MUTCD requires all units of government to use an assessment or management method that is designed to maintain the retroreflectivity of longitudinal pavement markings at or above:

- 50 mcd/m2/lx on roadways with a speed limit greater than 35 mph
- 100 mcd/m2/lx on roadways with a speed limit greater than 70 mph

To maintain compliance with the minimum pavement marking retroreflectivity values in the MUTCD, WisDOT utilizes the following approved assessment and management methods:

1. Service Life Based on Historical Data. Age and product type is tracked, and markings are replaced when it reaches its historical data replacement life expectancy.
2. Measured Retroreflectivity. Retroreflectivity of durable markings is measured on an annual basis. Due to the timing of LETs markings will need to be scheduled for replacement a year before they will fall under the required retroreflectivity. Over time the service life based on historical data cycle *may* be revised based on data from the Measured Retroreflectivity.
3. Service Life Based on Monitored Markings. Replacement of pavement markings in the field is based on the performance of a sample of control markings. The data from the control markings can provide engineering support to the Service Life Based on Historical Data method. Over time the service life based on historical data cycle *may* be revised based on data from the Monitored Markings.

DETAILED PAVEMENT MARKING REPLACEMENT POLICY

Service Life Based on Historical Data

1. The Department's Traffic Operations Asset Management System (TOAMS) **shall** be used to track inventory data on pavement markings that include install date, product type, and painted footage.
2. In general, replace:
    a. Waterborne every year
    b. Epoxy every 3 Years
    c. Black lag should be installed on epoxy retrace projects where lane lines are being retraced.
    d. Wet reflective epoxy 5 years
        i. Will only be replaced if the groove has sufficient depth to support another application of wet reflective epoxy, otherwise standard epoxy should be used.
3. Tape every 10 Years Markings needed for let projects **shall** be replaced using the flow chart in 3-10-1 and 6-6-78.
4. Waterborne pavement marking will be replaced by County Highway Departments, through Traffic Maintenance Agreements. WisDOT **shall** provide a pavement marking material contracts for the County Highway Departments to purchase from.
5. Durable pavement marking products will be replaced by LET Contracts.

Measured Reflectivity

1. Markings no longer meeting minimum retroreflectivity *should* be replaced.
2. Every year mobile and/or handheld retroreflectivity readings are taken on state-maintained highways.
3. Durable markings *should* be *scheduled* for replacement when the roadway reaches a retroreflective value of 140. Scheduled replacement is above the minimum retroreflectivity because the retroreflectivity readings are collected from May to September and those readings are used for the next years LET.

Service Life based on Monitored Markings

Due to staffing issues, size of state, and limited window to collect retroreflective readings, Wisconsin will also use the monitored markings service life. Monitored service life will be used to verify the service life based on historical data and used to replace other markings at the same age, similar traffic volumes and location within the state.

*While retroreflectivity is very important that is not the only performance indicator that will be looked at for replacement of markings.

SPECIAL MARKINGS

Special markings are not covered under Section 3A.03 of the MUTCD. However, WisDOT still feels these markings are important. Arrows, words, symbols, stop lines, yield markings, dotted extensions, railroad crossings, crosswalks, and diagonals *should* be replaced on the same cycle as longline markings. Curb markings, island noses, corrugated median, and chevron gore markings *should* be replaced as needed.

3-15-15 Dynamic Envelope Marking November 2015

PURPOSE

The MUTCD Section 8B.29 defines dynamic envelope pavement markings as a 4-inch solid white line, placed parallel to and 6 feet away from the nearest rail of an at-grade crossing. The MUTCD further defines a supplemental marking consisting of 12-inch solid white lines, placed at a 45-degree angle and 5 foot spacing between the 4-inch solid lines. This policy will clarify dynamic envelope pavement marking installation on state maintained roadways.

POLICY AND GUIDELINES

Between the 4-inch parallel lines, dynamic envelope markings fully cover 20 percent of the driving surface. This broad coverage area presents a potential safety hazard to bicycles and motorcyclists, as pavement marking material offers significantly less surface friction than unmarked pavement. In addition, this large amount of marking creates a maintenance issue for the department. For these reasons, dynamic envelope markings **shall not** be utilized on state maintained roadways.

Certain grade-crossing locations on state maintained roadways *may* present operational issues. In lieu of dynamic envelope markings, the following signing countermeasures *may* be implemented:

1. The R8-8 "DO NOT STOP ON TRACKS" sign *may* be used at grade crossings where drivers tend to stop on the tracks.
2. The R10-6 "STOP HERE ON RED" sign *may* be used at grade crossings with signals downstream of the crossing.
3. The W10-11-A "XX FEET BETWEEN TRACKS & HIGHWAY" sign *may* be mounted in advance of a grade crossing where limited storage space exists between the tracks and a downstream intersection.
4. The W10-11-B "XX FEET BETWEEN HIGHWAY & TRACKS BEHIND YOU" sign *may* be used downstream of a grade crossing where limited storage space exists between the tracks and a downstream controlled intersection. If used, this sign *should* be mounted either below the STOP or YIELD sign, or just prior to the signalized intersection.

3-25-1 Field Crew Guidance and Contacts

December 2024

PURPOSE

This subject was developed to provide guidance to improvement project inspectors as well as Department and County field and maintenance crews for the installation, service and maintenance of all types of highway signs and pavement markings on the State Highway network. The goal for this is manual is to install signs and pavement markings to provide a safe, understandable and efficient system of guidance to the motoring public.

These guidelines are intended to provide a framework of policies and practices for the systematic reporting and handling of pavement marking installation and replacement or sign repair activities done by others under the direction of the Wisconsin Department of Transportation through its Regions. It is inherent these guidelines that the basic thrust be to promote safety of the motorist, safety for the improvement and maintenance crews and standardization of practices toward uniform application and appearance statewide.

Improvement project crews and maintenance crews will perform their operations in accordance with the Wisconsin Manual on Uniform Traffic Control Devices, Traffic Guidelines Manual and other Department policies as referenced within.

The Department recognizes these guidelines *may* require adjustments and revision as they are implemented.

INSTALLING MARKINGS

Pavement marking **shall** be in accordance with the WMUTCD, Facilities Development Manual and the Wisconsin Standard Specification Manual.

Types of Roadway Markings

Skip line is a broken or dashed line. The standard is a 12.5’ line with a 37.5’ gap.
Dash is a painted portion of a skip line. Typically a 3’ line with 9’ gap.
Cat track is a painted line for guidance. Typically a 2’ line with a 6’ gap.
Channelizing line is double the thickness of a standard line. Typically 8”.

<u>County Maintenance</u>

Counties will be given segments of roadways that need to be painted. The scheduling of pavement marking operations will be left to the county. Counties will then be able to schedule their crews to what fits their needs, but the work **shall** be completed in a timely manner. WisDOT is requiring all marking to be placed at or above manufacture specifications. Each stripping crew is responsible for completing the Pavement Marking Daily Report. These reports **shall** be sent to the Regional Pavement Marking Coordinator or representative at the end of every week. State actual time spent not painting at the bottom of the report (drive time, weather delay, maintenance, etc.)

<u>Improvement/Refurbishment Projects</u>

Install per Spec 646, 647, and 649.

FIELD OPERATIONS

Paint and Beads **shall** be purchased off of the Statewide Bid for all State work. It **shall** be the responsibility of the County to order all paint and beads, unless other arrangements have been made with the Region. Return all empty paint totes to the provider. For application standards see the appropriate section below.

<u>No Passing Zones</u>

- No Passing Zone “T” is a mark on the roadway, which indicates the beginning and ending points of a barrier line.
- No Passing Zone “X” on the end of a line indicates that it needs to be extended or removed.
- No Passing Zone Dot indications the center of the roadway.

Figure 1. New Marking

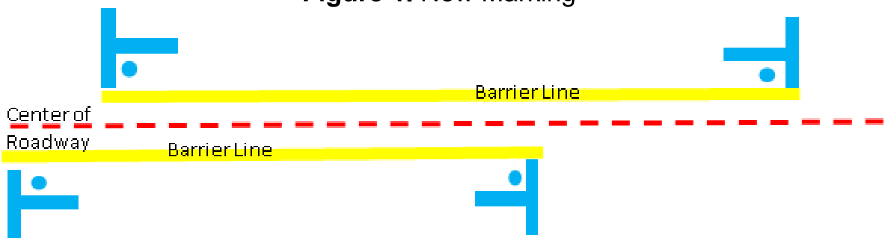
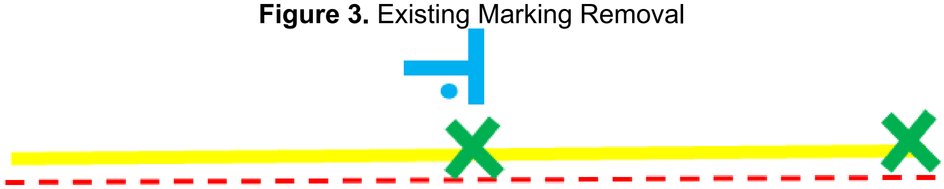


Figure 2. Existing Marking Extension

Figure 3. Existing Marking Removal



Waterborne Paint

General

Store waterborne paint in a dry area that will not freeze. Do not store paint for more than 12 months. Keep in mind the weather will drastically change the dry time of this product. Humidity and cooler weather are the biggest factors. Please let the Marking Coordinators know of any and all issues with the paint.

Types of Spraying

There are 2 ways to spray paint:

- Conventional: Air jets with a pressure (60 psi to 140 psi) at the tip of the paint gun that breaks up the paint. The tip defines the size of the line.
- Airless: The pressure created by the pump forces paint out through an orifice in the tip of the gun. The angle and size of tip affect the size of the line.

Temperature

Refer to manufacture specifications for the temperature the paint *should* be applied at. Typically the ambient temperature *should* be above 50°F.

Beads

Wisconsin is currently using the AASTHO Type I bead gradation with 80% rounds. These can also be purchased off of the State Contract.

Application

Product	Mil thickness	Gallons per Mile	Feet per Gallon	Lbs Beads per Gallon
Paint	16	26.4	200	10

Epoxy

General

Epoxy is a two part system. Epoxy has a longer life expectancy and can be applied at lower temperatures; however, it takes longer to dry than waterborne paint. Epoxy has a life expectancy of 3-5 years. Humidity and cooler weather are the biggest factors. Please let the Marking Coordinators know of any issues.

Mixing

Since epoxy is a two part system the resin has to be mixed with a hardener. Typically it is 2 parts resin to 1 part hardener.

Temperature

Refer to manufacture specification for the temperature the epoxy *should* be applied at. Typically the ambient temperature *should* be above 35°F

Beads

Wisconsin is currently using the AASTHO Type I bead gradation with 80% rounds. See table above for how many pounds of beads per gallon are required.

Application

Product	Pavement Type	Mil Thickness	Gallons per Mile	Feet per Gallon	Beads per Gallon
Epoxy	SMA/ Seal Coat/ Epoxy Overlays	25	41.1	129	25
Epoxy	All Others not stated above	20	32.8	161	22.5

Reflective Glass Beads

General

Beads are added to lines to increase the visibility of the lines at night. The beads help reflect light from a vehicle back to the driver as shown in the picture to the right.

Figure 1: No Beads

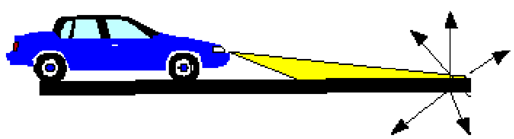
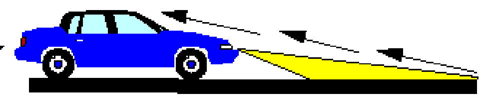


Figure 2: Beads added



Optimum embedment of beads is 50-60%. Anything less than that *may* cause the beads to pop out and any more than that affects how much light the bead can reflect back to the driver.

Bead Calibration

Bead calibration is very important since to many beads is expensive and doesn't adhere to the paint, and not enough beads can result in low retros. Hold a container under the bead gun for 10 seconds. Measure beads in milliliters. Use the table below to measure the volume of beads in milliliters per 10 seconds for a 4" wide line drop rate.

Bead Calibration Chart (AASHTO Type I to Type 4)
Lbs/100ft Bead Calibration Chart

Speed	8 lbs/1000 ft²	10 lbs/1000 ft²	12 lbs/1000 ft²	22 lbs/1000 ft²	24 lbs/1000 ft²
10 mph	1620	2010	2400	4395	4800
9 mph	1440	1800	2160	3840	4320
8 mph	1275	1605	1920	3525	4320
7 mph	1125	1410	1680	3060	3330
6 mph	960	1200	1440	2640	2880
5 mph	795	990	1200	2190	2400
4mph	645	795	960	1740	1920
3 mph	480	600	720	1320	1440

Source: Ennis Flint Traffic Paint Guide Book

Troubleshooting Tips

Below are the common problems that occur during painting.

Table 1: Conventional Paint Application Troubleshooting

PROBLEM	CAUSE	REMEDY
Excessive Thickness (overall)	• Paint tank or pump pressure too high • Paint gun volume control open to wide (if present) • Applicator speed too low	• Reduce tank or pump pressure • Adjust paint gun volume control • Increase speed
Excessive Thickness (middle of line)	• Paint tank or pump pressure too high • Paint gun volume control open too wide (if present) • Atomizing air pressure off or too low • Material buildup in paint gun tip and/or shroud	• Reduce tank or pump pressure • Adjust paint gun volume control • Increase atomizing air pressure • Clean tip and/or shroud
Excessive Thickness (along one side)	• Material buildup in paint gun tip and/or shroud • Clogged hole(s) in paint gun atomizing tip	• Clean paint tip and/or shroud • Clear clogged hole(s) in paint gun atomizing tip
Insufficient Thickness	• Paint tank or pump pressure too low • Paint gun volume control not open enough (if present) • Vehicle speed too high • Atomizing pressure too low. • Material buildup in paint gun tip and/or shroud • Material buildup in paint filter(s) and/or plumbing	• Increase tank or pump pressure • Adjust paint gun volume control • Increase applicator speed. • Increase atomizing air pressure • Clean paint gun tip and/or shroud • Clean paint filter(s) and/or plumbing

Wide Paint Line	• Paint gun set too high • Worn or damaged paint gun tip and/or shroud	• Lower gun • Repair or replace tip and/or shroud
Narrow Paint Line	• Paint gun too low • Paint gun tip slot not at 90° angle to paint line • Clogged paint gun tip and/or shroud • Low air pressure in paint machine tire.	• Raise paint gun • Reposition paint gun tip • Clean paint gun tip and/or shroud • Inflate tire
Uneven Paint Line (spotty)	• Atomizing air pressure too low • Paint tank pressure too low • Old paint (viscosity too high) • Loose paint gun tip and/or shroud • Not enough heat for paint to flow evenly • No shroud	• Increase atomizing air pressure • Increase material tank pressure • Rotate material stock • Secure paint gun tip and/or shroud • Increase heat • Install shroud

Source “MnDOT Pavement Marking Field Guide”

Table 2: Epoxy Spray Application Troubleshooting

PROBLEM	CAUSE	REMEDY
Heavy or Light centers	• Inadequate fluid delivery	• Increase fluid pressure • Decrease tip size
Surging pattern	• Pulsating fluid delivery	• Reduce demand • Remove restrictions in supply system • Check individual pump pressures for unequal pressure • Check supply hose for leaks
“Lop-sided” millage	• Worn tip sides • Clogged tip	• Replace tips • Clean tips
Line too wide	• Gun too high • Too wide a fan angle on tip	• Lower gun • Adjust tip size if necessary
Line too narrow	• Gun too low • Too narrow a fan angle on tip	• Change tip size • Decrease speed of application • Verify pressure settings
Too much or too little hardener	• Displacement pumps not properly synchronized	• Adjust pumps

Source “MnDOT Pavement Marking Field Guide”

Table 3: Reflective Bead Application Troubleshooting

PROBLEM	CAUSE	REMEDY
Beads on one side	• Bead gun out of alignment • Clogged bead gun	• Adjust alignment of gun cap
Excessive bead use	• Worn gun needle, seat and orifice • Excessive glass bead pressure	• Rebuild gun • Decrease pressure
Beads in middle of line	• Bead tank pressure too low • Bead gun “off” and “on” control screw not adjusted • Bead gun cap out of alignment • Too big of a bead gun tip	• Increase pressure • Adjust control screw • Align cap deflector • Change to a smaller tip
All beads buried	• Bead gun too close to paint • Bead gun angle too shallow • Excessive paint millage	• Re-align bead gun • Adjust angle of bead gun • Check wet millage thickness
All beads on top of line	• Bead gun too far from paint gun	• Re-align bead gun
Pulsed bead application	• Bead tank pressure inadequate	• Raise tank pressure • Rebuild applicator to increase pressure
Excessive amount of beads beside line	• Too much overlap of bead pattern on line pattern	• Move bead gun closer to roadway

Source “MnDOT Pavement Marking Field Guide”

CONTACTS

DOT Contacts			
Region	**Contact Person**	**Number**	**Email**
Pavement Marking Staff 3609 Pierstorff St Madison, WI 53704	Jeannie Silver	608-246-5408	jeannie.silver@dot.wi.gov
SW Region- La Crosse 3550 Mormon Coulee Rd. La Crosse, WI 54601	Kory Keppel	608-785-9953	kory.keppel@dot.wi.gov
SW Region- Madison 3601 Pierstorff St Madison, WI 53704	Jeff Holloway	608-246-3268	jeffrey.holloway@dot.wi.gov
SE Region- West Allis 935 S. 60th St. West Allis, WI 53214	Chuck Saldivar Bree Johns-Konkol	414-266-1164 414-266-1171	chuck.saldivar@dot.wi.gov bree.johnskonkol@dot.wi.gov
NE Region- Green Bay 944 Vander Perren Way Green Bay, WI 54304	Steven Herlache	920-492-3512	steven.herlache@dot.wi.gov
NC Region- Wis Rapids 2841 Industrial St Wis Rapids, Wi 54495	Al Smith	715-421-8364	alan.smith@dot.wi.gov
NC Region- Rhinelander Hanson Lake Rd Rhinelander, WI 54501	Al Smith	715-421-8364	alan.smith@dot.wi.gov
NW Region- Spooner W7102 Green Valley Rd Spooner, WI 54801	Ken Jansky	715-225-9318	kenneth.jansky@dot.wi.gov
NW Region- Eau Claire 5009 USH 53 South Eau Claire, WI 54701	Ken Jansky	715-225-9318	kenneth.jansky@dot.wi.gov

South West		
Adams	David Johnson	(608) 339-3355
Dane	Robert Peterson	(608) 575-5209
Dodge	Joe Lechner	(920) 210-1760
Iowa	Neil Wegner	(608) 574 2936
Vernon	Phil Hewitt	(608) 606-3777
Southeast		
Milwaukee	Jake Reinke	(414) 587-5012
Ozaukee	Joe Thoennes	(262) 770-8732
Racine	Mike Kirshling	(262) 770-9690
Walworth	Dave Gross	(262) 949-7835
Washington	Tim Herman	(262) 483-3081
Waukesha	B Kerr	(262) 442-9161
Northeast		
Brown	Andy Sell	(920) 609-4020
Calumet	Chad Scheinoho	(920) 929-3491
Fond du Lac	John Hoffman	(920) 929-3491
Kewaunee	Ron Schleis	(920) 255-1026
Marinette	Joe Baranek	(715) 923-6874
Sheboygan	Dustin Hammel	(920) 459-9182
North Central		
Adams	Joshua Oleson	(608) 547-0644
Iron	Kasey Krall	(715) 561-4965
Langlade	Brian Lowry	(715) 853-4742
Portage	David Johnson	(715) 247-4821
Shawano	Brian Lowry	(715) 526-9182
Waushara	George Nigh	(920) 787-3327
Northwest		
Taylor	Lonnie Ulrich	(715) 965-3141
Trempealeau	Tanner Kidd	(715) 538-3035
Washburn	Fred Gruenhagen	(715) 205-9960

3-25-2 Field Crew Safety and Training — May 2017

PERSONAL SAFETY

All Department of Transportation (DOT) personnel **and** any personnel working for the state are required to follow the safety policies stated in the DOT Transportation Administrative Manual (TAM). DOT, county, and contractor personnel **shall** wear:

- Eye Protection: (TAM SD 36)
  - Safety glasses with attached shields
- Foot Protection: Steel-toe boot or shoe (TAM SD30)
- Protective Headgear: (TAM SD 51)
  - Hard hat
- High Visibility Safety Apparel: (TAM SD 57)
  - Reflectorized Safety Vest at all times on or along the roadway
  - Reflectorized Safety Pants during nighttime hours.

Hazard Warning Information - Treated Wood Management (See Exhibit 5)

(Material Safety Data Sheets *should* be requested from the wood post vendor)

EMPLOYEE RECOMMENDED TRAINING

All agencies doing work for the DOT *should* make sure their employees are properly trained in the following areas:

1. Field Operations Awareness
2. Shop Tools
3. Major Equipment Operations
4. Utilities Locate. Call Diggers Hotline 811
5. Retraining
6. Vehicle Safety and Inspection

WORK AREA TRAFFIC CONTROL

All traffic control **shall** be in compliance with the WMUTCD and Departmental policies. See Standard detail drawings.

Vehicles used in highway signing operations **shall** be equipped with at least two (2) yellow, high intensity rotating beacons, clearly visible from the front, rear and both sides of the vehicle. These beacons **shall** be placed as high as possible on each vehicle. Vehicles **shall** have all warning lights operating when stopped or moving slowly along any highway. Warning lights **SHALL NOT** be displayed while the vehicle is traveling at highway speeds or when traveling between jobs.

When conditions are less than ideal, additional advance warning signs or devices *should* be added to the traffic control layouts. In some cases, the work *should* be deferred until the conditions are more favorable.

All lane closures on two lane roadways require flagging of traffic as well as advance signing and cone placement in the work area. Remember that all flaggers **shall** use stop/slow paddles.

An encroachment into a lane of traffic *may* require cones and/or flagging. The amount of encroachment, the volume and speed of passing vehicles will determine traffic control measures required. For example, a cone *may* be sufficient to mark the point where an outrigger makes contact with the pavement outside the overall width of the truck.

PUBLIC SAFETY

Workers **shall** park vehicles off the road as far as practical. Care *should* be taken to not block the vision of existing traffic control devices such as stop signs and signals. Work activities *should* be performed with an assumption the motorist does not know what the workers are going to do.

UTILITIES

Utility Locates. Diggers Hotline (811) **shall** be called and located before any work is performed. They *should* be given at least a 3 working day notice.

The following is a five-point plan for utility locates before digging in the highway right-of-way, which covers the routine steps required by Diggers Hotline:

1. Prepare a plan or work location sketch or drawing. Indicate a 25-foot radius around the stake or lath for "MARKING INSTRUCTIONS" for Diggers Hotline.

2. At each locate site, mark with a stake or by painting the pavement or shoulder of the highway. White or pink are the approved colors for ribbons, flags or paint when marking sign locations for utility locates.
3. Identify the exact location by measuring the distance from the nearest intersecting street or highway. Indicate which side of the highway the locate is on.
4. Contact Diggers Hotline to request the area to be located. Retain ticket number for a minimum of six years after work is completed.
5. Investigate the possibility of other utilities having services at the locate site.

Utility Damage Procedure. Damage prevention is the ultimate goal. As stated above it is essential to get clearance from utilities before doing any digging.

- ❑ BEFORE YOU DIG, CONFIRM UTILITIES HAVE BEEN LOCATED

IF UTILITY DAMAGE OCCURS:

- ❑ CALL THE UTILITY FROM A SAFE LOCATION AS SOON AS POSSIBLE.
- ❑ CLEAR AREA IF NECESSARY.
- ❑ EXTINGUISH ALL FIRE SOURCES; BE MINDFUL OF LOSS OF LIFE.
- ❑ NOTIFY EMERGENCY SERVICES (IF NECESSARY).
- ❑ NOTIFY SUPERVISOR.
- ❑ BE AVAILABLE ON OR NEAR THE SITE UNTIL REPAIR CREW ARRIVES.

MAJOR EQUIPMENT OPERATIONS

It is recommended that field operations that involve digger derricks or bucket trucks will NOT be performed with fewer than two crew persons on the job site.

HAVING A UTILITY LOCATE CLEARANCE DOESN'T NECESSARILY MEAN ALL DANGER HAS BEEN REMOVED.

Derrick operators must be aware of overhead lines to be certain the boom or its attachments remain the required distance away from the overhead lines.

ACRONYMS & DESCRIPTIONS

HMA - Hot Mix Asphalt
MSDS - Material Safety Data Sheets
PCC - Portland Cement Concrete
PMC - Pavement Marking Coordinator
TMA - Transportation Maintenance Agreement
Type H Sheeting - Prismatic High Intensity
Type F Sheeting - Prismatic High Intensity Fluorescent Sheeting

3-25-3 Field Inspections December 2024

PURPOSE

This subject was provided to provide guidance to traffic operations staff on quality control of pavement markings on the state system. The goal is to provide safe and efficient ways to spot check the statewide pavement marking program.

These guidelines are intended to provide a framework for checking pavement markings across the state for improvement programs and regionwide LETs.

SAFETY

All inspectors **shall** wear a high visibility safety vests during the day and high visibility safety vests and pants during nighttime hours. No out-of-vehicle inspections *should* be completed in inclement weather conditions. All vehicles **shall** be parked as far off the road as practical and be equip with lights on the top of the vehicle and hazards on when off the roadway. High ADT roadways 2 people is recommended to act as a spotter.

INSPECTION

Inspection will consist of durability or presence of the pavement marking as well as retroreflectivity of the pavement markings. The QA/QC form will be filled out including the date, inspection, route and segment collecting data on. The exact location of the reading *should* be:

- Easy to relocate (i.e., xx feet past intersection, house number, mile marker, etc.)
- Not at a high wear area (no turn lanes, driveways)

Readings must be taken on days when the roadway is dry, and temperatures are above 45F. ASTM E1710 (retro) and E1349 (color) will be followed.

DATA COLLECTION PROCESS

Step 1: Calibrate handheld meter in accordance with manufacturers' recommendations at the office.

Step 2: Record exact location following requirements above.

Step 3: All measurements **shall** be taken in the direction of travel. Centerline markings **shall** be taken in both directions.

Step 4: Take picture of each location.

Step 5: On all traffic lanes take 10 retroreflectivity readings every 25 feet or 2 readings per skip for 5 skips. Record findings.

Step 6: Record durability based on ASTM D913-15. Examples can be found here.

Step 7: Repeat Steps 2-6 approximately 3 miles down the road. If the meters are placed back in the box, please recalibrate before collecting readings.

Step 8: Repeat Steps 2-6 approximately 3 miles down the road. If the meters are placed back in the box, please recalibrate before collecting readings.

Step 9: Visually inspect roadway at highway speed. For mobile retroreflectivity routes only one county per route needs to be evaluated.

Step 10: Upload records to \BoxDrv\Box\DTSD\DTSD-BTO\Traffic\Marking\RegionwideLETS

WHEN TO COLLECT READINGS - REGIONWIDE LETS

Collect readings 2-3 weeks after crew has placed markings and before payment of invoices. Readings will be collected on 2 route per month per crew. Regions will be able to select which routes they want to collect data on. BTO can be asked to check color of the yellow marking if regions deem it necessary. Forms **shall** be saved as the project ID in this folder: \BoxDrv\Box\DTSD\DTSD-BTO\Traffic\Marking\RegionwideLETS

WHEN TO COLLECT READINGS – COUNTY WORK

Collect retro readings 2-3 weeks after crew has placed markings and before payment of invoices. Readings will be collected on 2 route per month per crew. Regions will be able to select which routes they want to collect data on. BTO can be asked to check color of the yellow marking if regions deem it necessary. If possible collect mil thickness of the markings on 2 routes per month. Forms **shall** be saved as the project ID in this folder: \BoxDrv\Box\DTSD\DTSD-BTO\Traffic\Marking\RegionwideLETS

WHEN TO COLLECT READINGS – IMPROVEMENT PROJECTS

Collect readings at least 2 weeks after crew has placed markings. Readings will be collected on 10 improvement projects per summer depending on weather and time of year. Temperatures must be higher than 45F. If possible, collect mil thickness of the markings. Regions will be able to select which projects they want to collect data on. Regions can also have a consultant collect this data using the regions or consultant's meters. Contractors' meters *should not* be used. BTO can be asked to check color of the yellow marking if regions deem it necessary. Forms **shall** be saved as the project ID in this folder: \BoxDrv\Box\DTSD\DTSD-BTO\Traffic\Marking\RegionwideLETS

RECALIBRATION

Recalibrations *should* be done every 5 years.

4-1-1 Traffic Signal Glossary

April 2025

This section offers terms and definitions used throughout Chapter 4. For other definitions, refer to WMUTCD Chapter 4A, Definition of Terms.

ACCESSIBLE PEDESTRIAN SIGNAL (APS): A device that communicates information about pedestrian timing in non-visual format such as audible tones, verbal messages, and/or vibrating surfaces.

ACTUATED CONTROLLER: A traffic signal controller that receives information from vehicle and/or pedestrian detectors and provides signal timing accordingly.

ADA: Americans with Disabilities Act (42 U.S.C. 12181).

ADAPTIVE MODE: A system operation that adjusts when phases start and end based on current traffic data as input by vehicle sensors within the network.

ANSI: American National Standards Institute.

ARTERIAL: A major urban roadway.

ASTM: The American Society for Testing and Materials.

AWG: American Wire Gauge. The standard measurement of wire size. It is based on the circular mil system. 1 mil equals .001 inch.

BACKPLATE: A strip of thin material extending outward parallel to the signal face on all sides of a signal housing to provide a suitable background for the signal indications.

BATTERY BACKUP: A battery-powered energy backup system capable of maintaining power for signal system operation. These devices are encouraged to be placed at railroad interconnected systems, single point urban interchanges and intersections with triple-left turn lanes.

CABLE: A group of separately insulated wires wrapped together.

CALL: A registration of a demand for right-of-way by traffic at a controller unit (NEMA). The call comes to the controller from a detector that is outputting an actuation.

CALLING DELAY: An adjustable feature used on a specific detector amplifier that does not issue an output until the detection zone has been occupied for a period.

CAPACITANCE: That property of a system of conductors and dielectrics which permits the storage of electricity separated charges when potential differences exist between the conductors. Its value is expressed as the ratio of an electric charge to a potential difference.

CHANNEL: Electronic circuitry which functions as a loop detector unit (NEMA).

CHANNELIZING ISLAND: Curbed or painted area outside the vehicular path that is provided to separate and direct traffic movement, which *may* also serve as a refuge for pedestrians.

CIRCUIT: A closed path followed by an electric current.

CONDUCTOR: A medium for transmitting electrical current. A conductor usually consists of copper or other materials.

CONDUIT: A raceway or tubing for protecting electrical wires or cables.

CONFLICTING PHASES: Two or more traffic phases which will cause interfering traffic movements if operated concurrently.

CONTROLLER: A device that controls the sequence and duration of indications displayed by traffic signals.

COORDINATION: The establishment of a definite timing relationship among adjacent traffic signals.

CYCLE: In a pretimed controller unit, a complete sequence of signal indication. In an actuated controller unit, a complete cycle is dependent on the presence of calls on all phases.

CYCLE LENGTH: The time period in seconds required for a complete cycle.

DEMAND: The need for service, e.g., the number of vehicles desiring to use a given segment of roadway during a specified unit of time.

DENSITY: A measure of the concentration of vehicles, stated as the number of vehicles per mile per lane.

DESIGN SPEED: The speed used as typical by the designer of the detector/controller scheme in their kinematic analysis of the scheme under free traffic flow conditions (typically 85% speeds).

DESIGN VEHICLE: The longest vehicle permitted by the State on that roadway. Refer to FDM 11-25 for further guidance.

DETECTION: The process used to identify the presence or passage of a vehicle at a specific point or to identify the presence of one or more vehicles in a specific area.

DETECTION ZONE: That area of the roadway within which a vehicle will be detected by a vehicle detector (NEMA). Also called "ZONE OF DETECTION" or "SENSING ZONE."

DETECTOR: A device for indicating the presence or passage of vehicles or pedestrians (NEMA). This general term is usually supplemented with a modifier indicating type (e.g., loop detector, magnetic detector, etc.), operation (e.g., point detector, presence detector, etc.), or function (e.g., calling detector, extension detector, etc.).

DETECTOR DISCONNECT: A controller function which when used allows detection to be ignored by the controller during a specific phase.

DETECTOR FAILURES: The occurrence of detector malfunctions, including non-operation, chattering, or other intermittently erroneous counting.

DETECTOR SYSTEM: The complete sensing and indicating group consisting of the detector unit, transmission lines (lead-ins), and sensor.

DETECTOR UNIT: The portion of a detector system other than the sensor and lead-in, consisting of an electronics assembly.

DILEMMA ZONE: A distance or time interval related to the onset of the yellow interval. Originally the term was used to describe that portion of the roadway in advance of the intersection within which a driver can neither stop prior to the stop line nor clear the intersection before conflicting traffic is released. That usage pertained to insufficient length of timing of the yellow and/or all red intervals. More recently the term has been used also to describe that portion of the roadway in advance of the intersection within which a driver is indecisive regarding stopping or clearing, although the signal timing is long enough to permit either. That portion of the roadway in advance of the intersection within which a driver is indecisive regarding stopping prior to the stop line or proceeding into or through the intersection. *May* also be expressed as the increment of time corresponding to the dilemma zone distance.

DILEMMA-ZONE PROTECTION: Any method of attempting to control the end of the green interval so that no vehicle will be in the dilemma zone when the signal turns yellow.

EMERGENCY VEHICLE PREEMPTION (EVP): The transfer of the normal control of signals to a special control mode for emergency vehicles.

EXTENDED CALL DETECTOR: A detector with carryover output. It holds or stretches the call of a vehicle for a period of seconds that has been set on an adjustable timer incorporated into the detector. It can be designed to begin the timing of that period when the vehicle enters the detection area, or when it leaves. See STRETCH DETECTOR.

EXTENSION DETECTOR: A detector that is arranged to register actuations at the controller only during the green interval for that approach to extend the green time of the actuating vehicles (NEMA).

EXTENSION STRETCH: Feature used in detector operations which *may* add green time to the current phase allowing a vehicle to pass from a point of detection to some other position.

FDM: *Facilities Development Manual*, published by The Wisconsin Department of Transportation.

FREQUENCY: The number of times an alternating current repeats its cycle in 1 second.

GAP: The time interval between the end of one vehicle actuation and the beginning of the next actuation.

GAP OUT: Terminating of green due to an excessive time interval between the actuations of vehicles arriving on the green, so green *may* be served to a competing phase.

GREEN EXTENSION SYSTEM: Hardware assembly of extended call detectors and auxiliary logic. The logic can monitor the signal display, enable, or disable the selected extended call detectors, and hold the controller in artery green.

HEADWAY: The time (in seconds) between two successive vehicles as they pass a point on the roadway, measured from the same common feature of both vehicles (e.g., the front axle or the front bumper)

HSIP: Highway Safety Improvement Program

HOLD: A command to the controller which causes it to retain the existing right-of-way.

INDUCTANCE: That property of an electric circuit or of two neighboring circuits whereby an electromotive force is generated in one circuit by a change of current or in the other. The ratio of the electromotive force to the rate of change of the current.

INITIAL INTERVAL: The first timed interval actuated controller unit:

1. Fixed Initial Interval - A preset initial interval that does not change. (See MINIMUM GREEN INTERVAL)
2. Added Initial Interval – An increment of time in response to each vehicle actuation during red that extends the green. Added initial times concurrently with the minimum green.
3. Maximum Initial Interval - The limit of the added or computed initial.

INTERCONNECT: The communication network usually consisting of electrical or fiber optic cable connecting the system master with local intersection controllers and intersection controllers to networks.

INTERVAL: A discrete portion of the signal cycle during which the signal indications remain unchanged.

JUNCTION BOX: A container that is typically placed within bridge parapets and on wingwalls with a removable cover. Splices between cabling is located here.

LEAD-IN CABLE: The electrical cable which serves to connect the loop detector wire to the input of the loop detector unit (NEMA). Sometimes called "home-run" cable or transmission line.

LOCAL CONTROLLER: A controller supervising the operating of traffic signals at a single intersection.

LOOP DETECTOR: A detector that senses a change in inductance of its inductive loop caused by the passage or presence of a vehicle near the sensor (NEMA).

LOOP DETECTOR WIRE: Wire used for the inductive loop detector and lead-in (between loop and pull box).

LOOP-LEAD WIRE: The portion of the loop wire that is not a part of the loop but is in the conduit or saw slot connecting the loop to the edge of the roadway, where is it carried in conduit to the controller or to a pull box and connected to the lead-in cable.

LOS: Level of service per Highway Capacity Manual.

LUMINAIRE: A complete lighting unit consisting of a lamp or lamps together with the parts designed to distribute the light, to position and protect the lamps and to connect the lamps to the power supply.

MAST ARM: A structural support extending over the roadway from a pole, for supporting signal heads.

MASTER (PRIMARY): A control device for supervising a system of secondary controllers, maintaining definite time interrelationships, and/or accomplishing other supervisory functions.

MEMORY:

a. Locking Memory: A controller memory mode used to trigger a call for service with the first actuation received by the controller during the red (or yellow) interval. Typically, only used when there is no stop-bar detection.
b. Non-Locking Memory: A mode of actuated-controller unit operation which does not require memory (NEMA). In this mode of operation, the call of a vehicle arriving on the red (or yellow) is forgotten or dropped by the controller as soon as the vehicle leaves the detection area.

MINIMUM GREEN INTERVAL: The shortest green time of a phase. If a time setting control is designed as "minimum green," the green time **shall not** be less than that setting.

NEMA: The National Electrical Manufacturers Association.

OVERLAP: An overlap is a set of outputs associated with two or more phase combinations. In some instances, right-turn movements operating in exclusive lanes can be assigned to more than one phase that is not conflicting. The overlap forms a separate movement that derives its operation from its assigned phases (also called parent phases).

PASSAGE TIME: A phase timer that ends a phase when the time from the last detector output to the controller exceeds the timer setting.

PEDESTRIAN COUNTDOWN TIMER: A dynamic display that supplements standard pedestrian signal indications within the same section. The display is used to indicate the time remaining during the pedestrian clearance interval.

PEDESTRIAN DETECTOR: A detector that is responsive to operation by or the presence of a pedestrian (NEMA). This traditionally has been of the push-button type, installed near the roadway and operated by hand.

PEDESTRIAN PHASE: A traffic phase allocated to pedestrian traffic which *may* provide a right-of-way indication either concurrently with one or more vehicular phases, or to the exclusion of all vehicular phases.

PHASE: A part of the cycle allocated to any traffic movements receiving the right-of-way or to any combination of traffic movements receiving the right-of-way simultaneously during one or more intervals.

PHASE SEQUENCE: The order in which a controller cycles through all phases.

POINT DETECTION: The detection of a vehicle as it passes a point or spot on a street or highway.

PORKCHOP: A type of channelizing island that separates right turning traffic from through traffic on the same approach. (See CHANNELIZING ISLAND).

PREEMPTION: The term used when the normal signal sequence at an intersection is interrupted and/or altered in deference to a special situation such as the passage of a train, bridge opening, or the granting of the right-of-way to an emergency or mass transit vehicle.

PRESENCE DETECTION: The sensing of a vehicle passing over a detector. True presence is when the pulse duration is equal to the actual time the vehicle remains in the detector field of influence.

PRESENCE MODE: Detector output continues for a limited period if vehicles remain in field of influence (NEMA).

PROBE: The sensor form that is commonly used with a magnetometer-type (microloop) detector (NEMA).

PROGRESSION: Coordinated movement along an arterial at a given speed.

PULL BOX: A container, usually at least 1 cubic foot in size, that is placed underground with a removable cover flush with the ground surface. As an example, splices between lead-in cable and loop-lead wire are located here.

PULSE MODE: Detector produces a short output pulse when detection occurs (NEMA). The pulse lasts only about 100 ms, even if the vehicle remains in the detection zone for a longer time.

QUADRUPOLE: A loop configuration that adds a longitudinal saw slot along the center of the rectangle, so that the wire can be installed in a figure-eight pattern, thereby producing four electromagnetic poles instead of the normal two. The design improves the sensitivity to small vehicles and minimizes adjacent lane pick up.

QUEUE DETECTOR: Component of a traffic control system which senses the presence (or number) of vehicles waiting in a queue. Once the detector has reached a maximum time, or input is removed, the detector will no longer call the phase until corresponding green has been terminated.

QUEUE LENGTH: Number of vehicles that are stopped or slowly moving in a line where the movement of each vehicle is constrained by that of the lead vehicle.

RADAR DETECTOR: A vehicle detector installed above or adjacent to the roadway capable of being activated by the passage of a vehicle through its field of emitted microwave energy.

RECALL: A call is placed for a specified phase each time the controller is serving a conflicting phase. This ensures that the specified phase will be served again. Types of recalls include maximum, minimum, pedestrian, and soft.

RED CLEARANCE INTERVAL: The period of time following a yellow change interval, indicating the end of a phase and allowing additional time before the beginning of conflicting traffic.

SENSITIVITY: As it relates to a loop system the change in total inductance of a system caused by a vehicle at one loop, expressed as a percentage of the total inductance. As it relates to a detector, is the minimum inductance change in percent required at the input terminals to cause the detector to actuate.

SPI: Single Point Interchange; Turning movements are arranged around a single point with fewer conflict points. This allows for safer and smoother traffic movement with more efficient signal timing.

SPLIT: The time assigned to a phase during coordinated operations. *May* be expressed in seconds or as a percentage.

SPLIT PHASE: The assignment of the right-of-way to all movements of an approach, followed by all the movements of the opposing approach.

SYSTEM DETECTOR: Detector located to provide information to central control computers selecting appropriate control programs to meet the traffic demands.

TRAFFIC DETECTOR: A device by which vehicles, streetcars, trolley buses, or pedestrians are enabled to register their presence with a traffic-actuated controller (Institute of Transportation Engineers, ITE).

TRAFFIC PHASE: A timing unit associated with the control of one or more movements. Phases are often assigned to vehicular and pedestrian movements.

TRAFFIC RESPONSIVE MODE: A system operation wherein the selection of signal timing programs is based on current traffic data as input by vehicle sensors within the network.

TURNS: Used to describe the placement of loop wire around a detector. One turn is equivalent to one complete revolution around the loop

TWISTED PAIR: Two insulated conductors twisted together and coded.

VARIABLE INITIAL INTERVAL: An interval that times concurrently with the minimum green interval and increases by each vehicle actuation received during the initial period. This time cannot exceed the maximum variable initial.

VEHICULAR PHASE: A traffic phase allocated to vehicular traffic.

VIDEO DETECTION SYSTEM: A detection system which analyzes a video image of an approach and identifies and classifies (optional) vehicles in that approach.

WEC: *Wisconsin Electrical Code*, published by the Wisconsin Electrical Manufacturers Association. This manual consists of a supplement to the *National Electrical Code* (NEC), and the Wisconsin supplement.

WMUTCD: *Wisconsin Manual on Uniform Traffic Control Devices*, published by the Wisconsin Department of Transportation.

YELLOW CHANGE INTERVAL: An indication warning users that the green, flashing yellow, or flashing red indication has ended, and the red indication will begin.

ZONE OF DETECTION (SENSING ZONE): That area of the roadway within which a vehicle is detected by a vehicle detector system (NEMA).

4-1-2 Alternatives to Signals — April 2025

The decision to install a traffic signal at an intersection resides in the Regional traffic unit and **shall** be made based on an intersection control evaluation (ICE) study at that location. The warrants stated in the WMUTCD *should* be viewed as guidelines to help the traffic engineering staff decide whether a traffic signal *may* be installed, not as a legal requirement for their installation. The decision to install a traffic signal is not based solely on the satisfaction of warrants; rather, it is also based on the need for operational improvements at the intersection.

As with all traffic control device analysis procedures, the adequate trial of less restrictive remedies *should* be undertaken, prior to the installation of a traffic signal. If these remedies fail to reduce the crash frequency and/or improve operations at the intersection, a warrant analysis **shall** be completed. Such less restrictive improvements *may* cost less and *may* result in less overall delay than the installation of a traffic signal. These improvements include but are not limited to:

- Addition of exclusive right or left turn lane(s)
- Intersection lighting
- Improvement to pavement markings (left turn arrows, stop lines, etc.)
- Acceleration/deceleration lanes
- Channelization to eliminate certain movements (access restrictions)
- Sight distance improvements
- All-way STOP control
- Installation of rumble strips on STOP sign controlled approaches

- Improved signing (doubling up STOP AHEAD signs, larger STOP signs or route markers)
- Hazard beacons
- Roundabouts
- Grade separations
- Geometric improvements
- Demand management (control of trip arrival times)
- Signal timing changes at nearby intersections

4-1-3 Signal Development Process April 2025

The signal development process is outlined below.

STATE MAINTAINED HIGHWAYS

Intersection Control Evaluation (ICE)

- ❑ Need for an ICE study identified or Local Agency/Constituent contacts region traffic unit to request signal
- ❑ Regional Traffic Unit notifies constituent on procedure, eligibility, agreements, etc.
- ❑ Regional Traffic Unit or consultant preparation of ICE study as detailed in FDM 11-25-3.
- ❑ Formal submittal to Regional Traffic Unit (if study is prepared by consultant)
- ❑ Regional Traffic Unit review (if study is prepared by consultant) and recommendation
- ❑ Central Office review and approval of ICE study.
- ❑ If a signal is recommended through a completed ICE study, Regional Traffic Unit preparation of Central Office cover letter and two copies of Traffic Control Signal Approval Request Form DT 1199 to be submitted for BTO approval.

Project Definition Phase

- ❑ Region/consultant prepares capacity analysis, assess proposed/existing geometric considerations, cost estimations, etc.
- ❑ Coordinate with existing/future highway needs
- ❑ Coordination within other Regional functional areas and municipalities as needed.

Signal Design

- ❑ Region/consultant prepares signal plan
- ❑ Region/consultant prepares signal timing/system coordination
- ❑ Regional Traffic Unit performs plan reviews at the Design Study Review Meeting and Plans, Specification & Estimates (PS&E) Meeting approval prior to submitting to Central Office
- ❑ PS&E package (including signal plans) submitted to BTO

Traffic Impact Analysis (TIA)

- ❑ For signals that are proposed on a state maintained highway through a TIA, the TIA Guidelines Manual **shall** be followed.

CONNECTING HIGHWAYS

Intersection Control Evaluation (ICE)

- ❑ Need for an ICE study identified or Local Agency contacts Regional Traffic Unit to request signal
- ❑ Region notifies constituent on procedure, eligibility, agreements, etc.
- ❑ Local agency or consultant preparation of ICE study as detailed in FDM 11-25-3.
- ❑ Formal submittal to Regional office
- ❑ Regional review and recommendation
- ❑ Central Office review and approval of the ICE study.
- ❑ If signal recommended, Regional preparation of Central Office BTO cover letter and three copies of Traffic Control Signal Approval Request Form DT 1199 to be submitted for BTO approval.

Project Scoping Process

- ❑ Local agency/consultant prepares capacity analysis, assess proposed/existing geometric considerations, cost estimations, etc.
- ❑ Coordinate with existing/future highway needs
- ❑ Coordination within other Region functional areas and municipality.

Signal Design

- ❑ Local agency/consultant prepares signal plan
- ❑ Local agency/consultant prepares signal timing/system coordination
- ❑ Region *may* perform cursory plan review for WMUTCD compliance

- ❑ Plan approval by local maintaining agency
- ❑ PS&E package (including signal plans) submitted to Central Office DTSD

Traffic Impact Analysis

- ❑ Signals that are warranted by a TIA on a connecting highway are subject to the approval process outlined in the above signal investigation study section.

LOCAL SIGNALS

Signal Investigation Study

- ❑ No study required by the Department

Project Definition Phase

- ❑ Local agency/consultant prepares capacity analysis, assesses proposed/existing geometric considerations, cost estimations, etc.
- ❑ Coordinate with existing/future highway needs
- ❑ Coordination within other jurisdictions

Signal Design

- ❑ Local agency/consultant prepares signal plan
- ❑ Local agency/consultant prepares signal timing/system coordination
- ❑ If state administered project, Region *may* perform cursory plan review for WMUTCD compliance
- ❑ Plan approval by local maintaining agency
- ❑ PS&E package (including signal plans) submitted to Central Office DTSD

4-1-4 Funding — April 2025

Funding of a traffic signal installation typically is provided five ways:

- Improvement Program,
- Highway Safety Improvement Program (traffic signal items required to be incidental to construction, see PMM 04-01-01),
- Congestion, Mitigation & Air Quality (CMAQ) Program (generally only available in counties adjacent Lake Michigan, see PMM 02-20-01),
- Standalone ITS & Traffic Signals Program (Operations Allocation) funding,
- Permit Projects (TIA process -- non-State funded).

Contact the Regional Traffic Signal Engineer for appropriate funding mechanisms at specific locations.

4-2-1 Capacity Analysis April 2025

INTERSECTION CAPACITY ANALYSIS

In cases where the Signal Investigation Study indicates a traffic signal is warranted, the maintaining authority or its agents **shall** compute the capacity and level of service for the future signalized intersection during the peak hour periods for construction, as well as design or horizon year volumes. If no projection information is readily available, reasonable assumptions *should* be made to extrapolate turning movement volumes to the design/horizon year levels. It is typically assumed that traffic growth increases at a rate of 2 percent per year.

Capacity analysis *should* be based on actual turning movement volume counts and projected turning movement volumes. Only turning movement counts conducted within the previous three years *should* be used for capacity analysis. Refer to FDM 11-5-2 for information related to requesting traffic volume forecasts.

The purpose of the analysis is to determine proper intersection geometric design, and to begin to develop appropriate signal phasing and timing plans. If the signal is to be located on the STH system, an electronic version of the intersection capacity analysis **shall** be shared with the Regional Traffic Signal staff for review.

The analysis of the unsignalized vs. signalized intersection provides additional information for the review of the study, the design of the signal, and the need for possible geometric improvements. Signals that are a part of, or adjacent to, a coordinated system **shall** be studied as part of a systems analysis. In these cases, a traffic simulation model *may* also need to be developed, particularly when developing signal timing plans.

Computer software **shall** be used to determine the intersection capacity and using current versions of software as identified by FDM 11-05-03, section 3.7.

Capacity analyses that are performed for state-maintained signals **shall** be supplemented with a technical memorandum summarizing analysis results using existing and/or proposed geometrics and recommending preferred phasing and timing alternatives. The technical memorandum and capacity analysis **shall** be provided to Regional Traffic Signal Engineers in electronic and hard copy form.

BASIC PARAMETERS FOR CAPACITY ANALYSIS

GENERAL SIGNAL TIMING ANALYSIS PARAMETERS

Note: The Signal Timing Analysis Parameters below are recommended guidelines for general analysis of state-owned signals at typical at-grade intersections. For analysis that is conducted to determine actual design parameters (such as turn bay lengths) or for analysis of complex signals (such as at an interchange), contact the appropriate Region to check for additional regional guidance prior to submitting the analysis.

Minimum Green Values:

Mainline Through Phases (2 & 6) – 10 to 15 secs

Side Street Through Phases (4 & 8) – 7 to 10 secs

Mainline & Side Street Left Turn Phases (1,3,5,7) – 5 or 6 secs for single lanes, 8 secs for dual lanes.

Maximum Green Values:

Mainline Through Phases (2 & 6) – 35 to 70 secs

Side Street Through Phases (4 & 8) – 25 to 40 sec.

Note: At intersection of two STHs, on the lower volume STH a lower max time may be used.

Mainline & Side Street Left Turn Phases (1,3,5,7) – 15 to 35 sec.

Clearance Intervals:

Use ITE's kinematic formula for determining clearance intervals for signal installations on the STH system. Refer to TEOpS 4-7-5, Clearance Intervals.

Pedestrian Phase Times:

Walk Time – 7 sec.

Ped Clearance Time – [(Distance from curb to curb)/(3.5 ft/sec)].

Note: If it is known that Children or Elderly use the intersection, a walking speed of less than 3.5 ft/sec may be considered.

Ped Check – Walk Time + Ped Clearance Time ≥ the amount of time it takes for a person walking 3 ft/sec to cross from the pedestrian detector to the far side of the traveled way being crossed. Any additional time that is required to satisfy this condition *should* be added to the Walk Time.

Isolated Signal Cycle Lengths:

Typically Range from 60 secs – 120 sec.

Coordinated Signal Cycle Lengths:

Typically Range from 80 secs – 130 sec.

Interchanges:

Typically Range from 100 – 130 sec.

GENERAL SIGNAL ANALYSIS REVIEW PARAMETERS

1. PHF – Verify that the correct PHF is used.
2. % Heavy Vehicles – Verify that correct % Heavy Vehicles are used.
3. RTOR – Refer to TEOps 16-15-5.
4. Ideal Saturation Flow Rate – Ideal Saturation Flow Rate used for left-turn and through movements **shall** be 1900. If any other Ideal Saturation Flow Rate is used it must be supported by a study performed in a comparable location, with similar characteristics, and same geographical area.
5. Phasing –Verify that sequence of operation (phasing) is correct for existing conditions and that changes to existing phasing for future conditions are reasonable and *should* consider any necessary geometric changes. Split phasing on the mainline **shall** only be considered as last resort in extreme cases.
6. Geometric Design – Verify dimensions of turn bay lengths and that the existing/proposed lane configuration is appropriate and corresponds between field conditions, signal plan information and sequence of operations sheets.
7. Turning movement Volumes – Verify that the input volumes used in the analyses are correct.

9. Left Turn Requirements – Verify that under existing or future conditions that left turn movements are accounted for by signal phasing. A protected/permissive or protected only left turn phase **shall** be considered in accordance with the Left-turn Conflict Analysis.
10. Coordinated Signal System Analysis – When signals are in a coordinated system and pedestrian phases are present, verify that minimum green time given to through phase is enough time to cross pedestrians curb to curb unless pedestrian actuation is used.

4-2-2 Intersection Geometrics April 2025

BASIC GUIDELINES FOR INTERSECTION DESIGN

The following is a set of guidelines used by Regional Traffic Engineers for the review process of intersection geometrics submitted by Project Development and Consultants. These standards **shall** be followed when designing an intersection that *may* be signalized in the next 5 to 10 years or revising an existing signalized intersection. The guidelines contained in this chapter are a supplement to those found in the FDM 11-25.

The Regional Traffic Engineer *should* review the recommended queue length storage for left and right turns based on the capacity analysis. Intersection design *should not* be based solely on capacity analysis but also based on operation requirements. Additional considerations are listed below.

- When designing an intersection keep in mind that even if traffic signals are not an immediate design criteria, signals *may* be needed in the future.
- It is very important to include Traffic Operations personnel early in the scoping of a project. Volumes, storage, geometric, and R/W needs *should* be addressed. It can then be determined if further involvement of Traffic Operations is needed.
- Verify that the intersection design meets these criteria before R/W becomes an issue or is purchased.
- For proposed or reconstructed intersections, use desirable design criteria, not minimum. R/W restrictions are taken into consideration on modifications to existing intersections.
- Intersections *should* not be located on curves (horizontal or vertical). Experience has shown that motorists don't handle these situations well even if adequate sight distance is provided.
- Design of any signalized intersection **shall** consider applicability of heavy vehicles. All right turns and both opposing left turn movements *may* need to accommodate WB-67 vehicles. This includes two WB-67 vehicles making opposing left turns at the same time. Higher consideration for Oversized/Overweight vehicle turning movements *should* be given at locations within five miles along long-truck routes. Refer to FDM 11-25-2, Intersections at Grade – Design Criteria & Guidelines.
- Intersection geometrics **shall** be designed using turning templates. The intersection plan with turning template overlay **shall** be submitted to the Regional Traffic Unit for review.

Refer to FDM 11-25-1, *Intersections At Grade – General*

- Selection of Intersection Criteria
- Rural Intersections
- Urban Intersections

RIGHT-OF-WAY

Public right-of-way at STH intersections needs to accommodate design geometrics (for existing & future conditions), operations-related infrastructure, and adequate sight distance. All WisDOT maintained signal & electrical equipment **shall** be located within the public right-of-way. Such signal equipment typically includes cabinet bases, signal/lighting bases, vehicle detection, associated conductor runs, and *may* also include temporary signal support guy lines.

As a last resort when equipment cannot be located within the public right-of-way (i.e., far loops in mall entrances), it **shall** be necessary to have an established permitted limited easement (PLE) to access private lands before electrical staff can perform associated maintenance activities. Note: This could be problematic if it is necessary to install additional equipment or if repairs are time sensitive.

Consideration *should* also be given to future capacity expansion. Examples of this *may* include right- & left-turn lanes, widened medians, sidewalk, bike lanes, roundabouts or interchanges. Because of these issues, Regional Traffic Engineering staff **shall** be involved in identifying required right-of-way at signalized intersections early in the design process.

CORRIDOR CONSIDERATIONS

The design of an individual intersection will not only need to provide a safe environment with adequate capacity but will also need to reflect the needs of adjacent intersections and the corridor. As such, isolated intersection designs *may* need to include features not dictated by capacity alone. These features *should* be coherent with the overall facility, examples of which *may* include turn lanes, separation of turn lanes from adjacent through lanes, raised medians, islands, and separated bicycle facilities. Right-of-way *may* also need to be preserved for future corridor-based improvements.

The proximity of adjacent intersections to locations that are or *may* be signalized *should* be maintained at a minimum of 1200-ft. The distance to adjacent private driveways also need to be considered, especially as to how traffic along the corridor and at various access points interact.

Refer to FDM 11-30-1, Interchange – Design Elements regarding ramp terminal spacing and FDM 11-5-5, Access Control – Attachment 5.1 for access spacing guidelines.

DESIGN VEHICLE AND TRUCK TURNING

The design vehicle used to determine intersection geometrics at locations that *may* be signalized **shall** be at least a WB-62. If the area being designed is known to have WB-65 or WB-67s, that design vehicle *should* be used. Using the appropriate sized design vehicle has significant impacts on intersection operation and signal efficiency.

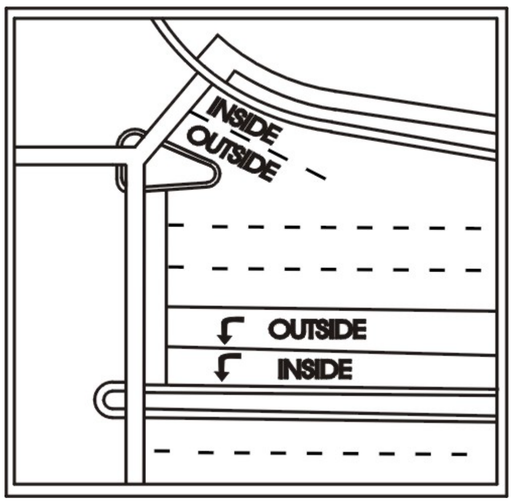
Movements *should* allow for the appropriate design vehicle~~s~~ to turn with a smooth continuous radius. Opposing left turns require a minimum of 3' clearance at the center of the intersection as they pass the opposing vehicle.

Dual lefts are typically designed for the truck (WB-62) using the outside lane a single unit using the lane. There *should* be a minimum of 3' between the vehicles as they turn with each other. Refer to Figure 2.1 for clarification on outside and inside lane terminology for dual left turn lanes.

Dual rights are designed for the truck (WB-62) using the outside lane and a single unit using the inside lane. There *should* be a minimum of 3' between the vehicles as they turn with each other.

Refer to FDM 11-25-2, *Intersections at Grade – Design Criteria & Guidelines*.

Figure 2.1. Outside and Inside Lanes for Left and Right dual turn lanes.

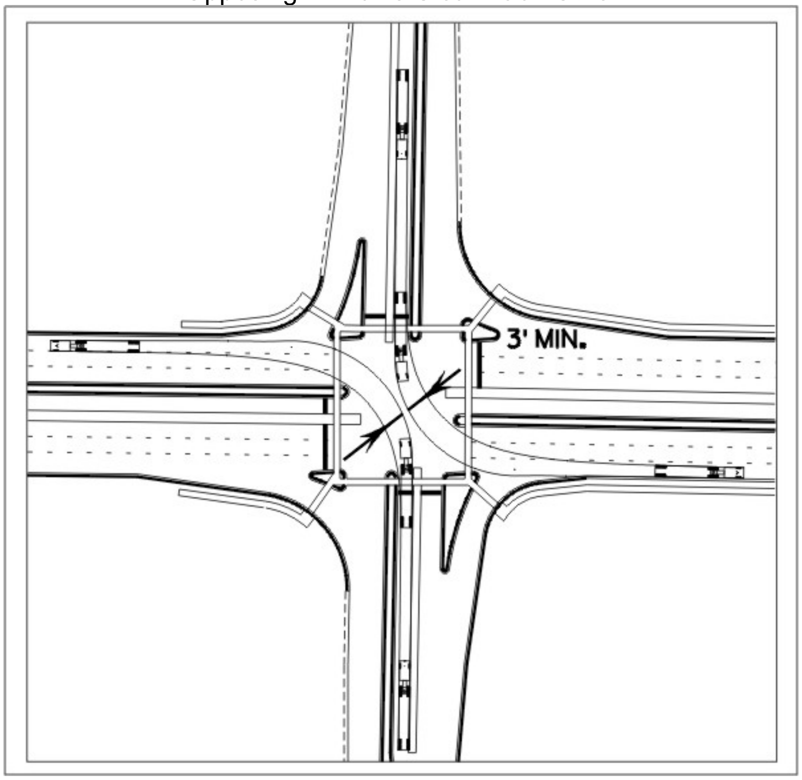


Left turning trucks *should not* encroach on the left turn lane for the approach that they are entering when making their left turn. Trucks need not be restricted to the nearest lane when making a turn. Trucks *may* encroach into other lanes on multiple lane roadways (not across the centerline for trucks making a right turn movement, in this case the stop line *may* be pulled back). Parking *may* need to be restricted at intersections to aid in truck turning movements.

Specific routes along the state-system have been established to accommodate either Over-sized/Over-weight (OSOW) and/or Over-height (OH) vehicles. Check with the Region Traffic Engineer to determine appropriate design requirements that *may* be needed for specific locations.

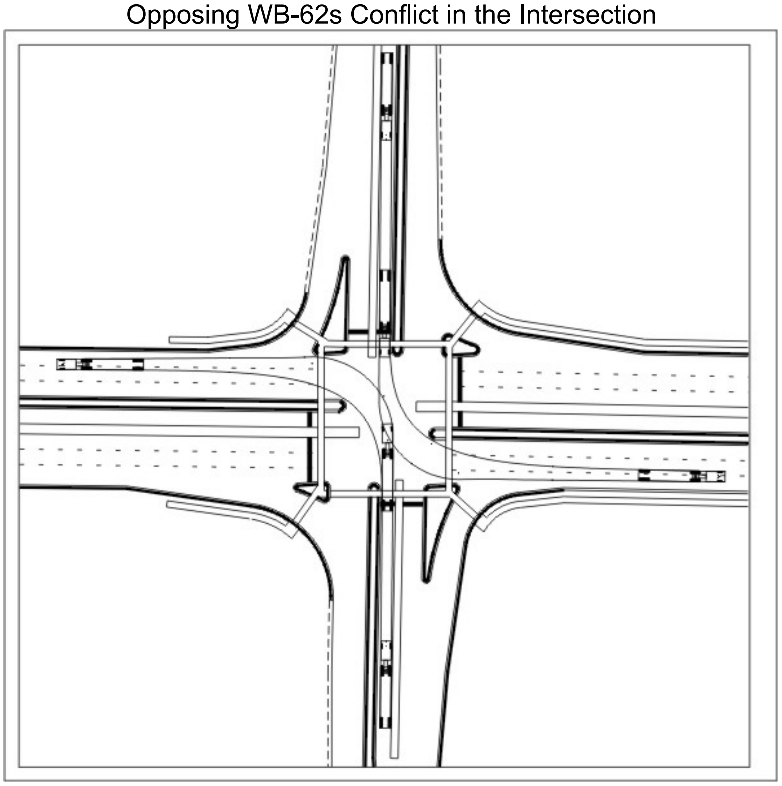
CORRECT

Opposing WB-62's Clear Each Other

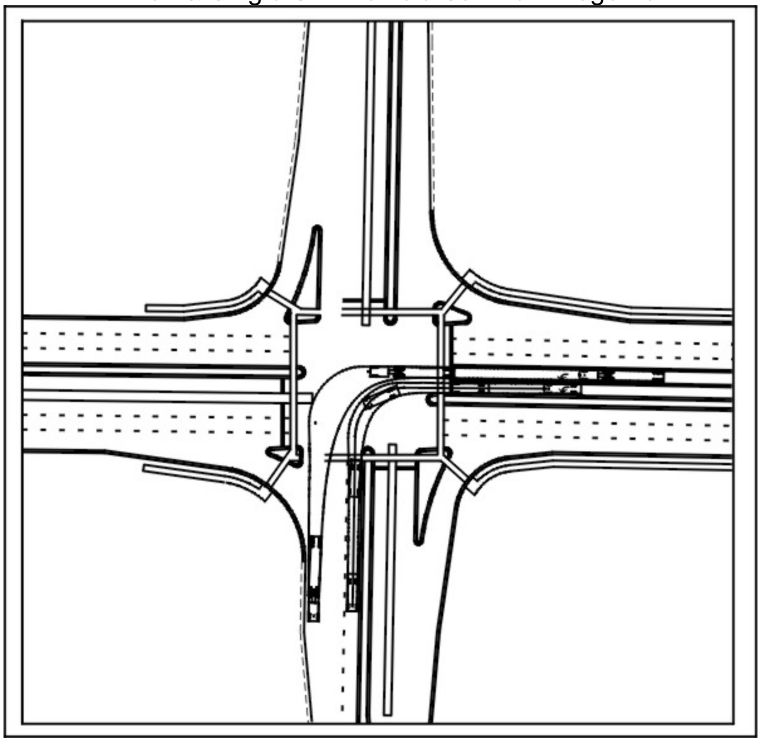


INCORRECT

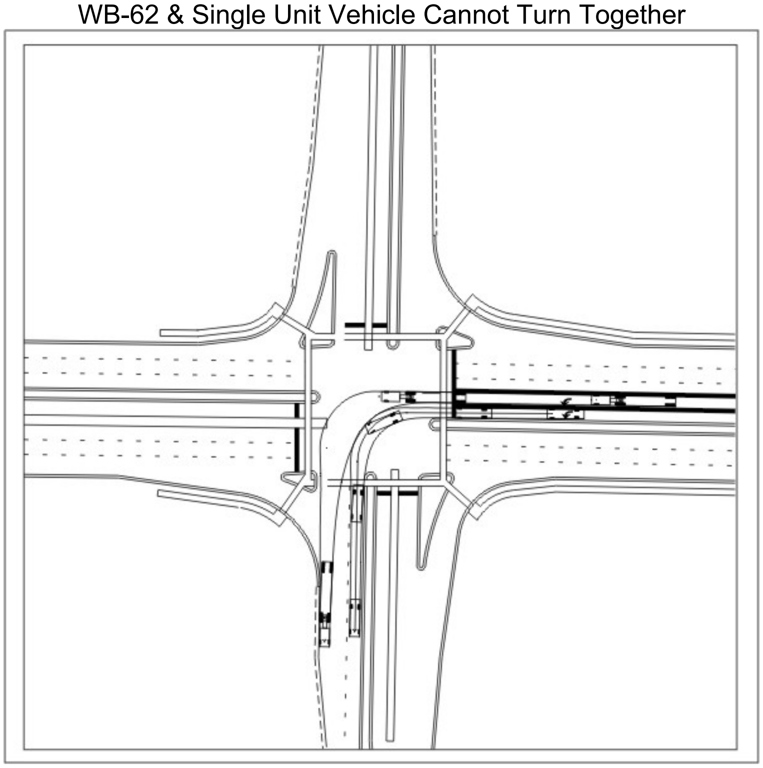
Opposing WB-62s Conflict in the Intersection



CORRECT
WB-62 & Single Unit Vehicle Can Turn Together



INCORRECT
WB-62 & Single Unit Vehicle Cannot Turn Together



LEFT TURN LANES

Refer to FDM 11-25-5, Intersections at Grade – Left Turn Lanes

The width of a left turn lane *should* desirably be the same as the width of the through lane. A left turn lane width of 12 feet *should* be used on rural and suburban arterial highways.

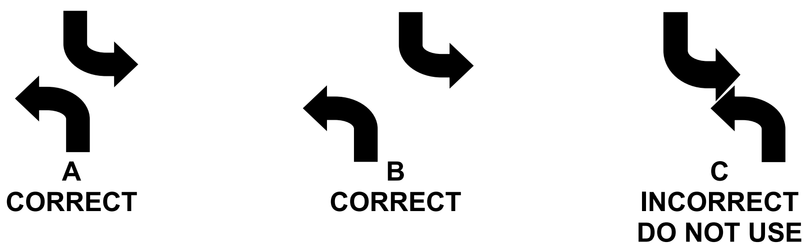
With the general exception of interchange ramp terminals, it is desirable to separate left turn lanes from the adjacent through movement at intersections on the STH system. Separation *may* be accomplished by the following different ways:

- Raised median including slotted left turn lanes
- Pavement Marking
- Corrugated median (generally not desirable)

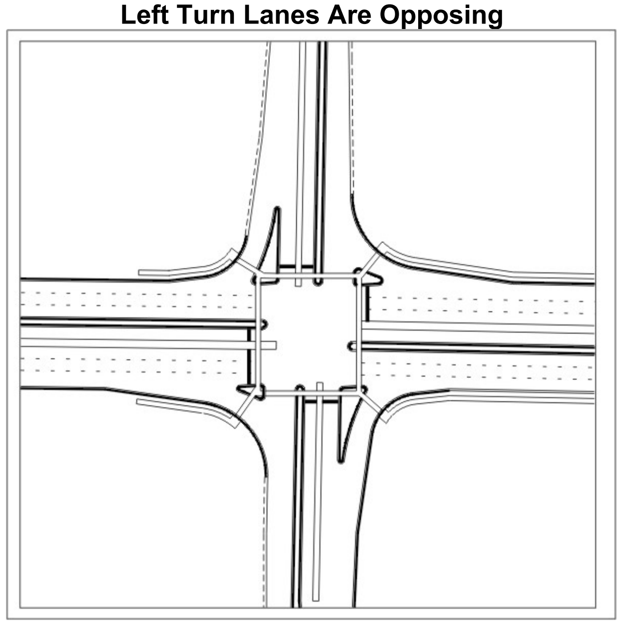
The Regional Traffic Engineer **shall** be consulted when selecting proper channelization methods.

The ideal alignment of left turn lanes is to have opposing left turns directly opposite (head-to-head) of each other (A) or to positively offset them as shown in (B). For visibility and safety reasons, the alignment shown in (C) *should not* be used.

- Alignment of left turn lanes is critical to enable turning vehicles to see past opposing left turners and view opposing through vehicles to allow them to pick an adequate gap to complete their maneuver.
- If there is poor alignment, Traffic Operations *may* be faced with prematurely adding protected left turn arrows for low volume left turn movements due to crashes that occur due to poor visibility. This will increase the delay at the intersection. See the Incorrect and Correct left turn design figures.
- It is sometimes advantageous to "hook" the ends of the left turn lane, which enables better sight around left turners in a "tight" intersection.



CORRECT
Left Turn Lanes Are Opposing



When designing dual left turn lanes, it is extremely important that opposing left turns complete their movements simultaneously. Dual left turn lanes do not need to be designed to accommodate two WB-62 vehicles, or larger, turning side by side since the chance of this occurring is quite remote, but rather a single unit vehicle in the inside turn lane and a truck (WB-62) in the outside turn lane.

1. Left turn lanes *should* be provided at signalized intersections wherever the turns are permitted.

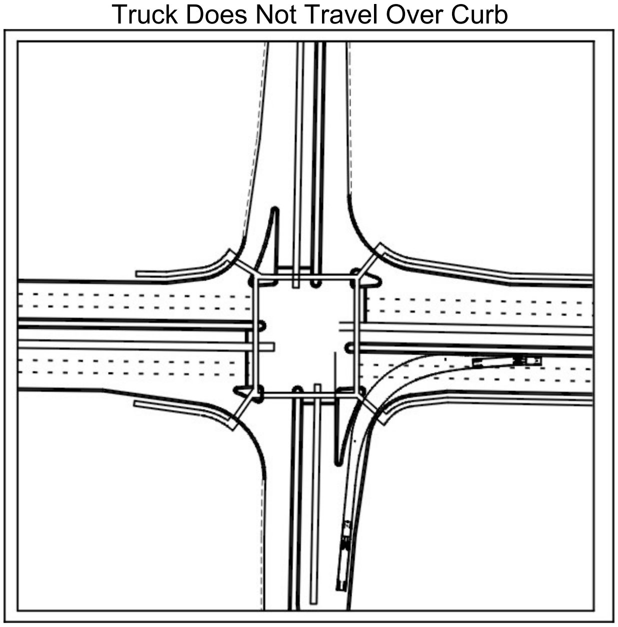
2. Shared left turn lanes are not desirable and *should* only be allowed along minor low-speed streets or where it is physically impossible to develop protected lanes. If allowed, their crash history *should* be monitored, especially along principal roads.
3. Dual left turn lanes are desirable and *should* be considered where left turn volumes exceed 300 vph (depends on opposing volumes). These lanes require sufficient width on the receiving roadway to accommodate design vehicles running side-by-side. The receiving roadway **shall** carry two through lanes a sufficient distance to allow both lanes to be utilized effectively (typically 1000 feet minimum).

RIGHT TURN LANES

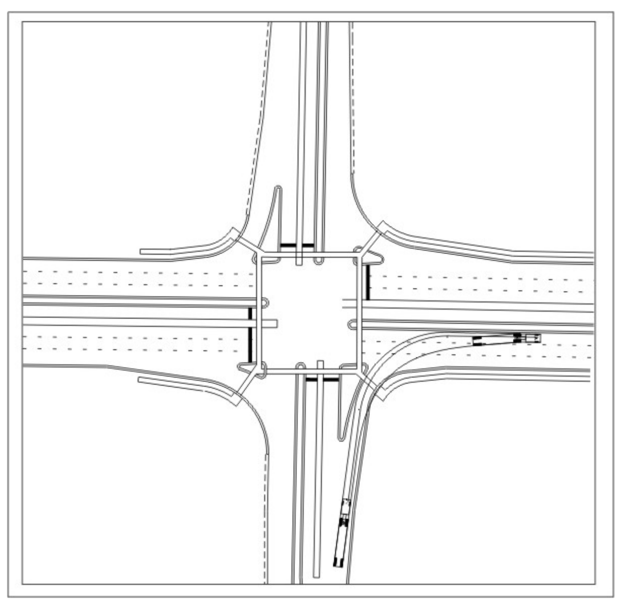
Refer to FDM 11-25-10, Intersection at Grade, Right Turn Lanes and FDM 11-25-15, Intersection at Grade, Turning Roadways (Channelized Right)

- Exclusive right turn lanes *should* always be considered on all approaches.
  - A right turn lane provides refuge for safe deceleration outside a high speed through lane and provides storage for right-turning vehicles to assist in optimizing traffic signal phasing.
- When the design of the radius is quite flat (i.e., > 70'), this creates a traffic signal design problem when locating the near right traffic signal. The preferred solution is to design a small pork chop island (minimum of 150 square feet) to place the traffic signal and lighting bases, pull box, pedestrian pushbuttons, pedestrian walkways, and to facilitate channelization of the right turn movement.
- Improperly designed right turn radii most likely will result in traffic signal knockdowns.
- For speeds more than 40 mph, the island *should* be offset 8-10 feet from the adjacent through lane.
- Consideration *should* be given for the type of controls to use for channelized right turns. Typically, it is preferred to use a least restrictive method and increase the degree of control as volumes, safety, and geometric conditions dictate.
- Channelized right turns *should* be brought in as near as perpendicular as possible for vision to the left.
- Adequate R/W width *should* be provided for future right turn lane expansion.

CORRECT
Truck Does Not Travel Over Curb



INCORRECT



MEDIANS AND ISLANDS

The desired minimum width for a median at a signalized intersection is 8 feet face to face, the absolute minimum width is 6 feet face to face. This width is required for signal and sign/structure placement, and pedestrian refuge. In addition, this minimum is wider than the wheelbase of a typical passenger vehicle and therefore if in an accident a vehicle traverses the median it *may* knock down the traffic signal standard but will not damage the bolts in the concrete base.

Right turn pork chop islands are typically needed for delineation, pedestrian refuge, and traffic signal placement at intersections with flat radii. This island *should* be no smaller than 150 square feet in area. It is inevitable revisions at a signalized intersection will need to be made at some point in the future. Therefore, the construction of islands is very important. Islands constructed as in Figure 2.2 are not desired because to install a pull box or base would require removal of 12”, + of concrete. The detail shown in Figure 2.3 is the preferred construction. Pork chop islands *should* be skewed to improve visibility for approaching vehicles.

Slotted left-turn islands *should* be set back for clarity of turning movement as shown in Figure 2.4.

Figure 2.2. Non-desirable island design

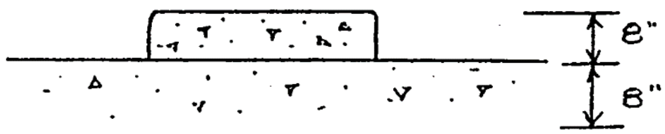
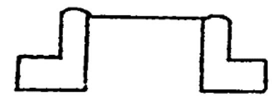


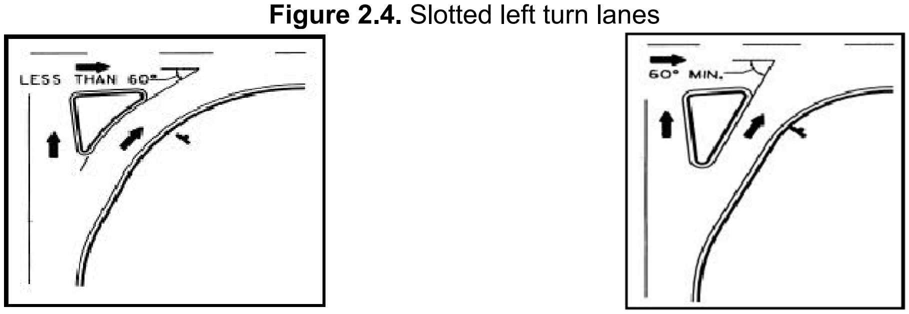
Figure 2.3. Desirable island design



Plowable noses *may* be an issue with pedestrian crossings. A cut-through *may* be necessary for pushbuttons to be pedestrian accessible. Coordination with design staff *should* take place to ensure proper placement of pedestrian crossing and signal bases.

Designers *should* be aware of the hazards that develop when right turn lanes separated by islands having intersecting angles less than 60 degrees with the cross street. These layouts require the driver to look back over their left shoulder to view oncoming traffic; this is particularly difficult for older drivers. Designers are encouraged to design all right turn islands in urban/suburban areas with the right-turn lane at an angle of 60 degrees or greater. 10:1 tapers on the approach to the right-turn lane *should* be used to allow the driver adequate time to decide and maneuver their vehicle in the direction of choice.

Figure 2.4. Slotted left turn lanes



Not Recommended Recommended

PEDESTRIANS

Intersections *should* be designed to accommodate pedestrian traffic whenever required. The surrounding area *should* be surveyed for schools, development which *may* lend towards pedestrian traffic, elderly housing, group homes, etc. to determine if pedestrian indications *should* be included. Pedestrian provisions need to include signal infrastructure design requirements and pushbutton placement that are ADA compliant. For more information on accessible design requirements refer to FDM 11-46-10, Curb Ramps or go to www.access-board.gov.

Traffic signal standards/poles *should* be located to accommodate the addition of pedestrian signals and pushbuttons in the future. To accomplish this the standards/poles must be located within 2 feet of the sidewalk and or crosswalk. Be sure the button is placed on the correct side of the pole.

It is recommended to place a pedestrian crossing on the right side of a T-intersection to prevent left turning vehicles from queuing due to pedestrians in the crosswalk. Refer to Figure 2.5 for typical layouts of crosswalks at a signalized intersection.

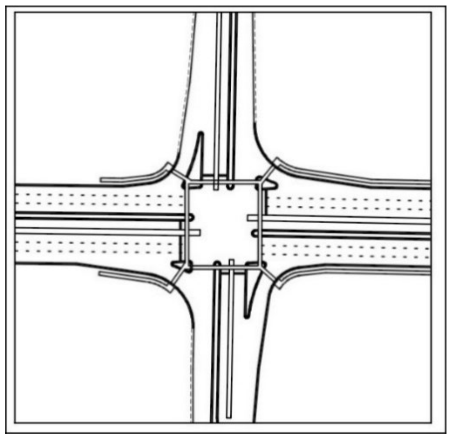
If there is no channelized right turn, the preferred design incorporates Type 2 curb ramps. These are particularly desirable in locations where visually impaired pedestrians *may* use the intersection. A Type 2 curb ramp will properly align pedestrians with the correct crosswalks whereas a Type 1 curb ramp will orient the pedestrian into the middle of the intersection.

If there is a channelized right turn, the preferred curb ramp design incorporates a Type 1 curb ramp that will direct pedestrians to the channelizing island (porkchop). Pedestrians *should* then be directed to cross the mainline or side street accordingly. This method implies that the channelizing island (porkchop) is large enough (150 ft^2 minimum) to accommodate space for pedestrians/bicycle cut-throughs, pull boxes, signal bases, and curb ramps.

Crossing pedestrians to a channelizing island, as described above has several advantages:

1. It reduces pedestrian crossing time,
2. It reduces the number of conflicting traffic turning maneuvers that pedestrians will need to negotiate,
3. This design will typically accommodate larger design vehicles and heavy turning movements with less intersection delay.

Figure 2.5. Typical crosswalk placement at a signalized intersection



ADJACENT ACCESS/INTERSECTIONS

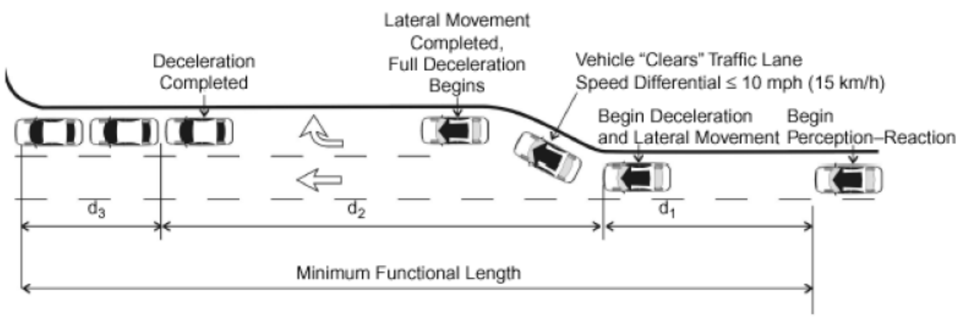
Access points located immediately near any intersection are generally problematic. Typically, vehicle turning movements at the intersection and the adjacent access further complicates driver decision making. This effect *may* cause safety problems. At a minimum, close access will affect operations.

Consideration *should* be given to the impacts of access points located immediately near signalized intersections. It *may* be necessary to close, move or restrict driveways so overall safety and operations can be effectively maintained at acceptable levels. The functional area of the intersection, as described below, *should* be considered relative to adjacent access. Typically, this functional area *should* include areas that experience routine queuing. Median openings in the intersection functional area *should* be avoided. According to FHWA's "Signalized Intersections: Informational Guide," (2nd Ed, 2013), the functional area has four parameters for which it is defined:

- Distance *d1*: Distance traveled during perception-reaction time as a driver approaches the intersection, assuming 1.5 seconds for urban and suburban conditions and 2.5 seconds for rural conditions.
- Distance *d2*: Deceleration distance while the driver maneuvers to a stop upstream of the intersection.
- Distance *d3*: Queue storage at the intersection.
- Distance immediately downstream of the intersection so that a driver can completely clear the intersection before needing to react to something downstream (stopping sight distance is often used for this).

Figure 3.6 illustrates the functional area distances. Refer to [FDM 11-25-1, Intersections At Grade] for additional information for determining the intersection distances for WisDOT projects.

Figure 2.6. Elements of upstream functional intersection area



The Regional Access Management Coordinator *should* be consulted prior to making changes to access points. Guidance regarding access management concepts *may* be found in the *Traffic Impact Analysis (TIA) Guidelines Manual, Highway Access Management Reference Guide*, Administrative Rules Trans 233 and Trans 231, *State Highway Maintenance Manual* Chapter 91, *FDM* Chapters 7 and 11, TRB *Access Management Manua*l, and NCHRP Report 348 *Access Management Guidelines for Activity Centers*.

Detection for signalized intersections *should* be placed such that vehicles entering or exiting adjacent driveways do not activate loops and subsequently interfere with signal operations.

FUTURE TRAFFIC SIGNALS

The Regional Traffic Unit needs to be involved during the scoping of a project. The installation of traffic signals as part of an improvement project can have an impact on the amount of right-of-way needed to accommodate signal equipment. Geometric configurations *may* be driven by the need for lane requirements, medians, islands, etc.

All intersections within project limits **shall** be evaluated to determine if traffic signals are warranted and *should* be included with the project.

If traffic signals are not currently warranted, it *may* be feasible to install conduit and pull boxes for future use. Factors that *may* or *may not* support installation of underground features are the timeline for future geometric changes, how close the intersection is to meeting warrants, and known future developments.

The installation of underground conduit systems *should* be considered when:

- It is apparent that signals will someday be located prior to the next project on a roadway.
- Project timing and location is appropriate.
- Post improvement project installation will not readily accommodate future installation (i.e., breaker run roadway base, conduit crossing structures, etc.).
- Impacts to adjacent land use and/or underground utilities necessitate the early placement of an underground system.

RIGHT TURN CONTROL

Right turn control at signalized intersections *should* be studied very thoroughly considering such factors as the volume of right turning vehicles, queue length, number of pedestrians, turn radii, cross street geometrics, channelizing islands, vehicular speeds, etc. Typically, it is preferred to use a less restrictive method and increase the degree of control as volumes, safety, number of pedestrians, and geometric conditions dictate.

<u>FREE FLOW (No control)</u>

- Right turn lane **shall** be channelized. The higher the right turn speed, the larger the channelizing island.
- The receiving approach **shall** have a designated traffic lane (acceleration lane) to be used exclusively for the right turning vehicles. It is recommended to extend the channelizing island to separate the right turn acceleration lane from the adjacent through lanes.
- Use only when no to very low volume of pedestrians crossing the right turn movement.
- Requires larger amount of right of way and is typically used in rural areas where continuous flow is preferred.

<u>YIELD CONTROL</u>

- Right turn lane **shall** be channelized.
- Channelized right turns *should* be brought in as near as perpendicular as possible for vision to the left.
- Recommended when no to very low volume of pedestrians crossing the right turn movement.
- Typically, is the preferred control type, unless more control is required.

<u>STOP CONTROL</u>

- Right turn lane **shall** be channelized.
- Channelized right turns **shall** be brought in as near as perpendicular as possible for vision to the left.
- Periodic enforcement *may* be needed to ensure drivers are obeying the stop sign.

SIGNAL CONTROL

Unchannelized right turn only lanes

- No channelizing island (porkchop). This layout is not the most desirable if there is a significant volume of conflicting pedestrians.
- Generally, a 3-section head (red, yellow and green ball) *should* be used.
- A 5-section head (red, yellow and green ball, yellow right arrow and green right arrow) configuration for the near and far right indications *may* be used, if considering the use of overlaps.
- The right turn arrow **shall not** be displayed at the same time as a conflicting pedestrian interval.
- Right turn FYA *may* be used with engineering judgement.

Channelized right turn lanes

- Per the WMUTCD, two signal faces **shall** be installed.
- A 3-section head configuration (red ball, yellow right arrow, and green right arrow) *should* be used when there is an opposing protected left turn.
- A 5-section head (yellow right arrow and green right arrow) *may* be used when there is an opposing permissive left turn.
- For control of dual right-turn movements, refer to State Statute 346.37(1)(c)3 regarding right turn on red from left most right-turn lane.
- In cases of multiple right turn lanes, "NO TURN ON RED" signing *may* be required at the discretion of the Regional Traffic Engineer. Red right arrows *may* only be used in conjunction with the "NO TURN ON RED" sign.
- Pedestrian crossings *should* be designed to direct the pedestrians from the radius to the channelizing islands (porkchops) and not to the median. This will allow for the possibility of utilizing a right turn overlap situation.

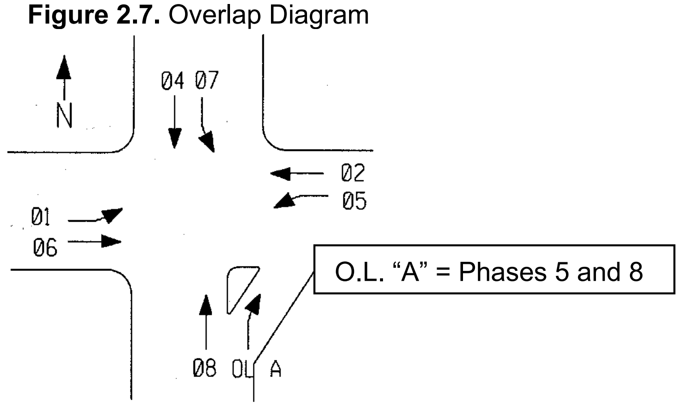
For geometric guidance for right turn lanes, refer to FDM 11-25-10, Right Turn Lanes.

VEHICLE OVERLAPS

An overlap is a vehicle movement that operates with more than one parent phase. Overlap movements will display a green when the phase to which the overlap is initially assigned within the cycle is green. Clearance (yellow and red) timings for the overlap signal indications are determined by the last parent phase of the overlap within the cycle. For example, if an overlap is assigned to phases 2 and 3, its green will begin timing with phase 2. The overlap will continue and then terminate with phase 3 yellow and all-red clearance intervals.

To distinguish from the basic vehicle and pedestrian phases, overlaps are designated alphabetically by letters (i.e., A, B, C, etc.). The overlap chart is located on the Sequence of Operations Sheet. The overlap *should* only be shown if it contains two (2) or more phases. The chart *should* indicate which phases the overlap times concurrently.

Figure 2.7. Overlap Diagram



In the example above, overlap "A" is a right-turn movement operating in conjunction with the complementary left turn movement (Phase 5) and will also operate with the adjacent through movement (Phase 8). Under this scenario, time given to the right turn overlap is governed by the associated left turn demand or the adjacent through movement depending on which phase is operating, not the right turn demand.

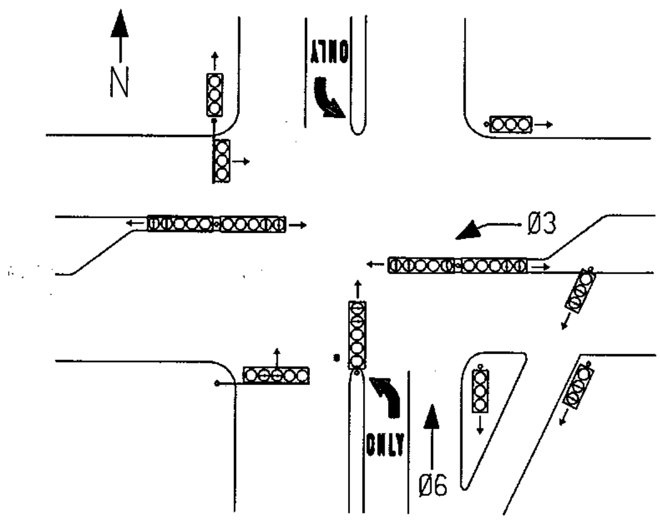
Figure 2.8. Overlap Chart

O.L. “A” =	O.L. “E” =
O.L. “B” =	O.L. “F” =
O.L. “C” =	O.L. “G” =
O.L. “D” =	O.L. “H” =

Geometrics

Right turn overlaps are best utilized at locations where there is an exclusive right turn lane, a complementary left turn lane and a left turn phase on the crossing street. Refer to figures 2.9 and 2.10 below for examples of typical signal head layouts with overlaps.

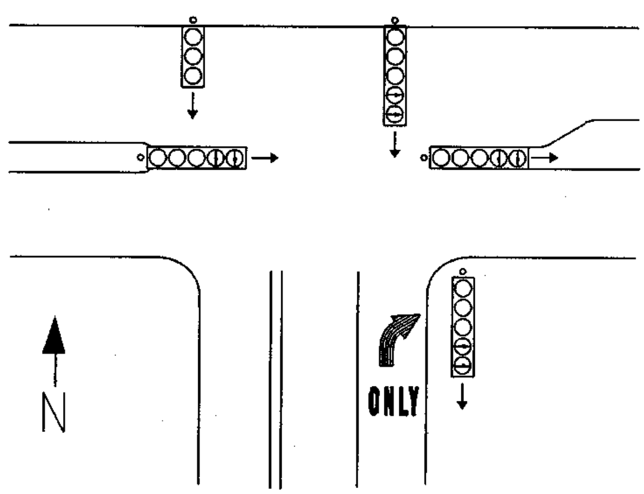
Figure 2.9. Right Turn Overlap with 3-Section Heads



NOTE: Signal heads only shown for EB/WB/SB left-turns and NB right-turn indications.
5-section heads are normally not recommended on right-turn bypasses, and may be dependent on opposing left-turn volumes. See Regional Traffic Engineer for guidance.
•If no median, then the signal head should be placed in far-left channelizing island.

The use of a protected only versus a permissive left turn for the southbound left turn movement (Phase 5) is dependent on receiving approach geometrics and intersection turning movement volumes. The Regional Traffic Signal Engineer **shall** be consulted.

Figure 2.10. Right Turn Overlap at T-intersection



NOTE: Signal heads only shown for EB/WB left-turns and NB right-turn indications

For information about flashing yellow arrow overlaps, see TEOpS 4-7-1.

Interchanges

At interchanges, overlaps are commonly used in conjunction with the ramp phases and the through phases between the ramps when one controller is used.

Figure 2.11. Single Controller – Dual Ring

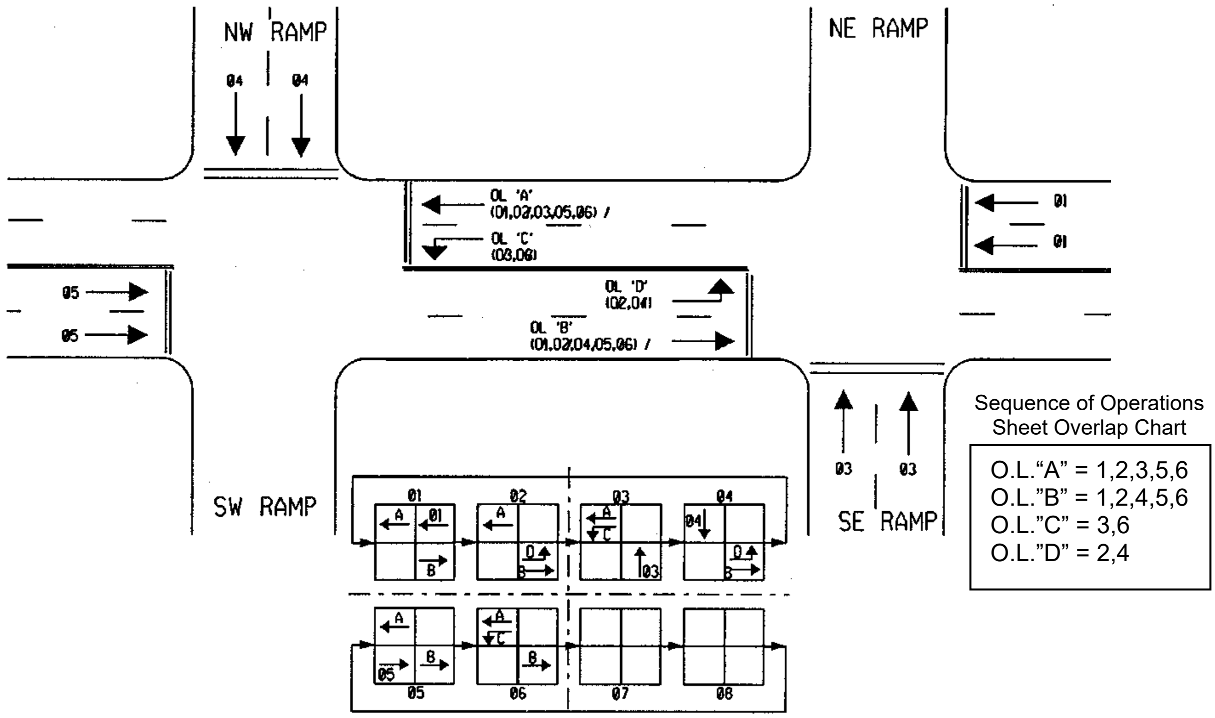
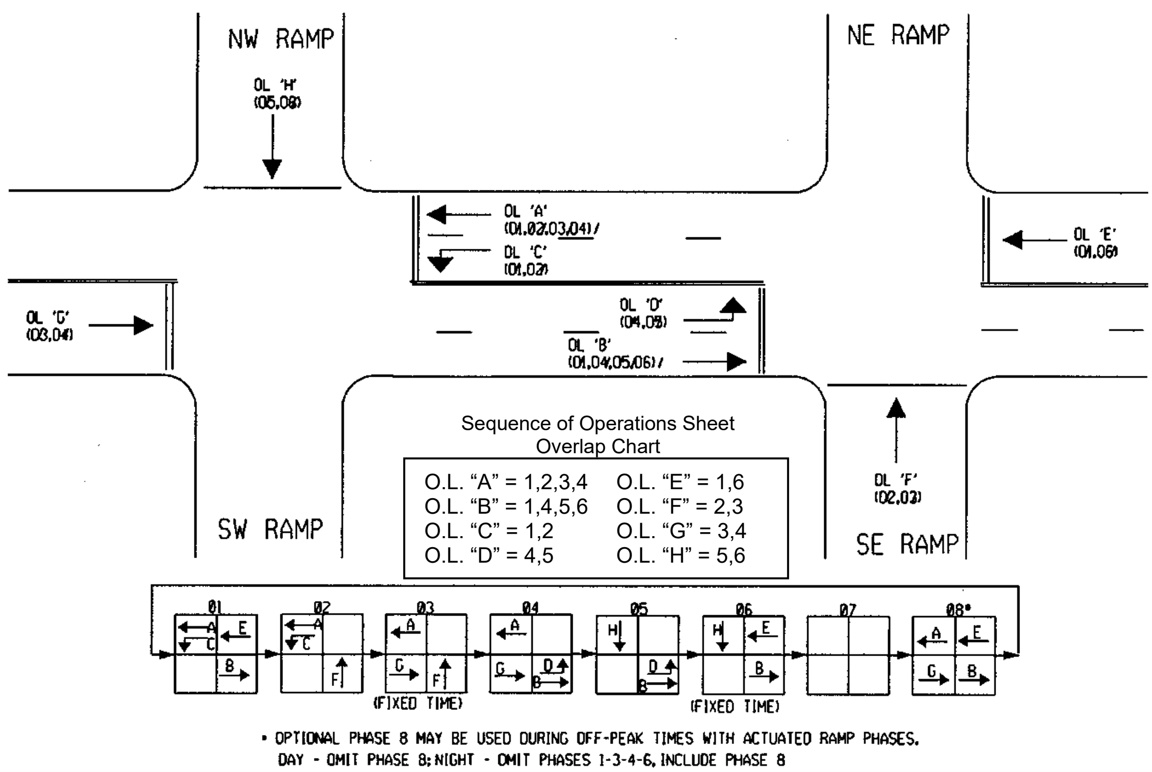


Figure 2.12. TTI Lead – Sequential Interchange



Pedestrian Considerations

In areas where pedestrian demands are high, particularly in central business districts, school crossings, or locations associated with special events, the use of right turn overlaps *should* be carefully evaluated with respect to pedestrian safety.

RESTRICTED LOCATIONS

When justified by a traffic engineering study, traffic control signals provide benefits to intersection traffic operations and *may* provide some types of safety improvements as well. While certain benefits can be realized, there *may* be potential trade-offs caused by the installation of traffic control signals including increased delay and reduced mobility on the major approaches, as well as an increase of rear-end type crashes at an intersection.

POLICY

Traffic control signals at isolated, single-source, private access points **shall not** be allowed on the STH system for the following reasons:

1. Signals at isolated, private access points disregard the public interest and investment in STH highway facilities.
2. Private access points are limited to a width of 35 feet (per Trans 231). This width *may* not be great enough to accommodate the geometry required for adequate signalized intersection operations.
3. Signal infrastructure (i.e., detection, signal bases, pull boxes, conduit) *may* need to be installed outside of the public right-of-way.

In lieu of installing traffic signals on the STH system at private access points, other alternatives *may* include:

1. Development of adjacent local street systems to concentrate traffic from other generators and/or direct traffic to intersections that are already controlled by traffic signals or roundabouts,
2. Implementation of access restrictions (i.e., right-in/right-out or median modifications), or
3. Use of standard side-street stop control.

Private access point intersections that are aligned with public street connections are not the focus of this policy and are generally not considered to conflict with the points made above. However, in these cases, it is desirable to locate signal infrastructure within public right-of-way.

The limited number of traffic control signals installed at private access points on the STH system prior to the adoption of this policy will continue to be operated by WisDOT until they are removed, replaced by other forms of intersection traffic control, or jurisdictionally transferred to local government agencies.

SUPPORT

In addition to a traffic engineering study that is performed to justify signal installations at a specific location, other factors *should* be considered. System and access issues also need to be considered when deciding whether signals are appropriate. Examples of these issues are indicated below:

1. Type of facility being proposed for signalization (i.e., it is generally not desirable to signalize expressways or high-speed bypasses around communities)
2. Signal spacing for progressive traffic flow along a corridor
3. Treatment of consolidated access points
4. Connectivity of the access point to the local roads network
5. Relative safety implications
6. Signal maintenance and operation implications.

Other guidance in this topic area *may* be found in the Traffic Impact Analysis (TIA) Guidelines Manual, Highway Access Management Reference Guide, Administrative Rules Trans 233 and Trans 231, State Highway Maintenance Manual Chapter 91, Facilities Development Manual Chapters 7 and 11, TRB Access Management Manual, and NCHRP Report 348 Access management Guidelines for Activity Centers.

If signals are to be installed at public street connections that are aligned with private access points, from a systems perspective, it *may* be desirable to have a portion, or all the private drive dedicated as a public street. There are several reasons for this:

- Provides system consistency for connectivity to local network
- Allows for access control on the subject approach, near the signalized intersection
- Signal infrastructure placement and signal maintenance considerations
- Will allow for greater control of features that *may* reduce sight distance (such as on-premises signing or landscaping)
- *May* provide greater design flexibility for intersection capacity.

When driveways are dedicated as public streets to meet the objectives of effective access and signal systems management, local agreements that are designed to cover or share the additional operations and maintenance costs for the additional infrastructure, *should* be considered.

TEMPORARY SIGNALS

Temporary traffic signals are typically installed for traffic control, when an existing signalized intersection is partially or totally reconstructed, as part of construction staging, detours, diversions or as part of a bridge rehabilitation project. Consult with the regional traffic section as to the type of temporary signal installation (partial or full) that *may* be needed for the project. The Regional Traffic Unit **shall** make the final decision regarding the installation, design, and operation of temporary traffic control signals.

The type of temporary signal installation is based on how much of the project work impacts the signalized intersection. The temporary signal could be as minor as overhead cable drops to the existing signal poles or standards or a complete overhead span wire signal head installation. When the signal heads are span wire mounted, the road work *may* require the signal heads to be moved on the plans for the different stages. If the scope of the project includes several stages, the temporary signal plan **shall** show the placement of the span wire signal heads for the various construction stages including temporary pavement markings, temporary signing, and placement of any work zone traffic control devices.

Before the temporary signal plan is developed, a field site review *should* be conducted to determine constructability. Additionally, all utilities *should* be located by contacting Diggers Hotline. Any utilities that are not on Diggers **shall** require a call directly to that utility to get their facilities located.

- Conduct a site review after all the utilities have been located.
- Check for any overhead facilities such as fiber optic, telephone, cable TV, and electrical lines both primary and secondary voltages that could conflict with any signal poles, light poles, and temporary wood poles for the temporary traffic signal.
- Maintain span length less than 200 feet. If length exceeds 200 feet, an additional median wood pole is required.
- Consult the utility for their clear zone working clearances when working around their utilities.
- Place temporary signal wood poles free of overhead utility conflicts and free from any new utility installations that *may* be installed as part of the project. The proposed signal equipment **shall** also be taken into consideration so that temporary head remain visible throughout construction. Sufficient right-of-way (or temporary limited easements) must be available to install down guys, Temporary wood poles *should* be located away from the vehicular traffic or adequately protected from vehicle traffic.
- Determine the cabinet location during the site visit if the installation will be installed and maintained by WisDOT. Factors to consider for the cabinet location are the accessibility of the electrical service, good sight vision of the intersection from the cabinet, avoid low areas where the cabinet could be flooded, and located in an area to avoid being struck by vehicles.
- Provide for temporary lighting.
- Determine if coordinated signal operations need to be developed or maintained with adjacent signals. Typically, time-based coordination is used.

Temporary left turn phasing during construction needs to be considered and approved by the Regional Traffic Signal Unit prior to the project. Sight limitations and limited turning movements *may* require the use of split phasing or the use of protected left turn phases in place of a protected/permissive phase. Provide adequate turn lane storage and channelization during the project to avoid vehicles queuing into the adjacent thru lanes for turning movements. If appropriate turning accommodations cannot be made, consider restricting the turning movement at the intersection.

Temporary signals operated in the pretimed mode *should* consider time of day plans for efficient operations. Temporary signals *may* use non-intrusive vehicle detectors as staging allows. Typically providing detection for vehicles, pedestrians and emergency vehicles is constrained during construction. Detection can be accommodated and **shall** be discussed with the Regional Traffic Unit. Requirements *may* include:

- Show the type/placement of vehicular detection on the plan (temporary detection (video, microwave, radar)
- Provide adequate refuge for pedestrian storage.
- Provide unrestricted access to pedestrian push button detectors.
- Show the placement of the EVP detector heads on the temporary signal plan.
- Show the EVP operation on the temporary signal sequence sheet.
- Refer to WMUTCD 6L.01, Temporary Traffic Control Signals.

The temporary signal plan set will include construction staging plan, temporary pavement marking and signing plan, temporary timing plan, placement of work zone traffic control devices (barrel or wands), a temporary signal plan, and a sequence of operation sheet for the temporary signal.

Section 661 of the *State of Wisconsin Standard Specifications for Highway and Structure Construction* and SDD 9g1 sheets a through g (Span Wire Temporary Traffic Signal) provide additional information about temporary traffic signal installations. These specifications define:

- Equipment to be furnished for temporary signals,
- Electrical service requirements, and
- Required working clearance is 17 to 19 feet for the signal heads and lower tether wire above the roadway.

The Regional Traffic Signal Unit **shall** determine the need for signal controller cabinets of full or partial temporary signal.

- Full temporary signals typically require the use of a separate (contractor furnished) traffic signal cabinet and/or controller, remote communications and non-intrusive detection during the construction project. The use of a temporary control cabinet allows for a safe transition from the temporary signal operation to the permanent signal operation.
- Partial temporary signals *may* use existing controller cabinets if state maintained during construction.

Responsibility for developing temporary signal timing plans *should* be clearly established. For temporary signals within WisDOT jurisdiction, the Regional Traffic Unit will develop temporary signal timing plans. If the timing plan is consultant developed, the Regional Traffic Signal Unit **shall** review and accept the plan.

INTERCHANGES

<u>Selection of interchange signal operations</u>

A common question relating to the design of signals at diamond interchange ramp terminals is whether to use one or two controllers. There *may* be advantages or disadvantages to either alternative. This subject presents typical applications and some of the differences between these alternatives.

When deciding how many controllers and what type of phasing *should* be used, consider the following general factors: required flexibility in signal operation/timing plan, physical interchange size, nature/volume of ramp traffic, mainline coordination with adjacent signals, vehicle storage requirements, and motorist expectancy. In any case, the Regional Traffic Engineer **shall** make the final determination regarding the type of operation at signalized interchanges.

Table 2.1 indicates some of the advantages and disadvantages of various interchange operations discussed below.

<u>SINGLE CONTROLLER INTERCHANGE APPLICATIONS</u>

Single controllers are typically used at interchanges with tightly spaced ramp terminals (less than 500 ft) where vehicle storage *may* be an issue. Signals at interchange ramps that use a single controller will generally use the following types of phasing options:

- <u>TTI phasing</u> is commonly used at interchanges with relatively consistent, heavy ramp volumes. When this type of phasing is used, right-of-way is assigned to a single mainline approach which is followed up with the ramp on the same side of the interchange. Next, right-of-way is assigned to the opposing mainline approach which is then followed up with the ramp movement on that side of the interchange. Put differently, the mainline approaches (followed up by their “complimentary” ramp movement) are alternated.

Vehicles will store on the outside of the ramp terminals; this will eliminate queuing on the roadway between the ramps. Phasing is appropriate for tightly spaced interchanges. It is advantageous because mainline movements will only be stopped once in the interchange area, due to leading protected left turn phasing on the mainline approach of the interchange.

- Dual Ring with Overlaps phasing *may* be preferred over TTI Phasing particularly if ramp volumes are more variable or unbalanced. External mainline movements are assigned to phases 1 and 5. Ramp movements are assigned to phases 3 and 4. Internal mainline through and left turn movements are assigned to overlaps within phases 1 through 6. Like a standard four-legged intersection, any non-conflicting phases that have demand can be serviced simultaneously. Also, within these phases multiple movements that have been assigned to overlaps can be serviced.

  Ramp spacing *should* be great enough to accommodate queuing between ramp terminals. As such, a queue analysis *should* be performed.

- Simultaneous Ramp Release *may* be either leading or lagging relative to the mainline through movements. With this type of phasing, traffic on opposing ramps are released at the same time and stored within the interchange. Next opposing interior through and left turn movements are released. This interval is followed by opposing exterior mainline through movements. Exterior mainline through vehicles that want to access the freeway by turning left at the opposite ramp terminal will also need to store within the interchange while the opposing through movement times out concurrently. This *may* necessitate multiple stops within the same interchange.

  This phasing requires that ramp spacing be great enough to accommodate queuing of the ramp traffic between terminals. As such, this phasing will not typically be appropriate for interchanges with tightly spaced ramp terminals and moderate to heavy ramp traffic. Even locations with relatively light ramp volumes would need to be analyzed carefully. As with the Dual Ring phasing alternative above, a queue analysis *should* be performed.

Splice Cabinets at Single Controller Interchanges

When a single controller is used to operate both terminals, a splice cabinet *may* be located on the opposite side of the interchange at the discretion of the Regional Traffic Engineer. A splice cabinet is a controller cabinet shell that houses the consolidated signal cable conductors from the separate indications for each phase. Once wiring splices have been made in the splicing cabinet, then a multi-conductor signal cable is run back to the controller cabinet on the opposite side of the interchange. Otherwise, a single conductor per indication type and per phase is required to run back to the controller cabinet for each of these phases. Installing a splice cabinet allows electrical personnel to pull only one cable instead of many.

The splice cabinet *should* be placed in a location where electrical service is accessible. This will allow for placement of a full signal control cabinet in the future, if necessary.

TWO CONTROLLER INTERCHANGE APPLICATIONS

In some situations, it *may* be more appropriate to use a controller for each interchange ramp terminal. This type of arrangement will typically be applied at interchanges with ramp spacing greater than 500 ft. In large part, this is due to the long distances to far detection that *may* be on the opposite side of the interchange from the signal cabinet and the ability for those devices to function effectively.

The use of two controllers will likely necessitate the need for coordination. One advantage of dual controller interchange operation is that a conduit crossing the interchange *may* not be necessary unless interconnected coordination is desired.

In some cases, two controller arrangements have flexibility for interchange signal operations due to the opportunity to program offsets. However, they are more labor intensive, in terms of coordination, maintenance, and cost when compared to single controller arrangements.

It is essential that two controller interchanges are accurate and remain in step with each other for coordination purposes.

These concepts will apply to standard diamond interchanges or modified interchange configurations, such as Diverging Diamond Interchanges (DDI’s).

Table 2.1. General Signalized Interchange Alternative Considerations

Operation or Phasing	Key Factors	Advantages	Disadvantages
Single Controller Applications (ramp terminal spacing < 500 ft)			
TTI	Heavy, consistent volumes at isolated location or where there is a relatively high percentage of left turning movements.	▪ Eliminates queuing within the interchange ▪ Works well in areas of high-demand ▪ Relatively straight-forward, consistent operation -- one movement occupies the interchange at any time ▪ *May* require only one stop within the interchange	▪ *May* not provide ideal conditions for coordination with adjacent signals ▪ *May* impose higher delay on users during periods of low use ▪ Forces queue outside of interchange ramps ▪ Basically, a pre-timed operation
Dual Ring w/Overlaps	Desire to provide progression on the mainline with more variable/unbalanced ramp volumes.	▪ Can provide improved conditions for coordination with adjacent signals ▪ Ability to provide leading-lagging left-turn phasing ▪ Omits phases 2 & 6 and recalls phases 3 & 4 ▪ Efficient	▪ Inconsistent operation, (penalized ramps (phase 3) must stop)
Simultaneous Release	Desire to provide high throughput on the mainline. Lower left-turning ramp volumes.	▪ Provides improved conditions for coordination with adjacent signals	▪ Requires storage of left-turning ramp traffic within the interchange ▪ Left-turns off the mainline *may* be delayed due to phasing sequence
Single Point	High volume interchanges in a tight, urban environment	▪ Improved operation and safety due to fewer conflict points ▪ Controlled by a single signal	▪ Higher cost due to needing a larger bridge ▪ Large areas of pavement needed ▪ Not pedestrian friendly ▪ Difficult to clear snow
Two Controller Applications (ramp terminal spacing > 500 ft)			
Coordinated Ramps	Desire to provide progression on the mainline & need to provide maximum flexibility for future operational alternatives.	▪ Provides improved conditions for coordination with adjacent signals ▪ Can be made to mimic the phasing alternatives above. ▪ Provides greatest opportunity for operational flexibility	▪ Identifying & implementing maximized operational/timing plan using multiple controllers is more complex than using a single controller ▪ Both controllers must be coordinated ▪ Increased maintenance & capital ▪ *May* require additional detection

VEHICLE DETECTION

In the cases where a single controller is used, large ramp spacing can impact the effectiveness of inductance loops used for vehicle detectors.

To operate properly, the differential between the inductance of the loop *should* exceed that of the lead-in cable by a factor of 2:1. There are two ways to compensate for the increased spacing.

The first method is to decrease the physical distance between the detection amplifiers that reside in the controller cabinet and the far loops. At diamond interchanges, the preferred location for the controller cabinet is inside the interchange footprint and adjacent to either off-ramp. Placement adjacent to either off-ramp is acceptable if sight-distance from the controlled approach is not impeded.

The second method is to increase inductance within the loop relative to the lead-in cable. This is done by using a larger number of turns within the loop or increasing the loop size. In general, the maximum number of turns a loop can contain is six.

RAMP METERING CONSIDERATIONS

In highly urbanized locations, future or pending ramp metering capabilities *may* need to be considered. Additional capacity treatments *may* include extension of right- and left-turn lanes used to access metered on-ramps, and additional lanes (at appropriate length) on the ramp itself to store vehicles.

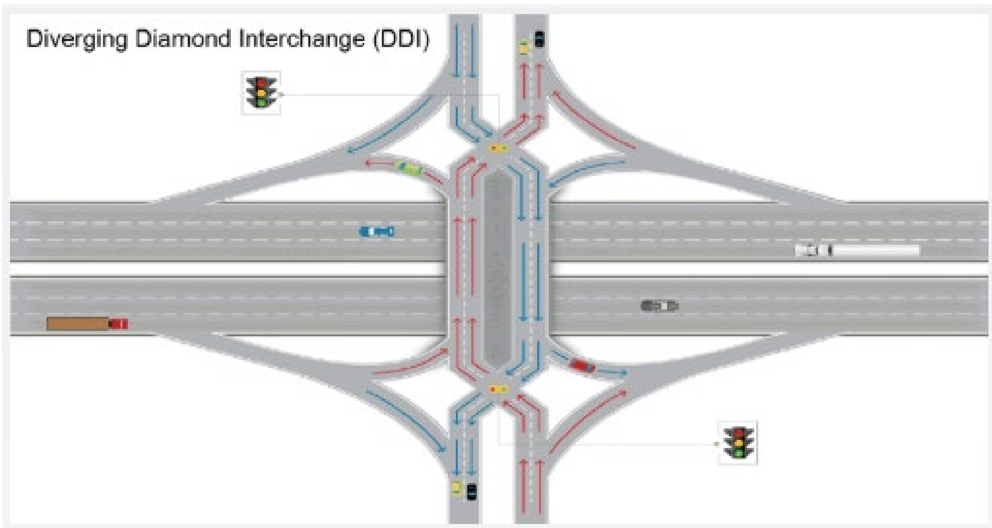
OTHER ELECTRICAL FACILITIES

Other facilities such as continuous roadway lighting or ITS elements (such as ramp meters and DMS), **shall** be contained within their own systems for maintenance and operational reasons.

ALTERNATIVE INTERCHANGE DESIGNS

Diverging Diamond Interchanges (DDI's) are a modified version of the standard diamond where vehicles entering the interchange, cross over to the opposite roadway through the interchange area. The advantage of this configuration is that ramp volumes are less impeded, similar to right-turn movements at standard intersections. Whether a DDI or stand diamond, the concepts discussed above regarding single- or dual controller operations, still apply. DDI's will typically use 2-phase operation.

Figure 2.13. Diverging Diamond Interchange



Single Point Interchanges (SPI's) consist of a distinct geometric design, such that all interchange movements converge at a single point within the interchange and left-turns phases are eliminated. SPI's are also a proper application for single controllers and will typically use 3-phase operation.

Figure 2.14. Single Point Interchanges

In the illustration on the right, vehicular movements served by individual phases are distinguished by color.

PEDESTRIAN APPLICATIONS/WARRANTS

Reference is made to the WMUTCD Sections 4C.05, 4C.06, 4D.03, and 4I.

The design and operation of traffic control signals **shall** take into consideration the needs of pedestrian as well as vehicular traffic. The decision to signalize pedestrian movements *should* be a collaborative decision between the regional signal engineer and the regional bicycle/pedestrian safety coordinator and *should* be based upon the warrants and other criteria provided hereafter.

POLICY

Sidewalk and curb ramps **shall** be provided at locations where pedestrian signal heads are to be installed.

Per WMUTCD 4I.01:

"Pedestrian signal heads **shall** be used in conjunction with vehicular traffic control signals under any of the following conditions:

A. If a traffic control signal is justified by an engineering study and meets either Warrant 4, Pedestrian Volume or Warrant 5, School Crossing (see WMUTCD 4C.05 and 4C.06);

B. If an exclusive signal phase is provided or made available for pedestrian movements in one or more directions, with all conflicting vehicular movements being stopped;

C. At an established school crossing at any signalized location; or

D. Where engineering judgment determines that multi-phase signal indications (as with split-phase timing) would tend to confuse or cause conflicts with pedestrians using a crosswalk guided only by vehicular signal indications."

"Pedestrian signal heads *should* be used in conjunction with vehicular traffic control signals under any of the following conditions:

A. If it is necessary to assist pedestrians in deciding when to begin crossing the roadway in the chosen direction or if engineering judgment determines that pedestrian signal heads are justified to minimize vehicle-pedestrian conflicts;

B. If pedestrians are permitted to cross a portion of a street, such as to or from a median of sufficient width for pedestrians to wait, during an interval but are not permitted to cross the remainder of the street during any part of the same interval; and/or

C. If no vehicular signal indications are visible to pedestrians, or if the vehicular signal indications that are visible to pedestrians starting a crossing provide insufficient guidance for them to decide when to begin crossing the roadway in the chosen direction, such as on one-way streets, at T-intersections, or at multi-phase signal operations."

In addition to the guidance provided above, there are a few other items to consider when deciding whether to install pedestrian signal indications:

1. Is a pedestrian with a visual disability requesting the accommodation? (It is WisDOT's policy to accommodate pedestrians with visual disabilities by installing pedestrian heads and APS devices, so long as the pedestrians with visual disabilities are the ones requesting it).
2. What is the land use adjacent to the intersection? Does the intersection serve as a connection between businesses? To a school? To a parking lot? To a transit/bus stop?

At locations where, pedestrian heads and push buttons are not initially installed, the designer *should* locate all signal poles with future pedestrian accommodations in mind. This way the intersection can be easily retrofitted with pedestrian heads and push buttons once the sidewalk and curb ramps have been installed.

SUPPORT

In Wisconsin, pedestrians can legally cross a roadway at a traffic signal even if that traffic signal does not have pedestrian signal heads.

Wisconsin State Statute 346.37 (1)(a)2: "Pedestrians, and persons who are riding bicycles or electric personal assistive mobility devices in a manner which is consistent with the safe use of the crosswalk by pedestrians, facing the (green) signal *may* proceed across the roadway within any marked or unmarked crosswalk."

Wisconsin State Statute 346.37 (1)(c)2: "No pedestrian, bicyclist, or rider of an electric personal assistive mobility device facing such signal (red) **shall** enter the roadway unless he or she can do so safely and without interfering with any vehicular traffic.

Also, Wisconsin State Statute 346.23 addresses motorists' responsibility at intersections relative to pedestrians:

(1) At an intersection or crosswalk where traffic is controlled by traffic control signals or by a traffic officer, the operator of a vehicle **shall** yield the right-of-way to a pedestrian, or to a person who is riding a bicycle or electric personal assistive mobility device in a manner which is consistent with the safe use of the crosswalk by pedestrians, who has started to cross the highway on a green or "Walk" signal and in all other cases pedestrians, bicyclists, and riders of electric personal assistive mobility devices **shall** yield the right-of-way to vehicles lawfully proceeding directly ahead on a green signal. No operator of a vehicle proceeding ahead on a green signal *may* begin a turn at a controlled intersection or crosswalk when a pedestrian, bicyclist, or rider of an electric personal assistive mobility device crossing in the crosswalk on a green or "Walk" signal would be endangered or interfered with in any way. The rules stated in this subsection are modified t intersections or crosswalks on divided highways or highways provided with safety zones in the manner and to the extent stated in sub. (2).

(2) At intersections or crosswalks on divided highways or highways provided with safety zones where traffic is controlled by traffic control signals or by a traffic officer, the operator of a vehicle **shall** yield the right-of-way to a pedestrian, bicyclist, or rider of an electric personal assistive mobility device who has started to cross the roadway either from the near curb or shoulder or from the center dividing strip or a safety zone with the green or "Walk" signal in the favor of the pedestrian, bicyclist, or rider of an electric personal assistive mobility device.

CONTROL FOR EMERGENCY VEHICLE ACCESS

Reference is made to the WMUTCD, Section 4F, and Wisconsin State Statute 346.455

POLICY

The following conditions describe various forms of traffic control associated with emergency vehicle access as well as general installation, design, and operational criteria.

Condition 1: Warning Device with No Traffic Control

Prescribed practice is to use the warning sign W11-8, Fire Station Truck, with or without a flashing beacon used to supplement the sign. Use of this type of warning is intended for use only at locations with restricted sight distances. If used with a flashing beacon, the beacon *should* be activated by a control in the firehouse for a preset period for the emergency vehicle to enter the highway.

An alternate method is to use a W11-8 at the emergency vehicle access with a yellow flashing beacon, and install an advance warning sign, W54-60, Fire Trucks (Emergency Vehicles) Enter when Signal Flashes.

On the state trunk highway system, signing will be furnished, installed, and maintained by the department. The municipality *may* have an option to install a flashing beacon subject to obtaining a permit from the regional office and accepting responsibility for operating and maintaining the beacon in accordance with the permit.

Condition 2: Emergency Vehicle Hybrid Beacons and Mid-Block Access

Under this condition, the emergency vehicle access is at mid-block and controlled by a hybrid beacon.

Application

Emergency vehicle hybrid beacons **shall not** be installed mid-block on two-lane roadways. In addition to guidance provided in the WMUTCD 4F, emergency vehicle hybrid beacons *may* be considered on multilane highways when the following volume criteria is met:

1. Traffic volume on the adjacent roadway exceeds 18,000 vehicles per day, or
2. Traffic volume on the adjacent roadway exceeds 1,800 vehicles during the peak hour of the day.

In addition to the volume criteria above, a specialized study **shall** be conducted by the agency requesting the beacons to demonstrate the need for control at emergency vehicle access points. Minimally, k=the study will consider adjacent roadway geometry (to include sight distance criteria), traffic volumes and characteristics, relative emergency vehicle exposure, and related vehicular conflicts (to include crash history). The study *should* also include a traffic capacity analysis to evaluate the effects of such an installation on the adjacent roadway. Such an installation *may* be denied if the study determines that a substantial, negative impact will be created by the installation of an emergency vehicle hybrid beacon.

Design and Operation

All design and operation requirements for an emergency vehicle hybrid beacon can be found in WMUTCD 4F.

Maintenance and Funding

Since emergency vehicle hybrid beacons are installed to serve a defined community, it is reasonable to assign maintenance responsibilities to the community being served. However, for installations outside connecting highway limits, communities *may not* have resources available to manage such systems. As such, this function will likely need to be fulfilled by WisDOT. In that case, an agreement with the community *may* be developed that will establish a means to reimburse WisDOT for any time and materials spent maintaining these installations. This agreement *may* address costs to install traffic control hybrid beacons as well.

Other Traffic Control Methods for Emergency Vehicle Access

Devices used to control traffic on the STH system, including connecting highways, at locations of emergency vehicle access are subject to Wisconsin State Statute 346.455, the WMUTCD, and this policy. Forms of traffic control outside of these standards are not permitted. Examples of this include using red flashing beacons with signs indicating “WHEN FLASHING – STOP FOR FIRE TRUCKS” or similar messages.

SUPPORT

Regardless of the reason traffic control devices are installed, they need to convey a purposeful, clear, and consistent message to motorists.

In addition to providing these types of devices on the STH system to promote safety, drivers of emergency vehicles *should* be properly trained regarding the proper operation of emergency vehicle hybrid beacons, and the concept that use of emergency vehicle hybrid beacons does not remove the responsibility of the vehicle operator from determining whether it is safe to enter the highway.

The local municipality **shall** be responsible for such training programs.

4-2-3 Other Considerations — April 2025

LOCAL COORDINATION

Coordination with Local Municipalities

When evaluating a location for traffic signal control, consideration *should* be given to the proximity of other types of intersection traffic control, including those in other jurisdictions. Despite ownership of traffic control devices, route continuity, intersection spacing, and traffic volumes *may* dictate the need to place signals in coordination if adjacent to other signals.

In the case of multi-jurisdictional coordinated systems, timing plans need to be developed collaboratively. Consideration *should* also be given to agreements that define roles of responsibility relative to maintenance of the system (i.e. interconnect demarcation for locates or repairs), and/or use of equipment that keeps signal controllers in step (i.e. GPS clocks).

More complex multi-jurisdictional systems, such as Traffic Responsive or Adaptive signal control, require central control of individual intersections. In this case, a Memorandum of Agreement (MOA) is strongly suggested to address jurisdictional authority, financial responsibilities (i.e. ongoing utility costs, sharing of software maintenance contracts), as well as operational and maintenance roles. In these cases, the Region Traffic Signal Engineer **shall** be contacted.

State-owned Equipment Located on Private Property

State-owned signal equipment **shall** be placed in public right-of-way. In the unusual case that equipment needs to be located on private property, a Permanent Limited Easement (PLE) is required to allow state personnel to routinely access this portion of the property for signal maintenance purposes and to install detection and other equipment. To establish a PLE, the Regional Real Estate Unit **shall** be contacted.

Specialty Equipment – Locally owned/maintained signals

Local municipalities/agencies *may* request decorative or ornamental signal equipment for poles, standards or mast arms. Cost of decorative or ornamental signal hardware **shall** be borne by the jurisdiction requesting the specialty items and is subject to standard project cost-sharing practices.

Specialty Equipment – State owned/maintained signals

Local municipalities/agencies *may* request standard signal equipment (i.e. poles, standards or mast arms) that have been manufacturer painted (or anodized) black. Requests **shall** be made in writing and submitted to the appropriate Region. The Region maintains discretion over the approval of such requests. If approved, the local municipality/agency **shall** sign an agreement with the state.

The specifics of this agreement are also at the discretion of the region and will cover items such as inventory management, delivery of spare equipment, and the billing of additional costs incurred outside of regular maintenance work back to the local municipality/agency. In addition, initial installation cost of black painted signal equipment **shall** be borne by the jurisdiction requesting the specialty items and is subject to standard project cost-sharing practices.

JURSIDICTIONAL TRANSFER CONSIDERATIONS

Signals and signal systems need to be considered when highways are transferred between agencies. The ownership of traffic signal installations *may* be jurisdictionally transferred several reasons:

- Jurisdictional transfer of a segment of highway due to a change to the route (i.e. bypass of a community),
- Establishing or changing the limits of connecting highway segment, or
- Reallocation to a specific agency for traffic management or operational benefits (i.e. establishing alternate routes during construction projects and/or coordinated systems).

Since many of the jurisdictional transfers/connecting highway changes take effect upon completion of a state let construction project which *may* include installation of new signals or rehab of existing signals, the transfer of any existing or new signal(s) *should* be a part of the highway jurisdictional process initiated by Regional Planning staff.

Regional Traffic and Planning staff, as well as the local municipality, *should* be involved in discussions relating to the details associated with the signal transfer. There are many key signal operation and maintenance issues to consider <u>early</u> in the highway jurisdictional process.

Ideally, the transfer of traffic signal installations will be addressed via the jurisdictional transfer agreement for the subject roadway. In some cases, the transfer agreements have been approved and signed by both agencies, however the actual transfer of the signal has been detained for several years after the transfer of the roadway due to various issues ranging from warranties to interconnect.

For any signal transfer it is important to remember that the utility costs *should* be transferred on the date the signal transfer is effective.

The lists of items below *should* be considered when jurisdictionally transferring signal installations between agencies. Items include, but are not limited to, the following:

<u>PROPOSED SIGNALS THAT WILL BE TRANSFERRED UPON COMPLETION OF INSTALLATION</u>

- Who is designing the signal (e.g. local municipality, consultant or DOT)?
- Will the signal be designed to DOT standards or to municipal standards?
- If designed to DOT standards, who will provide the signal equipment?
- Who will do the final electrical inspection and turn on the signal (i.e. DOT electricians, contractor or local municipality's electricians or contractor)?
- What conditions are to be met prior to the transfer to take place? Ideally, the signal will become jurisdiction of the local municipality upon signal turn on as opposed to completion and acceptance of the associated roadwork, which *may* occur several months after signal turn on.
- What agency (DOT, local municipality or consultant) will be responsible for initial signal timing required at turn on?
- Is signal in coordination with other state maintained or locally maintained signals? (If yes, see EXISTING OR PROPOSED COORDINATED SIGNALS)
- A key situation to address early, is if the signal(s) to be transferred operates in coordination with another agency's signal(s). In this case the following needs to be addressed, mutually agreed upon, and spelled out in the transfer agreement:
    - Type of coordination (TBC, closed loop, fiber, etc.)?
    - If multiple agencies will be involved, who will locate and maintain the interconnect conduit? Specific maintenance limits **shall** be defined in the agreement.
    - Who will review, update and pay for changes to timing to maintain or improve coordination?
    - Who will pay to change controllers in the future for compatibility reasons?
    - Who will respond to communication/network issues?

EXISTING SIGNALS THAT WILL BE TRANSFERRED

If an existing signal is being transferred, then the following issues need to be addressed, mutually agreed upon, and spelled out in the transfer agreement:

- Is the signal being transferred in “AS IS” condition, i.e. the signal equipment is in proper working condition or will upgrades be required?
- Condition/age of the existing controller?
- Coordination with other state maintained or locally maintained signals? (If yes, see EXISTING COORDINATED SIGNALS, above)
- What conditions *should* be met for the transfer to take place (e.g. inspection by local municipality)?
- Warranties **shall not** be used.
- A key situation to address early is the signal coordination status. The following issues *should* be addressed, mutually agreed upon and spelled out in the transfer agreement:
- Specify the signals in a coordinated system that are maintained by individual agencies.
    - Type of coordination (TBC, closed loop, fiber, etc.)?
    - Multiple Agencies:
    - Who will maintain the interconnect conduit? Specific maintenance limits **shall** be defined in the agreement.
    - Who will review, update and pay for changes to timings to maintain or improve coordination?
    - Who will pay to change controllers in the future for compatibility reasons?
    - Who will respond to communication/network issues?

SIGNAL TRANSFER CHECKLIST

When transferring an existing state owned/maintained traffic signal to another agency there are several associated issues to remember to take care of approximately <u>two weeks</u> prior to transfer:

- ❑ Request inspection of signal by WisDOT electricians, i.e., check loop functionality, lamp outages, etc.
- ❑ Notify electric utility of impending change in ownership.
- ❑ Remove WisDOT decals or other identification from control cabinet
- ❑ Send letter to receiving municipality to remind of pending transfer.

The text of the letter *should* include transfer date and a reminder to establish account with electrical utility (See sample letter). Copies of the following *should* be included with the letter:

- ❑ Latest timing
- ❑ Latest signal plan and sequence sheet
- ❑ Signed documentation for signal transfer
- ❑ Notify impacted law enforcement agencies including state patrol.
- ❑ Notify pertinent regional staff including:
    - ❑ Other pertinent regional staff who are responsible for the operation of the signals, paying the electrical service bill, and maintaining pavement marking and signing, if applicable.
    - ❑ Electricians
    - ❑ Planning staff who are responsible for manual traffic counts and updating STN log
    - ❑ Digger’s Hotline
    - ❑ Roadway Maintenance
    - ❑ Pertinent Bureau of Traffic Operations staff who are responsible for maintaining asset management tools and signal cabinet wiring diagrams.

SIGNAL TRANSFER SAMPLE LETTER

June 20, 2005

City Engineer

City XYZ

1234 Drive

City XYZ, Wisconsin 53200

Dear :

SUBJECT: STH XX & CTH XX

XX County

This letter is a reminder, that effective June 30, 2005, the subject traffic signal will become the maintenance and operational responsibility of the City of XYZ per the enclosed agreement.

We have informed the utility company of the pending transfer. They request that you contact them to provide the applicable billing information.

For your use you will find copies of the existing signal plan, sequence of operations sheet and timing.

If you have any questions, please feel free to contact me (XXX) XXX-XXXX.

Sincerely,

Regional Traffic Signal Engineer

UTILITIES, CULTURAL AND ENVIRONMENTAL ISSUES

Early in the design process, existing above- and below-ground utilities must be identified to determine if there is a potential conflict that will affect the placement of signal equipment and particularly for monotube signal bases that *may* require wing walls.

Underground facilities *should* be located and marked in the field prior to a field investigation. Examples of such facilities include:

- electric
- utility vaults
- high pressure gas lines
- fiber optic packages
- telecommunication
- cable
- water
- sewer lines
- municipal communication duct packages, etc.

Overhead electrical facilities *may* have proximity requirements regarding signal monotube and/or mast arm clearances.

Guidelines for historical boundaries and cemeteries are found in FDM Chapter 26, Cultural Resource Preservation.

Guidelines regarding required Environmental processes and documentation are found in FDM Chapter 20, Environmental Documents, Reports and Permits.

COMMUNITY SENSITIVE DESIGN (CSD)

According to FDM 11-3-1, Community Sensitive Design, CSD is a collaborative interdisciplinary approach that includes early involvement of all stakeholders to ensure that transportation projects not only provide safety and mobility, but are also in harmony with communities and the natural, social, economic, and cultural environments.

When requests are made for non-standard WisDOT signal equipment (i.e., decorative hardware), consideration *should* be given to establishing connecting highway limits so local jurisdictions can own and maintain signals that incorporate special equipment.

When decorative pavement is used near state owned and maintained intersections, the location of signal equipment *should* be considered. Decorative pavement *should not* be used near signal bases, pull boxes or in-pavement detection for maintenance and replacement reasons.

4-3-1 Field Investigation Introduction April 2025

Prior to commencement of plan preparation, a field investigation **shall** be conducted at the location proposed to be signalized, or at the site of the existing signal to be modified. The purpose of the field investigation **shall** be to verify and/or collect data on existing field conditions to facilitate plan preparation and identify potential utility conflicts prior to actual construction. In addition, the field investigation will enable the proposed electrical service location to be identified early on, which *may* or *may not* affect the location of the controller cabinet.

State-Owned Signal (either State Administered or Permit) Project

The signal designer **shall** coordinate with the Regional Traffic Unit prior to the field investigation. The Regional Traffic Unit will work with the local utility company and signal designer to determine the most appropriate location for the traffic signal control cabinet for state owned signal projects.

Locally Owned Signal (State Administered Project) (i.e., municipality, county, connecting highway)

The signal designer **shall** coordinate with the local agency that owns the signal prior to the field investigation.

4-3-2 Intersection Inventory April 2025

GEOMETRICS

Existing intersection and approach geometrics **shall** be verified in the field, including but not limited to:

- Approach grade
- Lane usage
- Lane widths
- Parking
- Left- and right-turn channelization
- Sight distance restrictions
- Sidewalks
- Bike paths
- Posted speed limit
- Other related information

Furthermore, information regarding right of way and drainage **shall** be checked. Right of way restrictions *may* require permanent easements to be obtained for the placement and maintenance of traffic signal equipment. Drainage characteristics *should* be taken into consideration to avoid placement of signal equipment, particularly controller cabinets in low points or flow lines.

Further investigation *may* be necessary to address certain special conditions, which could include the need for emergency pre-emption, signal interconnection, and accommodation of handicapped persons.

UTILITY CONFLICTS

Diggers Hotline (1-800-242-8511 or 811) **shall** be contacted during the design stage to determine the location of existing utilities. Marked locations for state-owned electrical facilities will need to be arranged through the Diggers Hotline.

Information regarding existing utilities from locates **shall** be incorporated into the preliminary signal plan. The utility information **shall** be verified during the field investigation and potential conflicts noted. Utility conflicts *may* consist of both underground and aboveground conflicts. Attention **shall** be given to underground utilities that could conflict with foundations for mast arm poles. At grade and aboveground utilities such as manholes and overhead lines **shall** be checked to avoid conflicts with proposed mast arms, pull boxes, concrete bases, and detection.

Signal poles and mast arms **shall** be a minimum of 10 feet from all overhead utilities. The designer **shall** contact the local utility companies for specific guidelines.

CONTROL CABINET LOCATION

Generally, electrical service disconnect *should* be located at or near the control cabinet.

For state-owned signals, the Regional Traffic Unit **shall** determine the placement of the control cabinet based on safety, visibility and aesthetics (i.e., to avoid placement on residential properties, etc.), not necessarily on service location. The electrical service provider **shall** be contacted prior to plan preparation to verify the location of the electrical service relative to the control cabinet, and what, if any, charges *may* apply.

For locally owned signals on state administered projects (i.e., municipality, county, connecting highway), the signal designer **shall** coordinate with the local agency who owns the signal prior to the plan preparation for the control cabinet and service location.

CHECKLIST

The field investigation **shall** include a thorough investigation of the location to familiarize the designer with the characteristics unique to that location. To facilitate the field investigation and design of the traffic signal, the designer *should* follow the guidelines listed below. In addition, the field investigation checklist *should* be completed during the investigation and filed with other project documentation.

1. A topographic survey of the location *should* be obtained prior to conducting the field investigation. The information represented on the survey *should* be verified for accuracy and include discrepancies noted during the field investigation. Information not included on the survey but observed in the field, *should* be added.
2. A photographic log of the location *should* be taken which could include photos of all approaches and photos of all the quadrants, at the intersection. This information could be used for the Signal Investigation Study and is useful during the design of the traffic signal installation.
3. The field investigation *should* be conducted when weather conditions are favorable.

The following field investigation checklist has been created by the Department for use during field visits. This list is a general checklist of items which *should*, as a minimum, be documented during the field investigation.

FIELD INVESTIGATION CHECKLIST

Intersection Geometrics

- ☐ Angles of intersecting streets
- ☐ Approach grades
- ☐ Physical features (pavement type, streetscaping, curb & gutter, loading zone, sidewalks, bike paths, shoulders, etc.)
- ☐ Distance to bridge approaches
- ☐ Corner radii (evidence of wheel tracking behind curb/median)
- ☐ Right turn movements (yield/stop conditions)
- ☐ Width of streets and travel lanes
- ☐ Lane usage and dimensions
- ☐ Turning lane storage length
- ☐ Roadway entrances within 500 feet on minor approaches and 1000 feet on Major approaches (driveways)
- ☐ One way streets
- ☐ Bus stops and loading zones
- ☐ Turning restrictions
- ☐ Future street connections at T-intersections

Pavement

- ☐ Existing pavement markings (stop bar locations, crosswalks, lane assignments)
- ☐ Concrete to asphalt joint locations
- ☐ Areas of extreme pavement distress (pavement rutting, alligator cracking)

Traffic Control Devices

- ☐ Location and message of roadside signs
- ☐ Railroad preemption/battery back-up system and/or potential preemption for emergency centers in vicinity
- ☐ Location and operation of existing signals and/or adjacent signals of state or another agency
- ☐ Existing speed limits
- ☐ Existing traffic signal standard/pole, controller, detector, etc. locations
- ☐ Potential locations for proposed underground signal facilities (potential bridge crossing for conduit)

Utilities

- ☐ Existing municipal lighting
- ☐ Utility locations including possible service location
- ☐ Overhead restrictions (phone/electrical lines, height restrictions)

Adjacent Land Use

- ☐ Right of way or property lines
- ☐ Current land use (schools, trucking, elderly housing)
- ☐ Existing site distance obstructions (buildings, trees, fences, outdoor advertising)
- ☐ Emergency use (fire station, police station, hospital, etc.)

Other

- ☐ Drainage features (culverts, catch basins, manholes, ditch bottoms, etc.)
- ☐ Parking restrictions

4-4-1 Signal Investigation Study — April 2025

For traffic signals to be considered on the STH-system, a Signal Investigation Study **shall** be developed to document its need.

All supporting discussion, information, and evaluation worksheets **shall** be presented in a standard format. This format will create uniformity in the presentation/review of the Signal Investigation Study for the intersection being evaluated.

The format of the signal investigation study is detailed below:

I. The cover letter **shall** include:
   - A recommendation and brief discussion of the study.
   - Any/All exceptions to the standards referenced in this manual and the WMUTCD.
   - A discussion of remedial actions tried, or, if none, explanation of need for signal.
   - Related agreements (i.e. railroad, maintenance).
   - Formal correspondence (letters from governmental officials, elected or non-elected, brief mention of local petitions, if any).
   - The local jurisdiction's recommendation and why rural warrants were used (if used).

II. DT1199 Traffic Control Signal Approval Request **shall** be completed by the Region and submitted with the investigation study to Central Office.

III. Analysis or signal investigation study stating reason for recommendation, to include statements regarding:
   a. Reasons / Justification for Signal Request
   b. Existing Physical Conditions and Control Devices
   c. Traffic Conditions
   d. Crash History
   e. Warrants met

IV. Appendices:
   a. Intersection Location Map
   b. Hourly Intersection Turning Movement Traffic Volume Counts
   c. Signal Warrant Analysis Worksheets
   d. Intersection Plan Sheets
   e. Signalized Intersection Capacity Analysis
   f. 3-yr Intersection Crash History Data Extract
      - Crash Reports
      - Collision Diagram (if available)

4-4-2 Data Collection — April 2025

VEHICULAR/PEDESTRIAN VOLUMES

Vehicular traffic counts and pedestrian volumes **shall** include the periods of the average day when signal control is expected to provide the greatest benefit. The traffic counts **shall** be at least 8 hours in duration; however, 16-hour counts are recommended. The traffic counts **shall** contain the greatest percentage of 24-hour traffic and *should* include 15-minute counts during the A.M. and P.M. peak hour to determine the peak-hour factor (PHF). Typical hourly volume counts are collected from 6:00AM to 6:00PM, however, if volumes remain steady after 6:00PM, counts *should* continue until volumes decrease significantly.

When vehicular volume data is unobtainable during the time when signals *may* be warranted, vehicular volumes *may* be factored to represent peak periods. Traffic volume factors are different in various regions of the state. These factors (seasonal, monthly, daily, or hourly) *may* be available from WisDOT Planning Section in some cases. When volume factors are used, they must be supported and fully explained as to why they are being used in lieu of actual turning movement counts.

Vehicular volume counts **shall** be recorded for each traffic movement by approach. Vehicles *may* be classified by type: heavy trucks, passenger cars, and buses. Refer to Figure 2.1 for an example of the "Vehicle Volume Summary" form.

When pedestrian volumes are significant, the pedestrian volume counts on each crosswalk **shall** be recorded during the same periods as the vehicular volume counts or during hours of highest pedestrian volume. Bicyclists using pedestrian crosswalks *should* be counted as pedestrians and bicyclists using the roadway *should* be counted as vehicles.

A summary of the vehicle and/or pedestrian count information *should* be prepared, using the Department form DT 1902 which can be obtained by contacting the Regional traffic unit or an equivalent summary (i.e., volume counting software). This form and the actual counts summarized hourly *should* be submitted with the signal investigation study. In some cases, it *may* be necessary to break the hourly volumes down into 15-minute intervals, although this is not a requirement.

For proposed developments, projected traffic volumes can be used to determine whether signals *may* be warranted. Volume projection methods *should* be documented, including the trip generation rates and source. Projected traffic volumes *should* be added to existing traffic counts for the location if traffic exists. The analysis of projected traffic volumes must follow all criteria as stated in this manual. A traffic signal installed, based on projected volumes, *should* have a follow-up study completed at the time of expected build-out to determine if actual volumes meet warrants.

Figure 2.1. Vehicle Volume Summary Example

Intersection Traffic Volume Report

15-Minute Motor Vehicle Data

Schoenhaar Drive and STH 33 - Washington Street

Count Basics		*Page 5 of 13*
Start Date: Thursday, January 10, 2019	Weekday	Schools in Session
Total Number of Hours Counted: 13	Non-Holiday	No Special Events

All Motor Vehicles

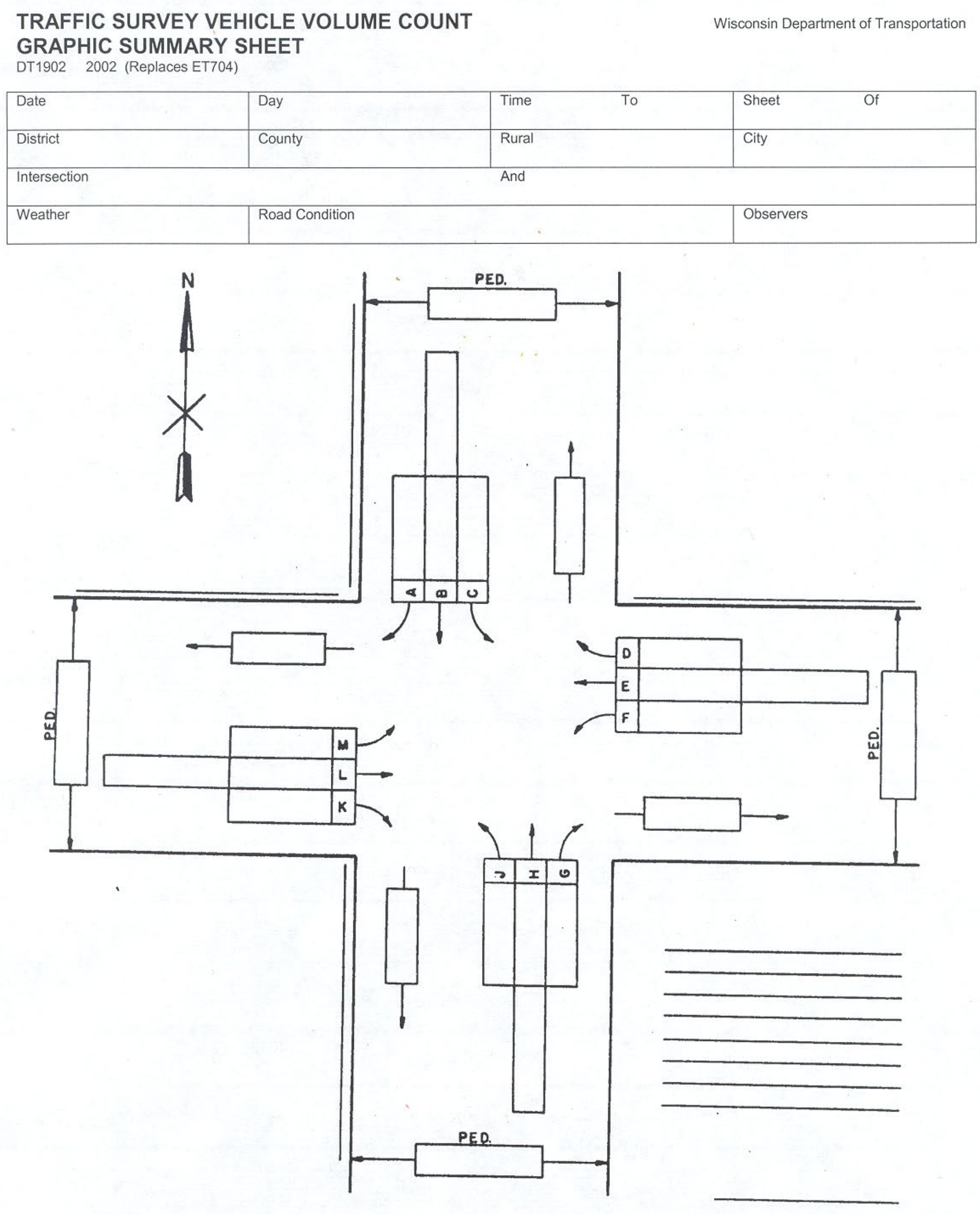
15-Minute Motor Vehicle Data

	15-Minute Time Period Start Time	From North (↓) Schoenhaar Drive Right	Thru	Left	U-Tn	Total	From East (←) STH 33 - Washington Street Right	Thru	Left	U-Tn	Total	From South (↑) Right	Thru	Left	U-Tn	Total	From West (→) STH 33 - Washington Street Right	Thru	Left	U-Tn	Total	15-Min Totals	Hourly Sum	PHF
AM Peak Period	6:00 AM	5	0	5	0	10	2	66	0	0	68	0	0	0	0	0	0	64	7	0	71	149	870	0.78
	6:15 AM	7	0	5	0	12	10	101	0	0	111	0	0	0	0	0	0	76	3	0	79	202	974	0.87
	6:30 AM	7	0	8	0	15	2	130	0	0	132	0	0	0	0	0	0	87	6	0	93	240	1072	0.89
	6:45 AM	12	0	2	0	14	6	171	0	0	177	0	0	0	0	0	0	69	19	0	88	279	1175	0.86
	7:00 AM	11	0	4	0	15	3	108	0	0	111	0	0	0	0	0	0	111	16	0	127	253	1245	0.89
	7:15 AM	12	0	8	0	20	8	156	0	0	164	0	0	0	0	0	0	103	13	0	116	300	1254	0.90
	7:30 AM	18	0	0	0	18	9	199	0	0	208	0	0	0	0	0	0	110	7	0	117	343	1193	0.85
	7:45 AM	10	0	3	0	13	6	206	0	0	212	0	0	0	0	0	0	101	23	0	124	349	1035	0.74
	8:00 AM	15	0	2	0	17	4	126	0	0	130	0	0	0	0	0	0	102	13	0	115	262	897	0.86
	8:15 AM	9	0	3	0	12	3	127	0	0	130	0	0	0	0	0	0	78	19	0	97	239	809	0.85
	8:30 AM	10	0	1	0	11	3	89	0	0	92	0	0	0	0	0	0	68	14	0	82	185	741	0.88
	8:45 AM	10	0	3	0	13	6	105	0	0	111	0	0	0	0	0	0	74	13	0	87	211	744	0.88
	9:00 AM	7	0	1	0	8	3	95	0	0	98	0	0	0	0	0	0	59	9	0	68	174	748	0.87
	9:15 AM	9	0	1	0	10	7	85	0	0	92	0	0	0	0	0	0	59	10	0	69	171	772	0.90
	9:30 AM	15	0	3	0	18	1	74	0	0	75	0	0	0	0	0	0	85	10	0	95	188	795	0.92
	9:45 AM	12	0	7	0	19	2	112	0	0	114	0	0	0	0	0	0	67	15	0	82	215	801	0.93
Midday Peak Period	10:00 AM	14	0	0	0	14	4	87	0	0	91	0	0	0	0	0	0	81	12	0	93	198	772	0.97
	10:15 AM	16	0	1	0	17	2	85	0	0	87	0	0	0	0	0	0	83	7	0	90	194	763	0.98
	10:30 AM	10	0	2	0	12	3	85	0	0	88	0	0	0	0	0	0	88	6	0	94	194	772	0.95
	10:45 AM	4	0	2	0	6	1	98	0	0	99	0	0	0	0	0	0	74	7	0	81	186	796	0.91
	11:00 AM	6	0	2	0	8	4	78	0	0	82	0	0	0	0	0	0	91	8	0	99	189	810	0.93
	11:15 AM	10	0	3	0	13	4	100	0	0	104	0	0	0	0	0	0	78	8	0	86	203	890	0.83
	11:30 AM	5	0	1	0	6	4	88	0	0	92	0	0	0	0	0	0	110	10	0	120	218	937	0.87
	11:45 AM	8	0	3	0	11	3	86	0	0	89	0	0	0	0	0	0	85	15	0	100	200	959	0.89
	12:00 PM	37	0	4	0	41	5	104	0	0	109	0	0	0	0	0	0	107	12	0	119	269	984	0.91
	12:15 PM	13	0	7	0	20	5	97	0	0	102	0	0	0	0	0	0	101	27	0	128	250	909	0.91
	12:30 PM	9	0	2	0	11	3	107	0	0	110	0	0	0	0	0	0	105	14	0	119	240	897	0.93
	12:45 PM	23	0	4	0	27	6	94	0	0	100	0	0	0	0	0	0	86	12	0	98	225	903	0.92
	1:00 PM	7	0	4	0	11	9	79	0	0	88	0	0	0	0	0	0	78	17	0	95	194	910	0.92
	1:15 PM	13	0	1	0	14	2	101	0	0	103	0	0	0	0	0	0	108	13	0	121	238	973	0.95
	1:30 PM	14	0	4	0	18	3	86	0	0	89	0	0	0	0	0	0	123	16	0	139	246	984	0.96
	1:45 PM	14	0	3	0	17	6	90	0	0	96	0	0	0	0	0	0	108	10	1	119	232	1123	0.73
PM Peak Period	2:00 PM	16	0	3	0	19	2	96	0	0	98	0	0	0	0	0	0	125	15	0	140	257	1184	0.77
	2:15 PM	15	0	4	0	19	6	111	0	0	117	0	0	0	0	0	0	105	8	0	113	249	1224	0.79
	2:30 PM	30	0	5	0	35	6	138	0	0	144	0	0	0	0	0	0	183	23	0	206	385	1320	0.86
	2:45 PM	10	0	1	0	11	4	116	0	0	120	0	0	0	0	0	0	134	28	0	162	293	1296	0.90
	3:00 PM	25	0	4	0	29	4	115	0	0	119	0	0	0	0	0	0	123	26	0	149	297	1321	0.91
	3:15 PM	14	0	4	0	18	5	156	0	0	161	0	0	0	0	0	0	148	18	0	166	345	1393	0.94
	3:30 PM	33	0	5	0	38	10	117	0	0	127	0	0	0	0	0	0	176	20	0	196	361	1407	0.95
	3:45 PM	12	0	5	0	17	9	128	0	0	137	0	0	0	0	0	0	146	18	0	164	318	1455	0.89
	4:00 PM	17	0	8	0	25	5	124	0	0	129	0	0	0	0	0	0	192	23	0	215	369	1538	0.94
	4:15 PM	20	0	1	0	21	5	130	0	0	135	0	0	0	0	0	0	180	23	0	203	359	1603	0.92
	4:30 PM	27	0	6	0	33	6	150	0	0	156	0	0	0	0	0	0	188	32	0	220	409	1600	0.92
	4:45 PM	12	0	3	0	15	7	148	0	0	155	0	0	0	0	0	0	210	21	0	231	401	1518	0.87
	5:00 PM	23	0	4	0	27	14	155	0	0	169	0	0	0	0	0	0	219	19	0	238	434	1423	0.82
	5:15 PM	13	0	4	0	17	2	148	0	0	150	0	0	0	0	0	0	177	12	0	189	356	1277	0.90
	5:30 PM	19	0	10	0	29	5	133	0	0	138	0	0	0	0	0	0	143	17	0	160	327	1162	0.89
	5:45 PM	10	0	3	0	13	2	109	0	0	111	0	0	0	0	0	0	173	9	0	182	306	1027	0.84
	6:00 PM	5	0	2	0	7	1	120	0	0	121	0	0	0	0	0	0	142	18	0	160	288	881	0.76
	6:15 PM	11	0	7	0	18	4	107	0	0	111	0	0	0	0	0	0	99	13	0	112	241		
	6:30 PM	4	0	1	0	5	4	88	0	0	92	0	0	0	0	0	0	86	9	0	95	192		
	6:45 PM	6	0	0	0	6	1	57	0	0	58	0	0	0	0	0	0	83	13	0	96	160		
	7:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
	7:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
	7:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
	7:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
	8:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
	8:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
	8:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
	8:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
	9:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
	9:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
	9:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
	9:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
Totals		694	0	179	0	873	241	5861	0	0	6102	0	0	0	0	0	0	5851	756	1	6608	13583		

Peak Hour All Vehicle Volume Summary

	Hourly Time Period Start Time	From North (↓) Schoenhaar Drive Right	Thru	Left	U-Tn	Total	From East (←) STH 33 - Washington Street Right	Thru	Left	U-Tn	Total	From South (↑) Right	Thru	Left	U-Tn	Total	From West (→) STH 33 - Washington Street Right	Thru	Left	U-Tn	Total	Total Hourly Volume	PHF
AM	7:00 AM	51	0	15	0	66	26	669	0	0	695	0	0	0	0	0	0	425	59	0	484	1245	0.89
MD	12:00 PM	82	0	17	0	99	19	402	0	0	421	0	0	0	0	0	0	399	65	0	464	984	0.91
PM	4:30 PM	75	0	17	0	92	29	601	0	0	630	0	0	0	0	0	0	794	84	0	878	1600	0.92

Figure 2.2. Form DT1902



TRAFFIC SURVEY VEHICLE VOLUME COUNT
GRAPHIC SUMMARY SHEET
DT1902 2002 (Replaces ET704)

Wisconsin Department of Transportation

Date	Day	Time To	Sheet Of
District	County	Rural	City
Intersection		And	
Weather	Road Condition		Observers

CRASH RECORDS/ANALYSIS

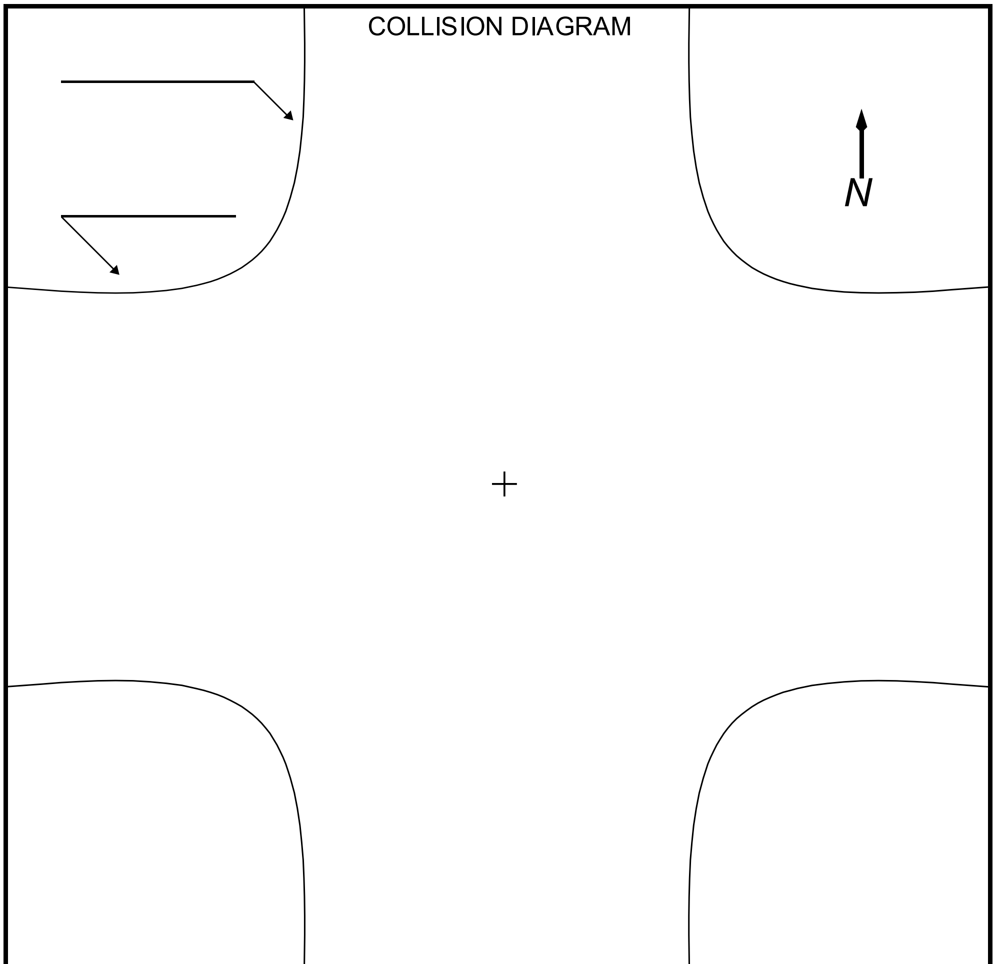
Crash reports provide an indication of relative intersection safety. Intersection crash history **shall** be reviewed for a minimum of a three-year period. To help determine trends, crash data *should* be summarized on a collision diagram or an as-built plan. Show crash experience by type, location, direction of movement, severity, pavement condition, time of day, date, and day of week.

To evaluate Warrant 7, Crash Experience, the most recent 12-month period **shall** be investigated prior to any other years. If the crashes at the intersection appear to form a pattern, these findings **shall** be documented in the Investigation Study.

Actual police crash reports *should* be reviewed to determine the driver's intention just prior to the crash. This is important in determining which crashes are susceptible to correction by a traffic signal.

Any improvements or changes to the intersection, which have been completed during or after the three-year period in which crashes are reported, **shall** be fully documented. It is important to note that a change *may* include "negative" improvements such as a driveway addition or new traffic generator. A comparison **shall** be made to the crashes before and after any such improvement or change to determine its effects.

Figure 2.3. Collision Diagram



SYMBOL	DESCRIPTION	SYMBOL	DESCRIPTION	INDICATE FOR EACH ACCIDENT
	MOVING VEHICLE		HEAD ON	1) DATE & TIME
	BACKING VEHICLE		SIDE SWIPE	2) WEATHER & PAV'T SURFACE
	PEDESTRIAN		OFF ROAD	(IF UNUSUAL CONDITION EXISTED)
	PARKED VEHICLE		LEFT TURN	3)
	FIXED OBJECT			4)
	FATAL ACCIDENT		RIGHT ANGLE	5)
	INJURY ACCIDENT			
	REAR END			

INTERSECTION OF: &

FROM: TO:

BY: DATE:

INTERSECTION CHARACTERISTICS

Data collection *should* include the creation of an Intersection Geometric Condition Sketch. This *may* be developed by obtaining an as built plan of the intersection and verifying the intersection layout with a field investigation. Any differences *should* be shown in the Intersection Geometric Condition Sketch. The Condition Sketch *should* show geometry, access point locations, nearest intersections, lane configurations, channelization, parking conditions, sight-distance restrictions, etc.

If aerial imaging is used, lane geometry **shall** be clearly visible.

The geometrics of the intersection **shall** be fully described in the Signal Investigation Study.

4-4-3 Traffic Signal Warrants April 2025

STANDARD INVESTIGATION PRACTICES

The analysis of intersection data **shall** proceed in the order indicated below unless intersection characteristics predicate specific warrant analysis. This order permits the most commonly used warrants to be evaluated first and the more difficult, data intensive (staff time and cost) warrants last, and only if added justification is needed or no other warrants are met. The Department has prepared Warrant worksheets for both urban and rural conditions. These worksheets are based upon the guidance provided in WMUTCD Section 4C and **shall** be utilized to determine whether existing/future intersection characteristics satisfy the warrants outlined in this text.

1. The traffic volumes **shall** be evaluated against the requirements for Warrant 1, (Conditions A, B and C), and Warrant 2.
2. The traffic volumes *may* be evaluated against the requirements for Warrant 3. Meeting Warrant 3 alone is not justification for the installation of a traffic signal. At least one additional warrant *should* also be met.
3. The crash history for the intersection(s) covering at least the past 3 years *should* be used to determine any trends. Any 12-month period (not a 3-year average) is evaluated against the requirements for Warrant 7. Only crash types susceptible to correction by a traffic signal **shall** be included in the Warrant 7 evaluation.
4. The existing and/or projected pedestrian volumes **shall** be evaluated for Warrant 4.
5. If an established school crossing is being investigated, Warrant 5 **shall** be evaluated.
6. The existing intersection characteristics and traffic volumes **shall** be evaluated against the requirements for Warrants 6 and 8. These warrants are used when it is necessary to properly control arterial or system flow. Warrant 6, Coordinated Signal System, is based upon the speed-distance relationship with adjacent signals. Warrant 7, Roadway Network, is used to complete networks on major routes.
7. If traffic signal warrants are expected to be met within 5 years of the completion of an improvement project, signals *may* be installed as a part of the project at the location being analyzed.
8. For T-intersections being analyzed for signals, side street traffic volume warrant thresholds *may* be inflated to 150 percent of the values indicated in the WMUTCD to reflect the lack of turning movements associated with a typical full access intersection, at the discretion of the Region Traffic Engineer.

If new signals are proposed at an intersection that will be reconstructed as part of an improvement project, a signal warrant analysis **shall** be completed using the proposed intersection geometrics.

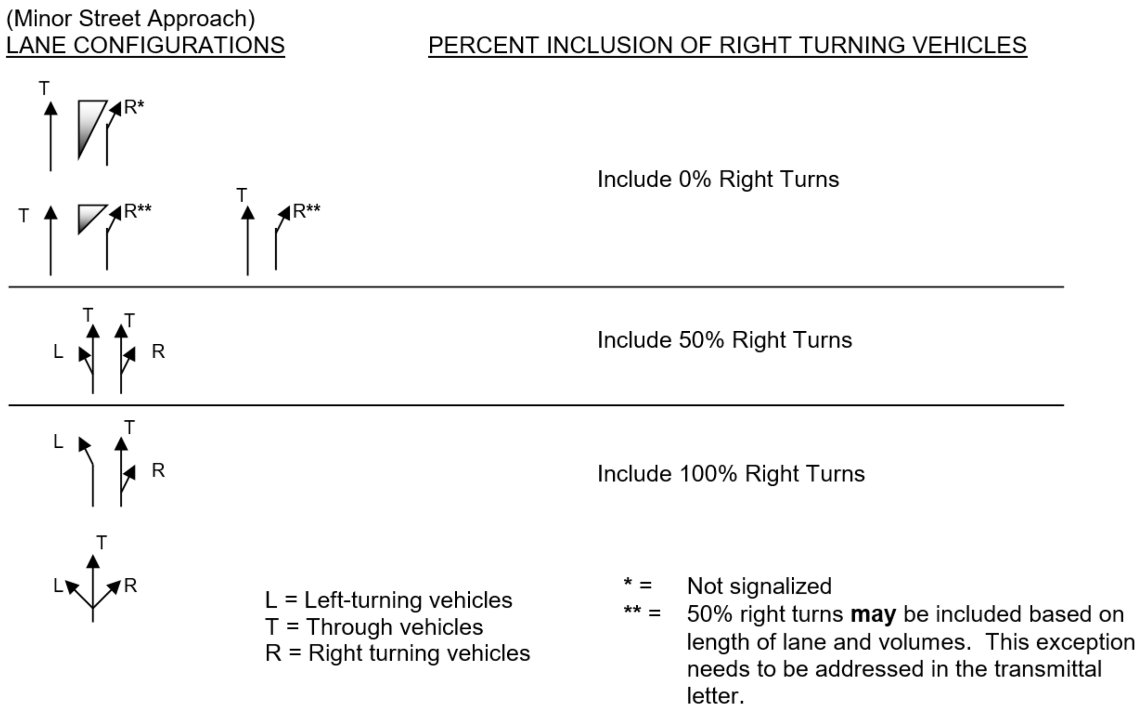
Guidelines for traffic signal warrants based on average daily traffic (ADT) can be found in the FDM 11-50-50, Tables 50.1 & 50.2. These *should not* be used as a justification for signals but rather *should* be used as a preliminary tool in determining if a site investigation study is needed.

RIGHT-TURN INCLUSIONS

Before evaluating traffic volumes against warrant criteria, inclusions of right turn vehicles **shall** be considered. The number of right turn vehicles included in the intersection analysis plays an important role in the overall operation of the intersection. The traffic control for the right turning vehicles *should* be known prior to determining the percentage of inclusion. The Department uses three right turn inclusion percentages based on the impact of the right turns on operation of the intersection. Figure 3.4 shows lane configurations and the corresponding percentages. These percentages *should* be applied to the minor street volumes in accordance with the WMUTCD 4C-1.

All mainline right turn traffic **shall** be included in the evaluation, unless there are unusual conditions, such as the subject mainline right turn lane being drastically displaced from the intersection. Provide justification for adjustments due to unusual conditions.

Figure 3.4. Right Turn Inclusion Percentages



4-4-4 Documentation April 2025

The following study has been prepared as a sample for this manual.

- Sample cover letter (Consultant to Region)
- Sample memorandum (Region to Central Office)
- Sample Investigation Study
  - DT1199 Traffic Control Signal Approval Request
  - Report Outline
    - a. Reason/Need for Study
    - b. Existing Physical Conditions and Control Devices
    - c. Traffic Conditions
    - d. Crash History
    - e. Warrants Met
  - Appendix
    - Site Map
    - Hourly Traffic Volume Counts
    - Vehicle Volume Count Graphic Summary Sheet
    - Warrant Analysis Worksheets
    - Intersection Plan Sheet (Intersection Geometric Condition Sketch)
    - Signalized Intersection Capacity Analysis
    - Crash Record Extract
    - Collision Diagram (If Available)

SAMPLE COVER LETTER
(CONSULTANT TO REGION)

Date

(Region Office)

Re: Signal Investigation Study
S.T.H. XX and C.T.H. YY
Town of Somewhere
Here County

Dear XXXXXX:

Attached for your review and approval is a signal investigation study for the intersection of S.T.H. XX and C.T.H. YY. The proposed installation is requested due to an increase in traffic, accidents, and congestion. In addition, there have been several requests from area residents to consider a traffic signal at this location.

In the fall of 1993 acceleration and deceleration tapers were installed on STH XX. This was an interim improvement prior to a signal being installed.

Traffic signal warrants 1, 2, 3 and 7 as stated in the *Wisconsin Manual on Uniform Traffic Control Devices (WMUTCD)*, are satisfied for the required number of hours for this location.

A signal capacity analysis was performed based on common signal phasing and timing parameters, existing turning movement counts, and current intersection geometrics. Results of the analysis (included in the appendix) have determined that the intersection will operate with acceptable levels-of-service, and the expected queues will not exceed intersection storage currently provided or planned for.

We recommend approval of this installation.

Sincerely,
Private Consultant

SAMPLE MEMORANDUM

(REGION TO BUREAU OF HIGHWAY OPERATIONS)

Date:

To: (State Traffic Signal Engineer)

From: (Regional Traffic Engineer)

Subject: Signal Investigation Study
Project ID (number)
S.T.H. XX and C.T.H. YY
Town of Somewhere
Here County

Attached for your review and approval is a signal investigation study for the intersection of S.T.H. XX and C.T.H. YY. The proposed installation is requested due to an increase in traffic, accidents, and congestion. In addition, there have been several requests from area residents to consider a traffic signal at this location.

In the fall of 1993 acceleration and deceleration tapers were installed on STH XX. This was an interim improvement prior to a signal being installed. Additional lane capacity with existing control is not possible due to local conditions, therefore a traffic signal is justified.

Traffic signal warrants 1, 2, 3, and 7, as stated in the (WMUTCD), are satisfied for the required number of hours for this location.

A signal capacity analysis was performed based on common signal phasing and timing parameters, existing turning movement counts, and current intersection geometrics. Results of the analysis (included in the appendix) have determined that expected queues will not exceed intersection storage currently provided, and the level of service for each movement will be satisfactory. Based on the analysis, left turn phasing will not need to be provided at this time.

Contracted forces will complete aboveground and underground work. Operations and maintenance of the installation will be at the expense of the Department.

The total estimated cost is $__, ___. __.

The project will be funded through (state funding source(s)).

We recommend approval of this installation.

Figure 4.5. DT 1199 Traffic Control Signal Approval Request

TRAFFIC CONTROL SIGNAL APPROVAL REQUEST

Wisconsin Department of Transportation

DT1199 8/2012 s.86.32(1) Wis. Stats.

Municipality	County
State Trunk Highway	Intersecting Road

☐ Check if connecting highway – Requires authorized municipal and departmental approval below. Approval of installation on the connecting highway system is required under s.86.32(1) Wis. Stats.

The Region requests approval of a traffic control signal at the location indicated above. Traffic volumes, crash experience and physical conditions at the described intersection have been reviewed. A traffic control signal is justified.

Approval Recommended ______________________________
(Regional Traffic Engineer) (Date)

Approval Granted ______________________________
(Bureau of Traffic Operations) (Date)

TRAFFIC CONTROL SIGNAL INSTALLATION, OPERATION AND MAINTENANCE AGREEMENT

The municipality identified above agrees to install, operate and maintain a traffic control signal at the specified intersection for the purpose of controlling the flow of traffic.

The following conditions precedent to approval of the signal are acknowledged and accepted by the municipality:

1. The design, installation and operation of the signal will comply with the Wisconsin Manual on Uniform Traffic Control Devices.
2. The cost of maintenance and operation of the signal will be the responsibility of the municipality or in any case will not be an obligation of the Wisconsin Department of Transportation.
3. Parking will be restricted by the municipality at locations on the identified intersecting streets in accordance with the need to provide adequate capacity and normal flow of traffic. Specific restrictions, if needed, are as follows:
4. The municipality, with the approval or at the request of the Department of Transportation, and at the municipality's expense, shall make such adjustments in the equipment and manner of operation of these signals as are deemed necessary for public safety and facilitation of traffic movement.

☐ Yes ☐ No Further provisions are stated on the back of this document.
☐ Yes ☐ No Attachments

Agreed on behalf of the Municipality

X ______________________________
(Signature of Authorized Representative for Municipality) (Date)

Agreed on behalf of the Department

X ______________________________
(Signature of Bureau of Traffic Operations) (Date)

SIGNAL INVESTIGATION STUDY
MAIN LINE (STH XX) & SIDE ROAD (CTH YY) INTERSECTION

a. REASON/NEED FOR STUDY

The traffic volume in this area has tended to increase rapidly over the last few years. In addition, we have received numerous requests (letters attached), mostly from area residents, to consider the installation of a traffic control signal at the intersection of STH XX and CTH YY. Accidents and congestion are increasing along with the increase in area development and traffic.

b. EXISTING PHYSICAL CONDITIONS AND CONTROL DEVICES

Each of these roadways is a two-lane road with 10-foot shoulders on STH XX and a minimal of 2 to 4-foot shoulders on the CTH YY. The Main Line (STH XX) has 150-ft left-turn bays at the intersection. STH XX has a 55-mph speed limit while CTH YY has 35 mph limits on each side of the intersection. Existing traffic control at the intersection consists of two-way STOP control for CTH YY. New acceleration and deceleration tapers were installed September of 2002 on STH XX as an interim operational improvement prior to a signal being installed. Additional lane capacity is not possible due to local conditions; therefore, congestion cannot be reduced on CTH YY if the Stop Signs remain.

c. TRAFFIC CONDITIONS

A 16-hour manual traffic count was conducted at this intersection on Tuesday, October 21, 2003 and Wednesday, October 22, 2003. The results of this traffic count are summarized in Figure 1 and included in the Appendix along with the actual count data.

d. CRASH HISTORY

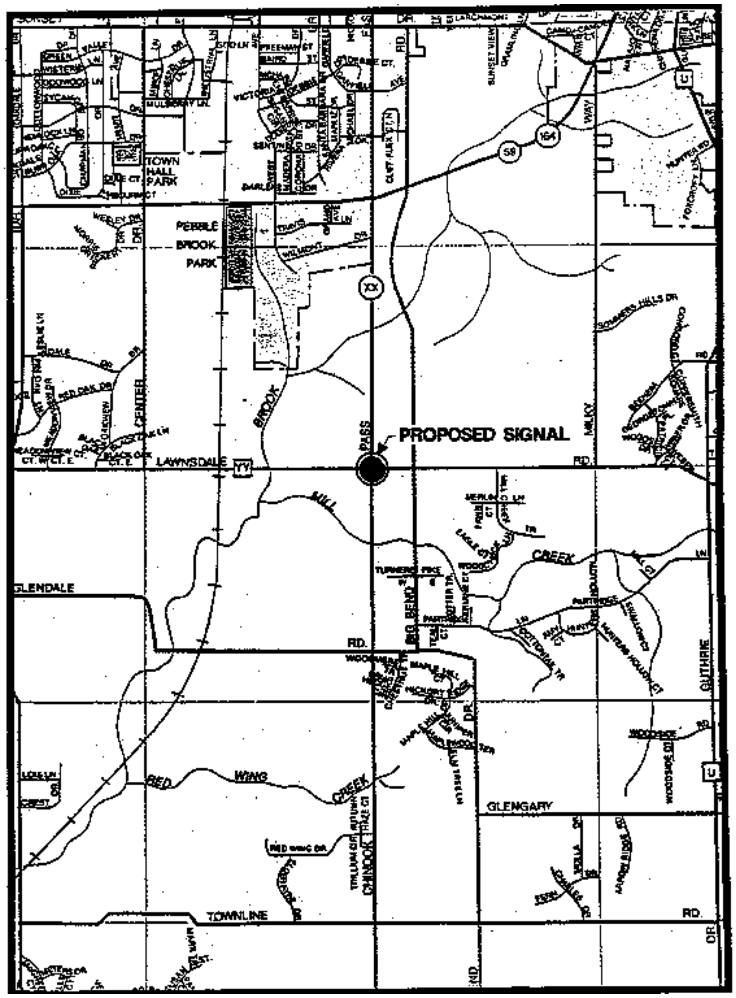
The crash history shows an increase in crashes and a minimum of 5 crashes in a 12-month period which are correctable by installation of a traffic control signal. There was one fatality crash at the intersection.

e. WARRANT MET

The following signal warrants are met and are summarized on the Warrant sheets:

Warrant #1 – Eight-Hour Vehicular Volume	
Condition A - Minimum Vehicular Traffic:	8 hours
Condition B - Interruption of Continuous Traffic:	14 hours
Condition C - Combination of Warrants:	9 hours
Warrant #2 - Four Hour Warrants:	9 hours
Warrant #3 - Peak Hour Warrant:	7 hours
Warrant #7 - Accident Experience:	8 hours

SITE MAP EXAMPLE



TRAFFIC VOLUME REPORT EXAMPLE

Intersection Traffic Volume Report

Count Basics	Version 2011.M3		Page 1 of 13
Start Date:	Wednesday, March 10, 2021	Weekday	Schools in Session
Total Number of Hours Counted: 13		Non-Holiday	No Special Events

Base Information, Observed (13) Hour and Estimated (24) Hour Volume Summaries

Intersection of: STH 164 & Lindsay Road

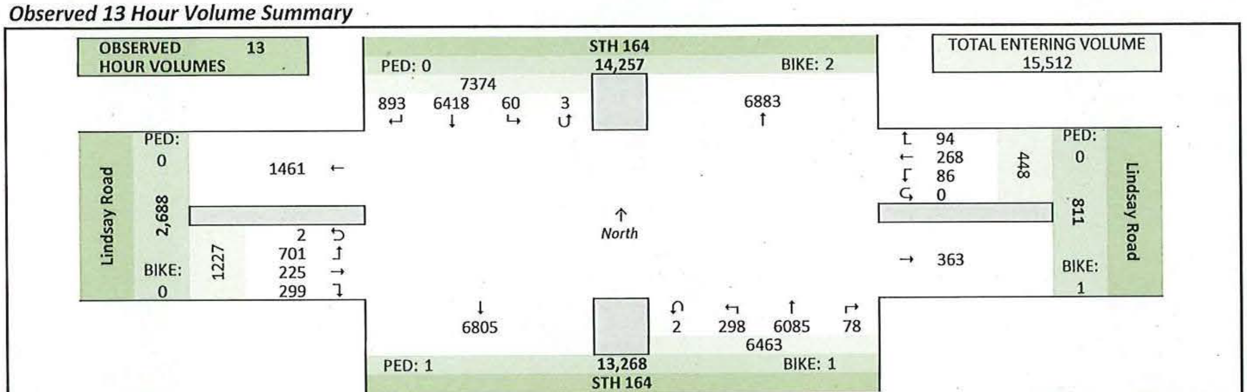
Site Information

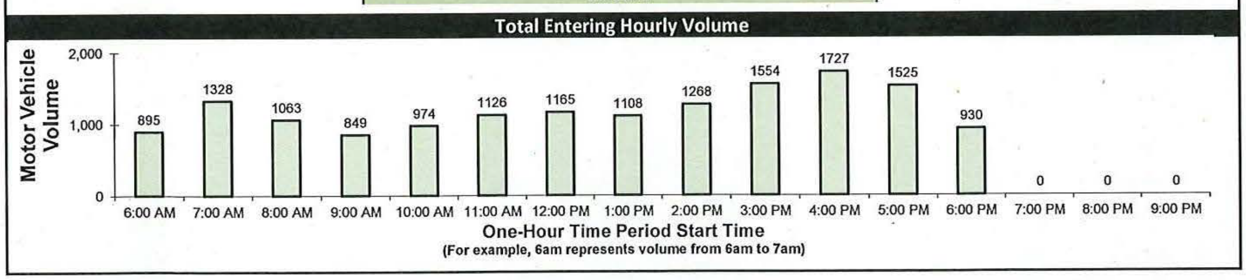
Municipality	Village of Pewaukee		
County	Waukesha	WisDOT Region	SE
Traffic Control	Partial Stop Control		
Roadway Names		North Direction	↑
North Leg	STH 164		
East Leg	Lindsay Road		
South Leg	STH 164		
West Leg	Lindsay Road		
Special Considerations			
Schools	In Session		
Holidays	None		
Special Events	None		
Special Pedestrians Observed			
Pre-school children	None		
Elementry school age children	None		
Visually impaired (white cane/helper dog)	None		
Elderly/disabled (except wheelchairs)	None		
Wheelchairs/electric scooters	None		
Other (describe)	None	None	

Count Information

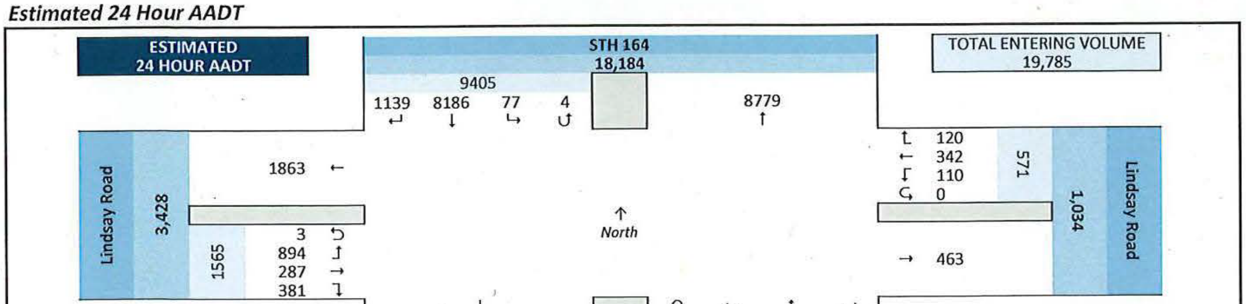
Hrs Counted:	6:00 AM-7:00 PM		
1st Day of Count	Wednesday, March 10, 2021	Weather	
AM Peak Period	Wednesday, March 10, 2021	Clear & Dry	
Midday Peak Period	Wednesday, March 10, 2021	Clear & Dry	
PM Peak Period	Wednesday, March 10, 2021	Clear & Dry	
Calculated Peak Hours			
AM 7:00-8:00am	MD 11:30-12:30am	PM 4:15-5:15pm	
Peak Hours Selected for Analysis			
AM 7:00-8:00am	MD 11:30-12:30am	PM 4:15-5:15pm	
Daily/Seasonal Adjustment Group	(4) Rural Arterials & Collectors		
Count Expansion Group	(4) Rural Arterials & Collectors		
Daily/Seasonal Adjustment Factor	1.073	Count Expansion Factor	1.188
Company Name	TranSmart, Inc.	Manual Adj.	1.000
Observers: AM Peak Period	Miovision Video Recording		
Midday Peak Period	Miovision Video Recording		
PM Peak Period	Miovision Video Recording		
Comments	2019 DOT Seasonal Factors		

Observed 13 Hour Volume Summary





Estimated 24 Hour AADT



Daily/Seasonal Factor	1.073
Count Expansion Factor	1.188
Manual Adjustment Factor	1.000
Total 24 Hr Expansion Factor	**1.275**

Intersection Traffic Volume Report

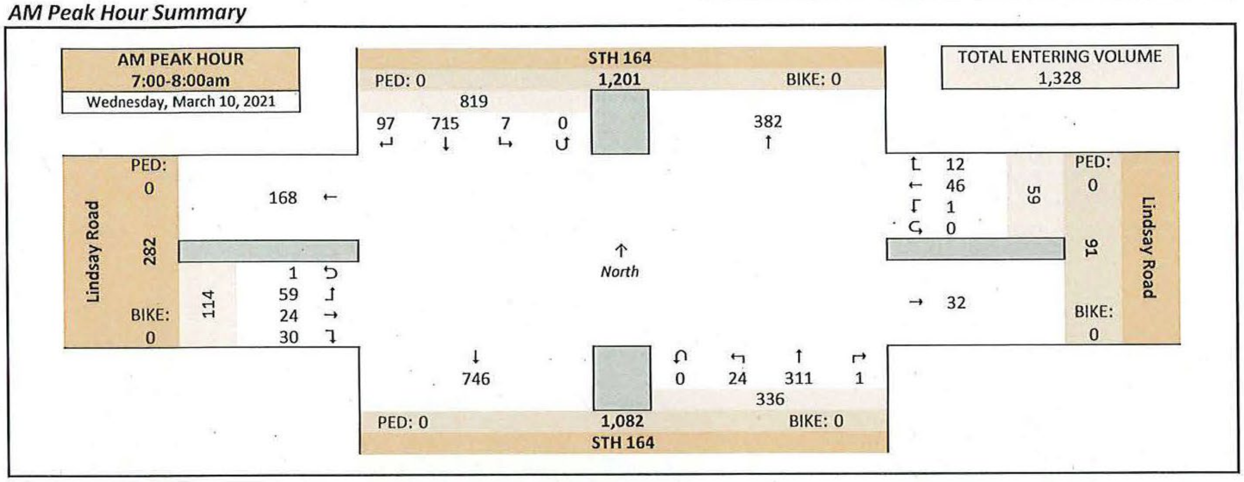
Count Basics			Page 2 of 13
Start Date:	Wednesday, March 10, 2021	Weekday	Schools in Session
Total Number of Hours Counted: 13		Non-Holiday	No Special Events

Peak Hour Volume Graphical Summary

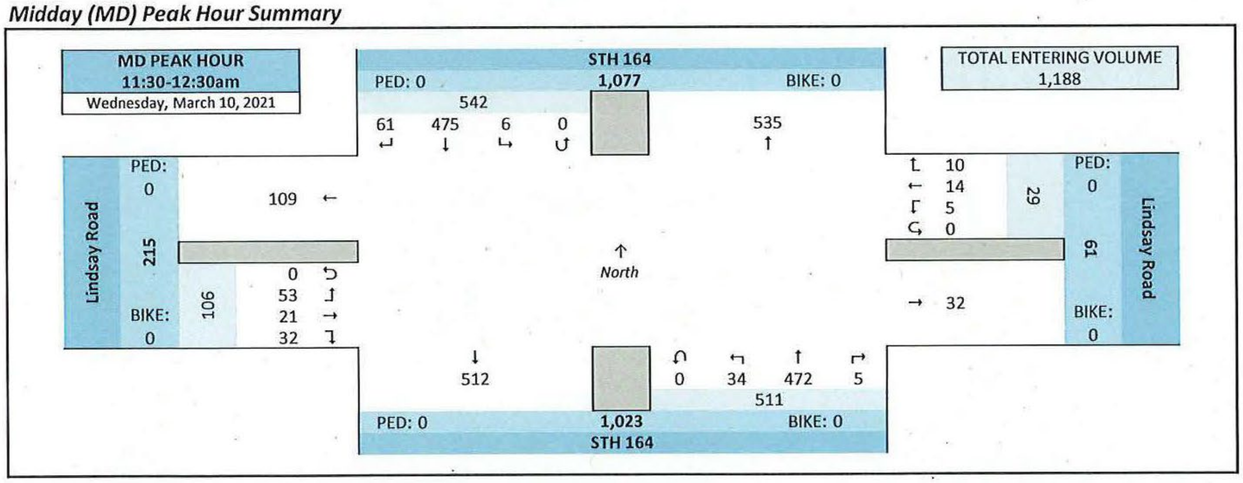
All Motor Vehicles

STH 164 & Lindsay Road

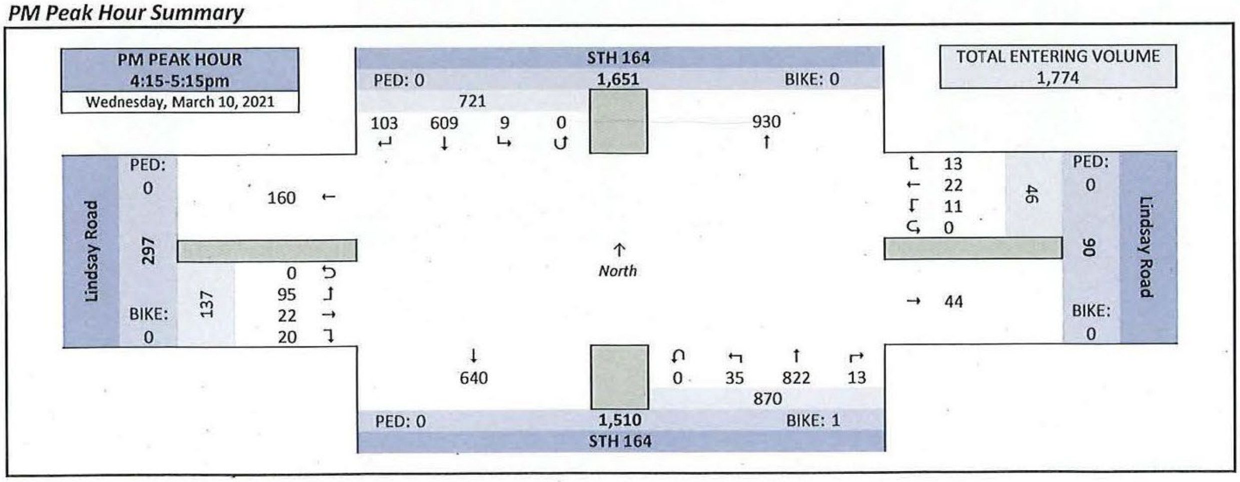
AM Peak Hour Summary



Midday (MD) Peak Hour Summary



PM Peak Hour Summary



Intersection Traffic Volume Report

Count Basics			Page 5 of 13
Start Date:	Wednesday, March 10, 2021	Weekday	Schools in Session
Total Number of Hours Counted: 13		Non-Holiday	No Special Events

15-Minute Motor Vehicle Data

All Motor Vehicles

STH 164 & Lindsay Road

15-Minute Motor Vehicle Data

Period	15-Minute Time Period Start Time	From North STH 164 Right	Thru	Left	U-Tn	Total	From East Lindsay Road Right	Thru	Left	U-Tn	Total	From South STH 164 Right	Thru	Left	U-Tn	Total	From West Lindsay Road Right	Thru	Left	U-Tn	Total	15-Min Totals	Hourly Sum	PHF
AM Peak Period	6:00 AM	8	76	1	0	85	1	0	0	0	1	0	26	0	0	26	1	5	7	0	13	125	895	0.78
	6:15 AM	8	97	0	0	105	2	2	1	0	5	0	67	1	0	68	0	1	20	0	21	199	1071	0.89
	6:30 AM	16	175	3	0	194	5	1	0	0	6	1	72	1	0	74	5	1	6	0	12	286	1195	0.92
	6:45 AM	29	153	0	0	182	4	10	1	0	15	0	64	4	0	68	5	1	14	0	20	285	1298	0.83
	7:00 AM	20	144	0	0	164	0	10	1	0	11	0	95	3	0	98	4	7	16	1	28	301	1328	0.85
	7:15 AM	30	168	1	0	199	4	9	0	0	13	0	75	4	0	79	8	9	15	0	32	323	1314	0.84
	7:30 AM	25	222	3	0	250	5	17	0	0	22	0	82	10	0	92	4	6	15	0	25	389	1259	0.81
	7:45 AM	22	181	3	0	206	3	10	0	0	13	1	59	7	0	67	14	2	13	0	29	315	1126	0.89
	8:00 AM	26	146	1	1	174	0	4	1	0	5	0	80	6	0	86	5	6	11	0	22	287	1063	0.93
	8:15 AM	19	144	0	0	163	1	5	2	0	8	0	70	1	0	71	8	1	17	0	26	268	976	0.91
	8:30 AM	17	121	0	0	138	0	4	4	0	8	2	89	2	0	93	3	2	12	0	17	256	917	0.90
	8:45 AM	15	129	0	0	144	0	6	0	0	6	0	73	2	0	75	12	5	10	0	27	252	880	0.87
	9:00 AM	14	87	1	0	102	1	4	1	0	6	0	72	1	0	73	5	1	13	0	19	200	849	0.96
	9:15 AM	16	89	1	0	106	1	6	2	0	9	1	81	3	0	85	3	2	4	0	9	209	868	0.98
	9:30 AM	4	111	0	0	115	3	5	2	0	10	2	76	4	0	82	2	6	4	0	12	219	885	0.98
	9:45 AM	11	99	2	0	112	2	1	3	0	6	4	81	3	0	88	5	1	9	0	15	221	937	0.86
Midday Peak Period	10:00 AM	8	121	0	0	129	1	0	3	0	4	2	62	5	0	69	4	2	11	0	17	219	974	0.90
	10:15 AM	12	109	0	0	121	0	2	1	0	3	1	84	4	0	89	4	1	8	0	13	226	1025	0.95
	10:30 AM	9	122	2	0	133	2	8	3	0	13	2	96	3	0	101	8	4	12	0	24	271	1060	0.98
	10:45 AM	13	107	0	0	120	0	3	5	0	8	2	97	4	1	104	7	4	15	0	26	258	1078	0.93
	11:00 AM	11	127	0	0	138	2	2	1	0	5	2	98	7	0	107	4	2	14	0	20	270	1126	0.92
	11:15 AM	16	96	0	0	112	1	4	0	0	5	1	114	5	0	120	4	4	16	0	24	261	1161	0.95
	11:30 AM	25	125	1	0	151	1	4	1	0	6	2	100	5	0	107	8	5	12	0	25	289	1188	0.97
	11:45 AM	11	114	2	0	127	6	3	2	0	11	0	127	5	0	132	14	6	16	0	36	306	1168	0.95
	12:00 PM	16	124	1	0	141	1	2	1	0	4	3	122	13	0	138	6	5	11	0	22	305	1165	0.95
	12:15 PM	9	112	2	0	123	2	5	1	0	8	0	123	11	0	134	4	5	14	0	23	288	1141	0.94
	12:30 PM	13	107	1	0	121	2	5	5	0	12	0	114	4	0	118	5	1	12	0	18	269	1122	0.93
	12:45 PM	14	129	1	0	144	1	3	0	0	4	1	124	4	0	129	8	3	15	0	26	303	1118	0.92
	1:00 PM	11	118	1	0	130	1	3	1	0	5	3	115	4	0	122	9	3	12	0	24	281	1108	0.95
	1:15 PM	17	108	0	0	125	2	2	4	0	8	1	114	6	1	122	2	5	7	0	14	269	1117	0.95
	1:30 PM	22	119	1	0	142	1	4	0	0	5	0	96	3	0	99	6	3	10	0	19	265	1164	0.92
	1:45 PM	12	110	0	0	122	2	6	2	0	10	2	122	7	0	131	7	6	17	0	30	293	1209	0.96
PM Peak Period	2:00 PM	12	134	1	0	147	1	3	1	0	5	2	115	4	0	121	7	1	9	0	17	290	1268	0.90
	2:15 PM	13	107	2	0	122	2	6	1	0	9	1	147	11	0	159	7	5	14	0	26	316	1361	0.89
	2:30 PM	16	119	2	0	137	2	7	1	0	10	2	118	9	0	129	7	14	13	0	34	310	1412	0.92
	2:45 PM	25	106	0	0	131	0	11	0	0	11	1	179	11	0	191	4	3	12	0	19	352	1525	0.90
	3:00 PM	22	120	3	0	145	1	12	1	0	14	2	184	11	0	197	4	7	16	0	27	383	1554	0.92
	3:15 PM	7	126	0	1	134	1	4	3	0	8	3	181	10	0	194	7	4	20	0	31	367	1566	0.93
	3:30 PM	22	158	1	0	181	2	5	1	0	8	3	190	6	0	199	11	6	17	1	35	423	1626	0.95
	3:45 PM	26	130	2	0	158	2	7	4	0	13	2	171	5	0	178	5	9	18	0	32	381	1647	0.93
	4:00 PM	31	135	3	0	169	1	5	3	0	9	2	173	11	0	186	7	8	16	0	31	395	1727	0.94
	4:15 PM	26	141	0	0	167	5	3	1	0	9	2	206	7	0	215	2	7	27	0	36	427	1774	0.96
	4:30 PM	27	161	3	0	191	1	8	4	0	13	2	193	4	0	199	7	4	30	0	41	444	1746	0.95
	4:45 PM	26	142	3	0	171	6	6	3	0	15	6	224	9	0	239	7	7	22	0	36	461	1698	0.92
	5:00 PM	24	165	3	0	192	1	5	3	0	9	3	199	15	0	217	4	4	16	0	24	442	1525	0.86
	5:15 PM	28	130	3	1	162	4	6	1	0	11	2	192	9	0	203	6	4	13	0	23	399	1370	0.86
	5:30 PM	27	124	0	0	151	1	9	1	0	11	0	195	8	0	203	9	6	16	0	31	396	1231	0.78
	5:45 PM	18	112	0	0	130	1	7	2	0	10	2	120	8	0	130	2	5	11	0	18	288	1034	0.90
	6:00 PM	18	110	3	0	131	2	5	2	0	9	2	121	3	0	126	5	5	11	0	21	287	930	0.81
	6:15 PM	10	97	1	0	108	1	6	3	0	10	2	113	5	0	120	3	6	13	0	22	260		
	6:30 PM	5	55	1	0	61	3	3	3	0	9	3	98	6	0	107	8	2	12	0	22	199		
	6:45 PM	11	56	1	0	68	0	0	0	0	0	3	96	4	0	103	3	3	7	0	13	184		
	7:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
	7:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
	7:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
	7:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
	8:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
	8:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
	8:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
	8:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
	9:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
	9:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
	9:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
	9:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
Totals		893	6418	60	3	7374	94	268	86	0	448	78	6085	298	2	6463	299	225	701	2	1227	15512		

Peak Hour All Vehicle Volume Summary

	Hourly Time Period Start Time	From North STH 164 Right	Thru	Left	U-Tn	Total	From East Lindsay Road Right	Thru	Left	U-Tn	Total	From South STH 164 Right	Thru	Left	U-Tn	Total	From West Lindsay Road Right	Thru	Left	U-Tn	Total	Total Hourly Volume	PHF
AM	7:00 AM	97	715	7	0	819	12	46	1	0	59	1	311	24	0	336	30	24	59	1	114	1328	0.85
MD	11:30 AM	61	475	6	0	542	10	14	5	0	29	5	472	34	0	511	32	21	53	0	106	1188	0.97
PM	4:15 PM	103	609	9	0	721	13	22	11	0	46	13	822	35	0	870	20	22	95	0	137	1774	0.96

Intersection Traffic Volume Report

Count Basics			Page 4 of 13
Start Date:	Wednesday, March 10, 2021	Weekday	Schools in Session
Total Number of Hours Counted: 13		Non-Holiday	No Special Events

Hourly Volume Summary - Motor Vehicle Data

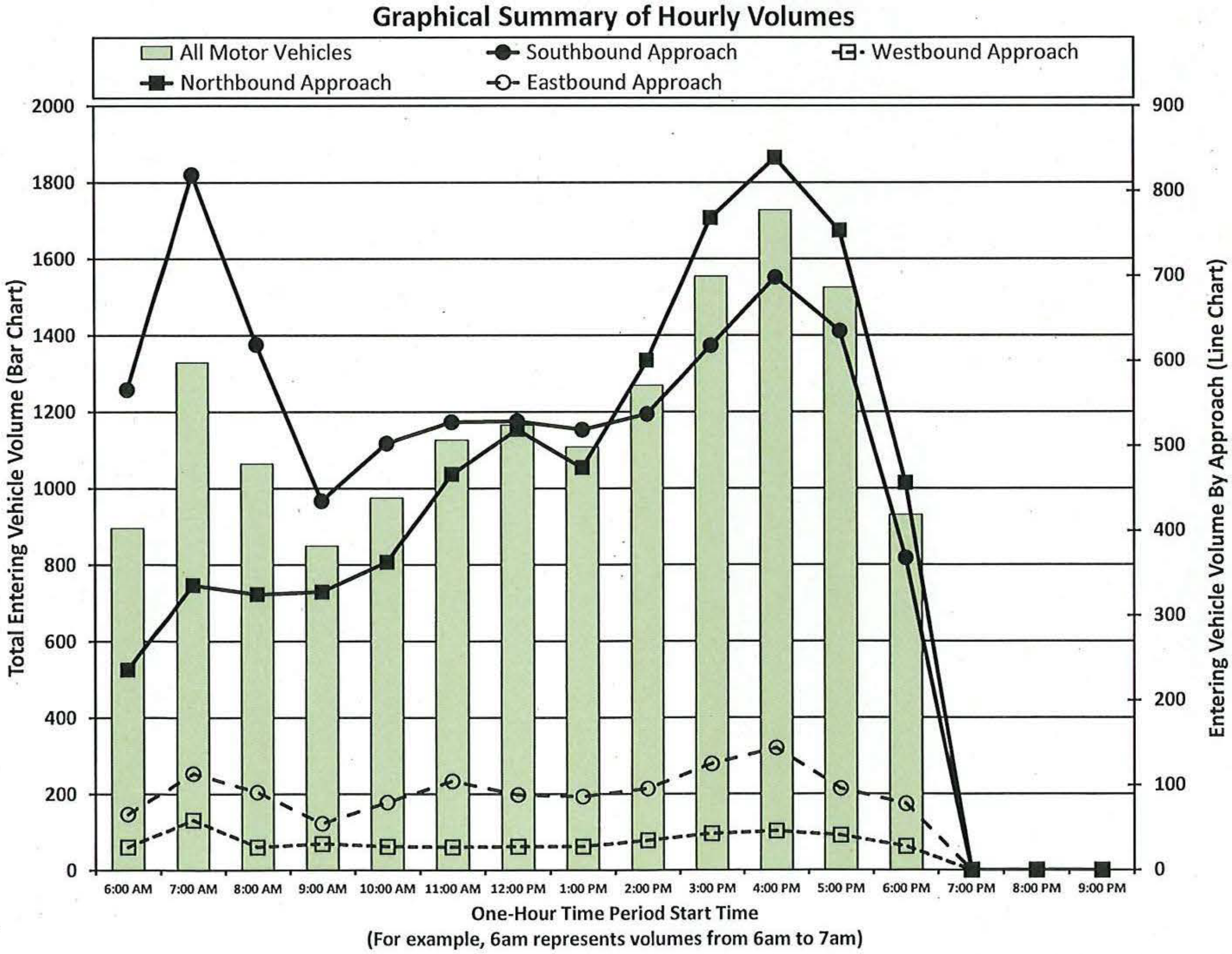
All Motor Vehicles

STH 164 & Lindsay Road

One-Hour Motor Vehicle Data

One-Hour Time Period Start Time		From North ↓ STH 164					From East ← Lindsay Road					From South ↑ STH 164					From West → Lindsay Road					Total Vehicle Volume	Directional Volume Totals	
		Right	Thru	Left	U-Tn	Total	Right	Thru	Left	U-Tn	Total	Right	Thru	Left	U-Tn	Total	Right	Thru	Left	U-Tn	Total		E/W	N/S
AM	6:00 AM	61	501	4	0	566	12	13	2	0	27	1	229	6	0	236	11	8	47	0	66	895	93	802
	7:00 AM	97	715	7	0	819	12	46	1	0	59	1	311	24	0	336	30	24	59	1	114	1328	173	1155
	8:00 AM	77	540	1	1	619	1	19	7	0	27	2	312	11	0	325	28	14	50	0	92	1063	119	944
	9:00 AM	45	386	4	0	435	7	16	8	0	31	7	310	11	0	328	15	10	30	0	55	849	86	763
MD	10:00 AM	42	459	2	0	503	3	13	12	0	28	7	339	16	1	363	23	11	46	0	80	974	108	866
	11:00 AM	63	462	3	0	528	10	13	4	0	27	5	439	22	0	466	30	17	58	0	105	1126	132	994
	12:00 PM	52	472	5	0	529	6	15	7	0	28	4	483	32	0	519	23	14	52	0	89	1165	117	1048
	1:00 PM	62	455	2	0	519	6	15	7	0	28	6	447	20	1	474	24	17	46	0	87	1108	115	993
PM	2:00 PM	66	466	5	0	537	5	27	3	0	35	6	559	35	0	600	25	23	48	0	96	1268	131	1137
	3:00 PM	77	534	6	1	618	6	28	9	0	43	10	726	32	0	768	27	26	71	1	125	1554	168	1386
	4:00 PM	110	579	9	0	698	13	22	11	0	46	12	796	31	0	839	23	26	95	0	144	1727	190	1537
	5:00 PM	97	531	6	1	635	7	27	7	0	41	7	706	40	0	753	21	19	56	0	96	1525	137	1388
	6:00 PM	44	318	6	0	368	6	14	8	0	28	10	428	18	0	456	19	16	43	0	78	930	106	824
	7:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	8:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	9:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Totals		893	6418	60	3	7374	94	268	86	0	448	78	6085	298	2	6463	299	225	701	2	1227	15512	1675	13837

Graphical Summary of Hourly Volumes



WARRANT ANALYSIS WORKSHEETS

Wisconsin Department of Transportation Traffic Signal Warrant Summary Worksheet

100%

The Worksheet(s) attached are provided as an attachment to the Engineering Investigation Study for:

Intersection:
County:
Select one:

Major Street:
Critical Approach Speed: mph
Lanes:

Minor Street:
Critical Approach Speed: mph
Lanes:

% Right Turns Included
From North (SB) 0%
From East (WB) 0%
From South (NB) 0%
From West (EB) 0%

In built-up area of isolated community of < 10,000 population?
Total number of approaches at intersection?
If it is a "T" intersection, inflate minor threshold to 150%?
Manually set volume level?

Analysis based on volume data.

		Time (HH:MM)			
		From	AM / PM	To	AM / PM

Warrant Evaluation Summary	Warrant Met:
Warrant 1: Eight - Hour Vehicular Volume	N/A
Condition A: Minimum Vehicular Volume	
Condition B: Interruption of Continuous Traffic	
Condition C: Combination: 80% of A and B	
Warrant 2: Four-Hour Volume	N/A
Warrant 3: Peak Hour Volume	N/A
Warrant 4: Pedestrian Volume	N/A
Criterion A: Four-Hour	
Criterion B: Peak-Hour	
Warrant 5: School Crossing	N/A
Warrant 6: Coordinated Signal System	N/A
Warrant 7: Crash Experience	N/A
Warrant 8: Roadway Network	N/A
Warrant 9: Intersection Near a Grade Crossing	N/A

Warrant Analysis Conducted By:
Name:
Agency:
Date:

1

Warrant 1: Eight - Hour Vehicular Volume 100%

Warrant Evaluated?

Warrant Satisfied? N/A

Manually Set To:

Condition A :		
Min. Veh. Volume		
Volume Level	100%	80%
Major Rd. Req		
Minor Rd. Req		
Number of Hours	0	0

Satisfied?

Condition B:		
Interruption of Continuous Traffic		
Volume Level	100%	80%
Major Rd. Req		
Minor Rd. Req		
Number of Hours	0	0

Satisfied?

Condition C:
Combination of A & B at 80%

Satisfied?

6:00 AM	Enter Start Time (Military Time) (HH:MM)				
Time Period	**From**	**To**	**Major Road: Both App. (VPH)**	**Minor Road: High App. (VPH)**	**Total**
1	6:00	7:00			
2	7:00	8:00			
3	8:00	9:00			
4	9:00	10:00			
5	10:00	11:00			
6	11:00	12:00			
7	12:00	13:00			
8	13:00	14:00			
9	14:00	15:00			
10	15:00	16:00			
11	16:00	17:00			
12	17:00	18:00			
13	18:00	19:00			
14	19:00	20:00			
15	20:00	21:00			
16	21:00	22:00			

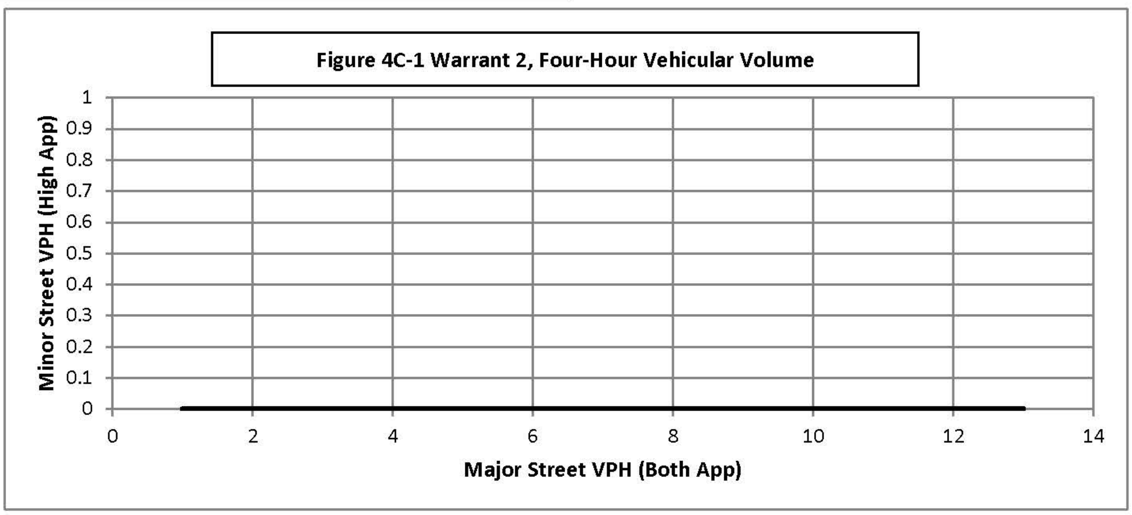
Warrant 2: Four-Hour Volume 100%

Warrant Evaluated?

Warrant Satisfied? N/A

Manually Set To:

Hour Start	#N/A	#N/A	#N/A	#N/A
Major Road Vol.	#N/A	#N/A	#N/A	#N/A
Minor Road Vol.	#N/A	#N/A	#N/A	#N/A



2

Warrant 3: Peak Hour Volume 100%

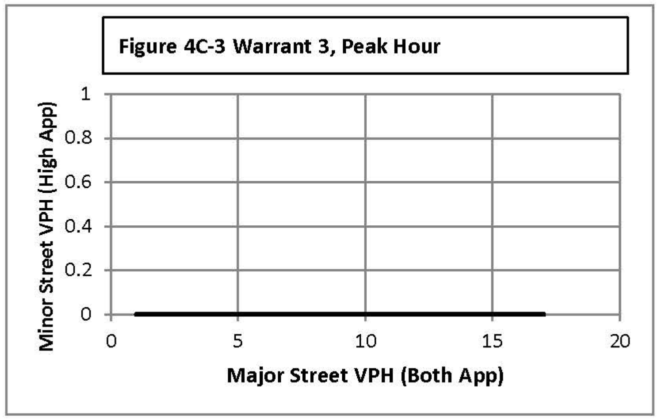
Warrant Evaluated? **Warrant Satisfied? N/A** **Manually Set To:**

Condition justifying use of warrant:

Criteria		Met?
Delay on Minor Approach		
Volume on Minor Approach		
Total Entering Volume (veh/h)		

Manually Set Peak Hour?

Peak Hour	Major Road Vol. (Both App.)	Minor Road Vol. (High App.)
#N/A	#N/A	#N/A



Warrant 4: Pedestrian Volume 100%

Warrant Evaluated? **Warrant Satisfied? N/A** **Manually Set To:**

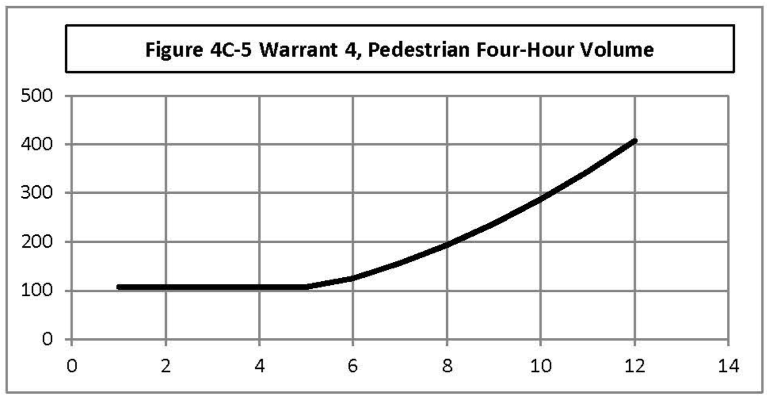
Criterion A: Four Hour

Hour (Start)	Pedestrian Volume	Major Road Vol.
		0
		0
		0
		0

Manually Set Major Rd Vol?

Avg. walk speed less than 3.5 ft/s?

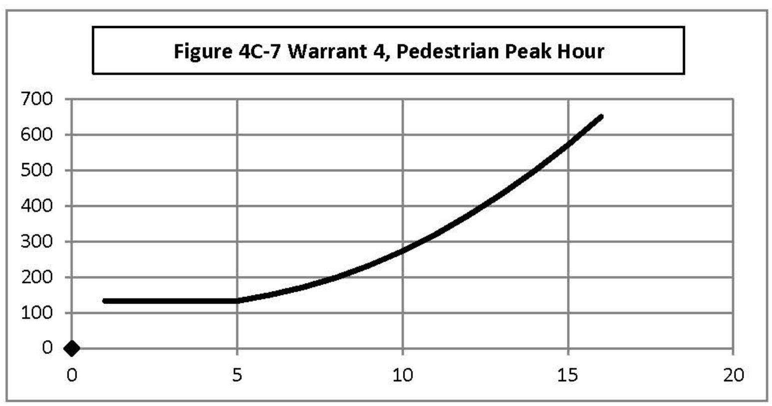
Criterion A Satisfied?



Criterion B: Peak Hour

Peak Hour	Pedestrian Vol.	Major Road Vol.
0:00	0	0

Criterion B Satisfied?



3

Warrant 5: School Crossing — 100%

Warrant Evaluated? **Warrant Satisfied? N/A** **Manually Set To:**

Criteria		Fulfilled?
1	There are a MINIMUM of 20 school children during the highest crossing hour.	
2	There are fewer adequate gaps in the major road traffic stream during the period when the school children are using the crossing than the number of minutes in the same period.	
3	The nearest traffic signal along the major road is located more than 300 ft away. Or, the nearest traffic signal is within 300 ft but the proposed traffic signal will not restrict the progressive movement of traffic.	

Warrant 6: Coordinated Signal System — 100%

Warrant Evaluated? **Warrant Satisfied? N/A** **Manually Set To:**

Criteria		Fulfilled?
1	Signal spacing > 1000 ft	
2	On a one-way road or a road that has traffic predominantly in one direction, the adjacent signals are so far apart that they do not provide the necessary degree of vehicle platooning.	
3	On a two-way road, adjacent signals do not provide the necessary degree of platooning and the proposed and the adjacent signals will collectively provide a progressive operation.	

Warrant 7: Crash Experience — 100%

Warrant Evaluated? **Warrant Satisfied? N/A** **Manually Set To:**

Criteria			Met?	Fulfilled?
1	Adequate trial of other remedial measures has failed to reduce crash frequency.			
	Measures Tried:			
2	Five or more reported crashes, of types susceptible to correction by signal, have occurred within a 12 month period.	# of crashes per 12 months		
3	Warrant 1, Condition A (80%)		No	Yes
	Warrant 1, Condition B (80%)		No	
	Warrant 4, Criterion A (80%)		No	
	Warrant 4, Criterion B (80%)		Yes	

Warrant 8: Roadway Network — 100%

Warrant Evaluated? **Warrant Satisfied? N/A** **Manually Set To:**

Criteria							Met?	Fulfilled?
1	Total entering volume of at least 1,000 veh/h during typical weekday peak hour					#N/A	#N/A	#N/A
	Five-year projected volumes that satisfy one or more of Warrants 1, 2, or 3.						No	
2	Total entering vol. of at least 1,000 veh/h for each of any 5 hrs of non-normal business day (Sat. or Sun.)							
	Hour							
	Volume							

Characteristics of Major Routes - Select yes if all intersecting routes have characteristic		Fulfilled?
1	Part of the road or highway system that serves as the principal roadway network for through traffic flow	
2	Rural or suburban highway outside of, entering, or traversing a city	
3	Appears as a major route on an official plan	

Warrant 9: Intersection Near a Grade Crossing 100%

Warrant Evaluated? **Warrant Satisfied? N/A** **Manually Set To:**

Adjustment Factors			Manually Set Peak Hour?				
Rail Traffic per Day	% High Occupancy Buses on Minor Road	% Tractor-Trailer Trucks on Minor Road	D	Peak Hour	Major Road Vol.	Minor Road Vol.	Adjusted Minor Vol.
1	0	0% to 2.5%	660	#N/A	#N/A	#N/A	#N/A

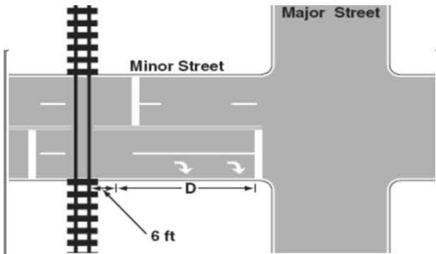
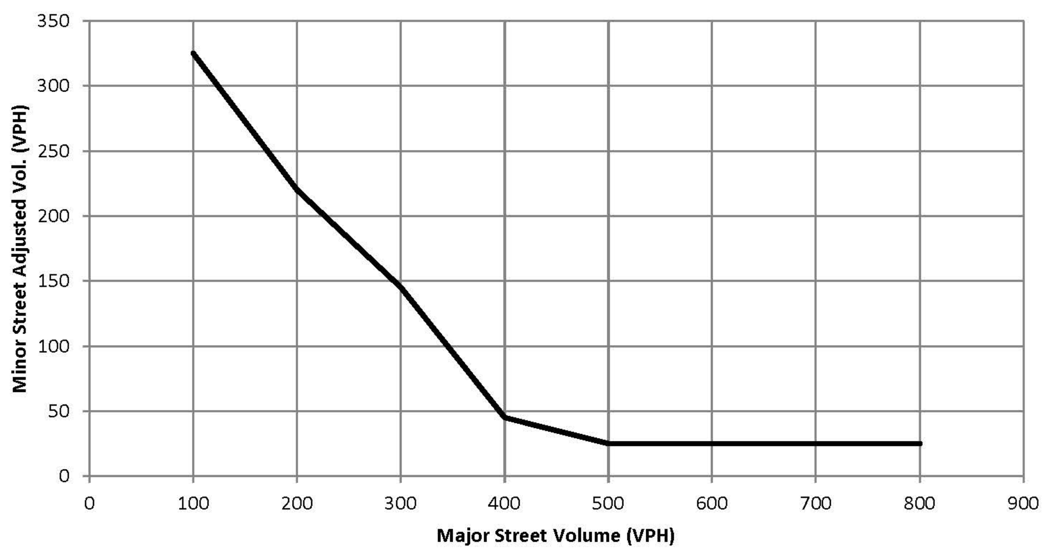


Figure 4C-10 Warrant 9, Intersection Near a grade Crossing (Two or More Approach Lanes at the Track Crossing)



Conclusions/Comments:

Updated: 12/6/2017

5

Example Intersection Plan Sheet

Conceptual Design

Traffic Signal Installation

WIS 164 & Lindsay Road

Lanes, Volumes, Timings
3: WIS 164 & Lindsay Road

AM Peak
01/11/2024

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	81	30	38	1	58	19	30	414	1	10	943	129
Future Volume (vph)	81	30	38	1	58	19	30	414	1	10	943	129
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		0	0		0	250		210	250		200
Storage Lanes	0		0	0		0	1		1	1		1
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	1.00	1.00	0.95	1.00
Frt		0.965			0.967				0.850			0.850
Flt Protected		0.974			0.999		0.950			0.950		
Satd. Flow (prot)	0	1717	0	0	1817	0	1671	3343	1495	1770	3539	1583
Flt Permitted		0.974			0.999		0.950			0.950		
Satd. Flow (perm)	0	1717	0	0	1817	0	1671	3343	1495	1770	3539	1583
Link Speed (mph)		35			35			45			45	
Link Distance (ft)		1442			1336			1442			1508	
Travel Time (s)		28.1			26.0			21.8			22.8	
Peak Hour Factor	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85
Heavy Vehicles (%)	4%	4%	4%	1%	1%	1%	8%	8%	8%	2%	2%	2%
Adj. Flow (vph)	95	35	45	1	68	22	35	487	1	12	1109	152
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	175	0	0	91	0	35	487	1	12	1109	152
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		0			0			12			12	
Link Offset(ft)		0			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		9	15		9	15		9
Sign Control		Stop			Stop			Free			Free	

Intersection Summary	
Area Type: Other	
Control Type: Unsignalized	
Intersection Capacity Utilization 47.8%	ICU Level of Service A
Analysis Period (min) 15	

HCM 6th TWSC
3: WIS 164 & Lindsay Road

AM Peak
01/11/2024

Intersection	
Int Delay, s/veh	7

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	81	30	38	1	58	19	30	414	1	10	943	129
Future Vol, veh/h	81	30	38	1	58	19	30	414	1	10	943	129
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	250	-	210	250	-	200
Veh in Median Storage, #	-	2	-	-	2	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	85	85	85	85	85	85	85	85	85	85	85	85
Heavy Vehicles, %	4	4	4	1	1	1	8	8	8	2	2	2
Mvmt Flow	95	35	45	1	68	22	35	487	1	12	1109	152

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	1481	1691	555	1153	1842	244	1261	0	0	488	0	0
Stage 1	1133	1133	-	557	557	-	-	-	-	-	-	-
Stage 2	348	558	-	596	1285	-	-	-	-	-	-	-
Critical Hdwy	7.58	6.58	6.98	7.52	6.52	6.92	4.26	-	-	4.14	-	-
Critical Hdwy Stg 1	6.58	5.58	-	6.52	5.52	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.58	5.58	-	6.52	5.52	-	-	-	-	-	-	-
Follow-up Hdwy	3.54	4.04	3.34	3.51	4.01	3.31	2.28	-	-	2.22	-	-
Pot Cap-1 Maneuver	~ 85	90	470	154	75	760	516	-	-	1071	-	-
Stage 1	213	272	-	485	513	-	-	-	-	-	-	-
Stage 2	636	505	-	460	235	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	~ 55	83	470	116	69	760	516	-	-	1071	-	-
Mov Cap-2 Maneuver	178	230	-	269	179	-	-	-	-	-	-	-
Stage 1	199	269	-	452	478	-	-	-	-	-	-	-
Stage 2	493	471	-	358	232	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	61.9	32.4	0.8	0.1
HCM LOS	F	D		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	516	-	-	224	221	1071	-	-
HCM Lane V/C Ratio	0.068	-	-	0.783	0.415	0.011	-	-
HCM Control Delay (s)	12.5	-	-	61.9	32.4	8.4	-	-
HCM Lane LOS	B	-	-	F	D	A	-	-
HCM 95th %tile Q(veh)	0.2	-	-	5.6	1.9	0	-	-

Notes

~: Volume exceeds capacity $: Delay exceeds 300s +: Computation Not Defined *: All major volume in platoon

CRASH REPORT EXAMPLE

MAPPED	DOCTNMBR	ACCDDATE	NTFYHOUR	REGION	COUNTY	MUNICIPALITY	MUNITYPE	ONHWYRP	ONHWYDIR	ONHWY	ONSTR	ATHWY	ATSTR	ATNMBR	INTDIR	INTDIS
Y	75L0P4K13N	6/4/2019	16	SE	WALWORTH	BLOOMFIELD	T	120	S	120			N BLOOMFIELD RD			0
Y	75L0V3XHJW	2/13/2019	7	SE	WALWORTH	BLOOMFIELD	T	120	S		N BLOOMFIELD RD	120			W	1
Y	B8L0NLHJNL	10/10/2017	16	SE	WALWORTH	BLOOMFIELD	T	120	S	120			N BLOOMFIELD RD			0
Y	B8L0NLHJQ6	10/31/2018	15	SE	WALWORTH	BLOOMFIELD	T	120	S	120			N WELLS ST		E	34
Y	B8L0NLHJQ7	10/30/2018	18	SE	WALWORTH	BLOOMFIELD	T	120	S	120			N BLOOMFIELD RD		E	0
Y	B8L0XTDXVT	5/29/2017	11	SE	WALWORTH	BLOOMFIELD	T	120	S		N BLOOMFIELD RD	120			W	1
Y	B8L0Z7RB01	1/27/2019	10	SE	WALWORTH	BLOOMFIELD	T	120	S		N BLOOMFIELD RD	120			W	1
Y	B8L0Z7RB0Q	11/13/2019	19	SE	WALWORTH	BLOOMFIELD	T	120	S	120			N BLOOMFIELD RD		S	1
Y	B8L0Z90C3S	1/11/2020	9	SE	WALWORTH	BLOOMFIELD	T	120	S		N BLOOMFIELD RD	120			W	2
Y	B8L0Z90C3T	1/11/2020	12	SE	WALWORTH	BLOOMFIELD	T	120	S		N BLOOMFIELD RD	120			W	2
Y	B8L0ZCGFBN	1/23/2020	15	SE	WALWORTH	BLOOMFIELD	T	120	S	120		120				0
Y	B8L0ZCGFC0	6/2/2020	18	SE	WALWORTH	BLOOMFIELD	T	120	S	120			N BLOOMFIELD RD		S	0
Y	B8L12XVNB8	1/17/2020	16	SE	WALWORTH	BLOOMFIELD	T	120	S		N BLOOMFIELD RD	120			W	2
Y	CNL097RB05	6/4/2018	16	SE	WALWORTH	LAKE GENEVA	C	120	N	120			N WELLS ST		E	36
Y	CNL0990C7C	11/7/2019	8	SE	WALWORTH	LAKE GENEVA	C	120	S	120			N BLOOMFIELD RD		N	1
Y	CNL09PBQ7H	9/5/2018	21	SE	WALWORTH	BLOOMFIELD	T	120	S		N BLOOMFIELD RD	120			W	1
Y	KR6KSW1	8/1/2016	16	SE	WALWORTH	BLOOMFIELD	T	120	N		N BLOOMFIELD RD	120				0
Y	LWJLK2R	4/15/2016	22	SE	WALWORTH	LAKE GENEVA	C	120	N	120 NB			N BLOOMFIELD RD			0
Y	LWMLXD9	11/23/2016	15	SE	WALWORTH	LAKE GENEVA	C	120	S	120			N BLOOMFIELD RD			0

DOCTNMBR	ACCDTYPE	MNRCOLL	RLTNRDWY	ACCDLOC	HWYCLASS	TRFCWAY	ROADCOND	WTHRCOND	LGTCOND	ROADHOR	ROADVERT	ACCDSVR	INJSVR	INJTRNS	TOTFATL	TOTINJ	CONSZONE	ALCFLAG	BIKEFLAG	CYCLFLAG	PEDFLAG
75L0P4K13N		ANGL	ON	I	R STH	ND		CLR				INJ	B	Y	0	3					
75L0V3XHJW		ANGL	ON	I	R TOWN	ND	ICE	WIND				PD			0	0					
B8L0NLHJNL		ANGL	ON	I	R STH	D/WO	WET	RAIN				INJ	B	Y	0	1					
B8L0NLHJQ6		ANGL	ON	I	R STH	D/WO		CLDY				PD			0	0					
B8L0NLHJQ7		ANGL	ON	I	R STH	ND	WET	RAIN	DUSK			INJ	C	Y	0	1					
B8L0XTDXVT	CULVRT	NO	RTSH	I	R TOWN	ND		CLR				INJ	A	Y	0	3					
B8L0Z7RB01		ANGL	ON	I	R TOWN	ND	WET	CLR				PD			0	0					
B8L0Z7RB0Q		REAR	ON	N	R STH	D/WO	WET	SNOW	LIGT			PD			0	0					
B8L0Z90C3S		ANGL	ON	N	R TOWN	ND	WET	RAIN				PD			0	0					
B8L0Z90C3T		ANGL	ON	N	R TOWN	ND	WET	RAIN				PD			0	0					
B8L0ZCGFBN		ANGL	ON	I	R STH	D/WO	WET	CLDY				PD			0	0					
B8L0ZCGFC0		ANGL	ON	I	R STH	ND		CLR				INJ	C	Y	0	1					
B8L12XVNB8		ANGL	ON	I	R TOWN	D/WO	SNOW	SNOW	DAWN			PD			0	0					
CNL097RB05		ANGL	ON	I	U STH	D/B		CLR				INJ	B		0	1					
CNL0990C7C		ANGL	ON	I	U STH	ND	ICE	CLR				INJ	C		0	1					
CNL09PBQ7H		ANGL	ON	I	R TOWN	ND	WET	RAIN	LIGT			PD			0	0					
KR6KSW1		ANGL	ON	I	R TOWN	D/WO		CLR				PD			0	0					
LWJLK2R	TFSIGN	NO	MED	I	U STH	D/WO		CLDY	LIGT			PD			0	0					
LWMLXD9		ANGL	ON	I	U STH	D/WO	WET	RAIN	DUSK			PD			0	0					

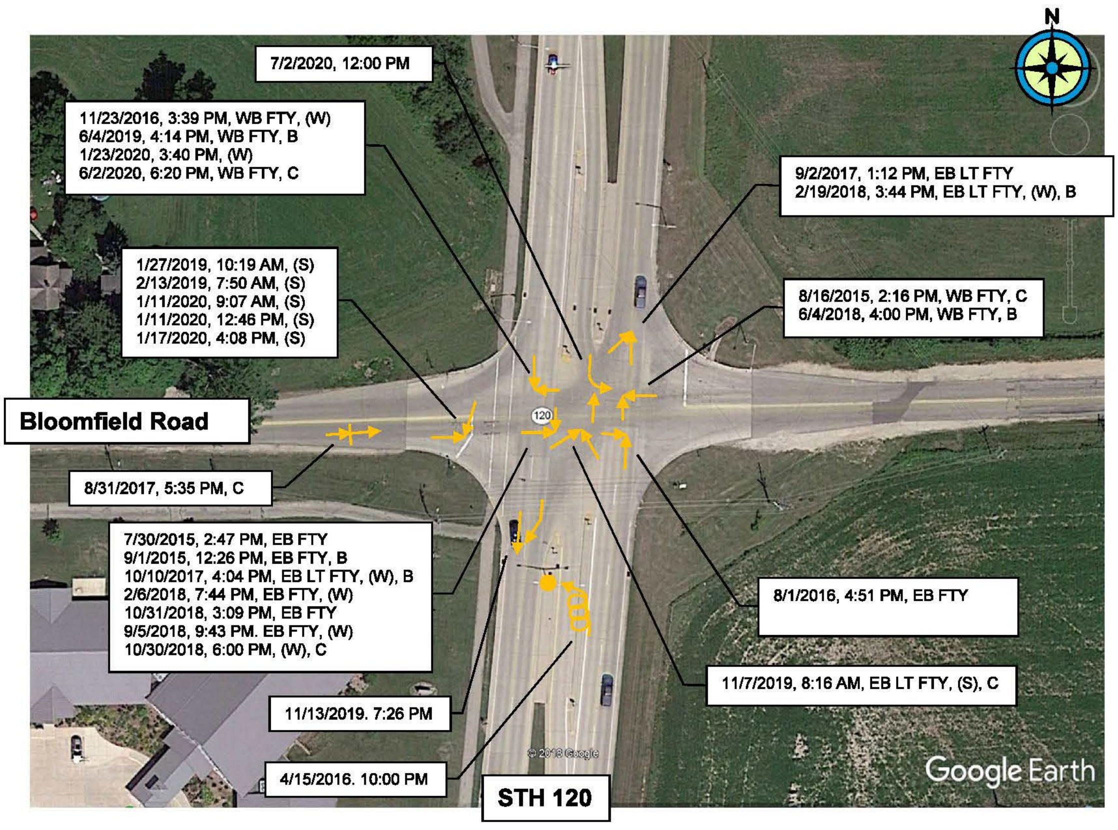
DOCTNMBR	TOTVEH	VEHTYPE1	VEHDMG1	TRVLDIR1	DRVRDO1	TRFCNTL1	POSTSPD1	AGE1	SEX1	INJSVR1	SAFETY1	DRVRPC1	STNM11	STNM12	VEHTYPE2	VEHDMG2	TRVLDIR2	DRVRDO2	TRFCNTL2	POSTSPD2	AGE2	SEX2	INJSVR2	SAFETY2	DRVRPC2	STNM21	STNM22
75L0P4K13N	3	CAR	SVR	W	GO STR	SS	35	66	F	B	SH/LP	FTY	346.06		CAR	SVR	S	GO STR	NONE	45	61	M	C	SH/LP			
75L0V3XHJW	3	CAR	MNR	N	STOPED	SS	25	49	F		SH/LP				CAR	MNR	N	STOPED	SS	25	58	M		SH/LP			
B8L0NLHJNL	2	CAR	MNR	E	LT TRN	SS FL	45	38	M		SH/LP	FTY	346.32		CAR	SVR	S	GO STR	SS FL	45	55	M	B	SH/LP			
B8L0NLHJQ6	2	CAR	MNR	E	GO STR	SS FL	45	17	M		SH/LP	FTY	346.18(3)		CAR	MNR	S	GO STR	NONE	45	19	F		SH/LP			
B8L0NLHJQ7	2	CAR	MNR	E	GO STR	SS	45	44	M		UNKN	FTY	344.62(1)	346.18(3)	CAR	SVR	S	GO STR	NONE	45	17	M		SH/LP			
B8L0XTDXVT	1	TRK UT	SVR	W	BLNK	SS	35	49	F	A	SH/LP	OTHR															
B8L0Z7RB01	2	CAR	MOD	S	RT TRN	NONE	45	23	F		SH/LP	TFC,FVC	346.57(3)		TRK UT	MNR	E	GO STR	SS	25	23	M		SH/LP			
B8L0Z7RB0Q	2	TRK UT	MNR	S	GO STR	NONE	45	56	M		SH/LP				CAR	MNR	S	CHG LN	NONE	45	23	F		SH/LP	FVC,FVC,IO		
B8L0Z90C3S	2	CAR	MNR	W	RT TRN	SS	35	67	F		SH/LP	TFC	346.57(3)		CAR	MNR	E	GO STR	SS	35	39	M		SH/LP			
B8L0Z90C3T	2	CAR	SVR	W	RT TRN	SS	35	31	F		SH/LP	TFC	346.57(3)		CAR	SVR	E	OTHR	SS	35	29	M		SH/LP			
B8L0ZCGFBN	2	CAR	MNR	S	GO STR	NONE	45	62	F		SH/LP				CAR	BLNK		BLNK	BLNK	45	0	N		NONE			
B8L0ZCGFC0	2	CAR	SVR	W	GO STR	SS	45	24	F		UNKN	FTY	346.18(3)		CAR	SVR	S	GO STR	NONE	45	18	M	C	SH/LP			
B8L12XVNB8	2	CAR	MNR	S	RT TRN	NONE	45	46	M		SH/LP	TFC,FVC			CAR	MNR	E	SL/ST	SS	35	17	F		SH/LP			
CNL097RB05	2	CAR	SVR	W	GO STR	SS	45	25	M		SH/LP	FTY	346.18(3)		CAR	SVR	N	GO STR	NONE	45	70	F	B	SH/LP			
CNL0990C7C	2	CAR	BLNK	E	LT TRN	SS	35	35	M		UNKN	FTY			CAR	MOD	N	LT TRN	SS	45	63	M	C	SH/LP			
CNL09PBQ7H	2	CAR	MOD	E	GO STR	SS	30	27	M		SH/LP		346.18(3)		CAR	SVR	S	GO STR	NONE	45	30	M		SH/LP			
KR6KSW1	2	CAR	SVR	E	GO STR	SS	35	61	F		SH/LP	FTY	346.18 3		TRK UT	MOD	N	GO STR	NONE	45	54	M		SH/LP			
LWJLK2R	1	CAR	MOD	N	GO STR	NONE	45	63	M		UNKN	FVC															
LWMLXD9	2	CAR	SVR	W	GO STR	SS	35	33	F		SH/LP	FTY	346.18 3	344.62 1	CAR	SVR	S	GO STR	NONE	45	36	M		SH/LP		344.62 1	

DTSD – SE Region
Intersection Safety Evaluation

Attachment 3: Crash Diagram

STH 120 & N. Bloomfield Road

Walworth County — **January 2015-Preliminary 2020**



LEGEND							
Signal/Sign Post	Bicycle	Right Angle	Out of Control	(S) = SNOW-ICE	K = FATAL
Tree/Utility Pole	Pedestrian	Left Turn	Rear-End	(W) = WET	A = SUS. SERIOUS INJURY
Non-Fixed Object	Non-Contact Vehicle	Right Turn	Head-On	(F) = FOG-MIST	B = SUS. MINOR INJURY
Fixed Object	Backing Vehicle	Sideswipe-Same	Overtake	(DUI) = ALCOHOL	C = POS. INJURY
Parked Vehicle	Moving Vehicle	Sideswipe-Opp.	Overturn	OR DRUG USE	BLANK = PROPERTY

Traffic Engineering, Operations & Safety Manual

Chapter 4 Signals

Section 5 Signal Plan Format

4-5-1 Permanent Signal Plan Format April 2025

GENERAL

Preparation of signal plans involves preparing a set of detailed drawings showing location, geometric configuration, quantities, and details of work to be performed on a project. The objective of this section is to present standards that will meet the requirements of the Department.

Preparation of traffic signal plan sheets **shall** follow base sheets that have been developed in the FDM Chapter 15, Plan Preparation. The signal plan sheet set **shall** be in one design file. The number and type of sheets are dependent on the type of traffic signal installation. As a minimum, the signal plan set **shall** include:

1. Plan Sheet(s)
2. Sequence of Operations Sheet
3. Cable routing sheet

And if applicable:

1. Temporary signal plan
2. Temporary Sequence of Operations Sheet
3. Miscellaneous quantities for electrical items
4. Engineering estimate for electrical items
5. Special provisions pertaining to electrical items
6. Signal Removal plans
7. Details of non-standard items
8. List of SDDs, general construction notes, and construction details pertaining to electrical items

To obtain a signal number (e.g., S 18-1006), the Regional Traffic Signal Unit will assign the signal number once the DT1199 form has been approved by the Bureau of Traffic Operations. In rare cases, a T-number *may* be assigned instead of an S-number due to the temporary nature of the signal.

The Sequence of Operations Sheet comes in three variations: 1) TS1; 2) Econolite TS2; and 3) Eagle TS2.

Consultants' logos **shall not** be included on the signal plans. These two sheets, along with the plan sheet and cell libraries, are available from the Department for CADD usage.

Consultant prepared plans **shall** be signed and sealed by a Professional Engineer registered in Wisconsin and submitted to the Regional Traffic Signal Engineer for approval. Electronic CADD files **shall** be submitted in accordance with the FDM.

An original, 11”X17” signal plan signed by the Regional Traffic Signal Engineer Professional Engineer (refer to Wis. State Statute 443) or delegate, needs to be submitted by the Regions to Central Office, Bureau of Traffic Operations for all new signal plans and for signal plan revisions.

All signal plan sets, including those in a PS&E submittal or permit application, must be submitted to the Regional Traffic Unit for approval. If the signal plan is part of a PS&E, the signal plan must be submitted to the Region at least one month prior to the draft PS&E date. Upon approval by the Regional Traffic Signal Engineer, it is the responsibility of the Region to submit the signal plan to the Bureau of Traffic Operations for approval. If a signal plan is to be included in a permit application, the permit coordinator will submit the signal plan to the Regional Traffic Signal Engineer for approval. Upon approval by the Region, it is the responsibility of the Region to submit the signal plan to the Bureau of Traffic Operations for approval.

PLAN SHEET

1. Signal plans **shall** have a signature block in the lower right hand corner showing approvals and revision history. Use the appropriate signature block on the signal plan to distinguish between connecting highways and state-owned signals.
    a. Page 1 Signature block for state owned signals (see Figure 1.1a)
    b. Page 1 Title block for connecting highways and locally owned streets (see Figure 1.1b)
    c. Signal plan page 2 identification block, if required (see Figure 1.1c)
    d. Page 1 Revision block, if required (see Figure 1.1d)
    e. Sequence of operations block (see Figure 1.1e)

Figure 1.1a. Traffic Control Signal Plan Page 1 Signature Block for State-owned Signals

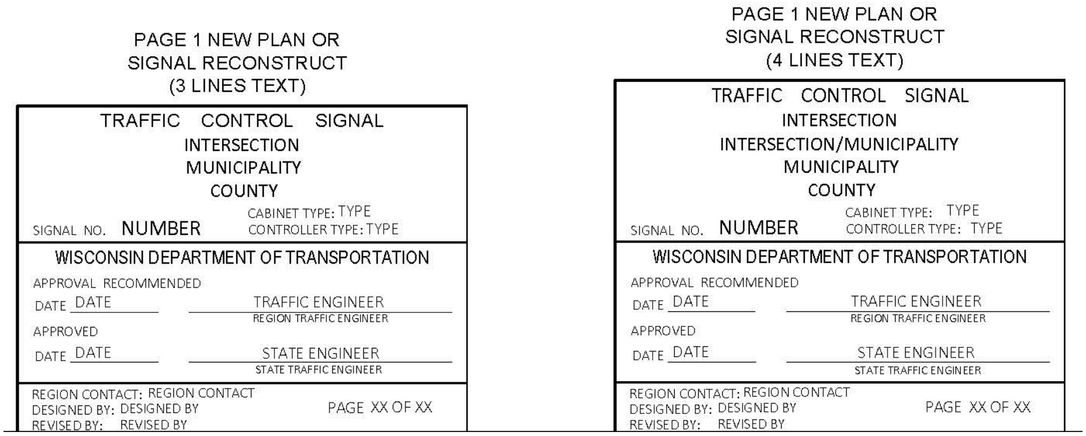


Figure 1.1b. Traffic Control Signal Plan Page 1 Title Block for Connecting Highway and Local Signals

Figure 1.1c. Traffic Control Signal Plan Page 2, 3, 4, etc. Block for state-owned signals

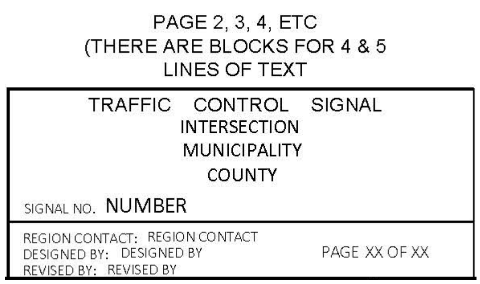


Figure 1.1d. Traffic Control Signal Plan Page 1 Revision Block for state-owned signals

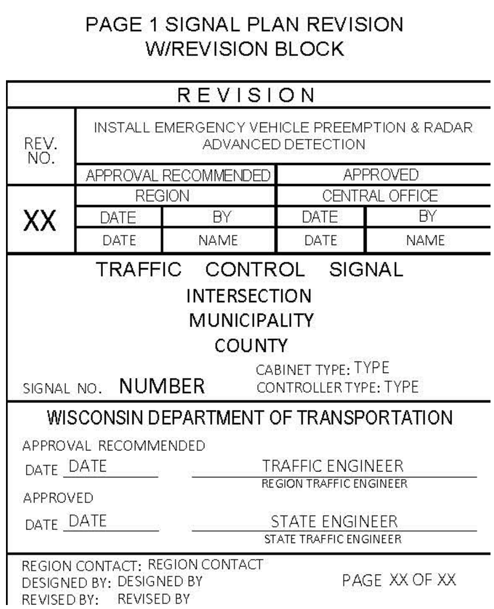
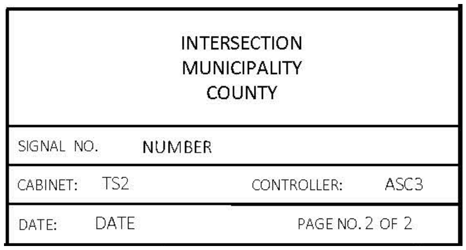


Figure 1.1e. Traffic Control Signal Plan Sequence of Operations Block



According to state statute 443.08(4)(b), final signal plans **shall** bear the signature of a professional engineer. In addition, PS&E plans not developed by WisDOT staff **shall** bear the stamp of the consultant designer.

1. Show North arrow on all sheets.
2. The mainline roadway *should* be oriented horizontally on the plan sheet. Typically, the STH *should* be designated as the mainline.
3. Matchlines **shall** be used instead of breaklines. Matchlines are helpful for indicating utility locates, approach geometries, intermediate access points, and signal infrastructure placement.
4. NEMA phasing convention **shall** be used. Typically, NEMA phase 6 is in the Cardinal direction (Northbound/Eastbound).
5. Show curb cuts, ramps, sidewalks, crosswalks and stop bars due to their influence on signal base and detection placement.
6. Pavement markings **shall** be shown on the signal plan. Lane lines need to be shown due to their effect on detector placement past the far loops. Informational lane designation arrows *may* be shown on complicated designs. If the pavement marking plan is not incorporated into the plan sheet, and arrows are shown for lane designation purposes, supply the symbols and a note in the legend saying, “Arrows shown are for lane designation and are for information only”.
7. Show posted speed limits on each approach.
8. Show right-turn control. STOP or YIELD if separated by an island and not controlled by the signal.
9. The Department has created a CADD cell library specifically to aid in the creation of signal and lighting plans. The State signal cell library **shall** be used for signal design. Each signal and pedestrian head **shall** have a number.
10. Show and label asphalt-to-concrete-pavement joints. Loop detectors *should not* cross these joints; therefore, they are important for detector placement.
11. Show municipal lighting, if any, and state lighting. It is the policy of the Department to light signalized intersections.
12. All signal plans **shall** show utilities, including overhead lines.
13. Show mast arm lengths for mast arm installations. Show monotube arm lengths for monotube arm installations.
14. Each detector **shall** be a two-digit number, the first digit of the number being the phase number with which it is associated.
15. Signal plans **shall** be drawn and printed at 1”=40’ scale on an 11”x17” (D-size) number 2 tab plan sheet. For signal plans to be included in a PS&E submittal, refer to FDM Chapter 15, Plan Preparation.
16. Show Right-of-way gray shaded.
17. Show reference line.
18. Show access points.
19. Existing geometrics on fully reconstructed intersections **shall not** be shown.

The Regional Traffic Signal Unit will assign an intersection signal number (“S”, “M”, “T” or “U” number) as required for proper identification & future reference.

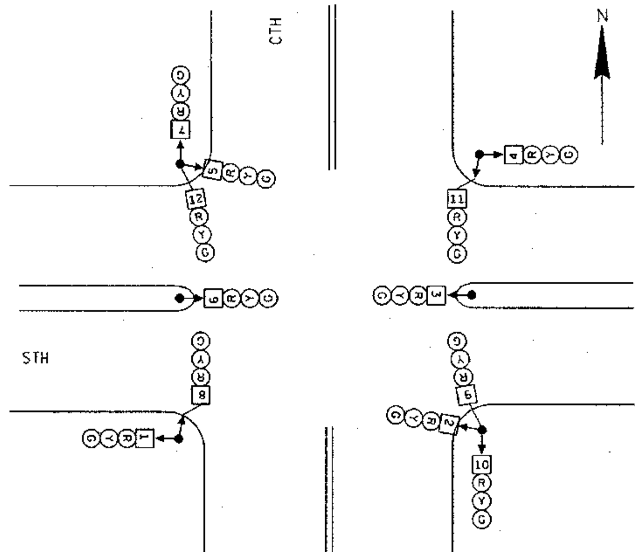
Signal equipment to be installed in the field are identified on the plan and quantity sheets by the schemes described below, these schemes *should* be applied on a per signalized intersection basis. In the case where multiple signal plans exist along a corridor within the same plan set, these numbering schemes **shall** apply to individual signal locations.

Signal Head Numbering

Individual signal heads **shall** be uniquely numbered. Head numbering is arbitrary, but typical practice is to number signal heads by approaches.

Pedestrian head numbers **shall** also be numbered. When using the same numbering scheme for both signal and pedestrian heads, first number all vehicular signal indications, then label pedestrian heads starting with the next consecutive number.

Figure 1.2. Signal Head Numbering



Detection Numbering

Loops **shall** be designated by two numbers (NEMA phase + consecutive numbering systems as described below). Detection associated with an overlap **shall** be designated with the NEMA phases that it accompanies. Dimensions and number of turns **shall** be included on the traffic signal plan sheet or in the case of a TS1 cabinet, the sequence of operation sheet.

Number loops starting at advanced detection to near stop bar detection, then right lane to left lane. If left turns phases are added, left turn loops do not influence renumbering of other detection.

Signal Base Numbering

Signal base numbers **shall** be prefixed with an "SB" and numbered consecutively in the clockwise direction starting at the signal cabinet.

Light Base Numbering

Lighting bases that only have lighting equipment on them **shall** be prefixed with an "LB".

Cabinet Numbering

The main cabinet base **shall** be called "CB1", a splice cabinet **shall** be called "CB2" and temporary cabinets **shall** be called "TCB1".

Pull Box Numbering

Pull box numbers **shall** be prefixed with a "PB" and numbered consecutively in the clockwise direction starting at the signal cabinet.

SEQUENCE OF OPERATIONS SHEET

The standardized Sequence of Operations Sheet is in the State standard cell library.

The guidelines listed below **shall** be followed when preparing the Sequence of Operations Sheet.

1. Show North arrow. It **shall** be oriented the same as the plan sheet. The arrows in the boxes on the sequence of operations **shall not** be rotated and **shall** remain oriented up and down or left and right. The north arrow *may* be rotated up to 45 degrees in either direction to accomplish this.
2. NEMA phasing **shall** be used for uniform phase numbering. Use phases 2 & 6 for the mainline and phases 4 & 8 for the cross street. Phase 6 **shall** be for the northbound or eastbound phase and phase 8 **shall** be counterclockwise from phase 6 (the phasing and directions can be changed only in special phasing situations, such as interchanges, T-intersections, or split-phase operations).
3. The pedestrian movements are shown with half arrow heads.

4. If the word "phase" is listed in a column, the symbol "Ø" does not need to be shown. Using just the number is sufficient.
5. In the controller logic box, the phase-recall column *should* be listed as "MIN", "MAX", "PED", and/or "SOFT". The remaining columns *should* have either a number or an "X."
6. Overlaps can be shown in one of two ways:
   a. A movement is active or allowed to be on with 2 or more phases.
   b. A Flashing Yellow Arrow.

SIGNAL CABLING

For all new or reconstructed state-owned signals installed under contract, a Cable Routing Schedule **shall** be included, and reviewed by the Regional Electrical staff and the Regional Traffic Signal Engineer as part of the signal plan review process.

The Cable Schedule assures the maintaining electrical staff that the standard WisDOT wiring scheme is followed. Electrical staff *should* be contacted prior to preparing the Cable Routing Schedule to discuss proper wiring practices. Additionally, it is important that this plan sheet correctly identifies the wiring scheme as installed at the intersection. A sample of the chart is provided.

The cable routing sheet is also used by the electrical contractor as a blueprint for the routing of the signal feeder cables and field connections. This sheet will also aid the signal designer when determining miscellaneous quantities.

This section presents information, some of which has been previously printed in such documents as the State of Wisconsin Standard Specifications for Highway and Structure Construction (Specification 655), Standard Detail Drawings, and the Wisconsin Electrical Code.

<u>COMPLETION OF THE CABLE ROUTING SCHEDULE</u>

At the top left of the cable routing sheet, insert the project identification number followed by the intersection name and signal number.

The color-coding chart provides identification of each conductor within the signal feeder cables. The conductor colors and sequence for cables can be found in the International Municipal Signal Association, Inc. (IMSA) specification No. 20-1. Base colors **shall** consist of colored insulation. Tracers **shall** be colored stripes or bands along the surface of the insulation. The color-coding chart utilizes the use of a three-letter abbreviation for each conductor color. Examples: RED=red, ORG=orange, GRN=green and for the tracer colors: WHT/BLK=white/black, RED/WHT=red/white, etc.

There are six tables placed in the cable routing sheet, which are:

- SIGNAL FEEDER CABLES
- EQUIPMENT GROUNDING CONDUCTOR
- CONDUCTIVE PULL BOX BONDING JUMPERS
- LIGHTING CABLES
- EMERGENCY VEHICLE PREEMPTION CABLES
- NON-INTRUSIVE DETECTION

To fill in the cable routing sheet from the example Second Revision Plan, the signal feeder cable goes from the cabinet base (i.e. CB1) to each signal base (i.e. SB1). For SB1, the minimum number of conductors needed is 7 and a maximum will typically be 15 conductors. The following concepts apply to the example chart provided: head no. 18 requires 3 conductors, head no. 23 requires 2 conductors, 1 conductor is needed for the pedestrian push button (in some cases loop lead-in cable *may* be used instead), and 1 conductor is used for the grounded conductor. This example used a 12 conductor as a feeder cable. A 15 conductor could also be used, in either case this will provide some additional spare conductors to meet future needs.

<u>Signal Cable, IMSA-20-1, Ungrounded Conductors</u>

During emergency situations, it is imperative that the maintenance staff knows the wiring at the intersection. For this reason, the Signal Cable, IMSA-20-1, Ungrounded Conductors (wiring table) is very important. The wiring table identifies the signal cable path and wiring scheme for all signal and pedestrian indications at the intersection it is important that a copy of this be located inside the controller cabinet for use during maintenance. Wiring color schemes vary among Regions and local jurisdictions. Prior to beginning the wiring table, the maintaining electrician *should* be contacted to determine the proper routing procedure.

<u>Signal Feeder Cables Table</u>

The preferred method for installing signal feeder cable is to run a separate home run cable from the control cabinet base to each individual signal base. When selecting the number of conductors needed in each signal feeder cable, future signal expansion *should* be considered such as adding pedestrian heads, pedestrian push buttons, turn arrows, etc. Consideration *should* also be given to minimize the number of different sized cables to be used as feeder cables. For intersection wiring, it is easier to provide a few standard size cables like a 12-conductor cable instead of providing 7, 9, or 10 conductor cables.

The next entry on the chart is the signal head number and the phase the head is associated with as shown on the signal plan. In the example, Head 18 is a phase 4 head, head 23 is a phase 6 pedestrian head, and the push button is for the phase 6 ped.

To complete the entries for SB 1, the signal indication wire color section needs to be entered. Across the top of the chart are the signal indications. We start with the circular indications of red, yellow, and green followed by the arrow indications, the pedestrian signal indications, the pedestrian push buttons, and other. For each indication used, a signal feeder conductor is assigned to the signal indication. These colors are entered as shown in the signal wire color-coding section. Head # 18, RED = red, ORG = yellow, and GRN = green. Head #23 the DON'T WALK = BLK and the WALK = BLU. The push button needs 2 conductors. One conductor will be the WHT/BLK and the other side of the button will be connected to the grounded conductor (neutral) in the signal feeder cable. If loop lead-in cable is to be used for the pedestrian push buttons refer to the pedestrian push button chart.

Cable Routing Schedule Example

PROJECT ID:	
INTERSECTION:	

			SIGNAL INDICATION WIRE COLOR									
SC1 TO	CABLE (AWG 14)	HEAD NO.	RED	YELLOW	GREEN	FLASHING YELLOW	<RED>	<YELLOW>	<GREEN>	<FLASHING YELLOW>	DON'T WALK	WALK
SB1	12/C	81	RED	ORG	GRN	-	-	-	-	-	-	-
		72	-	-	-	-	RED/BLK	ORG/BLK	GRN/BLK	BLUE/BLK	-	-
SB2	12/C	42,43	RED	ORG	GRN	-	-	-	-	-	-	-
		71	-	-	-	-	RED/BLK	ORG/BLK	GRN/BLK	BLUE/BLK		
SB3	12/C	21	RED	ORG	GRN	-	-	-	-	-	-	-
		12	-	-	-	-	RED/BLK	ORG/BLK	GRN/BLK	BLUE/BLK	-	-
SB4	12/C	62,63	RED	ORG	GRN	-	-	-	-	-	-	-
		11	-	-	-	-	RED/BLK	ORG/BLK	GRN/BLK	BLUE/BLK	-	-
ESB307	12/C	41	RED	ORG	GRN	-	-	-	-	-	-	-
		32	-	-	-	-	RED/BLK	ORG/BLK	GRN/BLK	BLUE/BLK	-	-
		P62	-	-	-	-	-	-	-	-	BLK	BLUE
ESB308	12/C	31	RED	ORG	GRN	BLUE	-	-	-	-	-	-
		73	-	-	-	-	RED/BLK	ORG/BLK	GRN/BLK	BLUE/BLK	-	-
SB8	12/C	82,83	RED	ORG	GRN	-	-	-	-	-	-	-
		P82	-	-	-	-	-	-	-	-	BLK	BLUE
			-	-	-	-	-	-	-	-	-	-
			-	-	-	-	-	-	-	-	-	-
			-	-	-	-	-	-	-	-	-	-
			-	-	-	-	-	-	-	-	-	-
			-	-	-	-	-	-	-	-	-	-
			-	-	-	-	-	-	-	-	-	-
			-	-	-	-	-	-	-	-	-	-

To complete the wiring chart, an entry is added for each signal base and associated signal heads and pedestrian push buttons. The OTHER column is used for any shadow box signs, time of day signs, etc., fed out of the signal feeder cable.

Equipment Grounding Conductor

The equipment grounding conductors provide grounding for the physical elements at the intersection (i.e. controller cabinet, signal poles, pull boxes, light poles powered from signal cabinet). As with signal cable, the maintaining electrician *should* be contacted to determine the correct routing for the equipment grounding conductors.

Equipment Grounding Conductor Table

The equipment-grounding conductor is a stranded 10 AWG XLP insulated conductor used for grounding purposes. This wire **shall** have an insulation that is green. The conductor starts at the cabinet base and is jumpered in and out of each signal base and returning to the cabinet base. This creates a loop around the intersection. A stranded 10 AWG conductor is used due to the mechanical strength of the conductor. The use of a spare conductor from the signal feeder cable to be used as permitted. In the example, the equipment-grounding conductor starts at CB1 runs to SB20, to SB1, in and out of the signal bases to SB 19 and from SB 20 terminating back at CB1.

EQUIPMENT GROUNDING CONDUCTOR 10 AWG GRN XLP	
FROM	TO
CB 1	SB 1
SB 1	SB 2
SB 2	SB 3
SB 3	SB 4

SB 4	SB 5
SB 5	SB 6
SB 6	SB 7
SB 7	SB 8
SB 8	SB 9
SB 9	SB 10
SB 10	SB 11
SB 11	SB 12
SB12	SB 13
SB 13	SB 14
SB 14	SB 15
SB 15	SB 18
SB 19	SB 16
SB 16	SB 17
SB 17	SB 19
SB 19	SB 20
SB 20	CB 1

Conductive Pull Box Bonding Jumper Table

The pull box bonding jumper **shall** be in accordance with Specification 655.2.5. The purpose of this conductor is to bond all metal pull boxes and metal pull box covers that are used as a raceway for cables that carry voltages of 50 volts or more to ground. The pull box bonding jumper extends from the pull box to the nearest signal base or cabinet.

PULL BOX BONDING JUMPER 10 AWG GRN XLP	
FROM	TO
CB 1	PB 1
SB 2	PB 4
SB 3	PB 2
SB 4	PB 5
SB 6	PB 6
SB 6	PB 7
SB 8	PB 10
SB 10	PB 11
SB 11	PB 12
SB 11	PB 13
SB 13	PB 16
SB 14	PB 17
SB 16	PB 22
SB 18	PB 18
SB 18	PB 19
SB 19	PB 24
SB 20	PB 23
CB 1	PB 25

Lighting

The Lighting Chart identifies the routing for the lighting wire/cable. Since some Regions provide separate conduit for lighting systems, the cable routing *may* have been previously discussed with the maintaining engineer or electrician during the design; nevertheless, the wire/cable routing **shall** be included in the plans. Refer to Specification 655.3.4.

Lighting Table

Lighting fed from a signal cabinet is line to neutral (120V) or line to line (240V) Individual lighting feeder cables could be run to each light pole. Typically, a 12 AWG 2 conductor UF cable with ground feeds the intersection. For higher lighting loads and to maintain minimal voltage drops a larger conductor *may* be required. A maximum 5% voltage drop for a branch circuit is recommended according to the NEC. It is preferred to design up to a 3.5% maximum voltage drop, which would allow for some limited expansion of the lighting system in the future.

LIGHTING UF 12 AWG W/GROUND	
FROM	TO
CB 1	SB 21
SB 21	SB 5
SB 5	SB 6
SB 6	SB 9
CB 1	SB 20
SB 20	SB 18
SB 18	SB 15
SB 15	SB 11

When the load of the luminaires exceeds 16 amps, a separate lighting cabinet is required.

When separate traffic signal and street lighting systems are used, the systems **shall** be electrically isolated from each other. Each system would have a separate cabinet and underground conduit system. Examples would include signals and street lighting fed from two different power sources, lighting branch circuit loads exceeding 16 amperes, and/or lighting systems maintained by different governmental agencies.

Emergency Vehicle Preemption Table

The EVP cable and confirmation light cable (if applicable) **shall** be installed as shown on the plan and in accordance with the manufacturer's specifications. The cable(s) **shall** be installed from the control cabinet to the EVP detector head and to the confirmation light (if applicable) in one continuous non-spliced length. The EVP detector cable **shall** be terminated at the detector head and control cabinet. The confirmation light cable **shall** be terminated at the confirmation light and control cabinet. The cable(s) **shall** be routed through the underground conduit system using the shortest route.

EVP CABLE	
FROM	TO
CB1	HEAD 'C'
CB1	HEAD 'A'
CB1	HEAD 'D'
CB1	HEAD 'B'

Loop Detector Lead-in Cable & Loop Wire Table

Although loop detector lead-in cables are not shown on the chart, a separate loop detector lead-in cable **shall** be provided for each individual loop. This cable **shall** run from the cabinet base (CB) to the loop pull box used as the splice point. The detector lead-in cable **shall** be pulled thru each pull box without any additional loops or coils in each pull box. Excessive coils of detector lead in cables *may* affect the loop detector amplifier or detector card operation. At the splice point pull box, the detector cable **shall** extend 3 feet above the pull box cover for splicing purposes. At the control cabinet, the detector cable **shall** extend 3 feet above the top of the control cabinet to allow for future landing of the detector cables on the associated loop panel. Splices are made between the loop detector wire and the lead-in cable at the pull box at the side of the road.

Non-Intrusive Detection Cable Table

Non-Intrusive Detection cable **shall** be installed as shown on the plan and in accordance with the manufacturer's specifications. The cable **shall** be installed from the control cabinet to the device. The cable **shall** be routed through the underground conduit system using the shortest route. The type of cable along with the use of splices, signal repeaters/extenders, etc. **shall** be used according to manufacturer's specifications.

PROJECT ID:	0000-00-00
INTERSECTION:	STH XX and CTH XX

Signal Wire Color Coding			
	BLK - black	RED - red	GRN - green
	WHT - white	BLU - blue	ORG - orange

			SIGNAL INDICATION WIRE COLOR										
CB1 TO	AWG14 # OF CONDUCTORS	HEAD NO.	RED	YELLOW	GREEN	<RED>	<YELLOW>	<GREEN>	<FLASHING YELLOW>	D/WALK	WALK	PED BUTTON	OTHER
SB1	12	1	RED	ORG	GRN								

Equipment grounding conductor 10 AWG Green XLP	
From	TO

Pull Box Bonding Jumper 10 AWG Green XLP	
From	To

Lighting UF #12 w/ground	
From	To

EVP CABLE	
From	To

VIDEO DETECTION CABLE	
From	To

*Use the white conductor in the cable assembly as the grounded conductor for all traffic signal indications
*Ensure the grounded conductor in the feeder cable and the pole cables are both 18" longer than the ungrounded conductors.
*At the signal bases, connect one terminal from the pedestrian push buttons to the color indicated in the chart. Connect the other terminal to the grounded conductor.
*Reconnect the grounding conductors wherever the circuit has been interrupted to ensure the grounding circuit is complete.
*Reserve the Blue/Black conductor in the cable assembly as the APS conductor for all push buttons

UNDERGROUND PLAN FOR FUTURE SIGNALS

If during the design of an improvement project, especially on reconstruction projects, an intersection is deemed to be close to meeting warrants in the next several years, then the underground conduit system and pull boxes *may* be installed under the improvement project. The signal designer *should* obtain a U number (e.g., U-XX-1004) from the regional traffic unit for identification purposes, i.e., diggers hotline locates, etc.

If breaker run is used in the construction of the roadway, it is recommended that conduit be installed for future signal installations due to the inability to bore through breaker run. In addition, consideration *should* be given to installation of signal bases and pull boxes in medians and islands when breaker run is used.

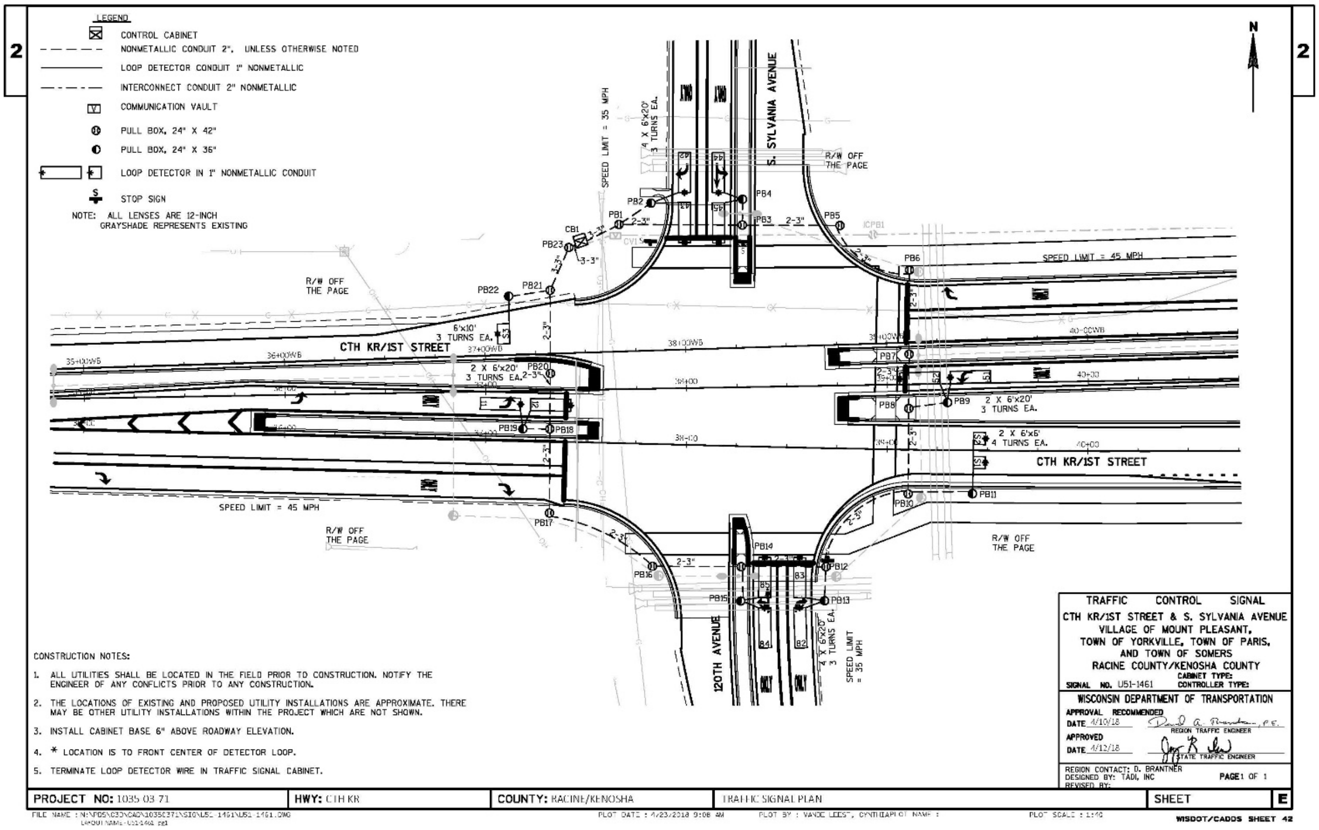
The conduit *should* be installed in an underground system around the complete intersection, not just under the roadway. The 24" diameter pull boxes *should* be installed at all angle points, medians and islands. Loop detector conduit *may* be installed at this time under the new concrete. If several adjacent intersections are being constructed, conduit for the interconnection of the future signals *may* also be installed. Additionally, according to standard specifications, a continuous pull wire **shall** be installed in all underground conduits for locate purposes. Loop detector wire *should* be installed in the loop detector conduit during construction with the number of turns indicated in the construction plans. Locate wire in loop conduit **shall** be accessible off the roadway.

The underground conduit system *should* be installed at a sufficient distance along the intersection approach to accommodate for future expansion of the intersection and installation of the future signals. Contact the Regional Traffic Signal Engineer for other considerations, such as possible future geometrics, i.e., turn lanes, radii, etc.

In concrete-capped medians and islands, box-outs *may* be added for future signal base placement. Box-outs *should* be sized so they will accommodate a standard concrete base. Conduits from the adjacent pull box *should* be stubbed and capped to the box-out.

Shown below is an example of an underground plan for a future signal.

Figure 1.3. Underground plan for a future signal



MISCELLANEOUS QUANTITIES

Plans **shall** be developed including the miscellaneous quantities according to the FDM 15-1-1, General Plan Preparation. The Regional and Central Office Traffic Signal staff will determine which specific plan type is required for each signal installation. Revisions to a plan that are not part of a let or permit project that will be performed by WisDOT forces, such as adding a left turn phase or right turn overlap, etc., do not require a miscellaneous quantities sheet, but will require a plan revision.

Let projects require a significant amount of information regarding the quantities. Discussions of these types of plans can be found in the FDM Chapter 19, PS&E.

<u>MISCELLANEOUS QUANTITIES SHEET</u>

The purpose of these sheets is to indicate specific types, sizes, and locations for the signal equipment at the intersection. The following are common items found in the electrical miscellaneous quantities sheet:

- SIGNAL HEADS
- SIGNAL POLES, LUMINARE POLES, MAST ARMS, BASES
- PULL BOXES
- CONDUIT, SPECIAL
- CONDUIT
- CONCRETE BASES
- MAJOR ITEMS REQUIRED FOR TRAFFIC DETECTORS
- CONCRETE CONTROL CABINET BASE
- CABLE, WIRE

Like items *should* be combined into one table to avoid several small tables. The item reference (i.e. signal base number, head number, pull box number, etc.) **shall** be included for all items labeled on the plan sheet of the signal installation. Station and offset reference *should* be linked only to items installed into the ground (i.e. pull boxes, concrete bases, detector loops, and control cabinet bases). Although not required, a solid line *may* be placed around each table to avoid confusion.

<u>QUANTITY TAKE-OFF PROCEDURES</u>

Methods used to estimate plan quantities follow standard engineering practices, which, for the most part, are self-explanatory. The following points *should* be reviewed prior to computing the final quantities.

Items must use same terminology as stated in the Standard Specifications, Supplemental Specifications, and Special Provisions.

Items appearing in the Miscellaneous Quantities Sheets (as part of the lump sum) **shall** be so noted.

All plan sheet item references (i.e. signal base number, head number, pull box number, etc.) **shall** be tied to the appropriate quantity.

All pay items must be shown in the Miscellaneous Quantities Sheet.

Station and offset references **shall** be used to locate pull boxes, concrete bases, detector loops, and control cabinet bases.

DETERMINING ELECTRICAL CABLE QUANTITIES

Tables 1.1, 1.2, and 1.3 show suggested cable measurements for poles, light poles, and monotubes that can be used to determine electrical cable quantities.

Table 1.1. Suggested cable measurements for poles

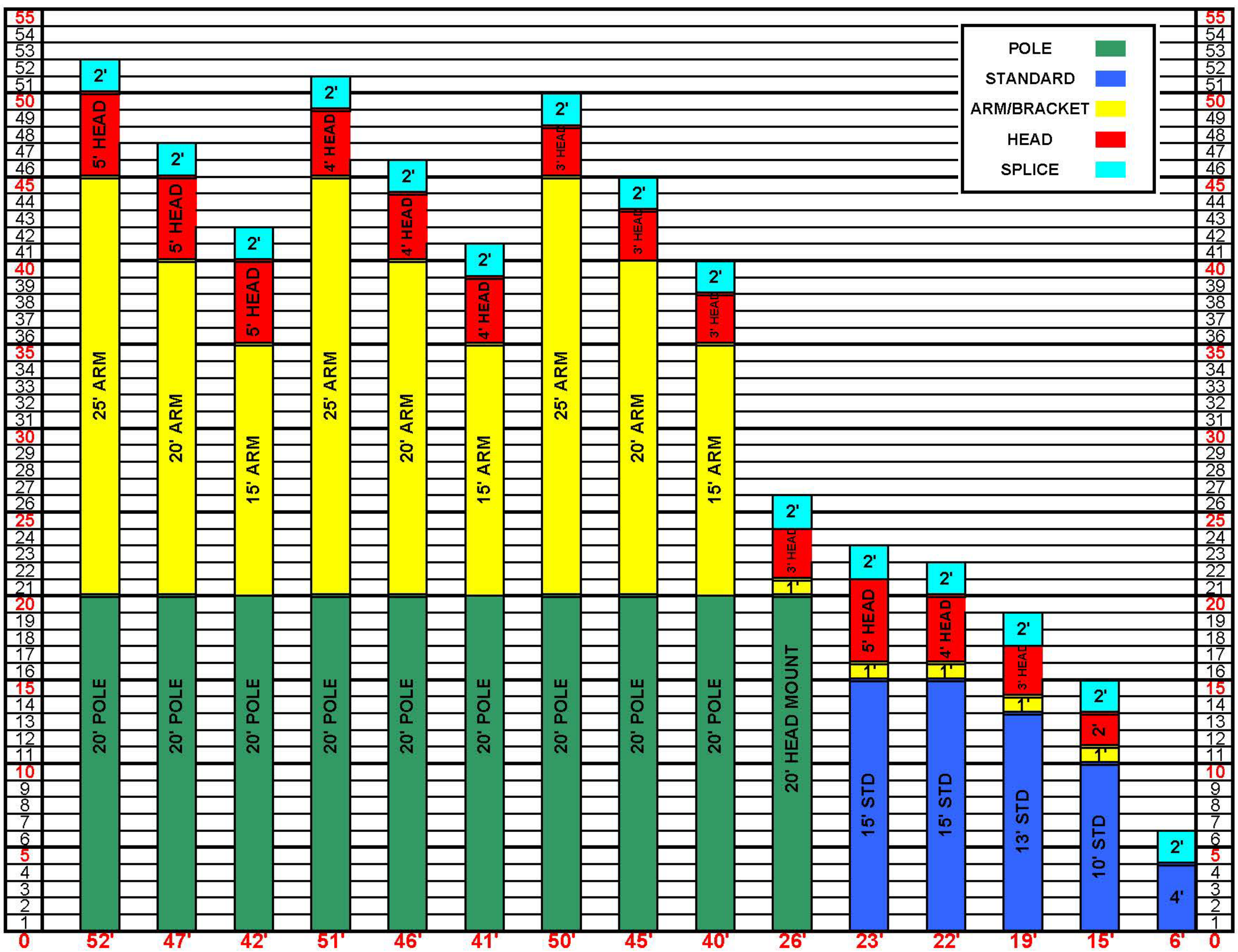


Table 1.2. Suggested cable measurements for light poles

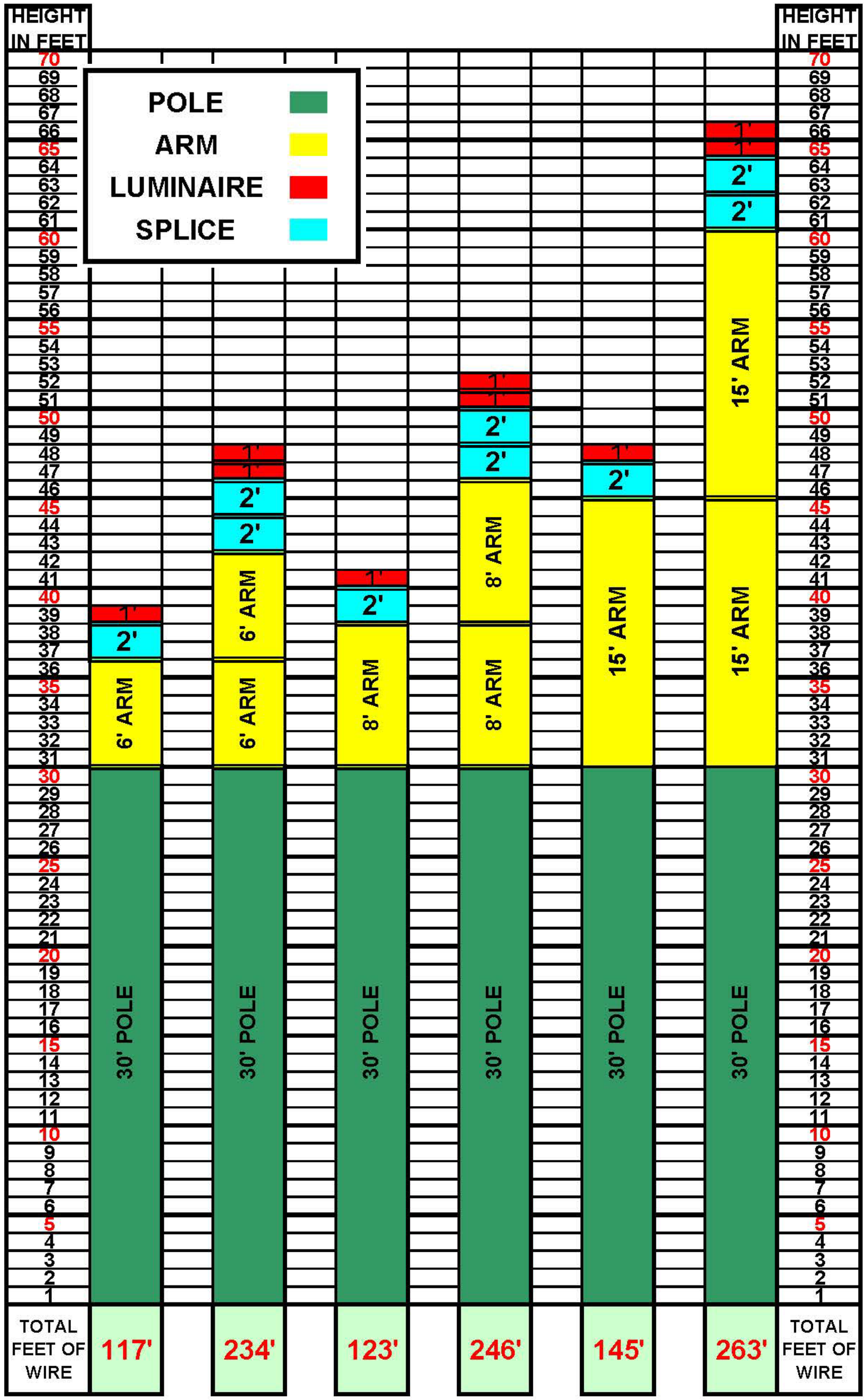
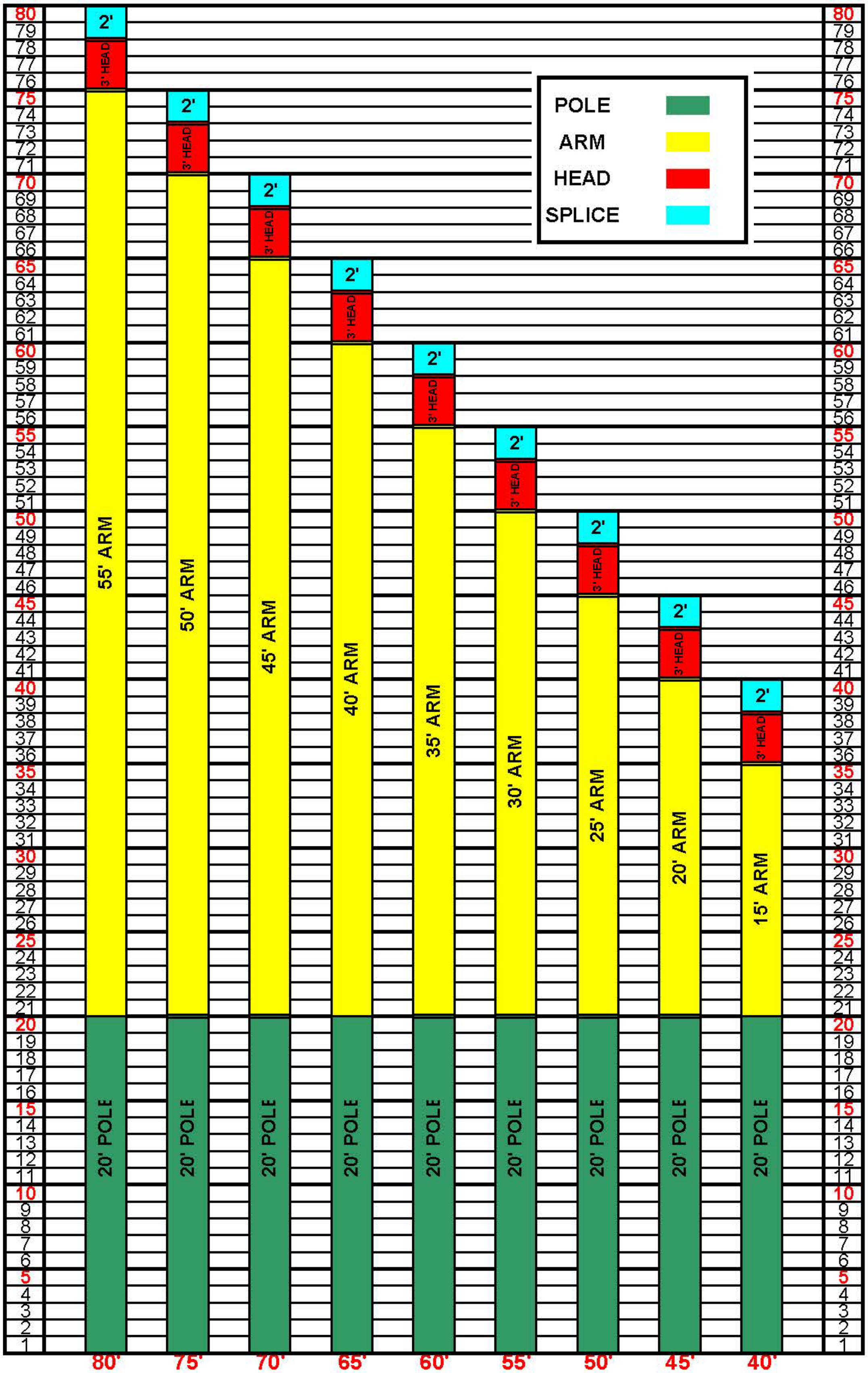


Table 1.3. Suggested cable measurements for monotubes



4-5-2 Signal Plan Revisions April 2025

Wherever an existing signal is modified, the change **shall** be reflected on the signal plan. Any change **shall** be documented in a revision block located in the bottom right of the signal plan sheet. Revisions **shall** be approved by Bureau of Traffic Operations Statewide Traffic Signal Engineer or a designated representative. Examples of these changes would include:

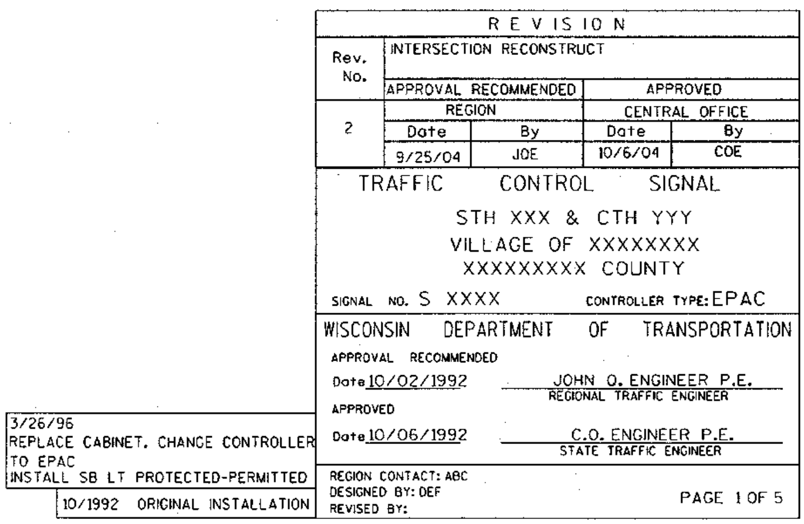
- adding pedestrian phasing and pushbuttons,
- modifying phasing, including reassigning to NEMA phasing,
- adding preemption,
- modifying detection design,
- modifying signal/lighting equipment,
- as-built plans, or
- other changes that would require a cabinet wire change.

An addition or deletion of a pull box, signal base, signal head, or detection to an existing installation does not require renumbering the existing PB, SB, etc. on the signal plan; the next consecutive number *should* be used.

Only one revision block will appear on the signal plan. Any previous revisions will be noted along with the date approved in history blocks, as shown in the example in Figure 2.1. The original signature block and signature *should* remain on the plan. With a CADD-prepared plan, the name of the original signers and dates *should* be inserted in place of the original signatures (see example).

Revised signal plans **shall** bear the initials of a Regional Traffic Signal Unit Professional Engineer. In addition, plans not developed by WisDOT staff **shall** include the stamp and signature of the Professional Engineer.

Figure 2.1. Sample History, Signature and Revision Blocks



4-5-3 Signal Plan Development Process April 2025

The PS&E review process is covered in FDM Chapter 3 and Chapter 19. Signal Plans that will require right-of-way acquisition, utility relocation, or railroad coordination *may* require greater coordination efforts. Approval of the traffic signal plan set at the Regional level is required to occur prior to the final submittal. The level of coordination between individuals developing the plan set and the regional traffic section is dependent on the project complexity.

Bureau of Project Development has set specific schedules for PS&E submittal. Chapter 19 of the FDM presents a detailed description of the review process, schedule/timing, and plan composition. The signal plan set within the PS&E *should* include the following sheets:

1. Plan Sheet(s)
2. Sequence of Operations Sheet
3. Cable routing sheet

And if applicable:

1. Temporary signal plan and timings

2. Temporary Sequence of Operations Sheet
3. Miscellaneous quantities for electrical items
4. Engineering estimate for electrical items
5. Special provisions pertaining to electrical items
6. Signal Removal plans
7. Details of non-standard items
8. List of SDDs, general construction notes, and construction details pertaining to electrical items

In cases where the maintaining authority is not the State (i.e. municipality, county, connecting highway), yet is installed through a state administered project on the local system, Regional Traffic Signal Engineers *may* provide a cursory plan review, however the ultimate maintaining authority will be responsible for the final design and approval.

Any questions regarding the approval process *should* be directed to the Bureau of Project Development.

Other necessary items that are part of the PS&E are the engineers' estimate plan letter and special provisions, and contract time for completion, etc., are the responsibility of the project manager.

SIGNAL PLAN DEVELOPMENT IN THE PS&E PROCESS
(Applies to state-owned signals only)

SCOPING MEETING (PDS & TRAFFIC UNIT)
Determine which existing signals will be affected by the project and discuss potential new signal locations.

↓

PDS
- Order manual turn count (if existing count is more than 3 years old)
- Order 10 & 20-year projections of turning movements at intersections for both AM and PM peaks
- Order base-mapping survey (see "Survey Requirements for Traffic Signals")
- Check with Systems Program Ops for determination on potential new signal locations
- Projections for weekend or other peak times *may* be necessary depending on the specific intersection or characteristics of the area.

↓

TRAFFIC UNIT
Conduct capacity analysis to determine recommended geometrics. *

* If consultants perform these tasks, the Traffic Unit and PDS staff *should* verify the results

↓

PDS
Designs intersection geometrics

↓

TRAFFIC UNIT
Review key intersection geometrics to check storage lengths, truck turning radii, island placement, left turn visibility, ADA requirements, etc.

↓

PDS
Revises geometrics if necessary

↓

TRAFFIC UNIT
Approves final geometrics. Signal designer prepares preliminary signal plan* for TRANS 220 deadline.

↓ (left) TRANS 220 SUBMITTAL

↓ (right) TRAFFIC UNIT
Prepares signal plan, sequence of operation sheet, special provisions, list of SDD's, etc. pertaining to electrical work.

↓

Plans distributed for draft 90% review

↓

DRAFT PS&E MEETING

↓

Consultant-prepared traffic signal plans are stamped and signed. Traffic signal plans **shall** be approved and signed by regional traffic signal PE.

↓ (left) PS&E SUBMITTAL

↓ (right) SIGNAL PLAN SUBMITTAL BY REGION TO BTO ELECTRICAL (STATE SIGNAL ENGINEER)

PERMIT PROJECTS

At times, signals or other roadway improvements are needed to mitigate adverse traffic impacts caused by land development. Signals that are designed and installed as a condition of an Access Permit (DT1646) or a Work on Highway Right-of-Way (DT1812) are referred to more generally as Permit Projects. Depending on the improvement program schedule, separate improvements that are required because of a development can be implemented through a let or non-let process, with cost-share provisions. Non-let projects can be performed by contract or State Forces. Signals that are warranted due to these situations are done so as part of a Traffic Impact Analysis (TIA).

Permit Project plan set will include:

1. Title Sheet
2. Signal Plan Set
3. Sequence of Operations Sheet
4. Miscellaneous Quantities
5. Special Provisions
6. Special Details
7. Standard Detail Drawings

Costs for State furnished materials and labor that are expended while overseeing Permit Projects *should* be assigned to the local municipality or developer responsible for the project.

SIGNAL PLAN DEVELOPMENT IN THE PERMIT PROCESS
(Applies to permit projects only)

Meeting between Traffic Section and Developer to discuss specifics / scope of project (typically cited by TIA).

↓

PDS / CONSULTANT
Designs intersection geometrics

↓

TRAFFIC UNIT
Review key intersection geometrics for operations (check storage lengths, truck turning radii, island placement, left turn visibility, ADA requirements, etc.)

↓

PDS / CONSULTANT
Revises geometrics if necessary

↓

TRAFFIC UNIT
Approves final geometrics. Signal designer prepares preliminary signal plan* for TRANS 220 deadline.

↓

TRAFFIC UNIT / CONSULTANT
Prepares signal plan, sequence of operation sheet, special provisions, list of SDD's, etc. pertaining to electrical work. *

↓

Plans distributed for draft 90% review

↓

90% DRAFT PLAN MEETING

↓

Consultant-prepared traffic signal plans are stamped. Traffic signal plans **shall** be approved and signed by regional traffic signal PE.

↓

FINAL PLAN SUBMITTAL

* If consultants perform these tasks, the Traffic Unit and PDS staff *should* review the results

4-5-4 Sample Plan Sheets — April 2025

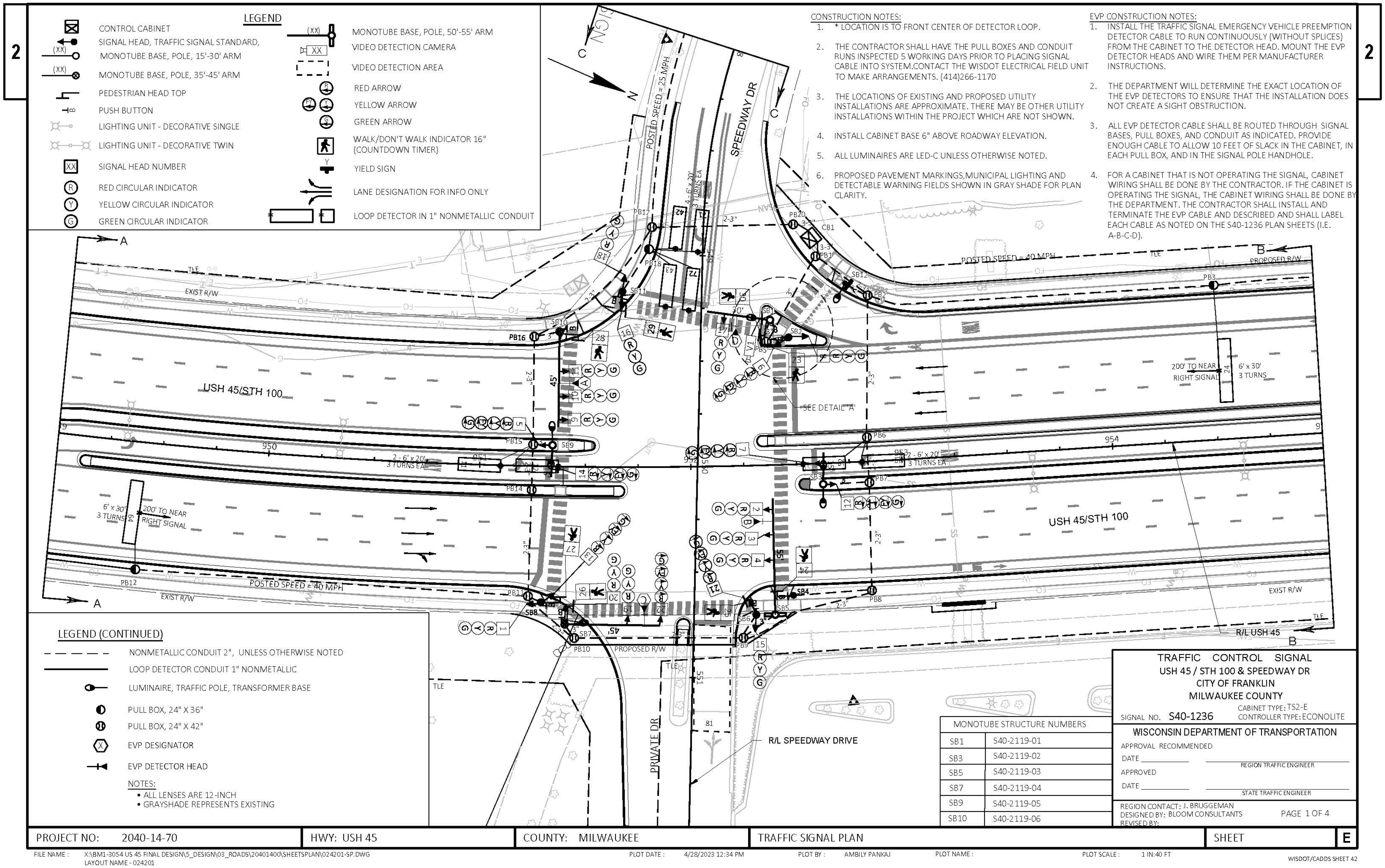
The following plan sets illustrate the possible stages a typical signalized intersection *may* go through when creating/revising traffic signal control plans of an example intersection. FDM 15-1-5 covers sample plans for all types of improvement projects.

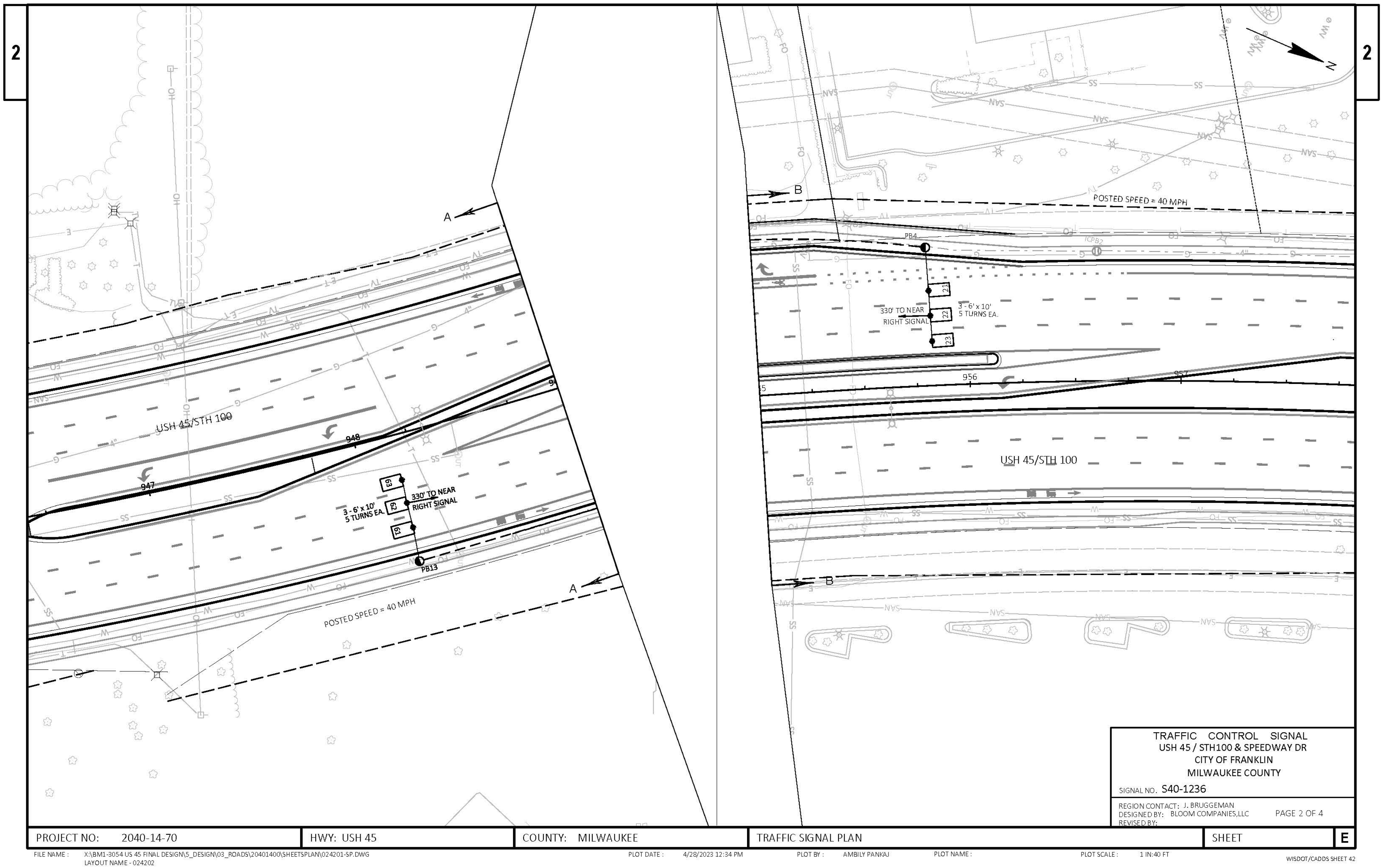
Example Plan Sets

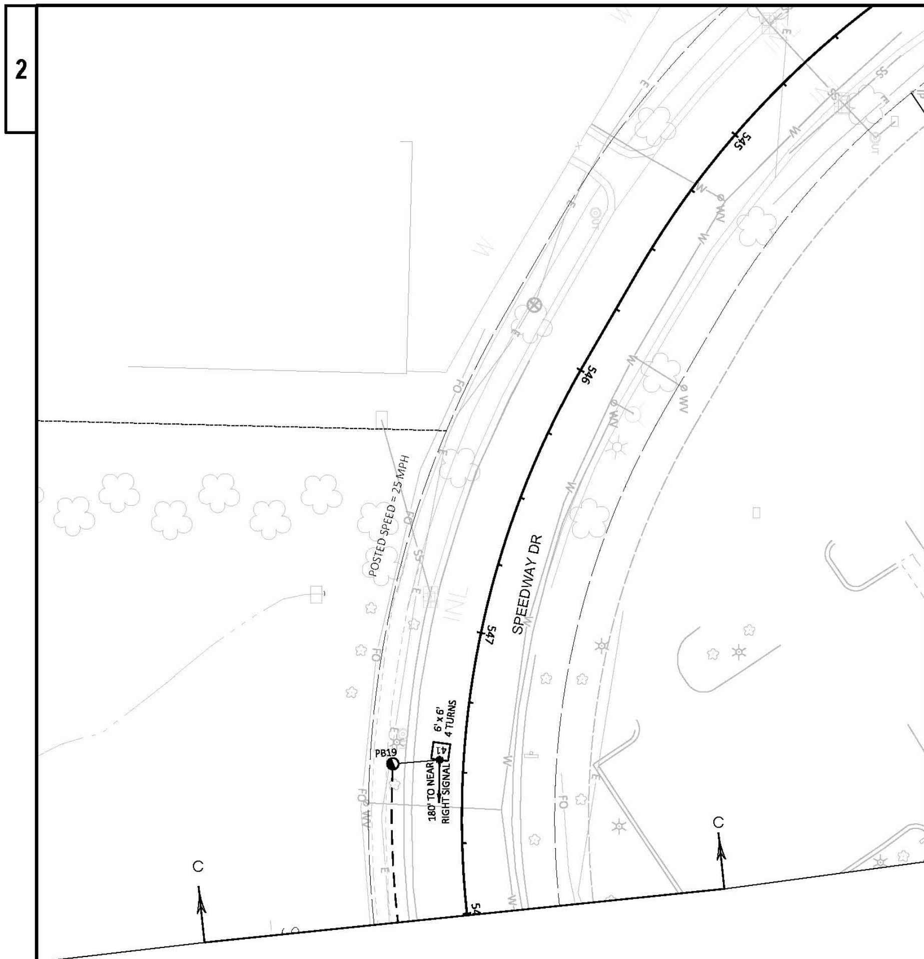
1. Original plan with existing geometrics
2. Removal plan
3. Temporary plan
4. Revision plan (add monotubes)
5. Signalized intersection plan with railroad preemption
6. Single controller plan at an interchange (dual ring with overlaps)
7. TTI Phasing plan at an interchange

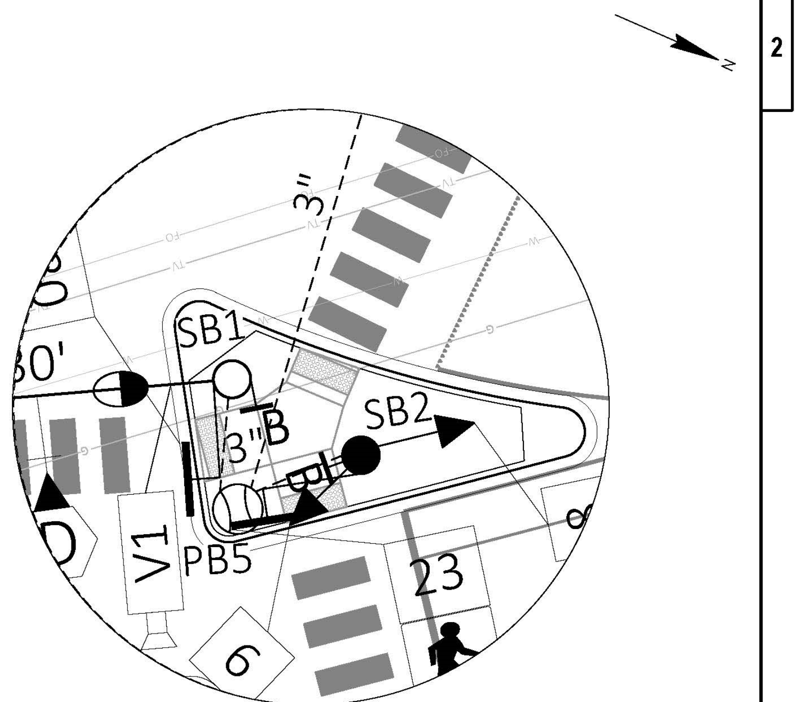
These sample traffic signal plans are strictly for reference. These plans attempt to demonstrate various signal operations and applications of special features (EVP, railroad, interchanges, overlaps). The Regional Traffic Signal Engineering staff *should* be involved during the development of traffic signal plans or special applications.

Example 1. Original plan with existing geometrics (4 sheets)




2
2
USH 45/STH 100
POSTED SPEED = 40 MPH
3 - 6' x 10'
5 TURNS EA.
330' TO NEAR
RIGHT SIGNAL
PB13
PB4
USH 45/STH 100
POSTED SPEED = 40 MPH
TRAFFIC CONTROL SIGNAL
USH 45 / STH100 & SPEEDWAY DR
CITY OF FRANKLIN
MILWAUKEE COUNTY
SIGNAL NO. S40-1236
REGION CONTACT: J. BRUGGEMAN
DESIGNED BY: BLOOM COMPANIES,LLC
PAGE 2 OF 4
REVISED BY:
PROJECT NO: 2040-14-70
HWY: USH 45
COUNTY: MILWAUKEE
TRAFFIC SIGNAL PLAN
SHEET
E
FILE NAME : X:\BM1-3054 US 45 FINAL DESIGN\5_DESIGN\03_ROADS\20401400\SHEETSPLAN\024201-SP.DWG
LAYOUT NAME - 024202
PLOT DATE : 4/28/2023 12:34 PM
PLOT BY : AMBILY PANKAJ
PLOT NAME :
PLOT SCALE : 1 IN:40 FT
WISDOT/CADDS SHEET 42





DETAIL 'A'

TRAFFIC CONTROL SIGNAL
USH 45 / STH100 & SPEEDWAY DR
CITY OF FRANKLIN
MILWAUKEE COUNTY

SIGNAL NO. S40-1236

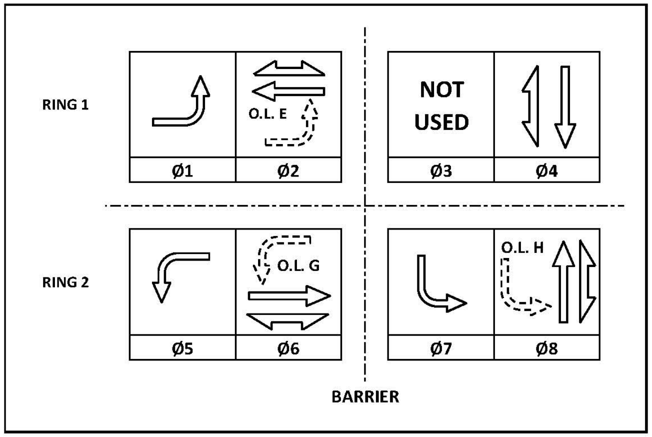
REGION CONTACT: J. BRUGGEMAN
DESIGNED BY: BLOOM COMPANIES,LLC PAGE 3 OF 4
REVISED BY:

PROJECT NO: 2040-14-70	HWY: USH 45	COUNTY: MILWAUKEE	TRAFFIC SIGNAL PLAN	SHEET	E

FILE NAME : X:\BM1-3054 US 45 FINAL DESIGN\5_DESIGN\03_ROADS\20401400\SHEETSPLAN\024201-SP.DWG
LAYOUT NAME - 024203
PLOT DATE : 4/28/2023 12:34 PM PLOT BY : AMBILY PANKAJ PLOT NAME : PLOT SCALE : ############ WISDOT/CADDS SHEET 42

2

	HEAD NUMBERS	FLASH
Ø1	5,6,7	R ←
Ø2	8,9,10,11	R
Ø3		
Ø4	18,19,20	R
Ø5	12,13,14	R ←
Ø6	1,2,3,4	R
Ø7	21,22	R ←
Ø8	15,16,17	R
Ø2P	29,30	
Ø4P	27,28	
Ø6P	25,26	
Ø8P	23,24	
OLE	5,6,7	-
OLF		
OLG	12,13,14	-
OLH	18,19	-



N

CONTROLLER LOGIC

PHASE NUMBER	PHASE LOCKING	DUAL ENTRY W / Ø	PHASE RECALL	PHASE ACTIVE
1		6		X
2	X	6	MIN	X
3				
4		8		X
5		2		X
6	X	2	MIN	X
7		4		X
8		4		X

EMERGENCY VEHICLE PREEMPTION SEQUENCE

EMERGENCY VEHICLE PREEMPTOR	A	B	C	D
MOVEMENT				
PHASE	2+5	1+6	4+7	8

AFTER PREEMPTION SEQUENCE 2+5 OR 1+6, CONTROLLER SHALL RETURN TO PHASES 2+6.
AFTER PREEMPTION SEQUENCE 4+7 OR 8, CONTROLLER SHALL RETURN TO PHASES 4+8.

TYPE OF INTERCONNECT/COMMUNICATION	
NONE	
CLOSED LOOP	
TWISTED PAIR	
FIBER OPTIC*	
FIBER OPTIC (ETHERNET)	X
RADIO	
CELL MODEM	

TYPE OF COORDINATION	
NONE	
TBC	X
TRAFFIC RESPONSIVE	
ADAPTIVE	
*LOCATION OF MASTER CONTROLLER NO: S-	
SIGNAL SYSTEM NO: SS-	

TYPE OF LIGHTING	
BY OTHER AGENCY	
IN TRAFFIC CABINET	X
IN SEPARATE DOT LIGHTING CABINET	

TYPE OF PRE-EMPT	
NONE	
RAILROAD	
EMERGENCY VEHICLE	X
GTT	
TOMAR	X
HARDWIRE	
OTHER	
CONFIRMATION LIGHTS	
LIFT BRIDGE	
QUEUE DETECTION	

DETECTOR LOGIC

DETECTOR INPUT	3	1	7	5	11	9	15	13
PLAN LOOP DETECTOR*(S)	11	21	23	41	43	51	61	63
CALLED PHASE	1	2	2	4	4	5	6	6
CALL OPTION	X	X	X		X	X	X	X
DELAY TIME					X			
EXTENTION OPTION	X	X	X	X	X	X	X	X
EXTEND TIME				X				
USE ADDED INITIAL		X	X				X	X
CROSS SWITCH PHASE	2					6		

DETECTOR INPUT	19	17	23	21	27	33	37	29
PLAN LOOP DETECTOR*(S)	71		81					
CALLED PHASE	7		8					
CALL OPTION	X		X					
DELAY TIME								
EXTENTION OPTION	X		X					
EXTEND TIME								
USE ADDED INITIAL								
CROSS SWITCH PHASE	8							

DETECTOR INPUT	4	2	8	6	12	10	16	14
PLAN LOOP DETECTOR*(S)	12	22	24	42		52	62	64
CALLED PHASE	1	2	2	4		5	6	6
CALL OPTION	X	X	X	X		X	X	X
DELAY TIME				X				
EXTENTION OPTION	X	X	X	X		X	X	X
EXTEND TIME								
USE ADDED INITIAL		X	X				X	X
CROSS SWITCH PHASE	2					6		

DETECTOR INPUT	20	18	24	22	28	34	38	30
PLAN LOOP DETECTOR*(S)	72							
CALLED PHASE	7							
CALL OPTION	X							
DELAY TIME								
EXTENTION OPTION	X							
EXTEND TIME								
USE ADDED INITIAL								
CROSS SWITCH PHASE	8							

GENERAL NOTES:

1.

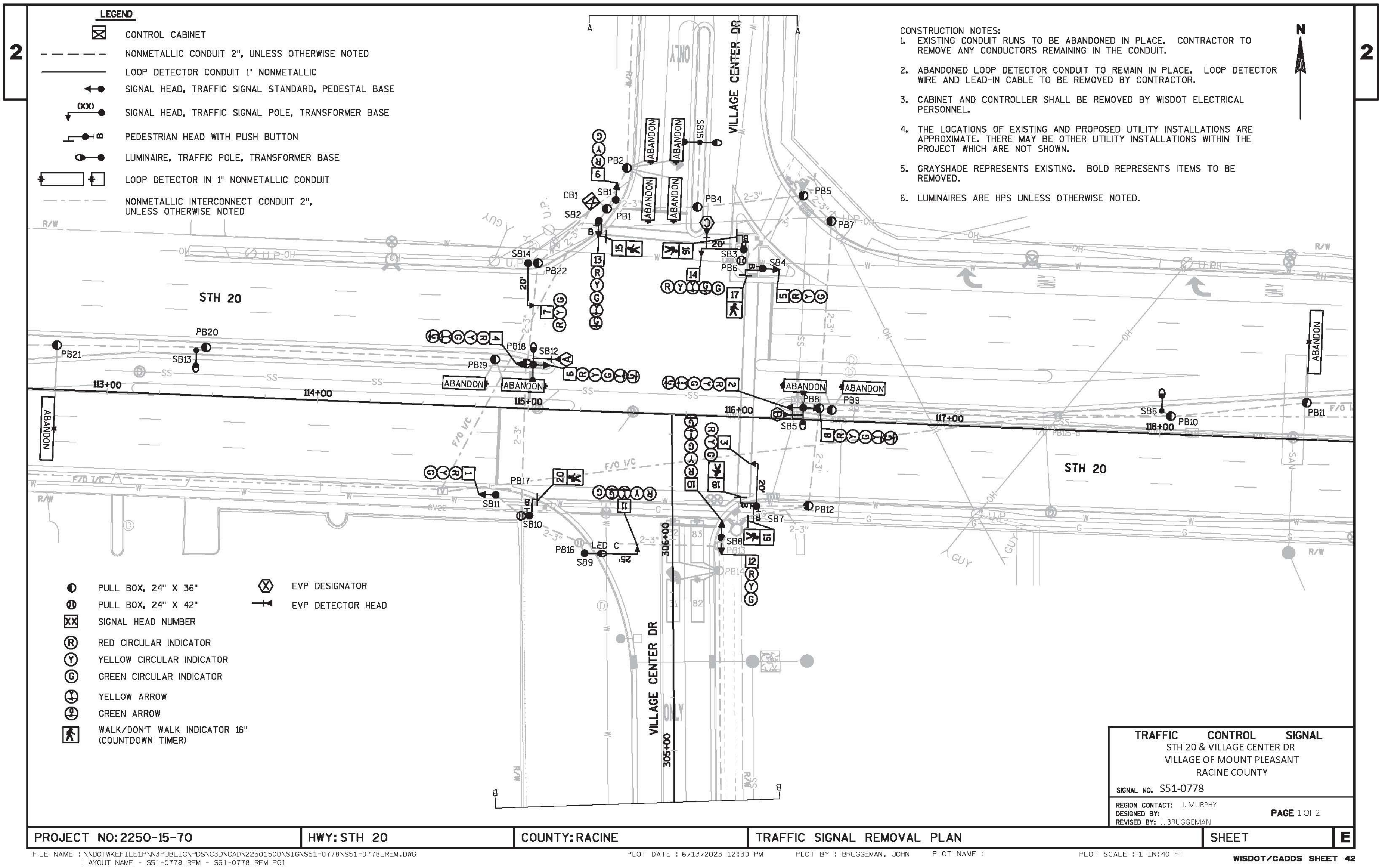
USH 45 / STH 100 & SPEEDWAY DR
CITY OF FRANKLIN
MILWAUKEE COUNTY

SIGNAL NO: S40-1236 | CABINET TYPE: TS2-E
CONTROLLER TYPE: ECONOLITE
DATE: 05/2023 | PAGE NUMBER: 4 OF 4

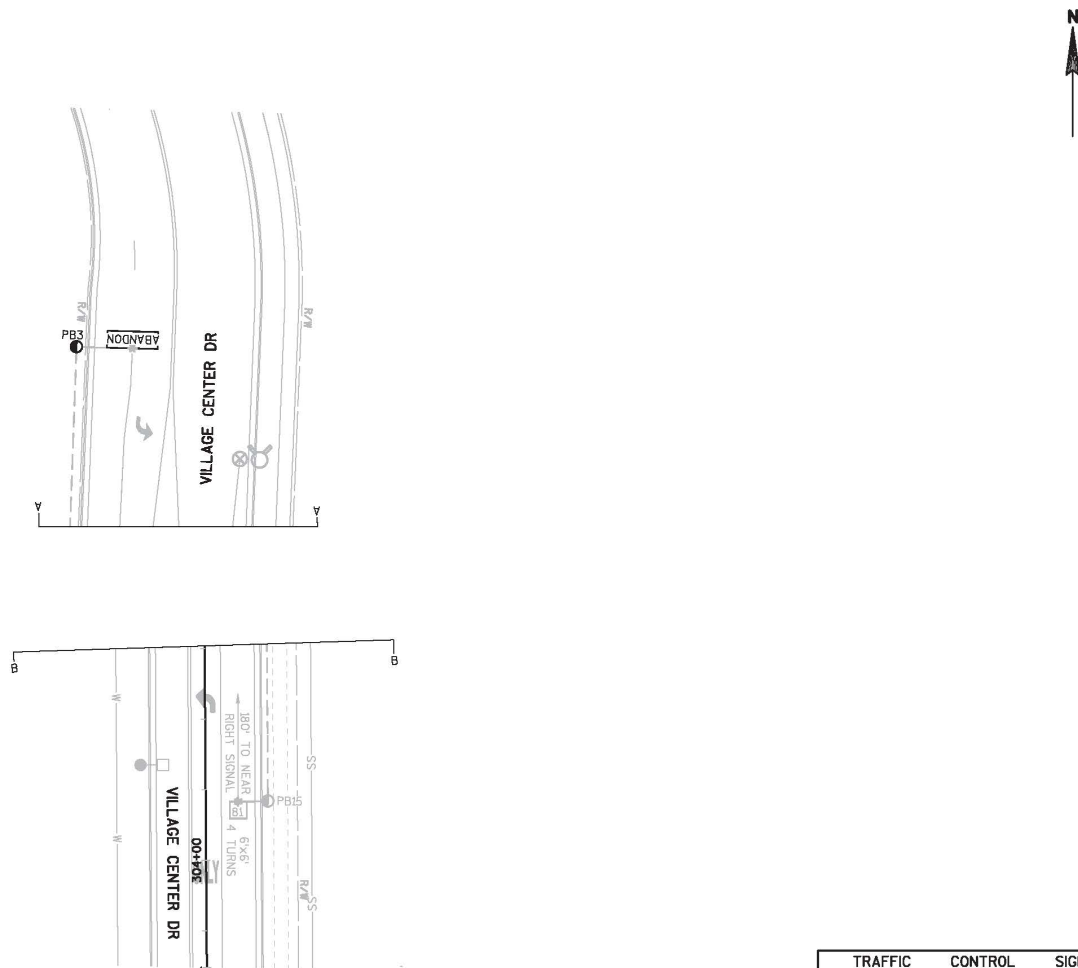
PROJECT NO: 2040-14-70	HWY: USH 45	COUNTY: MILWAUKEE	SEQUENCE OF OPERATIONS	SHEET NO:	E

FILE NAME: X:\BM1-3054 US 45 Final Design\5_Design\03_Roads\20401400\Sheets\Plan\Speedway\TS2-S_E_FYA_EFGH_Econolite_SEQ.xlsx PLOT DATE: 4/28/2023 PLOT NAME: TS2-S_E_FYA_EFGH_Econolite_SEQ.xlsx PLOT BY: ______ PLOT SCALE: 1:1

Example 2. Removal Plan (2 sheets)



2



2

TRAFFIC CONTROL SIGNAL
STH 20 & VILLAGE CENTER DR
VILLAGE OF MOUNT PLEASANT
RACINE COUNTY

SIGNAL NO. S51-0778

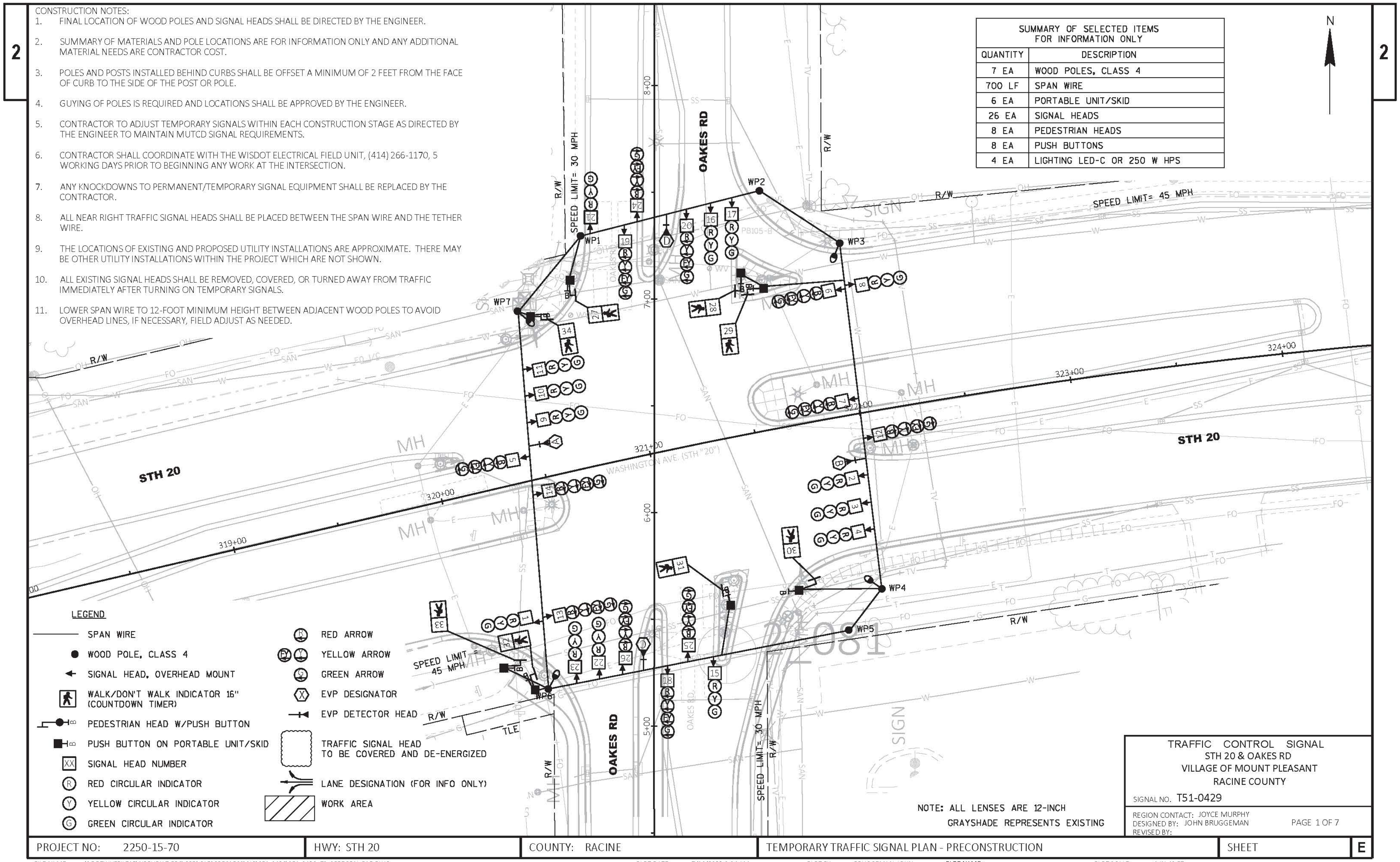
REGION CONTACT: J. MURPHY
DESIGNED BY:
REVISED BY: J. BRUGGEMAN

PAGE 2 OF 2

PROJECT NO:2250-15-70	HWY:STH 20	COUNTY:RACINE	TRAFFIC SIGNAL REMOVAL PLAN	SHEET	E

FILE NAME : \\DOTWKEFILE1P\N3PUBLIC\PDS\C3D\CAD\22501500\SIG\S51-0778\S51-0778_REM.DWG
LAYOUT NAME - S51-0778_REM - S51-0778_REM_PG2
PLOT DATE : 6/13/2023 12:30 PM PLOT BY : BRUGGEMAN, JOHN PLOT NAME : PLOT SCALE : 1 IN:40 FT
WISDOT/CADDS SHEET 42

Example 3. Temporary Signal Plan (7 sheets)



CONSTRUCTION NOTES:

1. FINAL LOCATION OF WOOD POLES AND SIGNAL HEADS SHALL BE DIRECTED BY THE ENGINEER.
2. SUMMARY OF MATERIALS AND POLE LOCATIONS ARE FOR INFORMATION ONLY AND ANY ADDITIONAL MATERIAL NEEDS ARE CONTRACTOR COST.
3. POLES AND POSTS INSTALLED BEHIND CURBS SHALL BE OFFSET A MINIMUM OF 2 FEET FROM THE FACE OF CURB TO THE SIDE OF THE POST OR POLE.
4. GUYING OF POLES IS REQUIRED AND LOCATIONS SHALL BE APPROVED BY THE ENGINEER.
5. CONTRACTOR TO ADJUST TEMPORARY SIGNALS WITHIN EACH CONSTRUCTION STAGE AS DIRECTED BY THE ENGINEER TO MAINTAIN MUTCD SIGNAL REQUIREMENTS.
6. CONTRACTOR SHALL COORDINATE WITH THE WISDOT ELECTRICAL FIELD UNIT, (414) 266-1170, 5 WORKING DAYS PRIOR TO BEGINNING ANY WORK AT THE INTERSECTION.
7. ANY KNOCKDOWNS TO PERMANENT/TEMPORARY SIGNAL EQUIPMENT SHALL BE REPLACED BY THE CONTRACTOR.
8. ALL NEAR RIGHT TRAFFIC SIGNAL HEADS SHALL BE PLACED BETWEEN THE SPAN WIRE AND THE TETHER WIRE.
9. THE LOCATIONS OF EXISTING AND PROPOSED UTILITY INSTALLATIONS ARE APPROXIMATE. THERE MAY BE OTHER UTILITY INSTALLATIONS WITHIN THE PROJECT WHICH ARE NOT SHOWN.
10. ALL EXISTING SIGNAL HEADS SHALL BE REMOVED, COVERED, OR TURNED AWAY FROM TRAFFIC IMMEDIATELY AFTER TURNING ON TEMPORARY SIGNALS.
11. LOWER SPAN WIRE TO 12-FOOT MINIMUM HEIGHT BETWEEN ADJACENT WOOD POLES TO AVOID OVERHEAD LINES, IF NECESSARY, FIELD ADJUST AS NEEDED.

SUMMARY OF SELECTED ITEMS FOR INFORMATION ONLY

QUANTITY	DESCRIPTION
7 EA	WOOD POLES, CLASS 4
700 LF	SPAN WIRE
6 EA	PORTABLE UNIT/SKID
26 EA	SIGNAL HEADS
8 EA	PEDESTRIAN HEADS
8 EA	PUSH BUTTONS
4 EA	LIGHTING LED-C OR 250 W HPS

LEGEND

- SPAN WIRE
- WOOD POLE, CLASS 4
- SIGNAL HEAD, OVERHEAD MOUNT
- WALK/DON'T WALK INDICATOR 16" (COUNTDOWN TIMER)
- PEDESTRIAN HEAD W/PUSH BUTTON
- PUSH BUTTON ON PORTABLE UNIT/SKID
- XX SIGNAL HEAD NUMBER
- R RED CIRCULAR INDICATOR
- Y YELLOW CIRCULAR INDICATOR
- G GREEN CIRCULAR INDICATOR
- RED ARROW
- YELLOW ARROW
- GREEN ARROW
- X EVP DESIGNATOR
- EVP DETECTOR HEAD
- TRAFFIC SIGNAL HEAD TO BE COVERED AND DE-ENERGIZED
- LANE DESIGNATION (FOR INFO ONLY)
- WORK AREA

NOTE: ALL LENSES ARE 12-INCH
GRAYSHADE REPRESENTS EXISTING

TRAFFIC CONTROL SIGNAL
STH 20 & OAKES RD
VILLAGE OF MOUNT PLEASANT
RACINE COUNTY

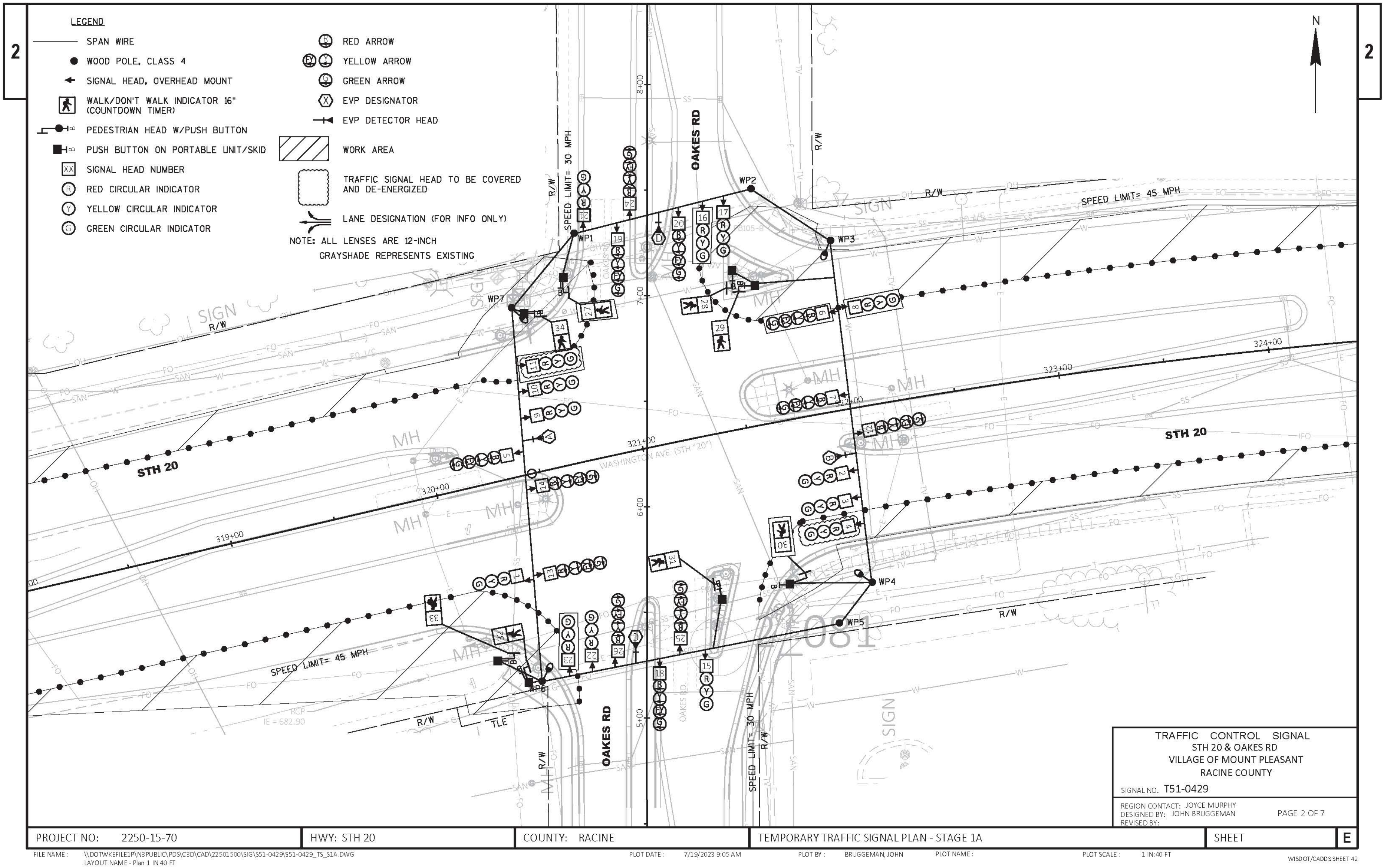
SIGNAL NO. T51-0429

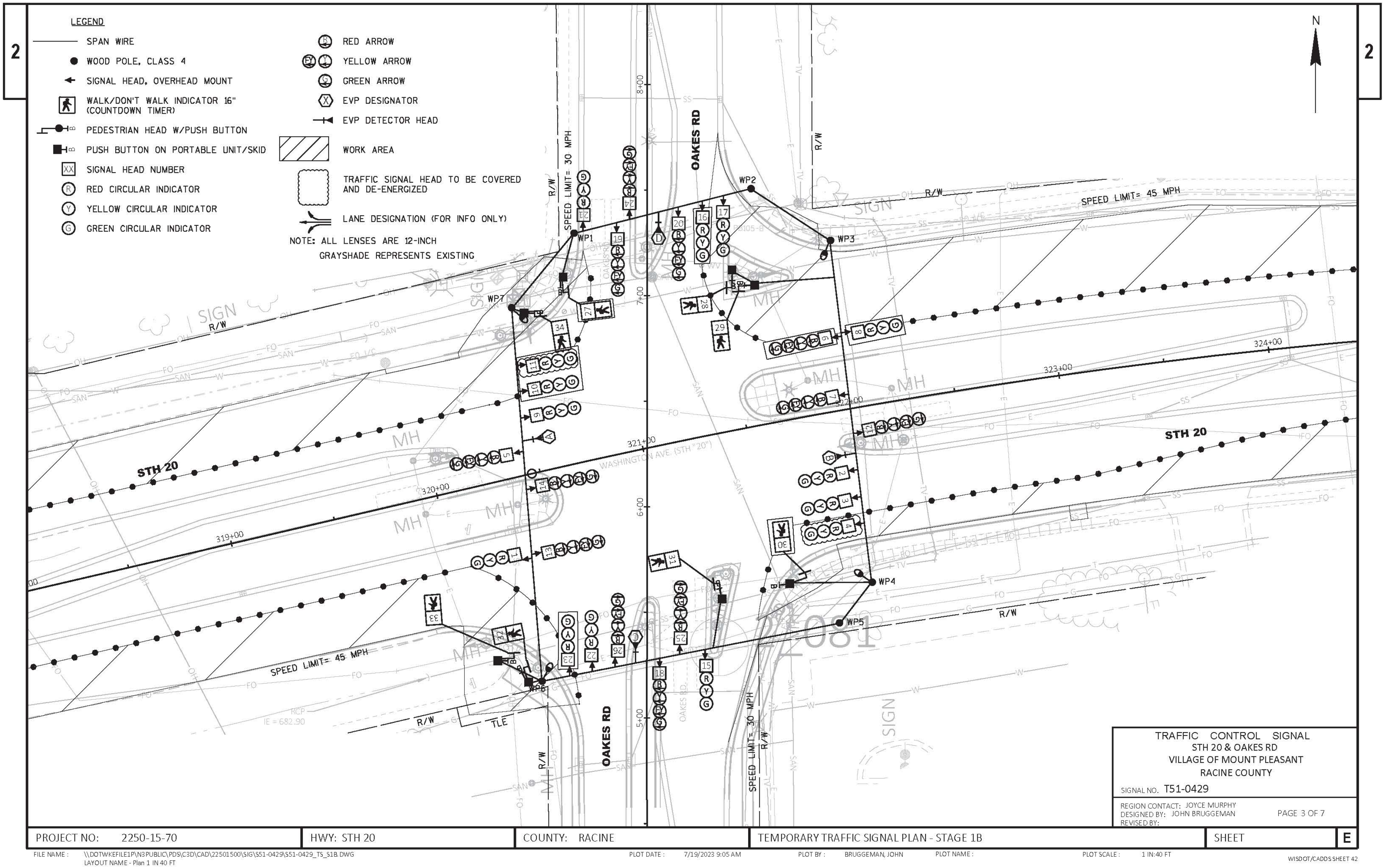
REGION CONTACT: JOYCE MURPHY
DESIGNED BY: JOHN BRUGGEMAN
REVISED BY:

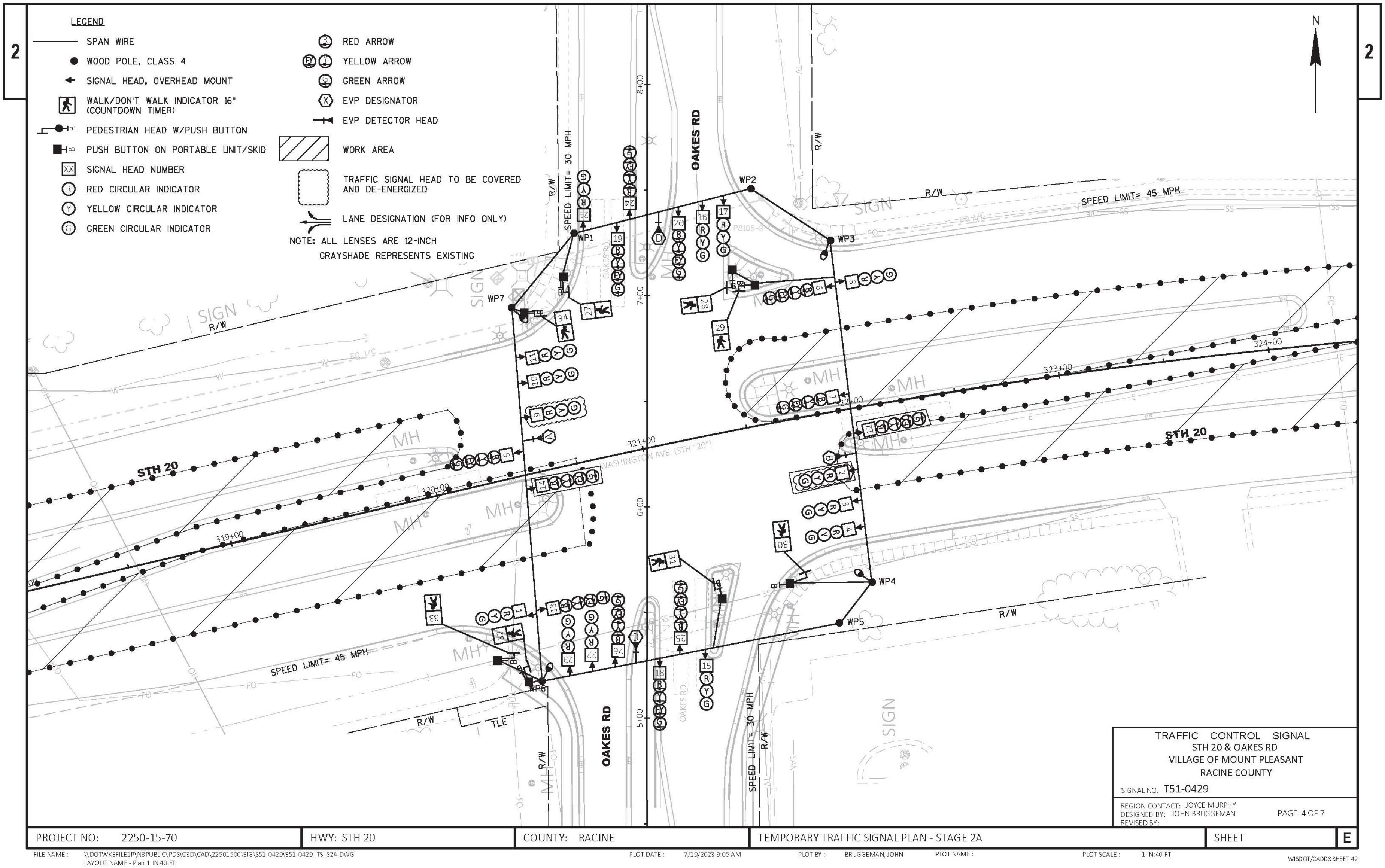
PAGE 1 OF 7

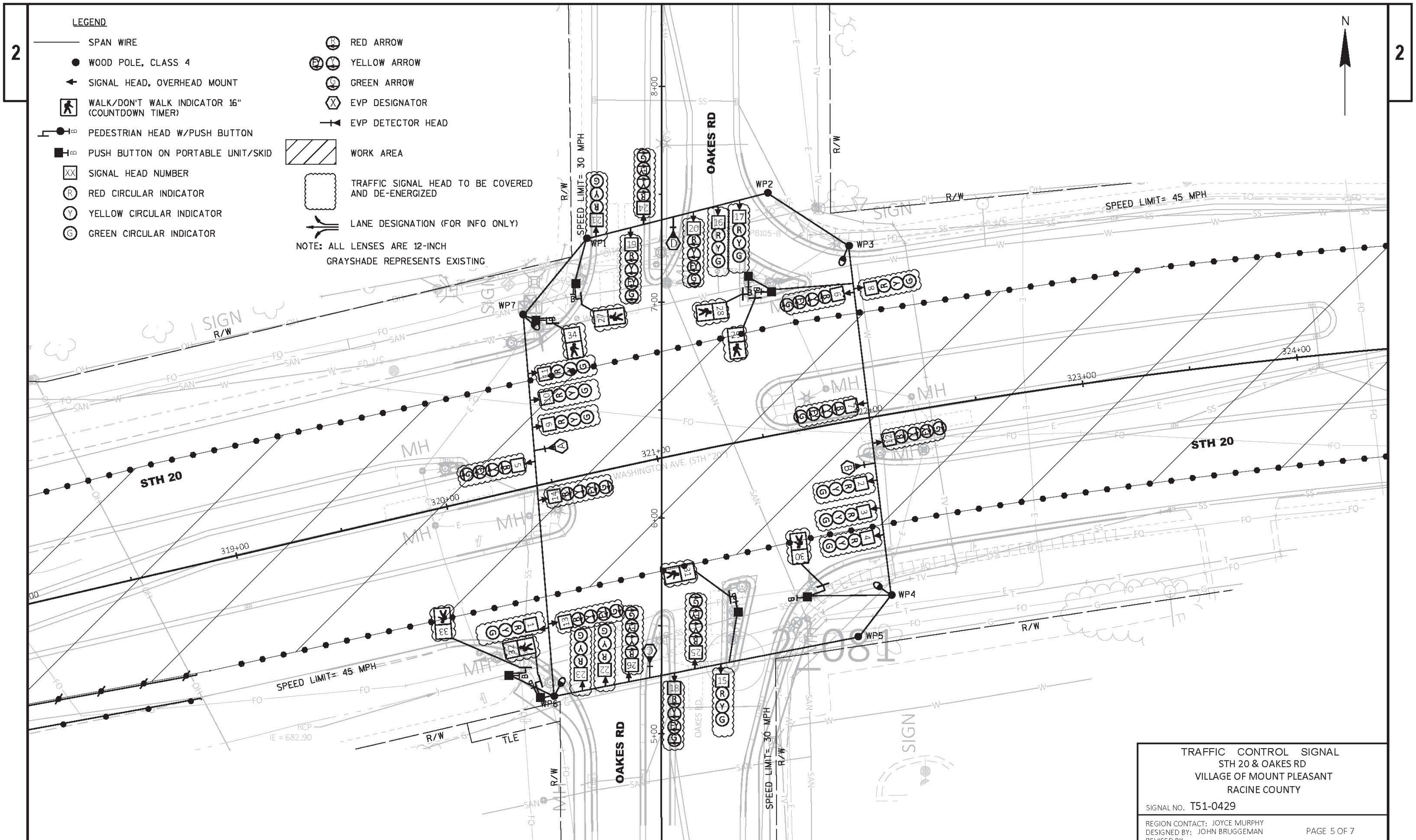
PROJECT NO: 2250-15-70	HWY: STH 20	COUNTY: RACINE	TEMPORARY TRAFFIC SIGNAL PLAN - PRECONSTRUCTION	SHEET	E

FILE NAME : \\DOTWKEFILE1P\N3PUBLIC\PDS\C3D\CAD\22501500\SIG\S51-0429\S51-0429_TS_SPRECON_R18.DWG
LAYOUT NAME - Plan 1 IN:40 FT
PLOT DATE : 7/19/2023 9:04 AM
PLOT BY : BRUGGEMAN, JOHN
PLOT NAME :
PLOT SCALE : 1 IN:40 FT
WISDOT/CADDS SHEET 42


LEGEND
SPAN WIRE
WOOD POLE, CLASS 4
SIGNAL HEAD, OVERHEAD MOUNT
WALK/DON'T WALK INDICATOR 16" (COUNTDOWN TIMER)
PEDESTRIAN HEAD W/PUSH BUTTON
PUSH BUTTON ON PORTABLE UNIT/SKID
SIGNAL HEAD NUMBER
RED CIRCULAR INDICATOR
YELLOW CIRCULAR INDICATOR
GREEN CIRCULAR INDICATOR
RED ARROW
YELLOW ARROW
GREEN ARROW
EVP DESIGNATOR
EVP DETECTOR HEAD
WORK AREA
TRAFFIC SIGNAL HEAD TO BE COVERED AND DE-ENERGIZED
LANE DESIGNATION (FOR INFO ONLY)
NOTE: ALL LENSES ARE 12-INCH
GRAYSHADE REPRESENTS EXISTING
OAKES RD
STH 20
SPEED LIMIT= 30 MPH
SPEED LIMIT= 45 MPH
WP1
WP2
WP3
WP4
WP5
WP6
WP7
R/W
TLE
TRAFFIC CONTROL SIGNAL
STH 20 & OAKES RD
VILLAGE OF MOUNT PLEASANT
RACINE COUNTY
SIGNAL NO. T51-0429
REGION CONTACT: JOYCE MURPHY
DESIGNED BY: JOHN BRUGGEMAN
PAGE 2 OF 7
REVISED BY:
PROJECT NO: 2250-15-70
HWY: STH 20
COUNTY: RACINE
TEMPORARY TRAFFIC SIGNAL PLAN - STAGE 1A
SHEET
E
PLOT DATE : 7/19/2023 9:05 AM
PLOT BY : BRUGGEMAN, JOHN
PLOT SCALE : 1 IN:40 FT
WISDOT/CADDS SHEET 42


LEGEND
SPAN WIRE
WOOD POLE, CLASS 4
SIGNAL HEAD, OVERHEAD MOUNT
WALK/DON'T WALK INDICATOR 16" (COUNTDOWN TIMER)
PEDESTRIAN HEAD W/PUSH BUTTON
PUSH BUTTON ON PORTABLE UNIT/SKID
SIGNAL HEAD NUMBER
RED CIRCULAR INDICATOR
YELLOW CIRCULAR INDICATOR
GREEN CIRCULAR INDICATOR
RED ARROW
YELLOW ARROW
GREEN ARROW
EVP DESIGNATOR
EVP DETECTOR HEAD
WORK AREA
TRAFFIC SIGNAL HEAD TO BE COVERED AND DE-ENERGIZED
LANE DESIGNATION (FOR INFO ONLY)
NOTE: ALL LENSES ARE 12-INCH
GRAYSHADE REPRESENTS EXISTING
N
OAKES RD
STH 20
SPEED LIMIT= 30 MPH
SPEED LIMIT= 45 MPH
WASHINGTON AVE. (STH "20")
WP1
WP2
WP3
WP4
WP5
WP6
WP7
R/W
TLE
TRAFFIC CONTROL SIGNAL
STH 20 & OAKES RD
VILLAGE OF MOUNT PLEASANT
RACINE COUNTY
SIGNAL NO. T51-0429
REGION CONTACT: JOYCE MURPHY
DESIGNED BY: JOHN BRUGGEMAN
REVISED BY:
PAGE 3 OF 7
PROJECT NO: 2250-15-70
HWY: STH 20
COUNTY: RACINE
TEMPORARY TRAFFIC SIGNAL PLAN - STAGE 1B
SHEET
E
FILE NAME : \\DOTWKEFILE1P\N3PUBLIC\PDS\C3D\CAD\22501500\SIG\S51-0429\S51-0429_TS_S1B.DWG
LAYOUT NAME - Plan 1 IN 40 FT
PLOT DATE : 7/19/2023 9:05 AM
PLOT BY : BRUGGEMAN, JOHN
PLOT NAME :
PLOT SCALE : 1 IN:40 FT
WISDOT/CADDS SHEET 42

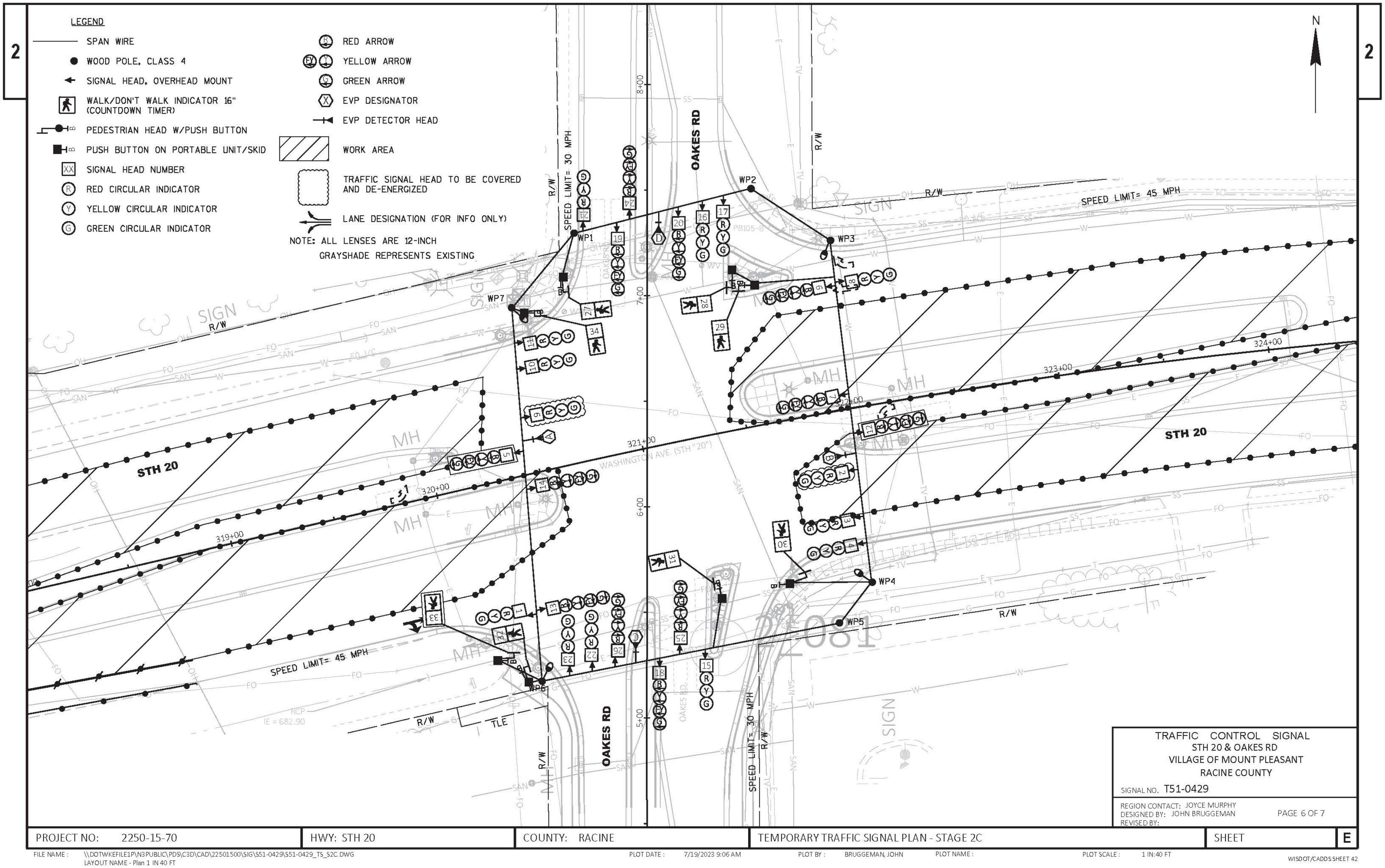

LEGEND
SPAN WIRE
WOOD POLE, CLASS 4
SIGNAL HEAD, OVERHEAD MOUNT
WALK/DON'T WALK INDICATOR 16" (COUNTDOWN TIMER)
PEDESTRIAN HEAD W/PUSH BUTTON
PUSH BUTTON ON PORTABLE UNIT/SKID
SIGNAL HEAD NUMBER
RED CIRCULAR INDICATOR
YELLOW CIRCULAR INDICATOR
GREEN CIRCULAR INDICATOR
RED ARROW
YELLOW ARROW
GREEN ARROW
EVP DESIGNATOR
EVP DETECTOR HEAD
WORK AREA
TRAFFIC SIGNAL HEAD TO BE COVERED AND DE-ENERGIZED
LANE DESIGNATION (FOR INFO ONLY)
NOTE: ALL LENSES ARE 12-INCH
GRAYSHADE REPRESENTS EXISTING
OAKES RD
STH 20
SPEED LIMIT= 30 MPH
SPEED LIMIT= 45 MPH
WP1
WP2
WP3
WP4
WP5
WP6
WP7
R/W
TLE
N
TRAFFIC CONTROL SIGNAL
STH 20 & OAKES RD
VILLAGE OF MOUNT PLEASANT
RACINE COUNTY
SIGNAL NO. T51-0429
REGION CONTACT: JOYCE MURPHY
DESIGNED BY: JOHN BRUGGEMAN
REVISED BY:
PAGE 4 OF 7
PROJECT NO: 2250-15-70
HWY: STH 20
COUNTY: RACINE
TEMPORARY TRAFFIC SIGNAL PLAN - STAGE 2A
SHEET
E
FILE NAME : \\DOTWKEFILE1P\N3PUBLIC\PDS\C3D\CAD\22501500\SIG\S51-0429\S51-0429_TS_S2A.DWG
LAYOUT NAME - Plan 1 IN 40 FT
PLOT DATE : 7/19/2023 9:05 AM
PLOT BY : BRUGGEMAN, JOHN
PLOT NAME :
PLOT SCALE : 1 IN:40 FT
WISDOT/CADDS SHEET 42



TRAFFIC CONTROL SIGNAL
STH 20 & OAKES RD
VILLAGE OF MOUNT PLEASANT
RACINE COUNTY
SIGNAL NO. T51-0429
REGION CONTACT: JOYCE MURPHY DESIGNED BY: JOHN BRUGGEMAN REVISED BY: PAGE 5 OF 7

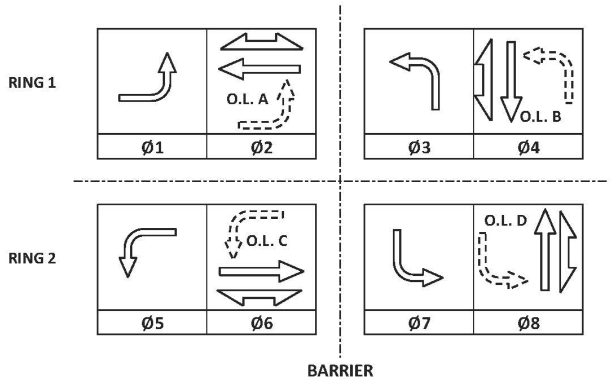
PROJECT NO: 2250-15-70	HWY: STH 20	COUNTY: RACINE	TEMPORARY TRAFFIC SIGNAL PLAN - STAGE 2B	SHEET	E

FILE NAME: \\DOTWKEFILE1P\N3PUBLIC\PDS\C3D\CAD\22501500\SIG\S51-0429\S51-0429_TS_S2B.DWG PLOT DATE: 7/19/2023 9:06 AM PLOT BY: BRUGGEMAN, JOHN PLOT NAME: PLOT SCALE: 1 IN:40 FT
LAYOUT NAME - Plan 1 IN:40 FT WISDOT/CADDS SHEET 42


LEGEND
SPAN WIRE
WOOD POLE, CLASS 4
SIGNAL HEAD, OVERHEAD MOUNT
WALK/DON'T WALK INDICATOR 16" (COUNTDOWN TIMER)
PEDESTRIAN HEAD W/PUSH BUTTON
PUSH BUTTON ON PORTABLE UNIT/SKID
SIGNAL HEAD NUMBER
RED CIRCULAR INDICATOR
YELLOW CIRCULAR INDICATOR
GREEN CIRCULAR INDICATOR
RED ARROW
YELLOW ARROW
GREEN ARROW
EVP DESIGNATOR
EVP DETECTOR HEAD
WORK AREA
TRAFFIC SIGNAL HEAD TO BE COVERED AND DE-ENERGIZED
LANE DESIGNATION (FOR INFO ONLY)
NOTE: ALL LENSES ARE 12-INCH
GRAYSHADE REPRESENTS EXISTING
OAKES RD
STH 20
SPEED LIMIT= 30 MPH
SPEED LIMIT= 45 MPH
WP1
WP2
WP3
WP4
WP5
WP6
WP7
TRAFFIC CONTROL SIGNAL
STH 20 & OAKES RD
VILLAGE OF MOUNT PLEASANT
RACINE COUNTY
SIGNAL NO. T51-0429
REGION CONTACT: JOYCE MURPHY
DESIGNED BY: JOHN BRUGGEMAN
PAGE 6 OF 7
PROJECT NO: 2250-15-70
HWY: STH 20
COUNTY: RACINE
TEMPORARY TRAFFIC SIGNAL PLAN - STAGE 2C
SHEET
E
PLOT DATE: 7/19/2023 9:06 AM
PLOT BY: BRUGGEMAN, JOHN
PLOT SCALE: 1 IN:40 FT
WISDOT/CADDS SHEET 42

2

	HEAD NUMBERS	FLASH
Ø1	5,6,7	-
Ø2	8,9,10,11	R
Ø3	18,19,20	-
Ø4	21,22,23	R
Ø5	12,13,14	-
Ø6	1,2,3,4	R
Ø7	24,25,26	-
Ø8	15,16,17	R
Ø2P	27,28	
Ø4P	33,34	
Ø6P	31,32	
Ø8P	29,30	
OLA	5,6,7	R
OLB	18,19,20	R
OLC	12,13,14	R
OLD	24,25,26	R



2

CONTROLLER LOGIC

PHASE NUMBER	PHASE LOCKING	DUAL ENTRY W / Ø	PHASE RECALL	PHASE ACTIVE
1		6	MAX	X
2	X	6	MAX	X
3		8	MAX	X
4		8	MAX	X
5		2	MAX	X
6	X	2	MAX	X
7		4	MAX	X
8		4	MAX	X

TYPE OF INTERCONNECT/COMMUNICATION	
NONE	X
CLOSED LOOP	
TWISTED PAIR	
FIBER OPTIC*	
FIBER OPTIC (ETHERNET)	
RADIO	
CELL MODEM	

TYPE OF COORDINATION	
NONE	
TBC	X
TRAFFIC RESPONSIVE	
ADAPTIVE	
*LOCATION OF MASTER CONTROLLER NO:	S-
SIGNAL SYSTEM NO:	SS-

TYPE OF LIGHTING	
BY OTHER AGENCY	
IN TRAFFIC CABINET	X
IN SEPARATE DOT LIGHTING CABINET	

TYPE OF PRE-EMPT	
NONE	
RAILROAD	
EMERGENCY VEHICLE	X
GTT	X
TOMAR	
HARDWIRE	
OTHER	
CONFIRMATION LIGHTS	
LIFT BRIDGE	
QUEUE DETECTION	

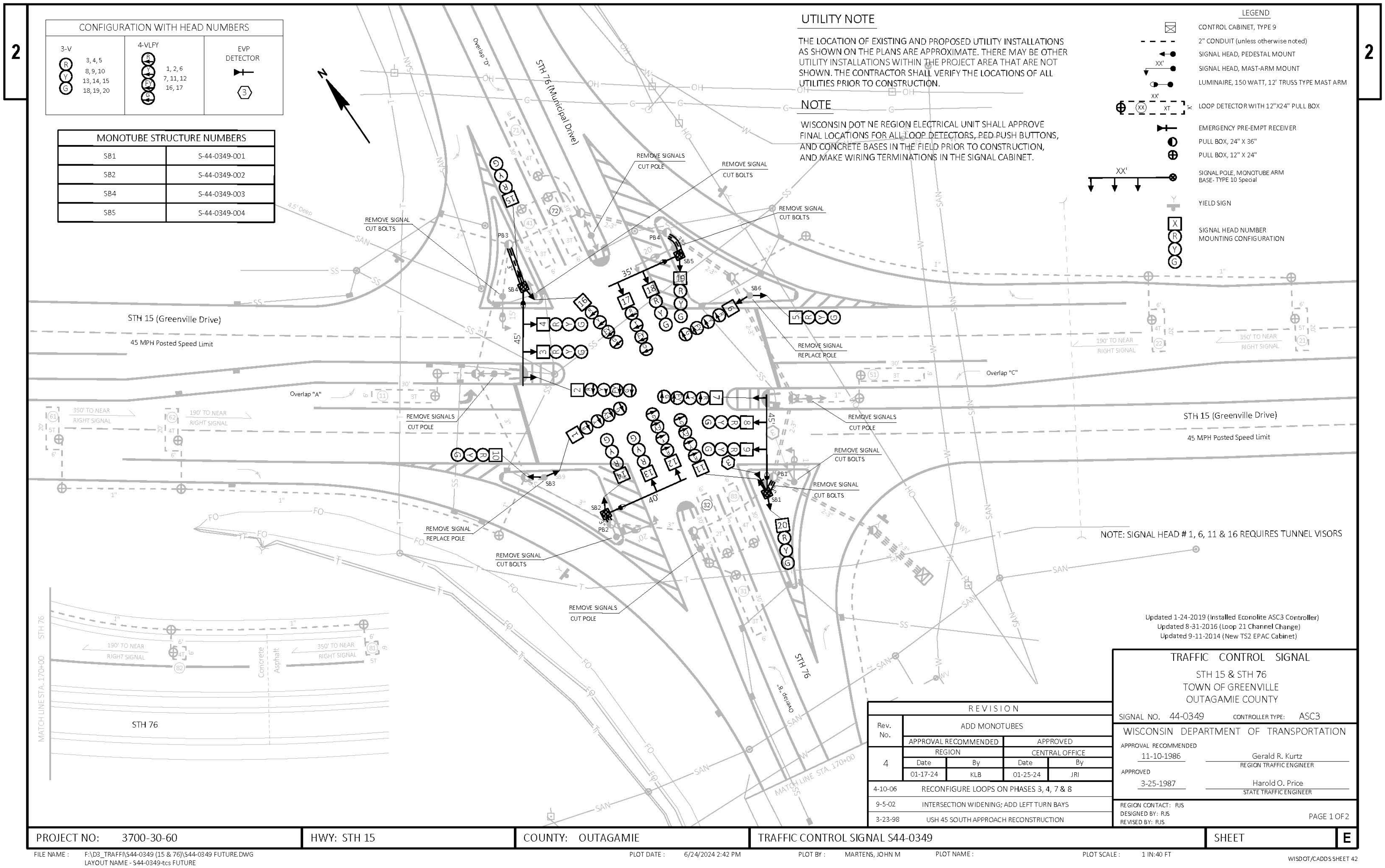
STH 20 & OAKES RD
VILLAGE OF MOUNT PLEASANT
RACINE COUNTY

SIGNAL NO:	T51-0429	CABINET TYPE:	TEMP
		CONTROLLER TYPE:	ECONOLITE
DATE:	AUGUST 2023	PAGE NUMBER:	7 OF 7

PROJECT NO: 2250-15-70	HWY: STH 20	COUNTY: RACINE	TEMPORARY SEQUENCE OF OPERATIONS	SHEET NO:	E

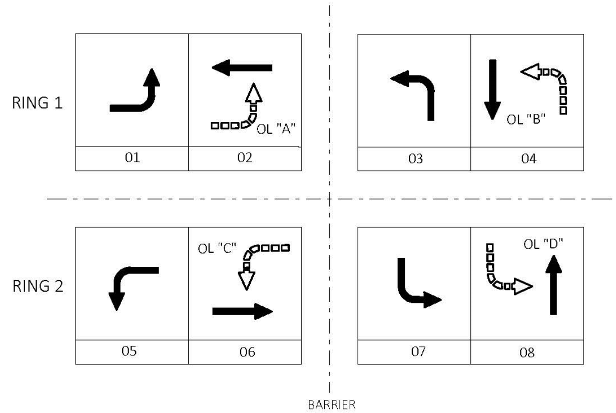
FILE NAME: \\WKERTOVFILPI01\n3public\SPO\Operations\Signals\Databases\Signal Intersection Files\S40-1144\PLANS\TS1.xlsx PLOT DATE: 3/2/2020 PLOT NAME: TS1.xlsx PLOT BY: ___________ PLOT SCALE: 1:1

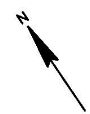
Example 4. Revision Plan to Add Monotubes (2 sheets)



2

	HEAD NUMBERS	FLASH
01	6, 7	-
02	3, 4, 5	R
03	16, 17	-
04	13, 14, 15	R
05	1, 2	-
06	8, 9, 10	R
07	11, 12	-
08	18, 19, 20	R
02P		
04P		
06P		
08P		
OLA	6, 7	R
OLB	16, 17	R
OLC	1, 2	R
OLD	11, 12	R





CONTROLLER LOGIC

PHASE NUMBER	PHASE LOCKING	DUAL ENTRY W / Ø	PHASE RECALL	PHASE ACTIVE
1				YES
2			MIN	YES
3				YES
4	YES	8		YES
5				YES
6			MIN	YES
7				YES
8		4		YES

EMERGENCY VEHICLE PREEMPTION

EMERGENCY VEHICLE DETECTOR	3
MOVEMENT	
PHASE	4+7

TYPE OF INTERCONNECT/COMMUNICATION	
CELL MODEM	X
CLOSED LOOP	
TWISTED PAIR*	
FIBER OPTIC*	
FIBER OPTIC (ETHERNET)	
RADIO	

TYPE OF COORDINATION	
NONE	X
TBC	
TRAFFIC RESPONSIVE	
ADAPTIVE	
*LOCATION OF MASTER CONTROLLER NO:	S00-0000
SIGNAL SYSTEM #:	SS-0000

TYPE OF LIGHTING	
BY OTHER AGENCY	
IN TRAFFIC SIGNAL CABINET	X
IN SEPARATE DOT LIGHTING CABINET	

TYPE OF PRE-EMPT	
NONE	
RAILROAD	
EMERGENCY VEHICLE	
GTT/3M	X
TOMAR	
HARDWIRE	
OTHER (GPS)	
LIFT BRIDGE	
QUEUE DETECTOR	

DETECTOR LOGIC

RACK # 1

DETECTOR CHANNEL	3	1	7	5	11	9	15	13
PLAN LOOP DETECTOR #(S)	11		31	41				
ASSIGNED PHASE	1		3	4				
OPERATION MODE	Veh	BAD	Veh	Veh				
SWITCH TO PHASE								
EXTEND								
DELAY								
DETECTOR CHANNEL	4	2	8	6	12	10	16	14
PLAN LOOP DETECTOR #(S)	21	22	32					
ASSIGNED PHASE	2	2	3					
OPERATION MODE	Veh	Veh	Veh					
SWITCH TO PHASE								
EXTEND	Yes							
DELAY								

RACK # 2

DETECTOR CHANNEL	19	17	23	21	27	25	31	29
PLAN LOOP DETECTOR #(S)	51	61	71	81	83			
ASSIGNED PHASE	5	6	7	8	8			
OPERATION MODE	Veh	Veh	Veh	Veh	Veh			
SWITCH TO PHASE								
EXTEND		Yes						
DELAY				Yes				
DETECTOR CHANNEL	20	18	24	22	28	26	32	30
PLAN LOOP DETECTOR #(S)		62	72	82				
ASSIGNED PHASE		6	7	8				
OPERATION MODE		Veh	Veh	Veh				
SWITCH TO PHASE								
EXTEND								
DELAY				Yes				

Revision 4 - Add Monotubes
Updated 1-24-2019 (Installed Econolite ASC3 Controller)
Updated 8-31-2016 (Loop 21 Channel Change)
Updated 9-11-2014 (New TS2 EPAC Cabinet)

GENERAL NOTES:

1. PROVIDE FOR HAND CONTROL
2. MMU SET UP FOR MODE B

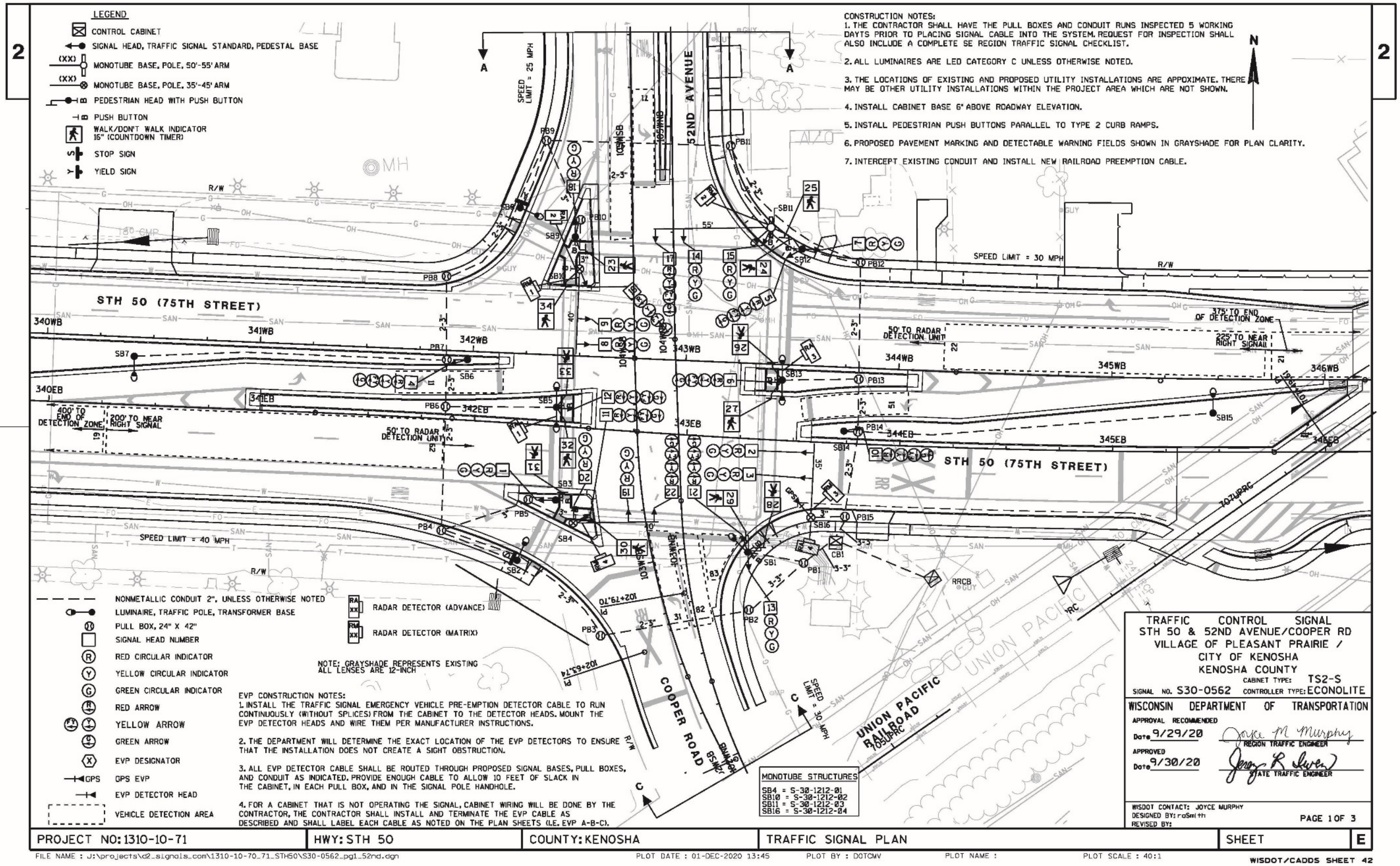
STH 15 & STH 76
TOWN OF GREENVILLE
OUTAGAMIE COUNTY

SIGNAL NO. 44-0349
CABINET: TS2 CONTROLLER: ASC3
DATE: 01-17-24 PAGE NO. 2 OF 2

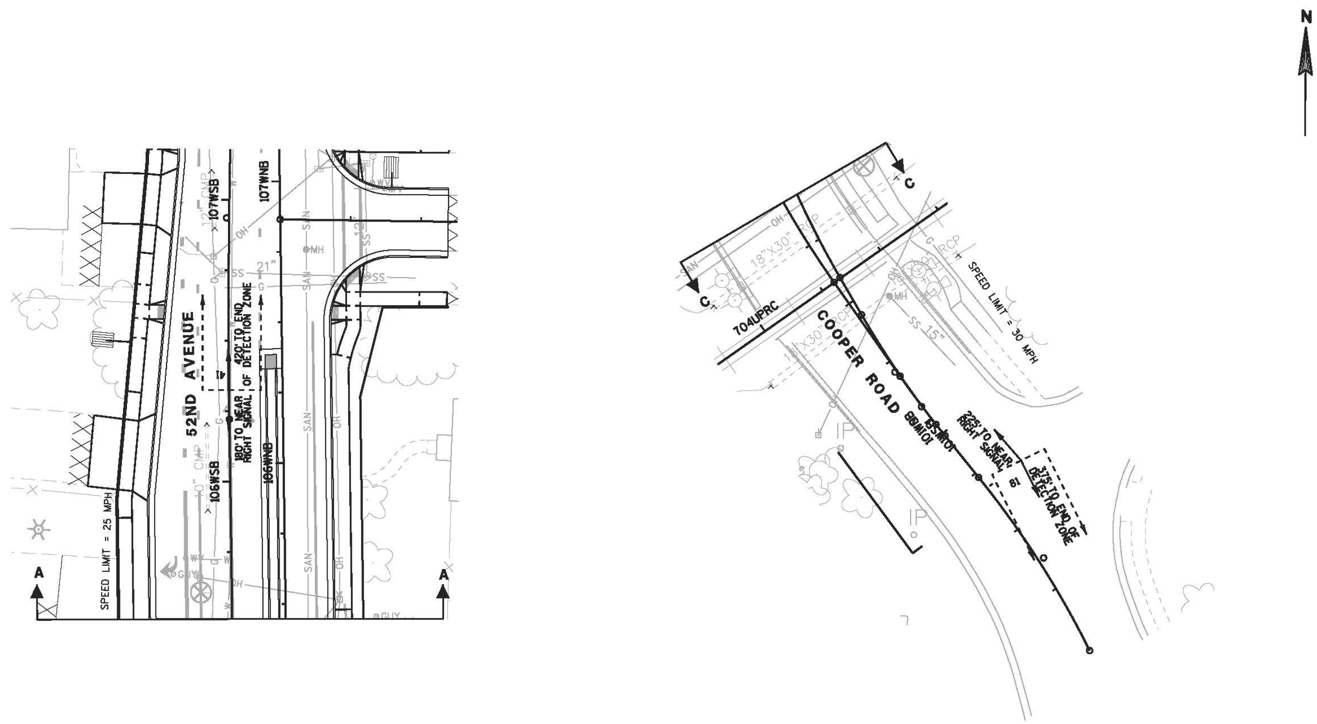
PROJECT NO: 3700-30-60	HWY: STH 15	COUNTY: OUTAGAMIE	SEQUENCE OF OPERATIONS - S44-0349	SHEET	E

FILE NAME : F:\D3_TRAFFI\S44-0349 (15 & 76)\S44-0349 FUTURE.DWG
LAYOUT NAME - S44-0349-seq FUTURE
PLOT DATE : 6/24/2024 2:42 PM PLOT BY : MARTENS, JOHN M PLOT NAME : PLOT SCALE : 1 IN:40 FT
WISDOT/CADDS SHEET 42

Example 5. Signalized Intersection Plan with Railroad Preemption (3 sheets)



2



TRAFFIC CONTROL SIGNAL
STH 50 & 52ND AVENUE/COOPER RD
VILLAGE OF PLEASANT PRAIRIE /
CITY OF KENOSHA
KENOSHA COUNTY

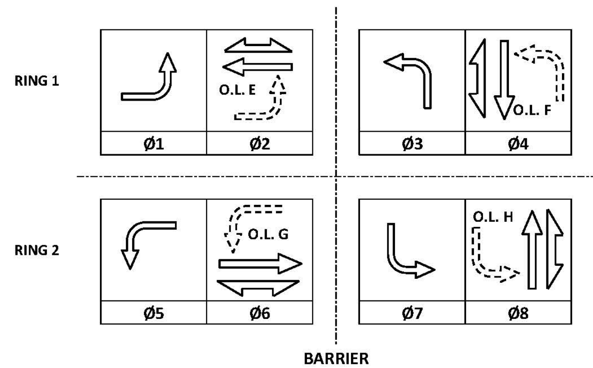
SIGNAL NO. S30-0562
WISDOT CONTACT: JOYCE MURPHY
DESIGNED BY: raSmith
REVISED BY:
PAGE 2 OF 3

PROJECT NO:1310-10-71	HWY:STH 50	COUNTY:KENOSHA	TRAFFIC SIGNAL PLAN	SHEET	E

FILE NAME : J:\projects\d2_signals_com\1310-10-70_71_STH50\S30-0562_pg2_52nd.dgn PLOT DATE : 01-DEC-2020 13:46 PLOT BY : DOTCMV PLOT NAME : PLOT SCALE : 40:1 WISDOT/CADDS SHEET 42

2

	HEAD NUMBERS	FLASH
Ø1	4,5,6	R
Ø2	7,8,9	R
Ø3	16,17	R
Ø4	18,19,20	R
Ø5	10,11,12	R
Ø6	1,2,3	R
Ø7	21,22	R
Ø8	13,14,15	R
Ø2P	23,24	
Ø4P	31,32,33,34	
Ø6P	29,30	
Ø8P	25,26,27,28	
OLE	4,5,6	-
OLF	16,17	-
OLG	10,11,12	-
OLH	21,22	-



CONTROLLER LOGIC

PHASE NUMBER	PHASE LOCKING	DUAL ENTRY W / Ø	PHASE RECALL	PHASE ACTIVE
1		6		X
2	X	6	MIN	X
3		8		X
4		8		X
5		2		X
6	X	2	MIN	X
7		4		X
8		4		X

EMERGENCY VEHICLE PREEMPTION SEQUENCE

EMERGENCY VEHICLE PREEMPTOR	A	B	C	D
MOVEMENT				
PHASE	2+5	6+1	4+7	8+3

AFTER PREEMPTION SEQUENCE 2+5 OR 6+1, CONTROLLER SHALL RETURN TO PHASES 2+6.

AFTER PREEMPTION SEQUENCE 4+7 OR 8+3, CONTROLLER SHALL RETURN TO PHASES 4+8.

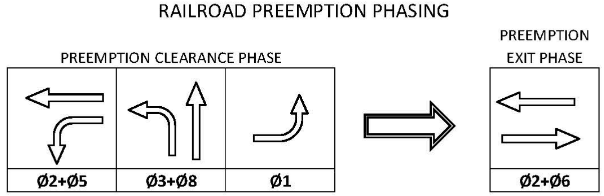
TYPE OF INTERCONNECT/COMMUNICATION	
NONE	
CLOSED LOOP	
TWISTED PAIR	
FIBER OPTIC*	
FIBER OPTIC (ETHERNET)	X
RADIO	
CELL MODEM	

TYPE OF COORDINATION	
NONE	
TBC	X
TRAFFIC RESPONSIVE	
ADAPTIVE	
*LOCATION OF MASTER CONTROLLER NO:	S-
SIGNAL SYSTEM NO:	SS-30-0116

TYPE OF LIGHTING	
BY OTHER AGENCY	
IN TRAFFIC CABINET	X
IN SEPARATE DOT LIGHTING CABINET	

TYPE OF PRE-EMPT	
NONE	
RAILROAD	X
EMERGENCY VEHICLE	X
GTT	X
TOMAR	
HARDWIRE	
OTHER - GPS	X
CONFIRMATION LIGHTS	
LIFT BRIDGE	
QUEUE DETECTION	

RAILROAD PREEMPTION PHASING



DETECTOR LOGIC

DETECTOR INPUT	3	1	7	5	11	9	15	13
PLAN LOOP DETECTOR*(S)	11	42	71	83				
CALLED PHASE	1	4	7	8				
CALL OPTION	X	X	X	X				
DELAY TIME				X				
EXTENTION OPTION	X	X	X	X				
EXTEND TIME								
USE ADDED INITIAL								
CROSS SWITCH PHASE								

DETECTOR INPUT	19	17	23	21	27	25	31	29
PLAN LOOP DETECTOR*(S)	21	41	62					
CALLED PHASE	2	4	6					
CALL OPTION	X		X					
DELAY TIME								
EXTENTION OPTION	X	X	X					
EXTEND TIME		X						
USE ADDED INITIAL								
CROSS SWITCH PHASE								

DETECTOR INPUT	4	2	8	6	12	10	16	14
PLAN LOOP DETECTOR*(S)	31	51	82					
CALLED PHASE	3	5	8					
CALL OPTION	X	X	X					
DELAY TIME								
EXTENTION OPTION	X	X	X					
EXTEND TIME								
USE ADDED INITIAL								
CROSS SWITCH PHASE								

DETECTOR INPUT	20	18	24	22	28	26	32	30
PLAN LOOP DETECTOR*(S)	22	61	81					
CALLED PHASE	2	6	8					
CALL OPTION	X	X						
DELAY TIME								
EXTENTION OPTION	X	X	X					
EXTEND TIME			X					
USE ADDED INITIAL								
CROSS SWITCH PHASE								

GENERAL NOTES:

1. TRAFFIC SIGNAL CABINET SHALL OPERATE WITH BATTERY BACKUP TO ACCOMMODATE RAILROAD PREEMPTION.
2. IN THE EVENT OF RAILROAD PRE-EMPTION, PHASES 2 + 5 SHALL RECEIVE A GREEN INDICATION FOLLOWED BY A CLEARANCE PERIOD TO CLEAR PHASES 3+8. THE INTERSECTION WILL DWELL IN PHASE 1 UNTIL THE CONCLUSION OF THE PRE-EMPTION EVENT. AT THE CONCLUSION OF PRE-EMPTION, THE INTERSECTION WILL RETURN TO PHASE 2 + 6 GREEN.

STH 50 & 52ND AVENUE/COOPER RD
VILLAGE OF PLEASANT PRAIRIE/CITY OF KENOSHA
KENOSHA COUNTY

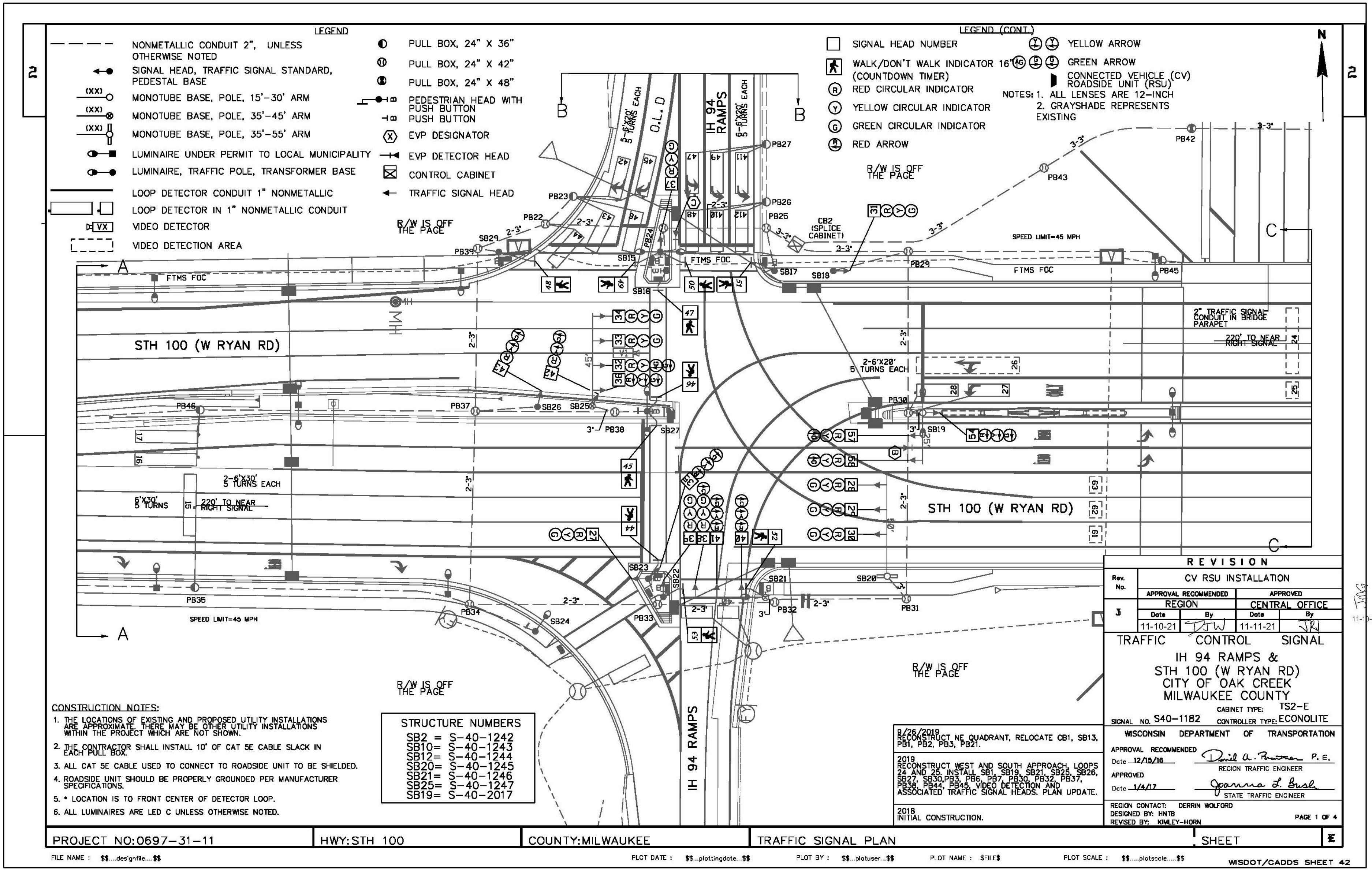
SIGNAL NO:	S30-0562	CABINET TYPE:	TS2-S
		CONTROLLER TYPE:	ECONOLITE
DATE:	10/2020	PAGE NUMBER:	3 OF 3

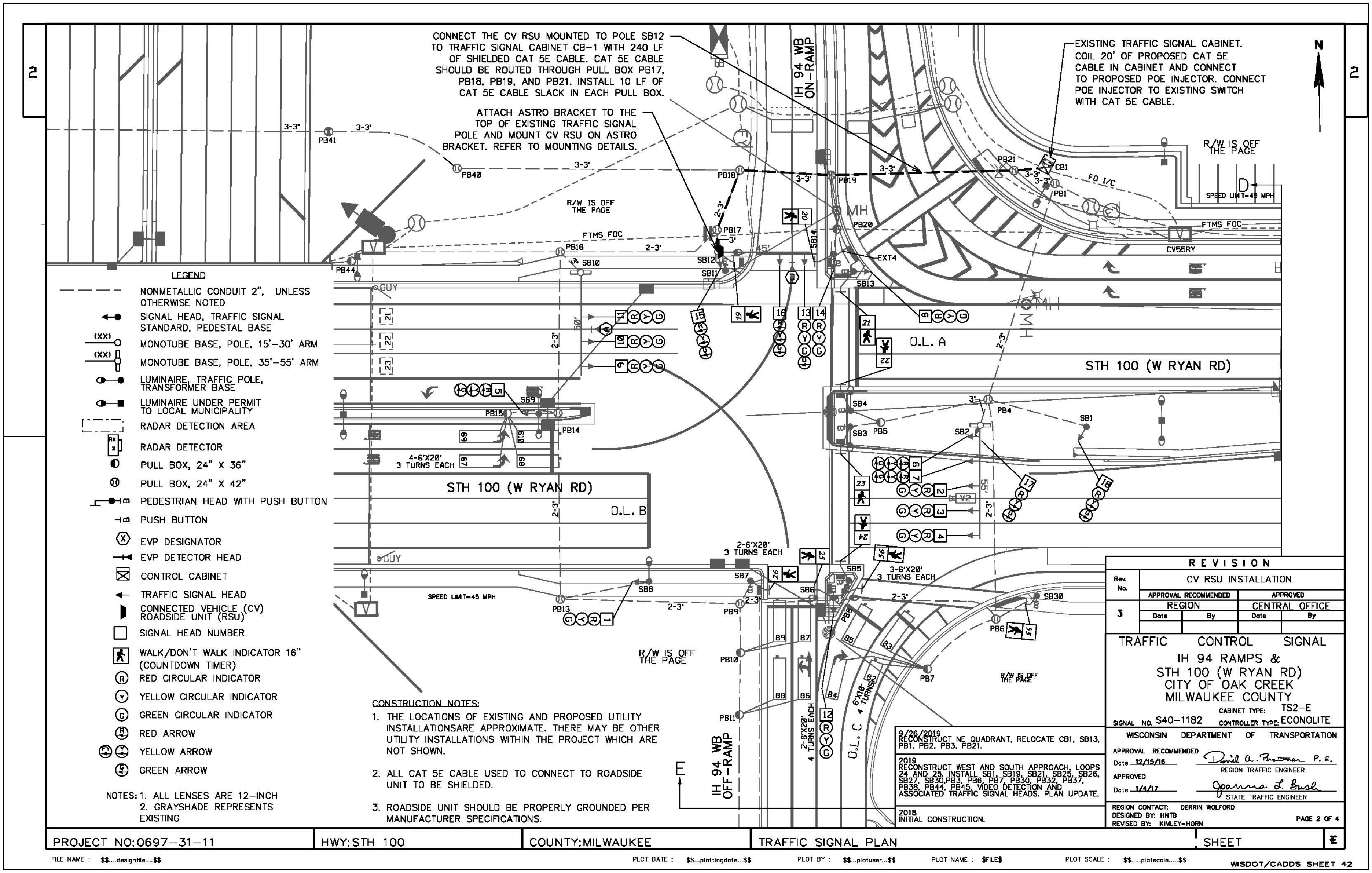
PROJECT NO: 1310-10-71	HWY: STH 50	COUNTY: KENOSHA	SEQUENCE OF OPERATIONS	SHEET NO:	E

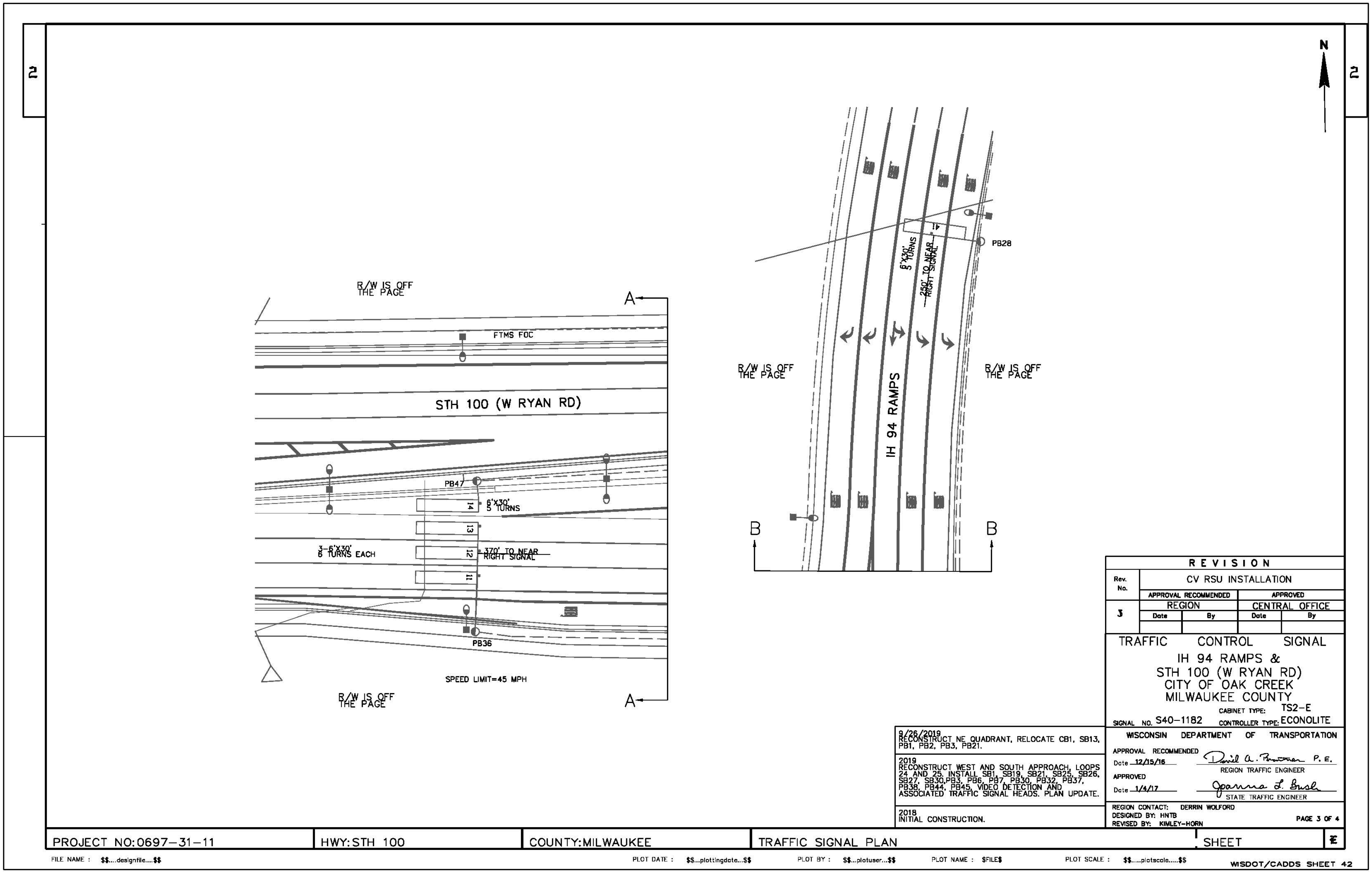
FILE NAME: \\rasmith.com\Brookfield\Transportation\1112711\Traffic\Signal Design\Sequence Sheets\WIS 50 & 52nd\TS2-S_E_FYA_EFGH_Econolite_SEQ.xlsx PLOT DATE: 9/29/2020 PLOT NAME: TS2-S_E_FYA_EFGH_Econc PLOT BY: ____________ PLOT SCALE: 1:1

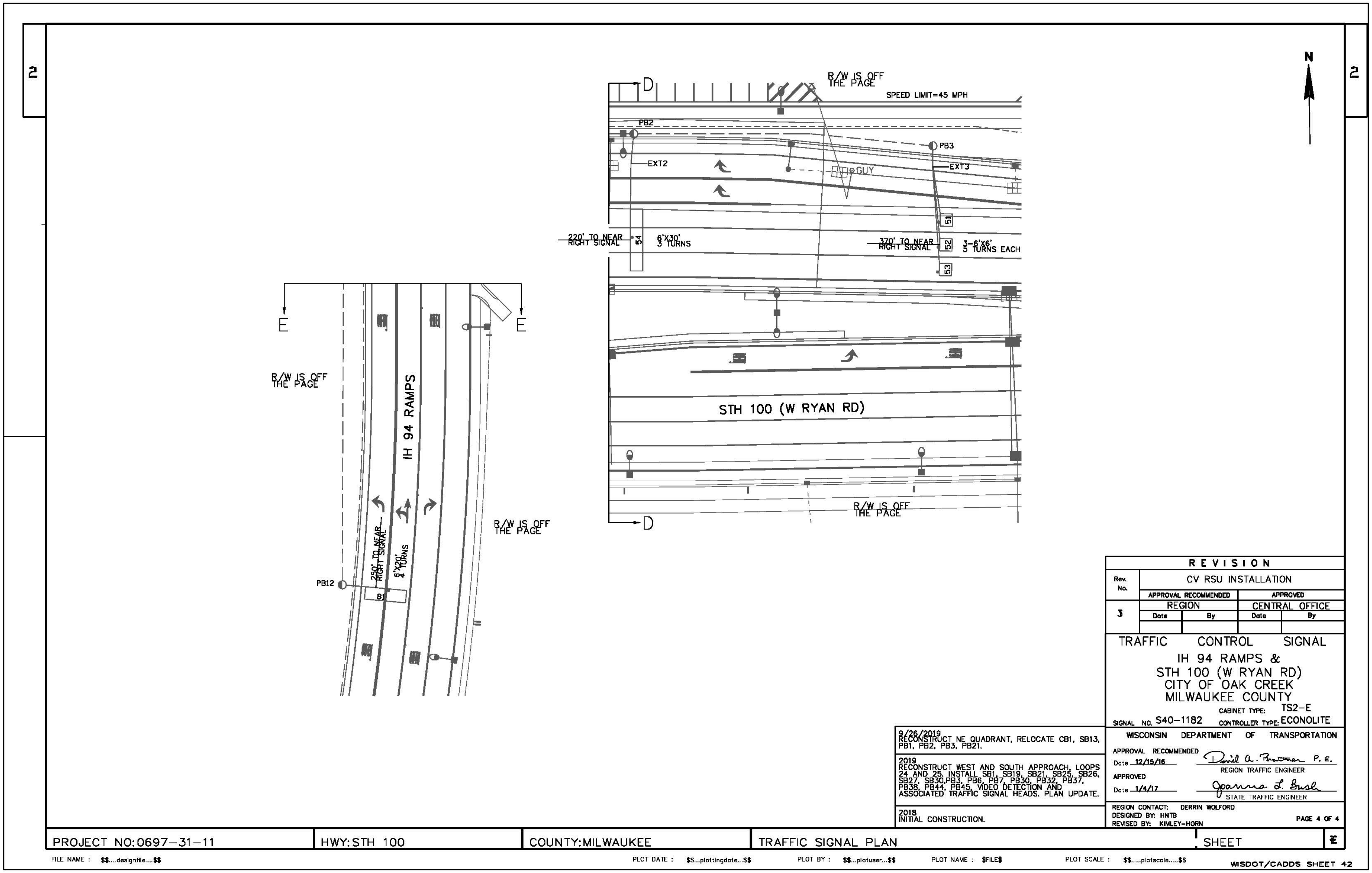
2

Example 6. Signal Controller Plan at an Interchange - Dual Ring with Overlaps (5 sheets)




CONNECT THE CV RSU MOUNTED TO POLE SB12 TO TRAFFIC SIGNAL CABINET CB-1 WITH 240 LF OF SHIELDED CAT 5E CABLE. CAT 5E CABLE SHOULD BE ROUTED THROUGH PULL BOX PB17, PB18, PB19, AND PB21. INSTALL 10 LF OF CAT 5E CABLE SLACK IN EACH PULL BOX.
ATTACH ASTRO BRACKET TO THE TOP OF EXISTING TRAFFIC SIGNAL POLE AND MOUNT CV RSU ON ASTRO BRACKET. REFER TO MOUNTING DETAILS.
EXISTING TRAFFIC SIGNAL CABINET. COIL 20' OF PROPOSED CAT 5E CABLE IN CABINET AND CONNECT TO PROPOSED POE INJECTOR. CONNECT POE INJECTOR TO EXISTING SWITCH WITH CAT 5E CABLE.
IH 94 WB ON-RAMP
IH 94 WB OFF-RAMP
STH 100 (W RYAN RD)
R/W IS OFF THE PAGE
SPEED LIMIT=45 MPH
LEGEND
NONMETALLIC CONDUIT 2", UNLESS OTHERWISE NOTED
SIGNAL HEAD, TRAFFIC SIGNAL STANDARD, PEDESTAL BASE
MONOTUBE BASE, POLE, 15'-30' ARM
MONOTUBE BASE, POLE, 35'-55' ARM
LUMINAIRE, TRAFFIC POLE, TRANSFORMER BASE
LUMINAIRE UNDER PERMIT TO LOCAL MUNICIPALITY
RADAR DETECTION AREA
RADAR DETECTOR
PULL BOX, 24" X 36"
PULL BOX, 24" X 42"
PEDESTRIAN HEAD WITH PUSH BUTTON
PUSH BUTTON
EVP DESIGNATOR
EVP DETECTOR HEAD
CONTROL CABINET
TRAFFIC SIGNAL HEAD
CONNECTED VEHICLE (CV) ROADSIDE UNIT (RSU)
SIGNAL HEAD NUMBER
WALK/DON'T WALK INDICATOR 16" (COUNTDOWN TIMER)
RED CIRCULAR INDICATOR
YELLOW CIRCULAR INDICATOR
GREEN CIRCULAR INDICATOR
RED ARROW
YELLOW ARROW
GREEN ARROW
NOTES: 1. ALL LENSES ARE 12-INCH
2. GRAYSHADE REPRESENTS EXISTING
CONSTRUCTION NOTES:
1. THE LOCATIONS OF EXISTING AND PROPOSED UTILITY INSTALLATIONSARE APPROXIMATE. THERE MAY BE OTHER UTILITY INSTALLATIONS WITHIN THE PROJECT WHICH ARE NOT SHOWN.
2. ALL CAT 5E CABLE USED TO CONNECT TO ROADSIDE UNIT TO BE SHIELDED.
3. ROADSIDE UNIT SHOULD BE PROPERLY GROUNDED PER MANUFACTURER SPECIFICATIONS.
9/26/2019 RECONSTRUCT NE QUADRANT, RELOCATE CB1, SB13, PB1, PB2, PB3, PB21.
2019 RECONSTRUCT WEST AND SOUTH APPROACH, LOOPS 24 AND 25. INSTALL SB1, SB19, SB21, SB25, SB26, SB27, SB30,PB3, PB6, PB7, PB30, PB32, PB37, PB38, PB44, PB45, VIDEO DETECTION AND ASSOCIATED TRAFFIC SIGNAL HEADS. PLAN UPDATE.
2018 INITIAL CONSTRUCTION.
REVISION
CV RSU INSTALLATION
TRAFFIC CONTROL SIGNAL
IH 94 RAMPS & STH 100 (W RYAN RD)
CITY OF OAK CREEK
MILWAUKEE COUNTY
CABINET TYPE: TS2-E
SIGNAL NO. S40-1182 CONTROLLER TYPE: ECONOLITE
WISCONSIN DEPARTMENT OF TRANSPORTATION
REGION CONTACT: DERRIN WOLFORD
DESIGNED BY: HNTB
REVISED BY: KIMLEY-HORN
PAGE 2 OF 4
PROJECT NO:0697-31-11
HWY:STH 100
COUNTY:MILWAUKEE
TRAFFIC SIGNAL PLAN
SHEET
WISDOT/CADDS SHEET 42


2
2
N
R/W IS OFF THE PAGE
A
FTMS FOC
STH 100 (W RYAN RD)
PB47
6'X30' 5 TURNS
3-6'X30' 6 TURNS EACH
370' TO NEAR RIGHT SIGNAL
14
13
12
11
PB36
SPEED LIMIT=45 MPH
R/W IS OFF THE PAGE
A
PB28
6'X30' 5 TURNS
250' TO NEAR RIGHT SIGNAL
R/W IS OFF THE PAGE
R/W IS OFF THE PAGE
IH 94 RAMPS
B
B
REVISION
Rev. No.
CV RSU INSTALLATION
APPROVAL RECOMMENDED
APPROVED
3
REGION
CENTRAL OFFICE
Date
By
Date
By
TRAFFIC CONTROL SIGNAL
IH 94 RAMPS &
STH 100 (W RYAN RD)
CITY OF OAK CREEK
MILWAUKEE COUNTY
CABINET TYPE: TS2-E
SIGNAL NO. S40-1182
CONTROLLER TYPE: ECONOLITE
9/26/2019
RECONSTRUCT NE QUADRANT, RELOCATE CB1, SB13, PB1, PB2, PB3, PB21.
2019
RECONSTRUCT WEST AND SOUTH APPROACH, LOOPS 24 AND 25. INSTALL SB1, SB19, SB21, SB25, SB26, SB27, SB30,PB3, PB6, PB7, PB30, PB32, PB37, PB38, PB44, PB45, VIDEO DETECTION AND ASSOCIATED TRAFFIC SIGNAL HEADS. PLAN UPDATE.
2018
INITIAL CONSTRUCTION.
WISCONSIN DEPARTMENT OF TRANSPORTATION
APPROVAL RECOMMENDED
Date 12/15/16
David A. Bowman P. E.
REGION TRAFFIC ENGINEER
APPROVED
Date 1/4/17
Joanna L. Bush
STATE TRAFFIC ENGINEER
REGION CONTACT: DERRIN WOLFORD
DESIGNED BY: HNTB
REVISED BY: KIMLEY-HORN
PAGE 3 OF 4
PROJECT NO:0697-31-11
HWY:STH 100
COUNTY:MILWAUKEE
TRAFFIC SIGNAL PLAN
SHEET
E
FILE NAME : $$...designfile...$$
PLOT DATE : $$...plottingdate...$$
PLOT BY : $$...plotuser...$$
PLOT NAME : $FILE$
PLOT SCALE : $$.....plotscale.....$$
WISDOT/CADDS SHEET 42



R/W IS OFF THE PAGE
SPEED LIMIT=45 MPH
PB2
PB3
EXT2
EXT3
GUY
220' TO NEAR RIGHT SIGNAL
54
6'X30' 3 TURNS
370' TO NEAR RIGHT SIGNAL
51
52
53
3-6'X6' 5 TURNS EACH
D
E
STH 100 (W RYAN RD)
IH 94 RAMPS
250' TO NEAR RIGHT SIGNAL
6'X20' 4 TURNS
81
PB12
N
2
REVISION
Rev. No.
CV RSU INSTALLATION
APPROVAL RECOMMENDED
APPROVED
REGION
CENTRAL OFFICE
Date
By
3
TRAFFIC CONTROL SIGNAL
IH 94 RAMPS &
STH 100 (W RYAN RD)
CITY OF OAK CREEK
MILWAUKEE COUNTY
CABINET TYPE: TS2-E
SIGNAL NO. S40-1182
CONTROLLER TYPE: ECONOLITE
9/26/2019 RECONSTRUCT NE QUADRANT, RELOCATE CB1, SB13, PB1, PB2, PB3, PB21.
2019 RECONSTRUCT WEST AND SOUTH APPROACH, LOOPS 24 AND 25. INSTALL SB1, SB19, SB21, SB25, SB26, SB27, SB30,PB3, PB6, PB7, PB30, PB32, PB37, PB38, PB44, PB45, VIDEO DETECTION AND ASSOCIATED TRAFFIC SIGNAL HEADS. PLAN UPDATE.
2018 INITIAL CONSTRUCTION.
WISCONSIN DEPARTMENT OF TRANSPORTATION
APPROVAL RECOMMENDED
Date 12/15/16
P. E.
REGION TRAFFIC ENGINEER
APPROVED
Date 1/4/17
STATE TRAFFIC ENGINEER
REGION CONTACT: DERRIN WOLFORD
DESIGNED BY: HNTB
REVISED BY: KIMLEY-HORN
PAGE 4 OF 4
PROJECT NO:0697-31-11
HWY:STH 100
COUNTY:MILWAUKEE
TRAFFIC SIGNAL PLAN
SHEET
E
FILE NAME : $$....designfile....$$
PLOT DATE : $$...plottingdate...$$
PLOT BY : $$...plotuser...$$
PLOT NAME : $FILE$
PLOT SCALE : $$.....plotscale.....$$
WISDOT/CADDS SHEET 42

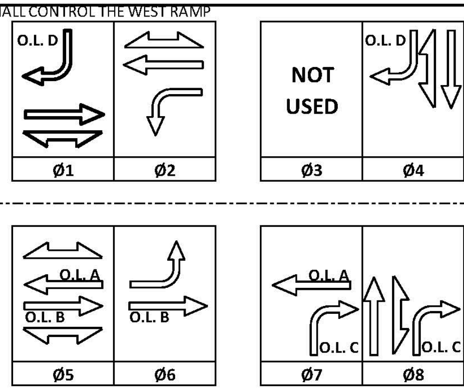
2

	HEAD NUMBERS	FLASH
Ø1	27,28,29,30,57,58	R
Ø2	21,32,33,34,35,36,54	R,R ←
Ø3		
Ø4	37,38,39,40,41	R,R ←
Ø5		
Ø6	5,6,7	R ←
Ø7		
Ø8	12,13,14,15,16	R,R ←
Ø1P	52,53	
Ø2P	48,49,50,10	
Ø4P	44,45,46,47	
Ø5P	19,20,25,26,55,56	
Ø8P	21,22,23,24	
OLA	8,9,10,11	R
OLB	1,2,3,4	R
OLC	17,18	R
OLD	42,43	R

** RING 1 SHALL CONTROL THE WEST RAMP

RING 1

RING 2



** RING 2 SHALL CONTROL THE EAST RAMP

CONTROLLER LOGIC

PHASE NUMBER	PHASE LOCKING	DUAL ENTRY W / Ø	PHASE RECALL	PHASE ACTIVE
1	X		MIN	X
2	X		MIN	X
3				
4				X
5				X
6	X		MIN	X
7				X
8				X

EMERGENCY VEHICLE PREEMPTION SEQUENCE

EMERGENCY VEHICLE PREEMPTOR	A	B	C	D
MOVEMENT	O.L A O.L B	O.L B	O.L D O.L B	O.L C
PHASE	5+2	1+6	4+6	8+2

AFTER PREEMPTION SEQUENCE 5+2, CONTROLLER SHALL RETURN TO PHASES 5+2.
AFTER PREEMPTION SEQUENCE 1+6, CONTROLLER SHALL RETURN TO PHASES 1+6.
AFTER PREEMPTION SEQUENCE 4+6, CONTROLLER SHALL RETURN TO PHASES 4+6.
AFTER PREEMPTION SEQUENCE 8+2, CONTROLLER SHALL RETURN TO PHASES 8+2.

TYPE OF INTERCONNECT/COMMUNICATION	
NONE	
CLOSED LOOP	
TWISTED PAIR	
FIBER OPTIC*	
FIBER OPTIC (ETHERNET)	X
RADIO	
CELL MODEM	

TYPE OF COORDINATION	
NONE	
TBC	X
TRAFFIC RESPONSIVE	
ADAPTIVE	
*LOCATION OF MASTER CONTROLLER NO:	S-
SIGNAL SYSTEM NO:	SS- 40-0012

TYPE OF LIGHTING	
BY OTHER AGENCY	X
IN TRAFFIC CABINET	X
IN SEPARATE DOT LIGHTING CABINET	

TYPE OF PRE-EMPT	
NONE	
RAILROAD	
EMERGENCY VEHICLE	X
GTT	X
TOMAR	
HARDWIRE	
OTHER	
CONFIRMATION LIGHTS	
LIFT BRIDGE	
QUEUE DETECTION	

DETECTOR LOGIC

DETECTOR INPUT	3	1	7	5	11	9	15	13
PLAN LOOP DETECTOR*(S)	11	13	15	17	28	42	44	46
CALLED PHASE	1	1	1	1	2	4	4	4
CALL OPTION	X	X	X	X	X	X	X	X
DELAY TIME						X	X	X
EXTENTION OPTION	X	X	X	X	X	X	X	X
EXTEND TIME								
USE ADDED INITIAL	X	X	X	X				
CROSS SWITCH PHASE								

DETECTOR INPUT	19	17	23	21	27	25	31	29
PLAN LOOP DETECTOR*(S)	48	410	412	52	54	68	610	82
CALLED PHASE	4	4	4	5	5	6	6	8
CALL OPTION	X	X	X	X	X	X	X	X
DELAY TIME								X
EXTENTION OPTION	X	X	X	X	X	X	X	X
EXTEND TIME								
USE ADDED INITIAL				X	X			
CROSS SWITCH PHASE								

DETECTOR INPUT	4	2	8	6	12	10	16	14
PLAN LOOP DETECTOR*(S)	12	14	16	27	41	43	45	47
CALLED PHASE	1	1	1	2	4	4	4	4
CALL OPTION	X	X	X	X		X	X	X
DELAY TIME						X	X	
EXTENTION OPTION	X	X	X	X	X	X	X	X
EXTEND TIME					X			
USE ADDED INITIAL	X	X	X					
CROSS SWITCH PHASE								

DETECTOR INPUT	20	18	24	22	28	26	32	30
PLAN LOOP DETECTOR*(S)	49	411	51	53	67	69	81	83
CALLED PHASE	4	4	5	5	6	6	8	8
CALL OPTION	X	X	X	X	X	X		X
DELAY TIME								X
EXTENTION OPTION	X	X	X	X	X	X	X	X
EXTEND TIME							X	
USE ADDED INITIAL			X	X				
CROSS SWITCH PHASE								

DETECTOR INPUT	35	33	39	37	43	41	47	45
PLAN LOOP DETECTOR*(S)	84	86	88					
CALLED PHASE	8	8	8					
CALL OPTION	X	X	X					
DELAY TIME	X							
EXTENTION OPTION	X	X	X					
EXTEND TIME								
USE ADDED INITIAL								
CROSS SWITCH PHASE								

DETECTOR INPUT	49	51	53	55	57	59	61	63
PLAN LOOP DETECTOR*(S)	21	23	25	61	63	65		
CALLED PHASE	2	2	2	6	6	6		
CALL OPTION	X	X	X	X	X			
DELAY TIME								
EXTENTION OPTION	X	X	X	X	X	X		
EXTEND TIME	X	X	X			X		
USE ADDED INITIAL								
CROSS SWITCH PHASE				5	5			

DETECTOR INPUT	36	34	40	38	44	42	48	46
PLAN LOOP DETECTOR*(S)	85	87	89					
CALLED PHASE	8	8	8					
CALL OPTION	X	X	X					
DELAY TIME	X							
EXTENTION OPTION	X	X	X					
EXTEND TIME								
USE ADDED INITIAL								
CROSS SWITCH PHASE								

DETECTOR INPUT	50	52	54	56	58	60	62	64
PLAN LOOP DETECTOR*(S)	22	24	26	62	64	66		
CALLED PHASE	2	2	2	6	6	6		
CALL OPTION	X	X	X	X	X			
DELAY TIME								
EXTENTION OPTION	X	X	X	X	X	X		
EXTEND TIME	X	X				X		
USE ADDED INITIAL								
CROSS SWITCH PHASE				5	5			

GENERAL NOTES:

1. CABINET IS EQUIPPED WITH BATTERY BACK-UP.

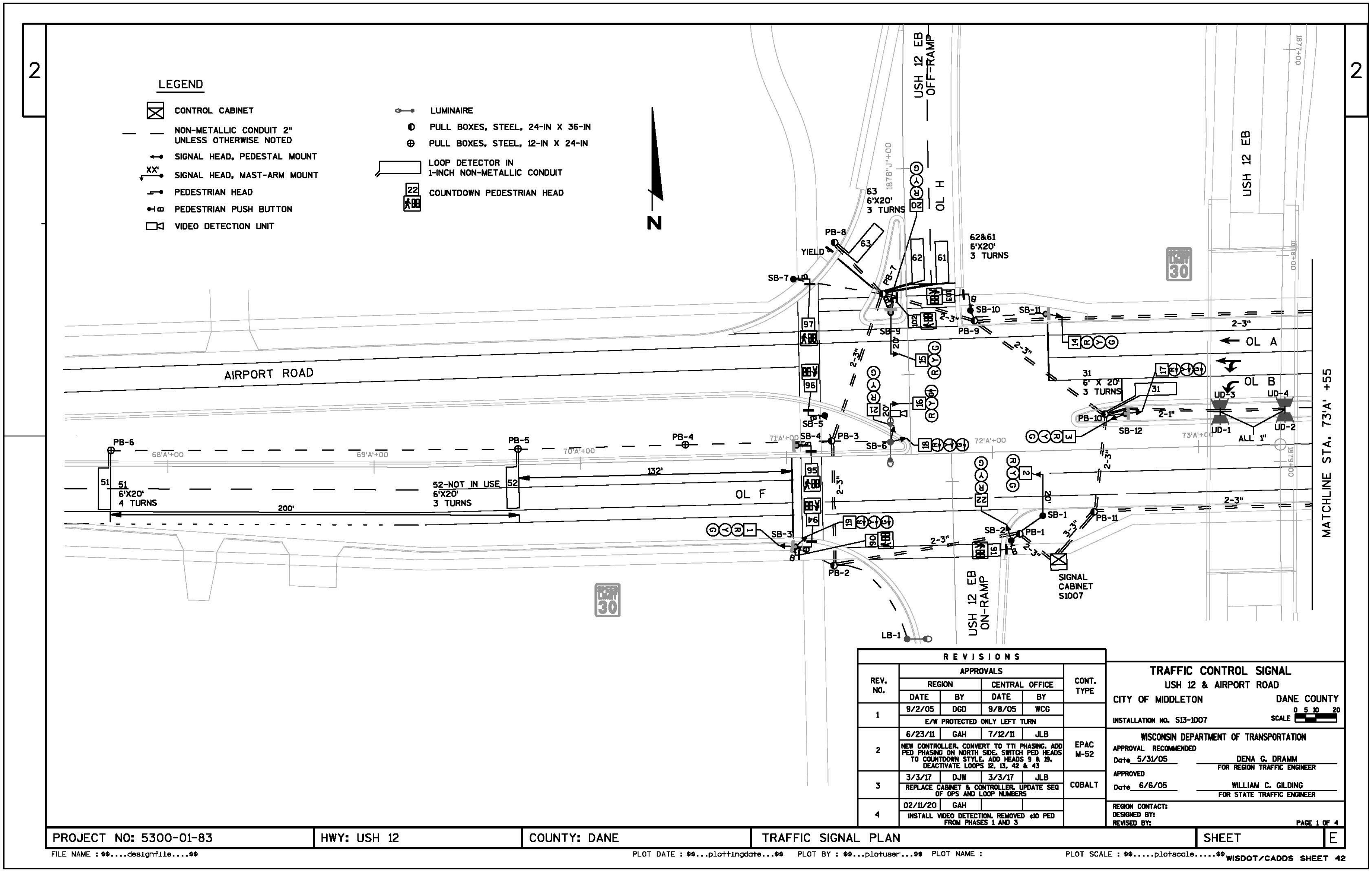
IH 94 RAMPS & STH 100 (W RYAN RD)
CITY OF OAK CREEK
MILWAUKEE COUNTY

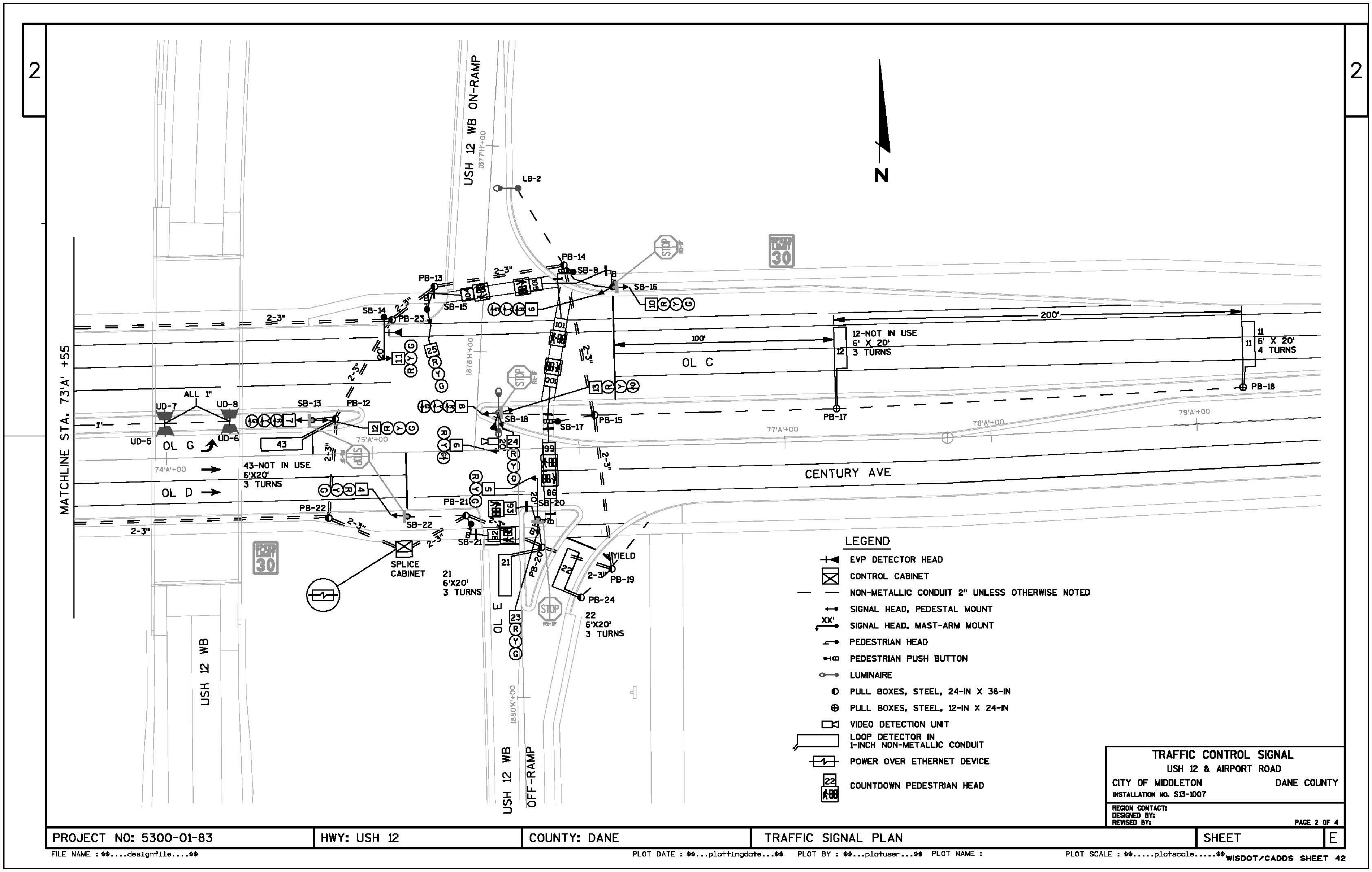
SIGNAL NO: S40-1182 CABINET TYPE: TS2-E
CONTROLLER TYPE: ECONOLITE
DATE: 7/21 PAGE NUMBER: 5 OF 5

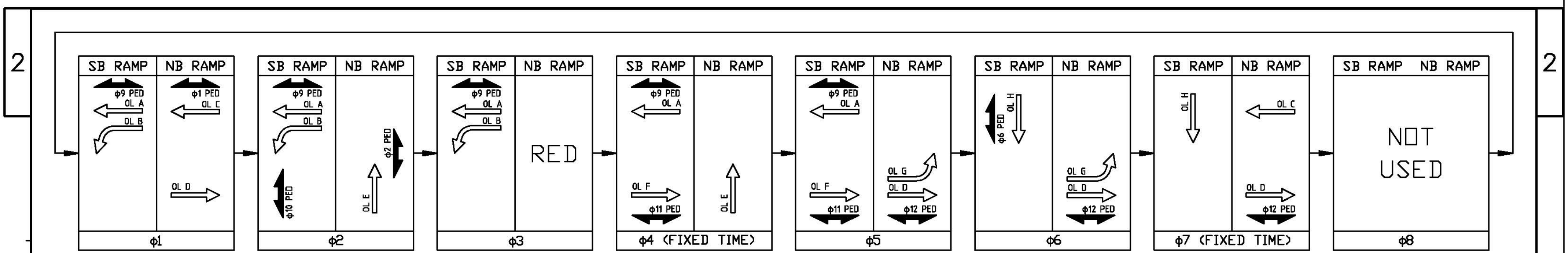
PROJECT NO: 0697-31-11	HWY: IH 94	COUNTY: MILWAUKEE	SEQUENCE OF OPERATIONS	SHEET NO:	E

FILE NAME: \\WKERTOVFILPI01\n3public\SPO\Operations\Signals\Databases\Signal Intersection Files\S40-1182\PLANS\TS2-S_FYA_ABCD_Econolite_SEQ.xlsx PLOT DATE: 7/16/2021 PLOT NAME: TS2-S_FYA_ABCD_Econoli PLOT BY: ________ PLOT SCALE: 1:1

Example 7. TTI Phasing Plan at an Interchange (4 sheets)




2
2
USH 12 WB ON-RAMP
N
LB-2
PB-14
SB-8
SB-16
PB-13
SB-15
SB-14
PB-23
200'
100'
12-NOT IN USE
6' X 20'
3 TURNS
11
6' X 20'
4 TURNS
OL C
PB-18
PB-17
PB-15
SB-17
SB-18
MATCHLINE STA. 73'A' +55
ALL 1"
UD-7
UD-8
UD-5
UD-6
OL G
SB-13
PB-12
43
43-NOT IN USE
6'X20'
3 TURNS
OL D
CENTURY AVE
PB-22
SB-22
PB-21
SB-21
SB-20
PB-20
SPLICE CABINET
21
6'X20'
3 TURNS
YIELD
PB-19
PB-24
22
6'X20'
3 TURNS
OL E
USH 12 WB
USH 12 WB OFF-RAMP
LEGEND
EVP DETECTOR HEAD
CONTROL CABINET
NON-METALLIC CONDUIT 2" UNLESS OTHERWISE NOTED
SIGNAL HEAD, PEDESTAL MOUNT
SIGNAL HEAD, MAST-ARM MOUNT
PEDESTRIAN HEAD
PEDESTRIAN PUSH BUTTON
LUMINAIRE
PULL BOXES, STEEL, 24-IN X 36-IN
PULL BOXES, STEEL, 12-IN X 24-IN
VIDEO DETECTION UNIT
LOOP DETECTOR IN 1-INCH NON-METALLIC CONDUIT
POWER OVER ETHERNET DEVICE
COUNTDOWN PEDESTRIAN HEAD
TRAFFIC CONTROL SIGNAL
USH 12 & AIRPORT ROAD
CITY OF MIDDLETON
DANE COUNTY
INSTALLATION NO. S13-1007
REGION CONTACT:
DESIGNED BY:
REVISED BY:
PAGE 2 OF 4
PROJECT NO: 5300-01-83
HWY: USH 12
COUNTY: DANE
TRAFFIC SIGNAL PLAN
SHEET
E
FILE NAME : **....designfile....**
PLOT DATE : **...plottingdate...**
PLOT BY : **...plotuser...**
PLOT NAME :
PLOT SCALE : **.....plotscale.....**
WISDOT/CADDS SHEET 42



PREEMPTION ASSIGNMENTS				
PREEMPTION DESIGNATION	PREEMPTION TYPE	EVP CHANNEL	PHASE(S) CALLED	PREEMPTED APPROACH
1	RESERVED			
2	RESERVED			
3	EVP	A	φ1	WB
4	NOT USED			
5	EVP	C	φ2	NB
6	NOT USED			
7	NOT USED			
8	NOT USED			
9	NOT USED			
10	NOT USED			

TYPE OF INTERCONNECT COMMUNICATION	
NONE	
TBC	
CLOSED LOOP TWISTED PAIR	
CLOSED LOOP FIBER OPTIC	
RADIO	
CELL MODEM	X
LOCATION OF MASTER	
CONTROLLER NO: S	
SIGNAL SYSTEM: SS	

TYPE OF LIGHTING	
BY OTHER AGENCY	
IN TRAFFIC SIGNAL CABINET	X
IN SEPERATE DOT LIGHTING CABINET	

N

TYPE OF COORDINATION	
NONE	
TBC	X
TRAFFIC RESPONSIVE	
ADAPTIVE	

TYPE OF PRE-EMPT	
NONE	
RAILROAD	
EMERGENCY VEHICLE	X
3M	X
TOMAR	
HARDWARE	
OTHER	
LIFT BRIDGE	
QUEUE DETECTOR	

	INTERSECTION	MOVEMENT	HEAD NUMBERS	FLASH	OL PARENT PHASES / PED PHASE COMPATIBILITY	CHANNEL	PED DETECTOR INPUT
OL A	W RAMP	WB THRU	14-16	R	φ1,φ2,φ3,φ4,φ5	1	
OL B	W RAMP	WB LEFT	17-19	R ←	φ1,φ2,φ3	2	
OL C	E RAMP	WB THRU	10-13	R	φ1,φ7	3	
OL D	E RAMP	EB THRU	4-6	R	φ1,φ5,φ6,φ7	4	
OL E	E RAMP	NB THRU	23-25	R	φ2,φ4	5	
OL F	W RAMP	EB THRU	1-3	R	φ4,φ5	6	
OL G	E RAMP	EB LEFT	7-9	R ←	φ5,φ6	7	
OL H	W RAMP	SB THRU	20-22	R	φ6,φ7	8	
OL I							
OL J							
φ1 PED	E RAMP	N PED	104,105		φ1	9	1
φ2 PED	E RAMP	E PED	98-101		φ2	10	3
φ6 PED	W RAMP	NW PED	96,97		φ6	11	2
φ9 PED	W RAMP	N PED	102,103		φ1,φ2,φ3,φ4,φ5	12	4
φ10 PED	W RAMP	SW PED	94,95		φ1,φ2,φ3	13	6
φ11 PED	W RAMP	S PED	90,91		φ4,φ5	14	8
φ12 PED	E RAMP	S PED	92,93		φ5,φ6,φ7	15	5

DETECTOR LOGIC

DETECTOR INPUT	3	1	7	5	11	9	15	13
DETECTOR(S)	11	21	31	43	51	63		
PHASE CALLED	1	2	3		5	6		
PHASE EXTENDED	1	2	3		5	6		
DISCONNECT PHASE								
CALLING DELAY						15		
EXTENSION STRETCH								
LOOP FUNCTION				NIU				

DETECTOR INPUT	19	17	23	21	27	25	31	29
DETECTOR(S)								
PHASE CALLED								
PHASE EXTENDED								
DISCONNECT PHASE								
CALLING DELAY								
EXTENSION STRETCH								
LOOP FUNCTION								

DETECTOR INPUT	4	2	8	6	12	10	16	14
DETECTOR(S)	12	22			52	61	62	
PHASE CALLED		2				6	6	
PHASE EXTENDED		2				6	6	
DISCONNECT PHASE								
CALLING DELAY		15						
EXTENSION STRETCH								
LOOP FUNCTION	NIU				NIU			

DETECTOR INPUT	20	18	24	22	28	26	32	30
DETECTOR(S)								
PHASE CALLED								
PHASE EXTENDED								
DISCONNECT PHASE								
CALLING DELAY								
EXTENSION STRETCH								
LOOP FUNCTION								

NIU = NOT IN USE

GENERAL NOTES

1. φ3 SHALL ONLY BE SERVED FOLLOWING THE TERMINATION OF φ2 AND AN ACTUATION ON DETECTOR 31.
2. φ4 SHALL ONLY BE CALLED FOLLOWING AN ACTUATION ON φ2 AND NO ACTUATION ON DETECTOR 31.
3. φ7 SHALL ONLY BE CALLED FOLLOWING AN ACTUATION ON φ6.
4. φ9 PED SHALL HAVE THE ABILITY TO BEGIN TIMING WITH φ1 AND FINISH TIMING WITH φ5.
5. φ10 PED SHALL HAVE THE ABILITY TO BEGIN TIMING WITH φ1 AND FINISH TIMING WITH φ3.
6. φ11 PED SHALL HAVE THE ABILITY TO BEGIN TIMING WITH φ4 AND FINISH TIMING WITH φ5.
7. φ12 PED SHALL HAVE THE ABILITY TO BEGIN TIMING WITH φ5 AND FINISH TIMING WITH φ7.
8. φ9 PED IS ASSIGNED IN RING 2 (NOT SHOWN).
9. φ10 AND φ11 PED ARE ASSIGNED IN RING 3 (NOT SHOWN).
10. φ12 PED IS ASSIGNED IN RING 4 (NOT SHOWN).

CONTROLLER LOGIC

PHASE NUMBER	PHASE LOCKING	DUAL ENTRY W / φ	PHASE RECALL	PHASE ACTIVE
1	X		MIN	X
2			MIN	X
3				X
4				X
5	X		MIN	X
6				X
7				X
8				

TRAFFIC CONTROL SIGNAL
USH 12 & AIRPORT ROAD
CITY OF MIDDLETON DANE COUNTY
SIGNAL NO. S13-1007
REGION CONTACT:
DESIGNED BY:
REVISED BY:
PAGE 3 OF 4

PROJECT NO: 5300-01-83	HWY: USH 12	COUNTY: DANE	TRAFFIC SIGNAL SEQUENCE OF OPERATIONS	SHEET	E

FILE NAME : **....designfile....** PLOT DATE : **...plottingdate...** PLOT BY : **...plotuser...** PLOT NAME : S-400,seq,rev2 PLOT SCALE : **.....plotscale.....** WISDOT/CADDS SHEET 42

2

USH 12 & AIRPORT ROAD (WEST INTERSECTION) TRAFFIC SIGNAL CABLING CHART NO. 14 CABLE

CABLE RUN	CABLE	HEAD NUMBER	MOVEMENT	LENS	CONDUCTOR COLOR	REMARKS
CABINET TO SB-1	5C	2	EB	R	R	OL F
				Y	O	
				G	G	
CABINET TO SB-2	12C	22	SB	R	R	OL H
				Y	O	
				G	G	
		91	S LEG	W	BLU	φ11 PED
				DW	BLK	
				PB	W	
CABINET TO SB-3	19C	1	EB	R	R	OL F
				Y	O	
				G	G	
		19	WB LT	←R	R/BLK	OL B
				←Y	O/BLK	
				←G	G/BLK	
		90	S LEG	W	BLU	φ11 PED
				DW	BLK	
				PB	W	
		94	W LEG	W	BLU/BLK	φ10 PED
				DW	BLK/W	
				PB	W/BLK	
CABINET TO SB-4	5C	95	W LEG	W	G	φ10 PED
				DW	R	
				PB	W	
CABINET TO SB-5	5C	96	W LEG	W	G	φ6 PED
				DW	R	
				PB	W	
CABINET TO SB-6	12C	21	SB	R	R	OL H
				Y	O	
				G	G	
		16	WB	R	R/BLK	OL A
				Y	O/BLK	
				G↑	G/BLK	
		18	WB LT	←R	BLK	OL B
				←Y	W/BLK	
				←G	BLU	

USH 12 & AIRPORT ROAD (WEST INTERSECTION) TRAFFIC SIGNAL CABLING CHART NO. 14 CABLE

CABLE RUN	CABLE	HEAD NUMBER	MOVEMENT	LENS	CONDUCTOR COLOR	REMARKS
CABINET TO SB-9	15C	20	SB	R	R	OL H
				Y	O	
				G	G	
		15	WB	R	R/BLK	OL A
				Y	O/BLK	
				G	G/BLK	
		97	W LEG	W	G/W	φ6 PED
				DW	R/W	
				PB	BLK/W	
		102	N LEG	W	BLU	φ9 PED
				DW	BLK	
				PB	W/BLK	
SB-9 TO SB-7	5C	97	W LEG	W	G	φ6 PED
				DW	R	
				PB	W	
CABINET TO SB-10	5C	103	N LEG	W	G	φ9 PED
				DW	R	
				PB	W	
CABINET TO SB-11	5C	14	WB	R	R	OL A
				Y	O	
				G	G	
CABINET TO SB-12	12C	17	WB LT	←R	R/BLK	OL B
				←Y	O/BLK	
				←G	G/BLK	
		3	EB	R	R	OL F
				Y	O	
				G	G	

USH 12 & AIRPORT ROAD TRAFFIC SIGNAL CHART

WIRE SIZE	LUMINAIRE WIRE RUN
2-12C	CABINET TO SPLICE CABINET

USH 12 & AIRPORT ROAD (EAST INTERSECTION) TRAFFIC SIGNAL CABLING CHART NO. 14 CABLE

CABLE RUN	CABLE	HEAD NUMBER	MOVEMENT	LENS	CONDUCTOR COLOR	REMARKS
SPLICE CABINET TO SB-13	12C	7	EB LT	←R	R	OL G
				←Y	O	
				←G	G	
		12	WB	R	R/BLK	OL C
				Y	O/BLK	
				G	G/BLK	
SPLICE CABINET TO SB-14	5C	11	WB	R	R	OL C
				Y	O	
				G	G	
SPLICE CABINET TO SB-15	12C	25	NB	R	R	OL E
				Y	O	
				G	G	
		104	N LEG	W	BLU	φ1 PED
				DW	BLK	
				PB	W/BLK	
SPLICE CABINET TO SB-8	5C	101	E LEG	W	G/BLK	φ2 PED
				DW	R/BLK	
				PB	W/BLK	
SPLICE CABINET TO SB-16	12C	10	WB	R	R	OL C
				Y	O	
				G	G	
		9	EB LT	←R	R/BLK	OL G
				←Y	O/BLK	
				←G	G/BLK	
		105	N LEG	W	BLU	φ1 PED
				DW	BLK	
				PB	W/BLK	
SPLICE CABINET TO SB-17	12C	99	E LEG	W	G	φ2 PED
				DW	R	
				PB	W	
		100	E LEG	W	G	φ2 PED
				DW	R	
SPLICE CABINET TO SB-18	15C	6	EB	R	R/BLK	OL D
				Y	O/BLK	
				G↑	G/BLK	
		8	EB LT	←R	BLK	OL G
				←Y	W/BLK	
				←G	BLU	
		24	NB	R	R	OL E
				Y	O	
				G	G	
		13	WB	R	R/W	OL C
				Y	BLK/W	
				G	G/W	

USH 12 & AIRPORT ROAD (EAST INTERSECTION) TRAFFIC SIGNAL CABLING CHART NO. 14 CABLE

CABLE RUN	CABLE	HEAD NUMBER	MOVEMENT	LENS	CONDUCTOR COLOR	REMARKS
SPLICE CABINET TO SB-20	12C	23	NB	R	R	OL E
				Y	O	
				G	G	
		5	EB	R	R/BLK	OL D
				Y	O/BLK	
				G	G/BLK	
		98	E LEG	W	BLU/BLK	φ2 PED
				DW	BLK/W	
				PB	W/BLK	
		93	S LEG	W	BLU	φ12 PED
				DW	BLK	
				PB	W	
SPLICE CABINET TO SB-21	5C	92	S LEG	W	G	φ12 PED
				DW	R	
				PB	W	
SPLICE CABINET TO SB-22	5C	4	EB	R	R	OL D
				Y	O	
				G	G	

USH 12 & AIRPORT ROAD LIGHTING CABLING CHART NO. 12 UF W/GROUND

CABLE	CABLE RUN	LUMINAIRE LOCATION
2C W/ GROUND	CABINET TO LB-1	W INT, SW QUAD
	CABINET TO SB-6	W INT, W MEDIAN
	CABINET TO SPLICE CABINET	
	SPLICE CABINET TO SB-17	E INT, E MEDIAN
	SB-17 TO LB-2	E INT, NE QUAD
	CABINET TO UD-1	BENEATH USH 12 EB
	UD-1 TO UD-2	BENEATH USH 12 EB
	UD-1 TO UD-3	BENEATH USH 12 EB
	UD-3 TO UD-4	BENEATH USH 12 EB
	CABINET TO UD-5	BENEATH USH 12 WB
	UD-5 TO UD-6	BENEATH USH 12 WB
	UD-5 TO UD-7	BENEATH USH 12 WB
	UD-7 TO UD-8	BENEATH USH 12 WB

CABLE ROUTING PLAN
USH 12 & AIRPORT ROAD

CITY OF MIDDLETON DANE COUNTY
SIGNAL NO. S13-1007
REGION CONTACT:
DESIGNED BY:
REVISED BY:
PAGE 4 OF 4

PROJECT NO: 5300-01-83	HWY: USH 12	COUNTY: DANE	CABLE ROUTING PLAN	SHEET	E

FILE NAME : \$\$....designfile....\$\$ PLOT DATE : \$\$...plottingdate...\$\$ PLOT BY : \$\$...plotuser...\$\$ PLOT NAME : S-400,seq,rev2 PLOT SCALE : \$\$.....plotscale.....\$\$ WISDOT/CADDS SHEET 42

2

4-6-1 Signal Infrastructure Design Introduction — April 2025

The design of new or updated traffic signal installations have many interrelated elements. Uniformity in the design of those elements promotes efficient traffic operations and reduces the potential for driver confusion and crashes. Traffic signals must be designed and installed to convey clear and positive guidance to drivers and pedestrians. This subject contains discussions, illustrations, and examples of the design elements that are necessary to achieve this.

In addition to the information contained in this subject there are several standard references that *may* prove valuable to the designer.

4-6-2 Signal Head Layout — April 2025

The layout and display of traffic signal heads are two of the most important elements in the design of a traffic signal installation. Traffic signals must be clearly visible (have good target value) and convey the proper message to the driver and pedestrian. Certain basic principles **shall** be followed at all times when developing the traffic signal head layout. These principles, explained in detail in the WMUTCD, include the following:

1. There **shall** be at least two primary signal faces provided to control the major movement on each approach. The major movement is defined as either the through movement, or the signalized turning movement that is considered as the major movement if a through movement does not exist on an approach. The two primary signal faces **shall** be located on the far side of the intersection, including one on the far left and one on the far right in relation to the approach roadway. A near right signal face *may* also be provided, based on the region traffic signal engineer's discretion or as required per WMUTCD 4D.07. If included, the near right signal face *should* be located approximately at the stopping point.
   a. On multi-lane highways / expressways, newly installed traffic signals **shall** include a signal face for each through lane, or for each lane associated with the major movement, on their respective approaches. These signal faces **shall** be mounted vertically and located approximately over the center of the lane.
2. For non-highway approaches, at least one, preferably both of the far side primary signal faces **shall** be located within a 20-degree cone of vision starting from 10 feet behind the stop line in the center of the approach as defined and illustrated in Figure 4D-4 of the WMUTCD (New installations on multi-lane highway / expressway approaches **shall** have the primary signal faces lined up overhead and approximately centered over each through lane). On all roadway approaches, except where the width of the intersecting street or other conditions make it physically impractical, at least one and preferably both far side primary signals **shall** be located not less than 40 feet or more than 180 feet beyond the stop line (a 50-foot minimum is recommended for post-mounted signals and a 75-foot minimum for overhead mounted signals). A near signal face is required per WMUTCD 4D.07, if the primary signal faces on an approach are located more than 180 feet beyond the stop line. The WMUTCD also states, where the nearest signal face is located between 150 and 180 feet beyond the stop line, engineering judgment of the conditions, including the worst-case visibility conditions **shall** be used to determine if the provision of a supplemental near-side signal face would be beneficial.
3. When a separate left-turn phase is provided, at least two signal faces **shall** be provided to control that movement. Their positions *should* make them readily visible to roadway users making that movement. If two or more left-turn lanes are provided for a separately controlled left-turn phase, then place one signal face per lane.
   a. Supplemental left-turn signal faces *may* be added if engineering judgment dictates their use based on visibility and / or knockdown potential (Consult with the Regional Traffic Signal Engineer).
   b. When right-turn signalization is used for a channelized right-turn lane, at least two signal faces **shall** be provided to control that movement. Their positions *should* make them readily visible to roadway users making that movement. If two or more right-turn lanes are provided for a separately controlled right-turn phase, then place one signal face per lane.

   c. Supplemental right-turn signal faces *may* be added if engineering judgment dictates their use based on visibility and / or knockdown potential (Consult with the Regional Traffic Signal Engineer).

4. The primary signal faces located on the far side of the stem approach to a “T” intersection, *should* be post mounted and one of the signals **shall** be placed directly in line with the center of the approach lane or lanes.
5. State owned traffic signals **shall** utilize 12-inch indications.
6. For new installations or modernization projects, the design goal *should* be to install vertically mounted signal faces in all cases. For signal modification or rehabilitation projects, consult the Regional Traffic Signal Engineer for signal layout questions.
7. Retroreflective backplates **shall** be utilized on all vehicular signal faces for added visibility. Consult with the Regional Traffic Signal Engineer and/or Regional Safety Engineer to discuss the backplate material and if the side street backplates *should* be retroreflective.
8. Pedestrian Signal Faces with Countdown Displays **shall** be utilized for all state-owned traffic signals. Pedestrian signal faces **shall** be located as nearly in line with the crosswalk as possible. If the signal pole is located such that the pedestrian signal will be blocked by stopped vehicles or if it is more than 20 feet outside of the crosswalk line extended, then an alternative means of mounting *should* be designed. Pedestrian faces **shall** be mounted at a minimum of 7 feet (to the bottom of the head) above the walking surface on the side of the pole away from conflicting vehicular traffic. Pedestrian faces are typically mounted on the pole alongside the vehicular signal controlling the corresponding through movement.
   a. Pedestrian push buttons, when needed, **shall** be located for convenient use by pedestrians as outlined in WMUTCD 4I.05 and as required by the Americans with Disabilities Act (ADA). In some situations, it *may* be necessary to install a pedestrian push button standard to make the buttons accessible (Refer to SDD 9E7-6). Each push button **shall** be accompanied by a R10-3 series sign explaining its use.
   b. Pedestrian signals *should not* be installed in the medians of divided highways unless vision and timing conditions require it.
9. Permanent traffic signal faces **shall not** be installed on overhead cables or by any other means, which would permit significant movement under windy conditions. Temporary traffic signal faces *may* be installed on overhead cables if construction or maintenance operations would not make post or mast arm mounting feasible. Temporary signal installations **shall** only be used for road construction purposes and *should* be removed upon completion of the project. If a signal will be placed for a long-term duration, a permanent signal *should* be considered.

These guidelines are intended to establish minimum design criteria for traffic signal head layout. Consideration must be given by the signal designer to the unique conditions associated with a specific location and an appropriate design developed in response to these conditions. Specifically, consideration must be given to left-turn movements, right-turn overlaps, pedestrian activity, preemption, and channelization. All these aspects must be evaluated to achieve the best design.

In establishing the traffic signal head layout, attention must be given to signal head displays. Signal head displays will have a direct effect on the location and orientation of the signal heads. These signal head displays must be consistent with the intersection geometrics, vehicular demands, and desired operation. Signal head displays typically consist of three, four, and five section displays. No more than five indications are allowed in each display. Within a signal face, two Circular Red or Red Arrow signal indications **shall not** be displayed immediately adjacent to each other. Reference WMUTCD 4D.08 for Typical Signal Face Arrangements used for Through Movements. Reference WMUTCD 4F.02 through 4F.08 for Typical Signal Face Arrangements used for various types of Left-Turn Movements. Reference WMUTCD Sections 4F.09 through 4F.15 for Typical Signal Face Arrangements used for various types of Right-Turn Movements. Reference WMUTCD 4F.16 for Typical Signal Face Arrangements used for various types of Shared Left-Turn / Right-Turn Lanes and No Through Movement.

In addition to the general design criteria already discussed, further consideration *should* be given to the following items:

- Arrows *should not* be used on near or far indications for through movements. Arrow displays significantly limit the luminance level and conspicuity compared to circular displays.
- Traffic movements that conflict with pedestrian movements **shall** be controlled by circular green or a flashing yellow arrow.

- Consideration *should* be given to using visibility-limiting or optically programmed heads (lenses, louvers, or tunnel visors) under certain conditions. These conditions *may* include two closely spaced intersections where the intent is to limit a driver's ability to see the adjacent intersection display; for exclusive turn movements; or possibly where irregular street alignments necessitates the placement of conflicting signal faces at small angles. In addition, these types of heads *may* prove beneficial where direct sunlight causes drivers problems in determining which indication is illuminated.
- The use of all arrow indications for protected left turn only phasing *should* be used. This eliminates the need for most signing and for programmed heads and their associated maintenance problems and cost.
- The bottom housing of a signal assembly not mounted over a roadway **shall** be at least 8 feet but no more than 15 feet above the sidewalk or, if no sidewalk, above the pavement grade at the center of the highway.
- The lowest part of a signal assembly and all other signal components suspended over a roadway **shall not** be less than 17 feet (20 feet Minimum if located on a Designated Overheight Corridor) nor more than 25.6 feet above the pavement grade of the highest point on the roadway.
- Poles **shall** be located such that all portions of the poles and attached equipment have clearances from overhead utilities in accordance with the requirements of the local utility and the National Electrical Safety Code (NESC).

4-6-3 Signal Poles and Foundations April 2025

In determining the location of traffic signal poles/standards and related foundations, primary consideration must be given to the proper visibility of signal faces. After determining the signal head placement/location for the intersection, the designer **shall** use WMUTCD 4D.10 (Lateral Offset / Clearances) and engineering judgment to determine safe setback distances from the edge of the traveled way for poles and foundations. Poles and standards at the side of a street with curbs must have a horizontal setback clearance of 2 feet minimum, 4' typical from the face of a vertical curb to the edge of the signal face or sign mounted on that pole (whichever extends closest to the curb). Where no curb exists, proper placement of supports is measured from the edge of the pavement. Traffic signal standards **shall not** have a horizontal setback greater than 12 feet from the face of a vertical curb (or edge of pavement if there is no curb). A signal support *should not* obstruct a crosswalk.

Poles **shall** be located such that all portions of the poles and attached equipment have clearances from overhead utilities in accordance with the requirements of the local utility and the National Electrical Safety Code (NESC).

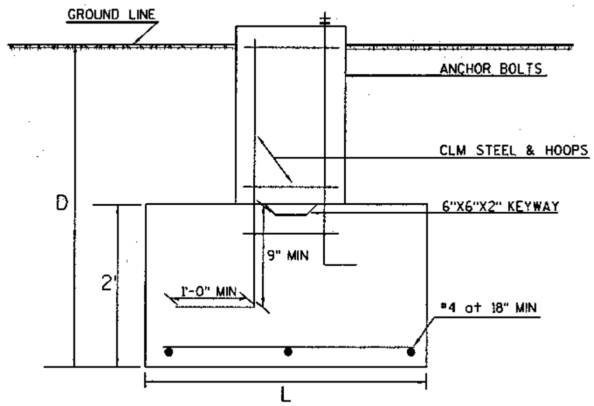
There are nine possible concrete bases available for use. (see FDM Chapter 16, Standard Detail Drawings).

Type 1	For use with Traffic Signal Standards, 15 feet or less.
Type 2	For use with Pole Types 2, 3, and 4
Type 5	For use with Pole Type 5 (Lighting Units 30 Ft)
Type 6	For use with Pole Type 6 (Lighting Units 35-Ft)
Type 7	For use with Pole Type 17 (Lighting Units 40-Ft)
Type 8	For use with Pole Type A (Lighting 46'6") and Type E (Lighting 49')
Type 10	For use with Type 9 and 10 Monotube Poles
Type 10 Special	For use with Type 9 Special and Type 10 Special Monotube Poles
Type 13	For use with Type 12 and 13 Monotube Poles

The current WisDOT signal standard (pedestal) bases and transformer bases (used with Type 1, 2 or 5 / 6 bases) are breakaway. Type 17, A, E, 9, 10, 9 Special, 10 Special, 12 & 13 Poles (used with Type 7, Type 8, Type 10, Type 10 Special and Type 13 bases) are not breakaway and while allowable within the clear zone, *should* be placed as far back from the back of curb as can be reasonable accomplished.

Some areas *may not* allow for the installation of concrete signal bases due to utility conflicts. In these cases, a spread-footing concrete base *may* be required (see Figure 3.1). The Regional Traffic Signal Engineer *should* be contacted to discuss the options when bedrock or utility conflicts obstruct the concrete base depth. Consult with the Bureau of Structures if a spread footing is needed.

Figure 3.1. Alternate Spread Footing Detail (Type 1, 2, 5, or 6 bases)



TYPE 1 POLES		TYPE 2 POLES	
D = 2'	L = 5'	D = 2'	L = 6'-6"
3'	4'-6"	3'	6'-6"
4'	4'-6"	4'	6'-0"
5'	4'-0"	5'	6'-0"
6'	4'-0"	6'	6'-0"

NOTES: Based on soil pressure of 2 kips/ft2
See SDD 9C-2 for anchor bolt, steel reinforcement, conduit and other requried details.

4-6-4 Conduit Size, Type and Layout — April 2025

CONDUIT SIZING

Conduit sizes of 1, 2 and 3-inch diameter *should* normally be used for traffic signal applications, or for interconnection. Below are the typical sizes of conduit used for various applications (Consult with the individual Regions regarding preferences):

Controller Cabinet to Pull Box:	Varies (see Standard Detail Drawings, and consult with Region Traffic Signal Engineer)
Main Ring Around Intersection (Pull Box to Pull Box):	Two 3" Typical
Pull Box to Signal or Light Base:	2" or 3"
Detector Lead-In:	2"
Loop Detector Conduit:	1"

The minimum conduit size is determined by the number and sizes of cables to be contained in the conduit. For large installations (interchange intersections, major intersections, etc.) the conduit sizing calculations used by WisDOT Regional electrical staff *should* be followed.

CONDUIT LAYOUT

All conduits **shall** be installed in accordance with the Standard Specifications, Wisconsin Administrative Code, and the Wisconsin State Electrical Code.

The conduit layout *should* be designed to minimize conflicts in construction. All conduit runs *should* be as straight as possible to minimize material costs, construction costs and to facilitate the pulling of electrical cable. An attempt **shall** be made to locate equipment such that conflicts between state-owned equipment and existing utilities are avoided.

A conduit **shall** be provided from each signal or light base to the nearest pull box, from pull box to pull box, from pull box to controller cabinet, and from detector to pull box.

Any conduit under a roadway **shall** have a pull box at each end. Spare conduit **shall** be installed as directed by the signal-maintaining authority. In general, conduit runs crossing existing streets, drives, and alleys *should* be directional bored rather than trenched. Conduit **shall** encircle the entire intersection due to the flexibility it will offer for future changes.

For new road construction, trenched conduit *may* be installed around the entire intersection. The conduit layout at the intersection *should* be designed so that the controller is in a quadrant and not on an island or median. This will allow for cabling in two separate directions, which minimizes voltage drop.

CONDUIT CROSSING STRUCTURES

At times, there *may* be a need to install conduit across structures. Typically, this will be the case at diamond interchanges when both ramp terminals are signalized.

When there needs to be a crossing of an existing structure, conduit *may* be installed on the structure itself or *may* be routed below the roadway that the structure crosses. To determine which method is appropriate, the Regional Traffic Signal Engineer and Regional Structures Engineer **shall** be consulted.

When installing conduit on the structure, the conduit *should* run either parallel to or at right angles to the structural girders. A variation of ± 15 degrees *may* be acceptable. A conduit expansion fitting **shall** be installed at each structure joint, hinge, or abutment where longitudinal movement greater than 1/2" *may* occur, or in accordance with manufacturer recommendations.

At locations where conduit runs through a structure, the conduit **shall** be terminated at a pull box. An adjustment *may* be needed to avoid guardrail posts. At the midpoint of the length of the wingwall, run all conduits out of the inside edge of the wingwall (into abutment fill) with a 45-degree bend and continue to a pull box (24” x 42”). The location of the pull box will be dependent on the presence of paved shoulder, sidewalk, terrace, curb, guardrail, drop inlet or surface drain. The intent is to avoid placing the conduit and pull box behind the guardrail. The preferred location will be in the sidewalk (or future sidewalk) or paved shoulder beyond a surface drain or inlet. The conduit *should* then continue from this first pull box to a second pull box located in the grass beyond the guardrail terminal end. Both pull boxes *should* be 24” x 42”.

For exposed locations, such as installations on structural girders, Schedule 80 PVC or RTRC (Reinforced Thermosetting Resin Conduit) **shall** be used. RTRC is generally preferable to PVC due to its durability. The regional traffic section *should* be involved in the selection of the exposed conduit materials.

A third alternative to provide conduit to the opposite side of a bridge, is to install an underground conduit system parallel to the structure and underneath the feature (i.e., roadway, railroad, etc.) being crossed.

USE OF SIGNAL CONDUIT FOR OTHER APPLICATIONS

Electrical wiring in state-owned signal conduit systems for other types of installations that are not associated with signal operation **shall** be avoided for several reasons:

- Reduces capacity of conduit that *may* be required for future signal modifications.
- Wiring used for multiple applications in the conduit *may* violate Electrical Code.
- WisDOT staff does not provide maintenance and locating services for the other electrical and municipal facilities (such as outsourced maintenance and locating of state-owned ITS facilities).
- Changes to wiring that could occupy the same space as signal wiring *may* affect signal operations.

4-6-5 Control Cabinet and Electrical Service — April 2025

SIZES

The standard traffic signal control cabinet in use is approximately 44" x 24” x 55" and is currently specified as a NEMA TS2 Type 1 cabinet. An oversized cabinet approximately 44” x 24” x 65” is available for intersections that require more components than usual (Consult with the Regional Traffic Signal Engineer).

LOCATION

The Regional Traffic Unit will work with the local utility company and signal designer to determine the most appropriate location for the traffic signal control cabinet and electrical service. Control cabinets **shall** be in accordance with, the following considerations:

1. The control cabinet *should not* be vulnerable to traffic. A distance of 20 feet back of curb or 30 feet off the edge of pavement is desirable for offsetting the control cabinet.
2. The control cabinet **shall not** be in a drainage ditch, in an area which could be under water, or where subjected to water from sprinklers. If the only option is to locate in a low area, it is necessary to fill the area in where cabinet is placed.

3. All traffic movements at the intersection *should* be visible from the control cabinet such that when an electrician is troubleshooting the intersection they *may* view the intersection and the interior of the control cabinet simultaneously. The door of the cabinet *should* open away from the curb or traveled way.
4. A maintenance vehicle *should* be able to park close to the cabinet and out of the traveled lanes.
5. The control cabinet **shall not** obstruct sidewalks, multi-use trails, curb ramps, or driveways.
6. The cabinet **shall not** obstruct pedestrian or driver visibility at the intersection.

ELECTRICAL SERVICE

For state-maintained signals, coordinate with the Regional Traffic Signal Engineer regarding how to prepare an application for the electrical service. Some regions *may* prepare the application / wiring affidavit and install the meter pedestal themselves. Other regions *may* set this all up as a contract item for the contractor's coordination / installation. Electrical installations maintained by other jurisdictions often submit their own application for their electrical service (Coordinate with the Local Municipality for clarification). The local utility company installs the electrical service lateral from the power source to the meter socket/pedestal.

The service connection point **shall** be located as close as possible to, or mounted on, the control cabinet. Electrical services *may* come from overhead or underground lines. Underground service feeds are preferred due to their protection from weather and aesthetics compared to overhead lines. The electrical service **shall** be in accordance with WisDOT *Standard Specifications and* local utility requirements.

COMMUNICATIONS

Similar to electrical service, provisions *should* be given for communications service for control cabinet placement options. When deciding if communications are required, consult with the Regional Traffic Signal Engineer. Future operations *should* also be considered when determining whether provisions for communications are applicable.

CONSTRUCTION INSPECTION

Refer to the Construction and Materials Manual, Section 6-55.1.3 Miscellaneous Construction, Electrical Construction for Checklists that pertain to the installation and inspection of these units:

- Figure 1 Conduit
- Figure 2 Lighting
- Figure 3 Traffic Signals
- Figure 4 Loop Detectors

CONTROL CABINET SERVICE PLACEMENT

Since a large part of a signal's design can relate to the location of the signal controller cabinet, this decision *should* be made early in the design. When selecting the location of the controller cabinet at an intersection, there are three primary considerations: available right-of-way, availability of electrical service, and drainage.

There must be an appropriate amount of right-of-way for control cabinet placement. The minimum amount of right-of-way needed to accommodate the signal controller only is approximately 10 x 10-ft. When dealing with very constrained locations, it is important to consider door swing, cabinet access & pull box placement.

Contact the Electrical Utility regarding availability of commercial power at the intersection quadrant being considered. In some cases, it is necessary to provide conduits under roadways, sidewalks, etc. within the design to allow to utility to feed the cabinet location.

Other location considerations include placing the cabinet where it is possible to observe vehicles within the intersection and where it's not likely to be struck by errant vehicles or snow removal operations. Signal controller cabinets *should* be located on higher ground and outside drainage features such as ditches or near spillways.

4-6-6 Battery Backup Systems — April 2025

The recent application of LED traffic signal indications, which consume less power than conventional incandescent lamps, has made battery-powered energy backup systems feasible. However, it is recognized that, because of the cost of such systems, that gradual deployment at strategic signalized intersection locations is appropriate.

Factors that *may* influence the placement of battery backup systems are proximity of other transportation systems, intersection geometry, traffic volumes, corridor (i.e., progressive movement) considerations, or safety considerations.

Signalized intersection locations that meet the criteria below **shall** be equipped with a battery backup system capable of maintaining signal operation, as defined and prioritized below:

1. RR interconnected installations, or
2. Single point urban interchanges, or
3. Diverging Diamond interchanges, or
4. Intersections with triple-left turn lanes

Signalized intersections with battery backup systems are not limited to these intersections. Use engineering judgement to determine other locations to equip signalized intersection with a battery backup system.

POLICY

Location Criteria

Signalized intersection locations that meet the criteria below **shall** be equipped with a battery backup system capable of maintaining signal operation, as defined and prioritized below:

1. RR interconnected installations, or
2. Single point urban interchanges, or
3. Intersections with triple-left turn lanes.

Signalized operations *should not* need to be modified to reduce energy requirements or extend service time. Rather than introducing modified signal operations or displays, signals that function with battery backup systems with low power reserves *may* go into flashing operation.

Intersections and roadway lighting **shall not** be connected to battery backup systems.

SUPPORT

Battery backup systems are expected to maintain safe and efficient traffic operations at critical signalized intersections during power outages. Of concern are intersections that are near railroad grade crossings (for preemption) and geometrically complex intersections.

Besides providing potential benefits to traffic safety and operations, the use of battery backup systems *may* allow increased response times by electrical personnel, which could provide an advantage considering increased signal infrastructure and associated maintenance demands.

4-6-7 Pull Boxes April 2025

MATERIAL

The old standard pull boxes were constructed from corrugated steel pipe. Because of corrosion associated with certain soil conditions, new side-of-the-roadway installations are now generally constructed from Non-Conductive Materials according to the Standard Specifications. Any pull boxes installed in concrete pavements for loop detectors **shall** be constructed of corrugated steel pipe.

For new construction, side-of-the-roadway pull boxes manufactured with Non-Conductive Materials *should* typically be used. However, like materials (i.e. Steel) *should* still be considered for rehabilitation projects where newly installed or added pull boxes are being intermixed with existing corrugated steel pull boxes (Consult with the Region Traffic Signal Engineer regarding the regional preferences).

SIZES

There are generally nine sizes of steel pull boxes used for traffic signal installations. 12-Inch pull boxes are used in concrete roadways for certain types of loop detector installations. 18-Inch or 24-Inch pull boxes are generally used for Side-Of-The-Roadway installations (Consult with the Region Traffic Signal Engineer regarding Size Preferences for Various Uses)

Standard Size Corrugated Steel Pull Boxes:

12x24-Inch
12x30-Inch
12x36-Inch
18x24-Inch
18x30-Inch
18x36-Inch

24x36-Inch
24x42-Inch
24x48-Inch

Currently, there are two sizes used for Non-Conductive Pull Boxes:
24x36-Inch
24x42-Inch

The engineer *may* use depths up to 42-inches for Non-Conductive and 48-inches for steel. 42-Inch depths are generally considered the minimum depth if running conduit under curb-and-gutter, roadways, and driveways. Refer to the Standard Specifications and Standard Detail Drawings for specific requirements for pull boxes and depth exceptions, or consult with the Region Traffic Signal Engineer for guidance

SPECIAL REQUIREMENTS

Pull boxes **shall not** be installed in asphaltic pavement. 12-Inch corrugated steel pull boxes **shall** be used in concrete pavements for certain types of loop detector installations and **shall** include locking covers.

PLACEMENT

Pull boxes *should* be located at junctions of two or more conduit lines and as near as possible to roadway loop detectors. Pull boxes provide a point from which cables are to be pulled through the conduit or where extra lengths of cables are stored. Pull boxes *should* also be installed:

1. At 200-foot, or less, spacing in conduit runs. Longer runs *may* be used for fiber optic interconnects.
2. At locations where conduits branch.
3. Adjacent to the foundations for signal standards, lighting poles, and controller cabinets.
4. Where loop detector leads are spliced to lead-in cable.

Pull boxes *should not* be in the sidewalk if an alternate location is possible, as they can present a tripping hazard for pedestrians. One possible exception is in the case where conduit is to cross a structure.

4-6-8 Signing and Pavement Marking — April 2025

SIGNS

Supplemental signs recommended for traffic signal operation need not be shown on the signal plan sheet (except for specific signing controlling right turns, i.e. STOP or YIELD). Some of the more common signs include:

SIGNAL AHEAD	W3-3
Pedestrian push button supplemental signs	R10-3 series
LEFT ON GREEN ARROW ONLY	R10-5
LEFT TURN SIGNAL	R10-10
NO TURN ON RED	R10-11b
LEFT TURN YIELD ON FLASHING YELLOW ARROW	R10-50L
RIGHT TURN YIELD ON FLASHING YELLOW ARROW	R10-50R

Foldable stop signs *may* be installed on signal poles for use when state-owned signals are not operating. If folding stop signs are to be used on an approach that has an emergency red flash, they **shall** be placed on the near right and in the median, if a near left signal support exists. Stop signs **shall not** be installed on approaches with an emergency yellow flash.

State of Wisconsin law allows U turns at signalized intersections, unless signs restrict the movement. See TEOpS 2-2-19.1 for additional guidance for placement and use of NO U TURN signs at signalized intersections.

The purpose of left turn arrows on signal heads is to eliminate the need for the use of left turn signs (LEFT ON GREEN ARROW ONLY, LEFT TURN SIGNAL, etc.). The use of these signs *should* be determined on a case-by-case basis. For guidance on the use and placement of LEFT TURN YIELD ON FLASHING YELLOW ARROW signs, refer to TEOpS 2-2-53.

Other traffic control signs (e.g. one-way, no parking, etc.) *should* be installed as needed. These signs **shall** meet the requirements of the WMUTCD and TEOpS policies.

PAVEMENT MARKINGS

Prior to designing the traffic signals on the plan sheet, the pavement markings *should* be located to act as a guide in the location of signal heads, pedestrian heads, and detector loops. All pavement markings **shall** be in conformance with Standard Specifications, TEOpS, and WMUTCD. Any questions regarding pavement markings *should* be directed to the Regional Pavement Marking Engineer.

As stated in 4-5-1, the signal plan sheet **shall** show all crosswalks and stop lines due to their influence on signal and detector placement. The location of handicap ramps *should* also be shown if the crosswalk marking does not adequately show where they are located. The lane lines need to be shown because of their effect on detector and signal head placement and to convey to the review staff the lane designations. Arrows and "ONLY" markings do not need to be placed in all left-turn lanes. Such markings are typically placed at locations where major roads cross, or certain geometric conditions exist. The Regional Pavement Marking Engineer will determine the use of these markings.

4-6-9 Intersection Lighting April 2025

All state-maintained traffic signals **shall** have lighting installed as part of the signal installation. Local municipality lighting under permit *may* be able to satisfy this requirement. Poles *should* be minimized as much as possible to provide clear sight lines to the signal heads. Therefore, the design *should* combine roadway luminaires with signal poles wherever feasible. When separate street light poles are required, they **shall** be placed to avoid obstructing signal indications.

Historically, it has been standard practice to install at least one luminaire per intersection approach, with additional lighting for high priority area (such as outbound vehicle paths, pedestrian crosswalks, large radius channelized right-turns, and slotted left-turn pockets). For more refined lighting design guidance, reference TEOpS 11-5-1, Signalized Intersection Lighting, and consult with the Regional Lighting Engineer regarding preferences.

Requests for decorative roadway lighting will be handled similar to requests for non-standard WisDOT equipment.

4-6-10 Pedestrian and Bicyclist Crossings April 2025

Once the determination to install pedestrian signals is made, the next step is to determine where to install the pedestrian signal faces and detection (push buttons) if applicable. The designer **shall** consult the WMUTCD, Section 4E for Pedestrian Control Features and Chapter 9, Traffic Controls for Bicycle Facilities.

Pedestrian push buttons **shall** be shown on the signal plan, mounted approximately perpendicular and in advance of the crossing as required by the WMUTCD.

All pedestrian push buttons **shall** be accessible from the sidewalk to be able to be reached by walkers or people in a wheelchair. This *may* require the installation of a separate pedestrian pushbutton standard. Attempts to locate the pedestrian push buttons as shown in the WMUTCD and per ADA requirements **shall** be made.

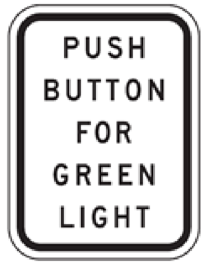
The R10-3E, 3H, 3I, and 3J series pedestrian signs **shall** be mounted on the same poles or standards as the pedestrian push buttons for pedestrian signals with countdown displays. The countdown display style of pedestrian signals **shall** be used on all state-owned traffic signals.

All pedestrian signal faces *should* be conspicuous and recognizable to pedestrians at all distances from the beginning of the controlled crosswalk to a point 10 feet from the end of the controlled crosswalk during both day and night. Sometimes this can be accomplished by attaching the pedestrian signal faces to traffic signal poles or standards. But, to meet the above requirement, a 10-foot pedestrian signal standard *may* need to be installed with just the pedestrian signal face and push button. If the pedestrian signal face can be installed on the traffic signal pole or standard, a 3.5-foot standard *may* still need to be used for a pedestrian push button to comply with the accessible requirements.

The pedestrian phasing *should* be shown adjacent the vehicular phasing on the sequence of operations sheet, shown by a double half arrow on the appropriate side of the vehicular phase arrow.

To accommodate bicyclists who want to cross a highway, a push button accessible to the bicyclist and sign stating, “Push Button for Green Light” (R10-3) as shown in Figure 10.1, *may* be installed. In this case, pedestrian signal faces are not installed; activation of the push button will call and time the pedestrian phase intervals or the bike minimum green interval.

Figure 10.1. R10-3 Sign for Bicyclist



ANIMATED EYES SYMBOL

Reference is made to the WMUTCD 4I.02.

The animated eyes symbol is a dynamic display that supplements standard pedestrian signal indications within the same section. This symbol consists of illuminated eyes that scan from side to side and is meant to prompt pedestrians to be aware of approaching vehicles.

POLICY

Pedestrian signal heads **shall** not incorporate the animated eyes symbol at state-owned signal installations.

SUPPORT

WisDOT supports the use of technologies that address a distinct need related to highway safety & traffic operations. Animated eyes are expected to have a limited effect on improving intersection safety but would require an increase in capital, operations, and maintenance costs. Benefits are not expected to outweigh additional resource expenditures.

IN-ROADWAY WARNING LIGHTS AT PEDESTRIAN CROSSINGS

Reference is made to the MUTCD Chapter 4U.

In-roadway warning lights (IRWLs) are special types of highway traffic control devices installed in the roadway pavement to warn road users that they are approaching a condition on or adjacent to the roadway that *may* not be clear and might require the road users to slow down and/or yield.

IRWLs are actuated devices with flashing indications that provide real-time warning of a specific condition. In-pavement lights that supplement pavement markings by operating in a steady burn state **shall** also require WisDOT approval but are not the focus of this policy.

On the STH system in Wisconsin, IRWLs are limited to situations warning of: marked school crosswalks, marked mid-block crosswalks, marked crosswalks on uncontrolled approaches, and other roadway situations involving pedestrian crossings that are not associated with other types of traffic control.

POLICY

IRWLs, as defined herein, *may* be used on the Wisconsin STH system provided the local jurisdiction:

1. Applies for a permit
2. Agrees to fund the installation, operation, and maintenance of the device
3. Agrees to be responsible for any corresponding damage to the roadway or damage to highway maintenance equipment, and
4. Properly cites appropriate locations based on the conditions of this policy.

The municipality *should* understand that the permit *may* be revoked, especially in the event of safety or operational issues. In such a situation, the original costs and costs to restore the pavement are the obligation of the permit holder.

When allowed by permit, IRWLs **shall** be installed perpendicular to the direction of travel on the roadway and used to supplement crosswalk markings. IRWLs placed along the centerline of a highway, parallel to the direction of travel, **shall not** be used. IRWLs **shall not** be allowed on freeways or expressways.

Prior to the use of IRWLs, adequate trail of standard remedial measures **shall** be used to warn motorists of pedestrian crossings. IRWLs will be used only to supplement typical warning devices such as signs, markings, and crossing guards. Other strategies, such as providing a median refuge roadway lighting in advance of the crossing, or enforcement campaigns, are more universally recognizable methods of warning motorists of these conditions and *should* also be implemented when practicable.

Location Criteria

It is recognized that the use of IRWLs *may* affect STH traffic operations by increasing delay and reducing mobility, especially if used near existing signalized or stop-controlled intersections. The following criteria **shall** be met:

1. Location is an uncontrolled pedestrian crossing.
2. Location is an established school route, accommodates a minimum pedestrian volume of 100 pedestrians/day, or location has experienced pedestrian crashes in the past 3 years.
3. Subject crossing is in municipal (non-rural) limits.
4. There exists a minimum of 300 feet between the subject crossing and the nearest uncontrolled pedestrian crossing, or intersection traffic control device on the STH.
5. There exists a minimum of 1200 feet between the subject crossing and the nearest uncontrolled pedestrian crossing supplemented with in-roadway warning lighting unless exceptional conditions exist.
6. Roadway has a maximum of four travel lanes with a maximum single-stage crossing distance of 50 feet.
7. Approach speed is posted at less than 50 mph.
8. Adequate stopping sight distance exists based on the following approach speeds:
    a. 15 or 25 mph = 200 ft
    b. 30 mph = 250 ft
    c. 35 mph = 300 ft
    d. 40 mph = 400 ft
    e. 45 mph = 500 ft

Design Requirements

In the interest of uniformity, reliability, and consideration for other highway users, the following minimum design requirements for IRWLs **shall** be met:

1. Number/positioning of lights:
    a. For two-lane undivided roadways: 5 IRWLs per direction
    b. For four-lane undivided roadways: 7 IRWLs per direction
    c. For four-lane divided roadways: 5 IRWLs per direction.
2. IRWLs **shall** be actuated and **shall not** flash continuously.
3. If pedestrian push buttons are used to actuate the IRWLs, a PUSH BUTTON TO TURN ON WARNING LIGHTS (R10-25) sign **shall** be mounted adjacent to or integral with each pedestrian push button.
4. For four-lane divided roadways with median widths equal to or exceeding 6 feet, pedestrian actuation in the median **shall** be provided to allow for a two-stage crossing of the roadway.
5. Lights **shall** be evenly spaced across the entire traveled way. Lights *should* be positioned outside of vehicle wheel paths and *should* also consider bicyclist routes adjacent the traveled way. Lights placed near the centerline of the roadway *should* be offset slightly to minimize interference with pavement marking operations.
6. Electrical wire **shall** be cast in a minimum of 8-inch concrete pavement. If IRWLs are being installed with an improvement project that requires a pavement section greater than 8 inches, then the pavement at the crossing *should* be made to match that of the adjacent roadway. Pavement reinforcement *may* not be required, but this decision will reside with the regional pavement design unit. Doweling to adjacent concrete pavement will also be required at the direction of the regional pavement engineer. A minimum 2 feet of clearance to the edge of the concrete **shall** be maintained. Pavement structure **shall** be installed according to WisDOT Standard Specifications. Installation in existing pavement by sawing or coring is not permissible. Minimal width of the concrete, measured longitudinally in the direction of traffic, **shall** be 12 feet.

7. Roadway profile **shall** be appropriately maintained by milling or wedging the approach to the crossing, as required.
8. IRWLs **shall** flash for the entire calculated pedestrian clearance time. Pedestrian clearance *should* be calculated based on a 3.5 ft/sec walking speed. Locations frequented by children and elderly users *may* have a pedestrian clearance based on a slower walking speed. A brief time extension of 3 to 7 seconds *may* be added to allow for vehicle/pedestrian response and separation.
9. Features meant to accommodate impaired pedestrians such as actuator buttons with locator tones, supplemental braille signing, etc., *should* be considered at individual locations on a case-by-case basis. If used, these devices **shall** be furnished and maintained by the municipality that requests the IRWLs.
10. Other design criteria **shall** conform to the manufacturer's recommendations.

SUPPORT

There are several general points of concern regarding the use of these devices:

1. IRWLs do not ensure that motorists will appropriately yield the right of way to pedestrians in the crossing.
2. A public awareness and education campaign *may* be required to educate the public prior to operating IRWLs.
3. IRWLs *may* cause rear-end collisions similar to a signal installation.
4. Placement of IRWLs between coordinated traffic control signals *may* cause progression problems.
5. Any improperly installed electrical equipment *may* pose a hazard to the public.
6. In Wisconsin, IRWLs *may* be susceptible to premature failure due to moisture buildup and/or snow removal operations.
7. The type of actuation used for IRWLs needs to be considered. Active detection (i.e. pushbutton) *may* create a false sense of security for pedestrians who are not familiar with the use of such devices or the rules of the road. Because of these factors, passive detection (i.e. infrared) is considered more appropriate for these types of applications, especially in crosswalks associated with school zones. In either case, an informational plaque *should* be used to briefly describe proper crossing behavior while using IRWLs. These are similar to informational plaques used at signalized pedestrian crossings (R10 series).
8. In IRWLs will be placed outside of existing connecting highway limits within a municipality, consideration *should* be given to extend those limits to include the installation location.

4-6-11 Emergency Vehicle Preemption (EVP) and Traffic Signal Priority (TSP) Detection April 2025

Follow the manufacturer's specification for correct mounting height of emergency vehicle detectors. Line of sight criteria **shall** be considered when showing EVP and TSP detectors on signal plans for certain kinds of systems. The newer GPS based systems do not rely on line-of-site. Check with the vendor supplying the equipment and local municipality requesting the system regarding system requirements.

4-6-12 Monotube Signal Arms and Pole Structures April 2025

The following is a set of guidelines related to the use and placement of monotube signal arm assemblies for traffic signals. It is to be used by Regional Traffic Signal Engineers and consultants for the design (or design review) of a signalized intersection.

1. Monotube arm assemblies **shall** be used on any approach with two or more through lanes for modernization projects (State owned signals only).
2. Monotube arm assemblies *should* be used on any approach with two or more through lanes for resurfacing, pavement replacement, and reconditioning projects (when feasible based on available right-of-way and other constraints) (State owned signals only).
3. Signal heads *should* be mounted in such a way that they are centered over their respective receiving lane. Two 3-section signal heads *may* be vertically mounted on a trombone arm if the far head placement does not exceed 22' from the pole. Engineering judgment *should* be used to determine the appropriate location

for each head when the roadway is skewed, or other unusual geometrics cause a shift between the approach lanes and receiving lanes.

4. Poles with monotube arm assemblies *may* be installed in “pork chop” divider safety islands and in median islands. A raised median is defined as having a minimum width of 6’ face-to-face (although 8’ is desirable).
5. Poles with monotube arm assemblies are not required to be shielded; however, engineering judgment *should* be used to determine a reasonable offset from any adjacent travel lanes since the bases are non-breakaway.
6. Reverse mounted monotube arm assemblies *may* be used.
7. Ideal pole placement *may not* facilitate proper ADA push button placement, therefore additional poles for pedestrian push buttons *may* be required.
8. Monotube arm assemblies with a signal head positioned for each lane *may* be utilized for single or multiple left turn lane designs however are not required.
9. A luminaire can be mounted above the monotube arm, 180-degrees from the monotube arm, or in both locations. Contact the Regional Signal Engineer for permission to add a clamp-on camera to the luminaire arm.
10. For typical design information, see Standard Detail Drawings 9E8.
11. The concrete base **shall** be further extended above ground when the ground elevation at the base is lower than the high point of roadway elevation. See Standard Detail Drawing 9C13 for construction information.
12. Each monotube arm assembly and pole structure **shall** be assigned a structure number by the Region. This number **shall** appear on the traffic signal plans and will be identified in the field on each pole. Regional electricians **shall** work directly with their Regional Signing Coordinator to place an order for each identification plaque. Installation of the plaques **shall** conform to the guidance in Standard Detail Drawing 12A4.
13. The Designer **shall** be responsible for calculating the overturning and twisting factors associated with each monotube arm assembly and pole structure layout to ensure that they have not exceeded the maximum loading. The table of maximum values for these factors (and an example calculation) can be found in Figure 12.1. The designer’s calculations *should* be made available to the Regional Traffic Signal Engineer or the Statewide Traffic Signal Engineer upon request. A few items to note when using these equations:
    - <u>No</u> additional calculations are required to account for the luminaire and luminaire arm on the Type 10 & Type 13 poles.
    - Signs and signals that are mounted perpendicular to the face of the monotube arm do <u>not</u> need to be included in the calculations.
    - Effects of push buttons are considered negligible and therefore do <u>not</u> need to be included in the calculation.
    - Square footage information for standard signal equipment is as follows:
        - 5 section signal head – 13.33 sq. ft.
        - 4 section signal head – 11.00 sq. ft.
        - 3 section signal head – 8.67 sq. ft.
        - 1 section pedestrian head – 2.0 sq. ft.

Figure 12.1. How to check loading on a monotube signal/sign structure

This example shows how to check the ability of a monotube traffic signal structure to carry a proposed loading. The number of traffic signal attachments, signs, and their dimensions are for illustrative purposes only. The calculations for any given installation will vary by the specific number of traffic signal attachments, signs, and their dimensions and positioning for that specific installation.

Given: Type 12 pole, 50' arm, loading with signals and signs, positioned and dimensioned as shown in illustration.

Determine: Adequacy of Type 12 pole with 50' arm to carry proposed attachments

Calculate overturning and twisting factors (mv) & (mh):

mv = sum (each attachment area X distance from arm attachment point to the bottom of the upright)

mh = sum (each attachment area X distance from the center of each attachment to the center line of the upright)

area of 5-head signal on arm = 2' X 6.67' = 13.33 sq.ft.

area of directional sign on arm = 2' X 2.50' = 5 sq.ft.

area of <u>each</u> 3-head signal on arm = 2' X 4.33' = 8.67 sq.ft. <u>each</u>

area of sign on pole = 3' X 4' = 12 sq.ft.

mv = [(13.33 sq.ft. + 5 sq.ft. + 8.67 sq.ft. + 8.67 sq.ft.) X (19 ft. nominal)] + [12 sq.ft. X 10 ft.] = 797.73 ft^3

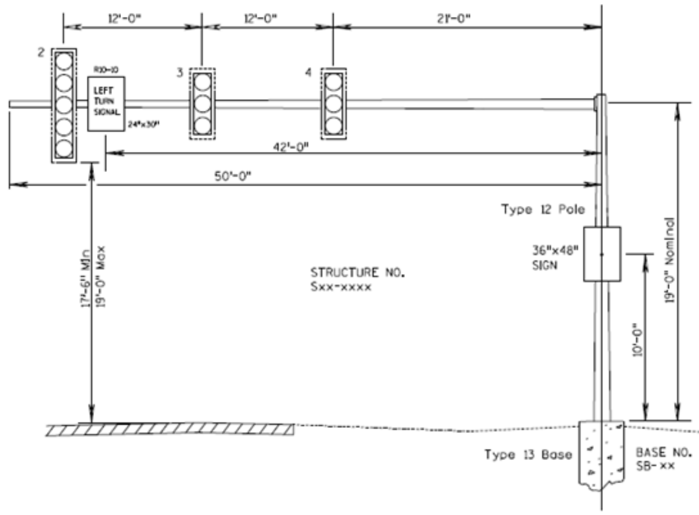
mh = (13.33 sq.ft. X 45 ft.) + (5 sq.ft. X 42 ft.) + (8.67 sq.ft. X 33 ft.) + (8.67 sq.ft. X 21 ft.) + (12 sq.ft. X 0 ft.) = 1278.0 ft^3

<u>Enter table for checking loading using the row for a 50 ft. arm length:</u>

Overturning factor = MV = 1733 ft^3 maximum

Twisting factor = MH = 2151 ft^3 maximum

The proposed loading of signal and sign attachments on the Type 12 pole with a 50 ft. arm is acceptable since mv = 798 ft^3 is less than MV = 1733 ft^3 and mh = 1278 ft^3 is less than MH = 2151 ft^3.



<u>Table for checking loading on a monotube traffic signal structure</u>

Arm length (ft)	MV (maximum) (ft^3)	MH (maximum) (ft^3)
15	834	295
20	1007	416
25	1007	594
30	1007	771
35	1560	1168
40	1560	1477
45	1733	1792
50	1733	2151
55	1733	2510

4-7-1 Sequence of Operations **April 2025**

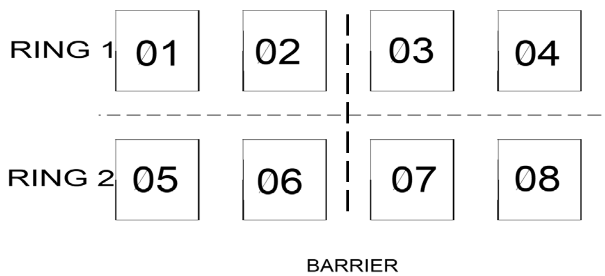
NEMA PHASING

The traffic signal maintaining authority **shall** be contacted for purposes of determining the type of NEMA phasing.

For all new state-owned signals, actuated controllers **shall** be used. Legacy equipment *may* remain for the remainder of the life of the equipment or until a construction project comes through; whichever comes first.

Traffic signal phasing **shall** be in accordance with NEMA standards for actuated signal controllers unless directed otherwise by a WisDOT Region Traffic Signal Engineer. Under NEMA phase designations, there can be a total of eight phases, which are grouped in two rings as illustrated in Figure 1.1.

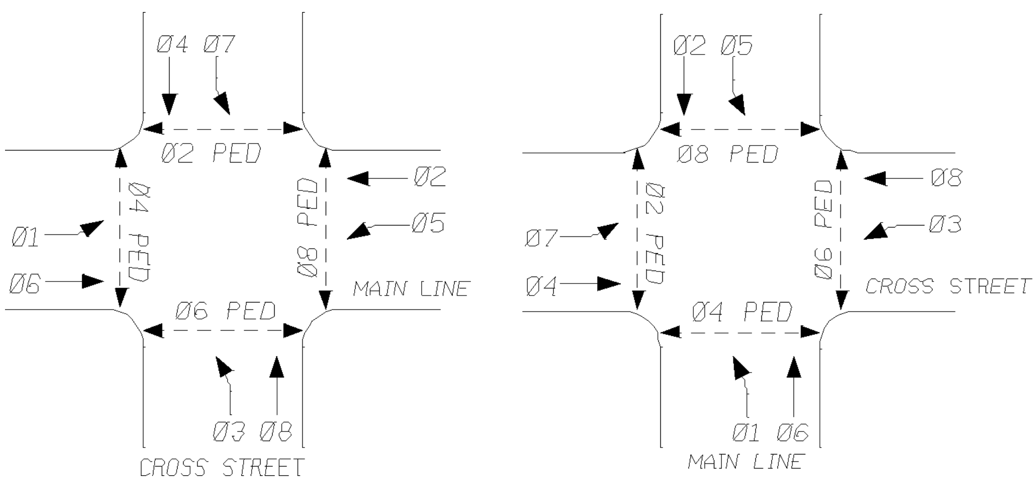
Figure 1.1. Ring Barrier Diagram



The phases are separated by what is referred to as a barrier, which prohibits the servicing of conflicting phases that are in separate rings simultaneously.

For standard traffic signal phasing the vehicular movements **shall** be referenced to the associated NEMA phase numbers as designated in Figure 1.2. The NEMA phase designation diagram represents an eight-phase signal operation with protected/permissive or protected-only left turns on all approaches. Pedestrian phasing, where applicable, *should* be designated by the complementary through movement phase associated with the specific pedestrian movement.

Figure 1.2. NEMA Phase Diagram



Phase 6 *should* normally be oriented in the mainline northbound or eastbound through direction for plan preparation purposes, with the remaining phases oriented according to the relationship illustrated in Figure 1.2.

For signals on a state trunk highway, NEMA phase designation **shall** be used. For example, mainline east-west through movements *should* be called out as Ø6 and Ø2, not just Ø2 (or just Ø6), and cross street through movements *should* be called out as Ø8 and Ø4, not just Ø8 or Ø4. In addition, left turn phasing *may* be added in the future. Due to this, eight-phase dual-ring controllers **shall** be used at state-owned signals.

STANDARD & SPECIAL OVERLAPS

Another factor related to phasing and head displays is the use of overlaps. There are two types of overlaps: standard overlaps and special overlaps. A Standard Overlap is defined as a right-of-way indication that allows traffic to turn when the right-of-way is assigned to two or more traffic phases. A Special Overlap is a non-standard overlap used to run a flashing yellow arrow which is tied to an opposing phase.

Standard Overlaps

Under this type of operation, for example, a right turn movement moves in conjunction with the complementary left turn movement from the crossing street. Typically, this type of operation is best utilized when there are exclusive lanes for each movement. This type of operation allows for efficient use of the green time for both streets by maximizing vehicle throughput. Standard Overlaps are also commonly used at interchanges, typically tying multiple complementary movements together across the interchange.

Right turn overlaps can be considered for use at locations where there is an exclusive right turn lane and a complementary left turn lane with a protected left turn phase on the crossing street. In areas where pedestrian demands are high, particularly in central business districts (CBDs), school crossings, or locations associated with special events, the use of right turn overlaps *should* be carefully evaluated with respect to pedestrian safety. In most cases, right-turn overlaps for these types of areas *should* be avoided.

Figure 1.3 illustrates the chart used for Standard Overlaps. This chart is located on the Sequence of Operations Sheet. The overlap *should* only be shown if it overlaps two (2) or more phases. The chart *should* indicate which phases the overlap times concurrently.

Figure 1.3. Standard Overlap Chart

O.L. “A” =
O.L. “B” =
O.L. “C” =
O.L. “D” =

Special Overlaps

Special Overlaps are non-standard overlaps used to control flashing yellow arrows for left or right turns tied to an opposing through phase.

The WMUTCD has instituted a requirement that green circular indications **shall not** be used in front of left turn lanes. Flashing yellow arrows (FYA) *should* be utilized by WisDOT for state owned signals to meet this requirement yet still provide either permissive only OR protected/permissive left turn and/or right turn movements. For right turn FYAs, the Region’s Traffic Signal Engineer **shall** be contacted on how to setup the right turn FYA.

The operation of the FYA signal heads is straight forward; however, it does require some additional wiring and programming in the cabinet. The following information details how to complete a Sequence of Operations Sheet for a traffic signal with a flashing yellow arrow.

Flashing yellow arrows are handled in the controller via the use of a SPECIAL overlap. To simplify and standardize the cabinet wiring, each overlap has been assigned to a specific phase as follows depending on what type of cabinet is used (TS1 or TS2):

Table 1.1 Overlap Assignments – TS2 Cabinet, Mode G

Overlap	Left Turn Phase	Opposing Thru Phase
“E”	1	2
“F”	3	4
“G”	5	6
“H”	7	8

For additional modes (e.g., Mode B) and TS1 cabinet overlaps, see signal controller & cabinet manufacturer documentation.

If your design only has one or two FYA operations, you do not simply assign Overlaps E & F, but rather the overlap that is associated with that left turn phase and/or opposing through phase as listed in Table 1.1.

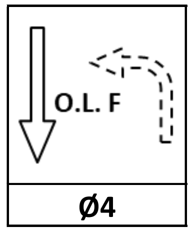
<u>Ring/Barrier Diagram:</u>

Permissive Only:

If your FYA is being operated in permissive mode only, your signal plan will show 3-section signal heads in the following configuration from top to bottom; red arrow, yellow arrow, flashing yellow arrow. The head numbers affiliated with these 3-section signal heads will be listed in the row for the associated overlap, only.

The overlap will graphically be shown in the same box as the arrow for the opposing through movement. It is recommended that this arrow either have a dotted/dashed pattern, or that it be hollow (with all other non-FYA arrows being filled in) to show that this is a flashing arrow, and not a green arrow (as shown in Figure 1.4).

Figure 1.4. Permissive Only FYA

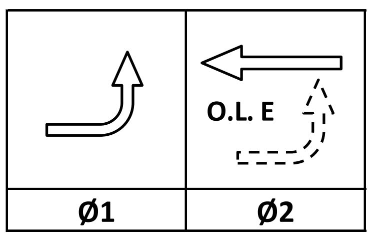


Protected / Permissive:

If your FYA is being operated in protected / permissive mode, your signal plan will show 4-section signal heads in the following configuration from top to bottom; red arrow, yellow arrow, flashing yellow arrow, green arrow. The head numbers affiliated with these 4-section signal heads will be listed in the row for the associated left turn movement **and** in the row for the associated overlap.

The overlap will graphically be shown in the same box as the arrow for the opposing through movement. It is recommended that this arrow either have a dotted/dashed pattern, or that it be hollow (with all other non-FYA arrows being filled in) to show that this is a flashing arrow, and not a green arrow (as shown in Figure 1.5).

Figure 1.5. Protected / Permissive FYA



OTHER TABLES

The Sequence of Operations Sheet contains several tables and charts. A complete description of the Detector Logic Chart and Controller Logic Chart is covered in TEOpS 4-8-2 and the Sequence of Operation Chart is discussed in TEOpS 4-7-1. Five tables have been created for special purposes; these are shown in Figure 1.6 below.

Figure 1.6. Sequence of Operations – Other Tables

TYPE OF INTERCONNECT/COMMUNICATION	
NONE	
CLOSED LOOP	
TWISTED PAIR	
FIBER OPTIC*	
FIBER OPTIC (ETHERNET)	
RADIO	
CELL MODEM	

TYPE OF COORDINATION	
NONE	
TBC	
TRAFFIC RESPONSIVE	
ADAPTIVE	
*LOCATION OF MASTER CONTROLLER NO:	S-
SIGNAL SYSTEM NO:	SS-

TYPE OF PRE-EMPT	
NONE	
RAILROAD	
EMERGENCY VEHICLE	
GTT	
TOMAR	
HARDWIRE	
OTHER	
LIFT BRIDGE	
QUEUE DETECTION	

TYPE OF LIGHTING	
BY OTHER AGENCY	
IN TRAFFIC CABINET	
IN SEPARATE DOT LIGHTING CABINET	

EMERGENCY VEHICLE PREEMPTION SEQUENCE

EMERGENCY VEHICLE PREEMPTOR	A	B	C	D
MOVEMENT				
PHASE	2+5	6+1	4+8	8+3

The main purpose of these tables is to indicate what additional equipment *may* be installed at the intersection. These tables *should* always be filled in.

TYPE OF COORDINATION AND TYPE OF COMMUNICATION TABLES

Coordinating traffic signals requires several additional coordination settings to be made in the controller. The type of coordination *should* be indicated with an "X." If the type of coordination is other than TBC, then the master signal controller location **shall** be identified by the signal number.

Designate, with an "X", the type of communication at the intersection in the Type of Communication Table.

TYPE OF PREEMPT AND EVP SEQUENCE TABLES

Use of a preempt device at some locations provides additional safety for both the motorist and preempt authority (i.e. railroad, emergency vehicle). The type of preempt *should* be indicated with an "X."

If railroad preemption is installed at the intersection, in addition to filling out the Type of Preempt Device Table, one *should* include a general note on the Sequence of Operations Sheet. The note *should* describe the preempt sequence beginning at the track clearance green through the preempt cycle. The note *should* describe the phases and sequence used at the intersection when the signal is preempted. A sample railroad preemption note is shown below:

> *IN THE EVENT OF A RAILROAD PREEMPTION CALL, PHASE 8 SHALL RECEIVE A GREEN INDICATION TO CLEAR THE SOUTH APPROACH. FOLLOWING THE TRACK CLEARANCE INTERVAL, THE CONTROLLER SHALL ADVANCE TO PHASES 2 & 6 GREEN AND HOLD FOR THE DURATION OF THE PREEMPTION. AT THE END OF THE PREEMPTION, THE CONTROLLER SHALL RETURN TO PHASES 4 & 8 GREEN.*

For Emergency Vehicle Preemption (EVP), emergency vehicle in the Type of Preempt Table and the brand of EVP equipment *should* be checked and the EVP Sequence Table *should* be filled in.

Additional discussion on the preemption of State signals; including eligibility, request procedure, review/approval, installation, and cost is covered in TEOpS 4-2-3.

TYPE OF LIGHTING TABLE

Designate with an "X" the type of lighting service installed at the intersection. It is important to indicate whether lighting is wired into the traffic signal cabinet or to a separate lighting cabinet. If state and local lighting exist at same intersection, multiple boxes **shall** be checked to reflect maintaining authority for all lighting.

FLASHING YELLOW ARROW

For information about flashing yellow arrows, see TEOpS 4-7-1 Standard & Special Overlaps, Special Overlaps topic.

4-7-2 Left Turn Phasing April 2025

Adding phases leads to an increase in cycle length and delay and decreases intersection efficiency, especially at pre-timed signals. In addition, adding non-warranted left turn phases *may* impact driver perception and lead to requests for left turn phases at other non-warranted locations. Left turn phasing *should* be determined early in the design process, prior to completing the capacity analysis and starting geometric design.

Left turn phases *should* be considered on approaches when:

- Visibility is limited. Queue spillback occurs into adjacent through lane
- Left turn queue does not consistently clear during permissive green.
- There exists a left turn delay of 2.0 vehicle hours or more in a peak hour on a critical approach.
- The left turn crash experience meets or exceeds: for one approach, four left turn crashes in one year or six in two years; or for opposing approaches, six left turn crashes in one year or ten in two years. Analysis **shall** include review of past 5 years of crash records. This will allow the engineer to determine if crash patterns exist, and what circumstances *may* be involved.
- The product of a left turning volume and its opposing through, and right-turn volume meet or exceed the minimum requirements given in the table below during the peak hour. All opposing through traffic including right turns *should* be considered unless the right turns are well removed from the intersection.

The number of phases at signalized intersections *should* be kept to a minimum.

Minimum Vehicular Volumes for Left Turn Analysis

Number of left turn lanes	Number of opposing through lanes	Product of peak hour left turning vehicles and opposing plus right-turn vehicles
1	1	50,000
1	2	100,000
1	3 or more	Engineering Judgement

In any case, left turn phasing **shall** be approved by the Regional Traffic Engineer.

Typically, separate opposing or positively offset left turn lanes *should* be provided on all approaches to allow for simultaneous leading left turn phases now and in the future. If the geometrics cannot be improved to allow simultaneous leading left turn phases, then alternative phasing could be considered (Such as “Split” or a “Lead-Lag Protected-Only Left”) to avoid the conflict. These phasing alternatives are not desired, therefore **shall** only be considered as last resort in extreme cases. These alternatives are inefficient, especially if there are pedestrian phases on both approaches of a street. Geometric improvements **shall** always be explored first.

In most cases, protected/permissive left turn phasing *should* be tried prior to installing protected only phasing. Installing protected/permissive phasing rather than protected only phasing typically results in increased intersection capacity and decreased intersection delay and driver frustration.

Protected only by time-of-day *may* also be an option when opposing through traffic is high at consistent, predicted times.

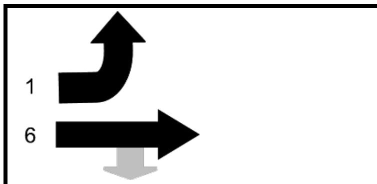
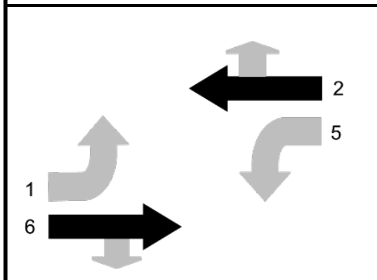
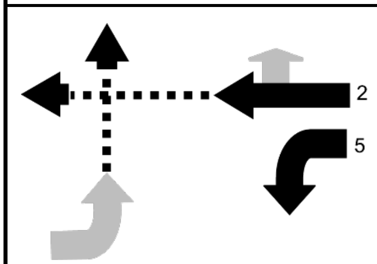
Protected only phasing *should* be used to control to control dual left turn lanes and **shall** be used to control triple left turn lanes. In addition, protected only phasing *should* be considered in cases where visibility of opposing thru traffic to left turning vehicles is not sufficient to allow for a safe movement and improving the geometrics is not feasible. This typically occurs with wide medians where left turn lanes are not opposing or positively offset. When protected only phasing is installed on one approach the opposing approach **shall** have protected only phasing **or** a flashing yellow arrow due to driver perception and safety.

Protected only left turn phasing *should* also be considered at locations with higher operating speeds (greater than 45 mph), when left-turn movements need to cross more than two opposing through lanes and when crash trends dictate.

Typically, left-turn phases are leading.

Lagging protected/permissive left turn phasing **shall not** be utilized as it creates a dangerous situation often referred to as a “left turn trap” or “yellow trap”. Figure 2.1 shows the phase intervals for this situation. Three exceptions are as follows; at T-intersections, at interchange ramp terminals where no opposing left turn movements exist, and when flashing yellow arrows are utilized for the protected/permissive left turn.

Figure 2.1. Left turn trap diagram

	**Interval 1**: Phase 1 eastbound shows protected left turn arrow while phase 6 eastbound through shows a green ball.
	**Interval 2**: Phase 1 eastbound and phase 5 westbound show permissive left turn (flashing yellow arrow or green ball) while phase 2 and phase 6 through shows green ball. At the end of interval 2, phase 1 displays a yellow indication. Since the eastbound left sees the yellow on all facing displays, they *may* incorrectly presume that westbound left and through is likewise receiving a yellow ball and about to stop.
	**Interval 3**: Phase 5 westbound shows protected left westbound turn arrow while phase 2 westbound through shows green ball. Eastbound left *may* have assumed the westbound through was stopping creating a crash situation.

Lead-lag left turn phasing *may* be utilized only when there is protected only phasing on both approaches of a street. This phasing sequence can be advantageous when used on a coordinated street as it has the potential to maximize two-way progression. An example of this sequence is: NB leading protected left phase and NB through phase followed by the NB and SB through phases, followed by the SB lagging left phase and SB through phase.

4-7-4 Flashing Operations — April 2025

Reference is made to the WMUTCD, Section 4G, and Wisconsin State Statute 346.37 and 346.39.

There are four types of flashing operations for traffic control signals: start-up flash, emergency flash, program flash, and manual override flash. Each of these conditions are described briefly below:

1. New signal start-up flash operation is used to acclimate motorists to the revised form of intersection traffic control at a given location prior to initiating steady stop-and-go mode operation.
2. Emergency flash operation *may* be caused by controller malfunction, utility service disruption, or physical damage to the installation (such as a pole knock-down).
3. Program (time-of-day) flash operation is generally limited to use at pre-timed signal installations where no actuation exists to detect vehicles and provide variable green time based on actual approach demand. This type of flash operation is used during off-peak hours (for example, from 10 PM to 6 AM) to reduce intersection delay at pre-timed signals.
4. Manual override flash operation *may* be used by law enforcement officers that assume intersection traffic control associated with special events or incidents.

In addition to flash operation, two flash modes are used: red-red or yellow-red flash.

POLICY

New Signal Installation Start-Up Flash Operation

At newly installed signals that have just become operational, consideration *should* be given to using flash-mode operations if the intersection was open to traffic during construction. This is used to acclimate motorists to the revised form of intersection traffic control at a given location prior to initiating steady stop-and-go mode operation.

Engineering judgment **shall** be used to determine the need for and duration of flash-mode operations. Consideration *should* also be given to the location of the signal and type of motorists that use the route. For example, along a commuter route, new signals *may* be flashed for a length of time between Monday and Friday. Similarly, new signals along a tourist route can be flashed during a weekend period.

Start-up flash for new signals *should* reflect the prior intersection traffic control condition. That is, if a signal is installed to replace a two-way STOP condition, a yellow-red flash mode *may* be used. If a signal is installed to replace an all-way STOP condition, a red-red flash mode *may* be used.

<u>Program (Time-of-Day) Flash Operation</u>

Pre-timed signals on the STH system *may* use program (time-of-day) flash operations but *should* be scheduled for upgrade to semi-actuation, at a minimum. Traffic signals on the STH system that are fully or semi-actuated **shall not** use program (time-of-day) flash operations. Actuated signals can detect and respond to actual demand on conflicting approaches; efficiencies gained by this type of operation at a pre-timed signal do not necessarily exist at an actuated signal. In addition, the transition out of flash operation to steady stop-and-go operations *may* be a time of potential confusion to motorists.

Traffic signals on the STH system that are interconnected with rail-grade crossing systems **shall not** use program (time-of-day) flash operations.

<u>Emergency Flash Operation & Manual Override Flash Operation</u>

Regardless of whether program flash operation is used at an installation, the flash mode must be determined for emergency and manual override situations. The bullet points below discuss these two modes:

1. <u>Red-red (R-R) flash mode</u> is prescribed for most signalized intersections, as this mode tends to reflect motorist expectancy. On multilane highways, this type of operation will benefit motorists on the side road since clearance distances can be large.
2. <u>Yellow-red (Y-R) flash mode</u> *may* be appropriate at signals where overall intersection volumes are relatively light, and the proportions of mainline volumes significantly exceed those on the side road. This rule of thumb reflects a consideration for intersection delay and maintaining priority based on route significance. However, driver expectancy *may* be violated causing drivers to unnecessarily stop on yellow, thereby creating a potential safety hazard for other drivers and negating the potential delay reduction.

Even if an isolated intersection meets the broad volume criteria above for yellow-red flash mode, other signalized intersections along a corridor *may* dictate the type of flash mode that *should* be used. For example, if adjacent signalized intersections use a red-red flash mode, driver expectancy *may* determine that any additional signals in the immediate area operate in the same manner, regardless of this generalized volume criteria.

SUPPORT

Whether a signal is operating in steady stop-and-go mode, R-R or Y-R flashing mode, or non-operable (dark) mode, driver expectancy *should* be considered. Careful engineering judgment *should* be used to balance the needs of safety, efficiency and motorist expectancy.

4-7-5 Vehicle Clearance Intervals — April 2025

Reference is made to the WMUTCD 4F.17.

According to State Statute 346.37(1)(b), “When shown with or following the green, traffic facing a yellow signal **shall** stop before entering the intersection unless so close to it that a stop *may not* be made in safety.”

The purpose of the YELLOW vehicle clearance interval is to inform drivers of an impending change in right-of-way assignment. Yellow clearance intervals are normally three to six seconds in duration.

The purpose of the ALL-RED clearance interval is to allow vehicles to travel through an intersection that have lawfully entered during the yellow clearance interval. It *may* also provide a brief period of separation time between opposing movements. All-red clearance intervals normally do not exceed three seconds in duration.

POLICY

By the WMUTCD, all traffic signal installations **shall** display a yellow indication following every green interval. In addition, by this policy, state-owned signal installations **shall** operate with an all-red clearance interval for mainline and side street intersection through-vehicle movements. All-red clearance intervals *may* be used for other intersection movements, such as protected left turns.

Fundamentally, there are three ways that yellow and all-red clearance intervals are developed: timing derived by kinematic principles, uniform timing, and rule of thumb. As a statewide organization, WisDOT routinely operates signals adjacent to various jurisdictions that *may* have differing perspectives about signal timing methodology. In the interest of providing uniform conditions to the extent possible, all methods are considered acceptable but *may* have greater applicability in certain situations or within specific areas of the state.

<u>Kinematic Method</u>

Develops a clearance interval duration based on driver behavior and physical principles. Clearance interval timing based on this method can be calculated for each intersection movement by using the following formula:

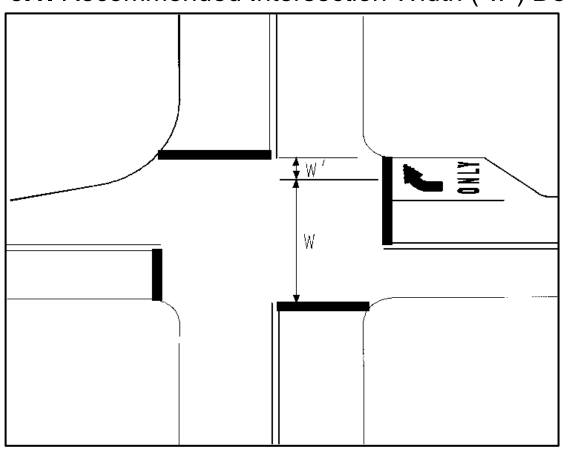
$$CT = \underbrace{prt + \frac{v}{2a+2Gg}}_{\text{yellow portion}} + \underbrace{\frac{L+w}{v}}_{\text{all-red portion}}$$

$$= \text{yellow portion} + \text{all-red portion}$$

Where:

CT	=	clearance time (*may* be rounded up to nearest 0.5 second)
prt	=	driver perception-reaction time (usually 1.0 second)
v	=	vehicle approach speed (feet per second, vehicle approach speed *should* be based on the posted speed, or the 85-percentile speed if data is available)
a	=	average vehicle deceleration rate (usually 10 to 15 feet per second^2, 10 to 12 fps^2 recommended)
g	=	acceleration due to gravity (32 fps^2)
G	=	approach grade (expressed as decimal)
L	=	vehicle length (usually 20 feet)
w	=	intersection width (measured in feet from the near-side stop bar, see "w" diagram below)

Figure 5.1. Recommended Intersection Width ("w") Determination



Intersection width measured from approach stop bar to center of conflicting vehicle lane on the far side of the intersection. Width *may* also include distance from center of far lane to the outside edge of the traveled way ($w + w^{l}$).

When used, variables within the formula above *may* need to be adjusted for various applications and for different intersection movements. For example, in the case of left-turns, driver perception-reaction times *may* be shorter and/or vehicle approach speeds lower.

As stated above, the upper limit of the yellow and all-red clearance intervals are typically 6 and 3 seconds, respectively. Longer clearance interval times *may* breed driver noncompliance that can degrade intersection safety benefits. Excessively long clearance interval times will also reduce the efficiency of signal operations. The lower limit of the yellow clearance interval is typically 3 seconds.

For isolated state-owned signals that can be considered outside the influence of established timing practices of adjacent jurisdictions (for purposes of driver expectancy), it is desirable to use the kinematic method of determining vehicle clearance intervals.

For given approach speeds and gradients, the table below indicates YELLOW CLEARANCE INTERVALS calculated by the equation above (considering a lower deceleration rate of 10 fps^2).

Table 5.1. Yellow Clearance Intervals at Deceleration Rate of 10 fps^2

Approach	Approach Grade								
Speed (mph)	+4%	+3%	+2%	+1%	0%	-1%	-2%	-3%	-4%
25	2.6	2.7	2.7	2.8	2.8	2.9	3.0	3.0	3.1
30	3.0	3.0	3.1	3.1	3.2	3.3	3.4	3.4	3.5
35	3.3	3.3	3.4	3.5	3.6	3.7	3.7	3.8	4.0
40	3.6	3.7	3.8	3.8	3.9	4.0	4.1	4.3	4.4
45	3.9	4.0	4.1	4.2	4.3	4.4	4.5	4.7	4.8
50	4.3	4.4	4.5	4.6	4.7	4.8	4.9	5.1	5.2
55	4.6	4.7	4.8	4.9	5.0	5.2	5.3	5.5	5.6
60	4.9	5.0	5.1	5.3	5.4	5.6	5.7	5.9	6.1
65	5.2	5.4	5.5	5.6	5.8	5.9	6.1	6.3	6.5

Gray-shaded values fall outside typical time intervals indicated. Use only as needed and at the direction of the regional traffic engineer.

For given approach speeds and gradients, the table below indicates YELLOW CLEARANCE INTERVALS calculated by the equation above (considering a higher deceleration rate of 15 fps^2)

Table 5.2. Yellow Clearance Intervals at Deceleration Rate of 15 fps^2

Approach	Approach Grade								
Speed (mph)	+4%	+3%	+2%	+1%	0%	-1%	-2%	-3%	-4%
25	2.1	2.2	2.2	2.2	2.2	2.3	2.3	2.3	2.3
30	2.4	2.4	2.4	2.4	2.5	2.5	2.5	2.6	2.6
35	2.6	2.6	2.6	2.7	2.7	2.8	2.8	2.8	2.9
40	2.8	2.8	2.9	2.9	3.0	3.0	3.0	3.1	3.1
45	3.0	3.1	3.1	3.2	3.2	3.3	3.3	3.4	3.4
50	3.3	3.3	3.3	3.4	3.5	3.5	3.6	3.6	3.7
55	3.5	3.5	3.6	3.6	3.7	3.8	3.8	3.9	3.9
60	3.7	3.8	3.8	3.9	3.9	4.0	4.1	4.1	4.2
65	3.9	4.0	4.1	4.1	4.2	4.3	4.3	4.4	4.5

Grey-shaded values fall outside typical time intervals indicated. Use only as needed and at the direction of the regional traffic engineer.

For given intersection widths and approach speeds, the table below indicates ALL-RED CLEARANCE INTERVALS calculated by the equation above.

Table 5.3. All-Red Clearance Intervals

Approach	Intersection Width (ft)								
Speed (mph)	24	36	48	60	72	84	96	108	120
25	1.2	1.5	1.9	2.2	2.5	2.8	3.2	3.5	3.8
30	1.0	1.3	1.5	1.8	2.1	2.4	2.6	2.9	3.2
35	0.9	1.1	1.3	1.6	1.8	2.0	2.3	2.5	2.7
40	0.7	1.0	1.2	1.4	1.6	1.8	2.0	2.2	2.4
45	0.7	0.8	1.0	1.2	1.4	1.6	1.8	1.9	2.1
50	0.6	0.8	0.9	1.1	1.3	1.4	1.6	1.7	1.9
55	0.5	0.7	0.8	1.0	1.1	1.3	1.4	1.6	1.7
60	0.5	0.6	0.8	0.9	1.0	1.2	1.3	1.5	1.6
65	0.5	0.6	0.7	0.8	1.0	1.1	1.2	1.3	1.5

Gray-shaded values fall outside typical time intervals indicated. Use only as needed and at the discretion of the region traffic engineer.

<u>Uniform Timing</u>

Assigns a standardized duration for the clearance interval regardless of location. In this case, times *may* be based on the type of movement being made. For example, based on higher vehicle speeds, a through movement on a mainline approach *may* have a longer yellow clearance time then for a side street through movement or for a protected left-turn.

This method *may* be used when a state-owned signal is near signals operated in this manner by another jurisdiction. The purpose being, to address driver expectancy issues. However, assigning a single clearance interval value for all intersections and intersection movements is not recommended.

Rule of Thumb

Assigns a standardized duration for the clearance interval based on vehicle approach speed, the type of movement being made, or roadway classification. For example, mainline and side street movements *may* have the following yellow clearance interval durations:

Approach speed <30 mph = 3 seconds

Approach speed between 30-50 mph = 4 seconds

Approach speed >50 mph = 5 seconds

Protected left turns = 3 seconds

The interval times are for demonstrative purposes only. Similarly, though, all-red clearance times *may* be categorized.

This method *should* typically be used when a state-owned signal is near signals operated by another jurisdiction using this method to address driver expectancy issues.

SUPPORT

Even nationally, there is no clear consensus on appropriate methodology for determining vehicle clearance times ("Determining Vehicle Signal Change and Clearance Intervals", ITE, August 1994). According to ITE, "Divergent and strongly held positions are common when vehicle signal change interval lengths are discussed. Some believe that a common interval length is best, while others believe that uniform yellow change interval lengths are wrong….". This finding was verified more recently in an ITE document titled *Signal Timing Practices and Procedures – State of Practice* dated March 2004.

The kinematic methodology is typically the most desirable unless driver expectancy would be better served using the other principals described above.

As stated above, since WisDOT signals routinely operate near locally owned installations, the intent *should* be uniformity across an appropriate area or along a specific corridor. As such, proper coordination with other jurisdictions *should* take place. If a crash or red light running problem exists, vehicle clearance intervals *should* be verified and, if needed, reasonably extended.

4-7-6 Traffic Signal Coordination and Communication — April 2025

"Signal systems…are proven to reduce stops, reduce delays and decrease accidents; increase average travel speeds; and decrease emissions." (ITE Traffic Control Devices Handbook, pg. 336, © 2001 Institute of Transportation Engineers). There are several parameters that affect coordinated signal system efficiency: spacing, vehicle travel time, cycle length, offset, splits, and phasing. The primary factors to consider for coordination of signals are spacing of signalized intersections, traffic characteristics, and signal operations.

When signalized intersections are spaced closer than a half-mile coordination **shall** be considered. This will usually include arterial segments and interchanges. Signalized intersections spaced less than a quarter mile can be coordinated but it *may* be difficult to maintain ideal two-way progression when closely spaced. Signals that are spaced greater than a half mile *should* also be considered for coordination if traffic progression can be maintained.

Traffic characteristics will also influence the decision to coordinate adjacent signals. Random arrival patterns and/or relatively light approach demand *may* indicate the need to coordinate signals only during certain times. Alternatively, heavy volumes with repetitive patterns such as commuter routes, *may* have variable timing plans throughout a day.

Regardless of existing volumes and turning movements, plans *should* include provisions for future coordination at closely spaced intersections. Such provisions will depend on the type of coordination but will commonly include a conduit run between controller cabinets to accommodate future interconnect cable.

There are multiple ways to provide coordinated systems; however, most state-owned systems will consist of Time-Based Coordination (TBC), traffic-responsive coordination, or adaptive coordination.

TBC uses the functionality of the internal controller clocks without a physical connection between control cabinets. Clocks need to be synchronized for TBC to be effective. This type of coordination utilizes minimal infrastructure yet *may* require a more significant effort from operations staff to maintain proper coordination.

Traffic-responsive and adaptive coordination requires communications between controllers. This can be achieved by radio, phone line (tone), twisted pair, fiber optic, or cellular modem. Fiber optic is the most common in urbanized areas where connection to the fiber backbone is possible. This type of connection requires a conduit run between each control cabinet with pull boxes and/or communication vaults spaced along the run. Cellular modem is most common in rural areas. Closed Loop systems have the added functionality of being remotely accessed for program changes and timing plan verification.

There are several methods for providing specialty equipment used for signal coordinated signal systems:

- Intersections where signals will be in the future. At such locations, underground facilities *should* be installed with an improvement project or permit project (TIA process). The underground facilities generally consist of conduit runs across the intersection approaches, some pull boxes, and *may* include some loop installations. These intersection locations will usually be cited based on an engineering study where warrants are close to being met, or at locations where adjacent properties are developing.

  At such locations, conduit *may* be installed between future controller cabinet locations (typically on the side of the highway segment). Common practice is to base the need for this equipment based on spacing between adjacent intersections that *may* become signalized. It is worth remembering that these electrical facilities will need to be included in the Regional database for purposes of marking them in the field during any construction activities.

- Intersections where signals are proposed. If an engineering study determines that a signal will benefit intersections operations, yet it will need to be interconnected with an adjacent signal installation, common practice is to fund and implement any interconnection provisions with that signal.

  If the installation cannot be provided for by an improvement project or is not the result of changes to the adjacent land use, The Regional operations budget *may* be used to fund candidate locations. Highway Safety Improvement Program (HSIP) or Signals and ITS Standalone Program (SISP) funds *may* also be applied for on a case-by-case basis.

- Intersection where signals exist. Funding opportunities are the same as bullet above.

4-7-7 Preemption of Traffic Signals near Railroad Grade Crossings April 2025

GENERAL

Reference is made to WMUTCD Section 4D.27 and Section 8D.09.

POLICY

When to Preempt

Preemption should be provided for traffic signals within 200 feet of a grade crossing and should be considered for traffic signals more than 200 feet from a crossing. The determination on when to preempt any traffic signal located near a grade crossing should be made based upon the likelihood of a queue extending across the tracks or through the intersection. Traffic engineering calculations, traffic simulation modeling, and field observations may be used to determine the queuing probability.

Preemption Timing

Once it is determined that preemption is needed, WisDOT's Guide for Determining Time Requirements for Traffic Signal Preemption at Highway-Rail Grade Crossings form (Figure 1) **shall** be completed and **shall** be included as an attachment to the railroad project submittal package (RPSP).

For additional guidance, refer to ITE's Recommended Practice on Preemption of Traffic Signals Near Railroad Grade Crossings.

Right-of-way Transfer Time and Pedestrian Clearance Intervals

Right-of-way transfer time is the maximum amount of time needed by the traffic signal system to safely exit any vehicular or pedestrian phase. According to WMUTCD Section 4D.27, during the transition into preempted control, the preemption sequence **shall not** shorten or omit the yellow change interval and any red clearance interval that follows. Minimum vehicular green times at actuated signals *should* be at least five seconds to allow drivers to react to the change in right-of-way and enter into the intersection. Additionally, according to WMUTCD Section 4D.27, pedestrian WALK and/or pedestrian change intervals *may* be shortened or omitted in order to begin the track clearance interval earlier. This practice, however, is not preferred since pedestrians may have begun crossing prior to preemption and be located in the driver's lane forcing them to yield to the crossing pedestrians. If a vehicle is unable to move while the pedestrian completes their crossing, this increases the amount of time it will take to clear a design vehicle off the tracks WisDOT standard practice is to set WALK time to zero (0) and reduce the FLASHING DON'T WALK time by calculating the necessary crossing time from gutter to gutter using the walking speed of 4 feet per second and subtracting off the yellow and all red time.

Eliminating the Left Turn Trap

When protected/permitted left turn phasing is used during the track clearance phase, special consideration *should* be taken to eliminate the possibility of the left-turn trap at the onset of railroad preemption. This possibility exists when the traffic signal is serving the track clearance phase and opposing through phase, and the opposing left turn is in a permissive operation. WisDOT standard practice is to exit all phases (ensuring min green as well as full yellow and all red clearance are displayed) before initiating the track clearance phase. Most modern controllers have a setting that will force the all-red prior to serving a track clearance phase.

Joint Annual Inspection of Signalized Intersections with Railroad Preemption

WMUTCD 8D.09 states, "Regular joint inspections by the highway agency or authority with jurisdiction, the regulatory agency with statutory authority, if applicable, and the railroad company or transit agency are a best practice and typically include verification of the preemption operation, the amount of warning time and/or preemption time being provided by the grade crossing warning system, and the timing of the highway traffic signals interconnected and/or coordinated with the flashing-light signals."

Furthermore, the Office of the Commissioner of Railroads (OCR), Wisconsin's regulatory agency with statutory authority, instituted a requirement in 2023 that all traffic signals with railroad preemption be inspected annually.

At a minimum, the joint annual preemption inspection team **shall** consist of an individual representing the traffic signal operating agency and an individual representing the railroad authority. The purpose of the inspection is to verify that the preemption system still operates as designed. Therefore, it is imperative that each party involved in the inspection thoroughly understands how their component of the preemption system is designed and expected to operate.

Observation of a live train movement, while beneficial, is not required as part of a joint annual inspection. The railroad operating agency can simulate a train movement in a variety of ways. The inspection team should discuss the options and select a methodology that best meets the goals of the inspection.

The traffic signal operating agency and the railroad operating company each have a form they **shall** complete and sign. The majority of the information on the forms should be completed in advance of the field work. This allows each party to refamiliarize themselves with the intended design and operation of their system. As a result, time spent in the field can be focused on verifying these operations.

The traffic signal operating agency **shall** submit their form (Form 1a) to the railroad. The railroad **shall** combine their form (Form 1b) with Form 1a in a single PDF and submit this final document to OCR via their E-Services Portal. Figures 2 & 3 provide a visual of these forms and fillable forms can be found online (Figure 2 Inspection 1a form, Figure 3 Inspection 1b form). Instructions on how to complete the form are also provided.

Figure 1. WisDOT Guide for Determining Time Requirements for Traffic Signal Preemption at Highway-Rail Grade Crossings

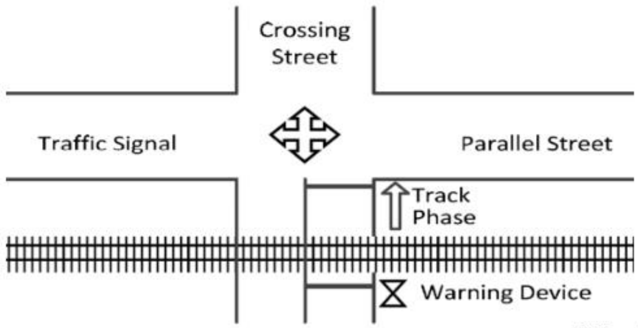
Version 1.4
(Rev. 2/22)

Wisconsin Department of Transportation
GUIDE FOR DETERMINING TIME REQUIREMENTS FOR
TRAFFIC SIGNAL PREEMPTION AT HIGHWAY-RAIL GRADE CROSSINGS

City
County
Region

Date
Completed by
Region Approval

Select North Arrow:



Parallel Street Name

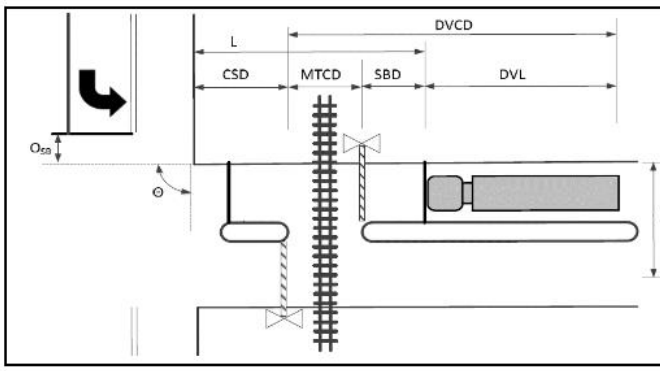
Crossing Street Name

Railroad
Crossing DOT #
M.P.

Railroad Contact
Phone

NOTE: After approval by the Region, a copy of this form, along with the traffic signal design sheets and the phasing diagrams for normal and preempted operation, shall be placed in the traffic signal cabinet. See Section 7 for traffic signal timings.

SECTION 1: GEOMETRY DATA & DEFAULTS



CSD = Clear storage distance (ft)
MTCD = Minimum track clearance distance (ft)
SBD = Stop bar setback distance (ft)
DVL = Design vehicle length (ft)
L= Queue start-up distance, also stop-line distance (ft)
DVCD = Design vehicle clearance distance (ft)
O_{SB} = Offset distance to Left-turn stop bar (ft)
B = Distance from curb line to center of nearest lane receiving left turns (ft)
Θ = Angle of turn (degrees)

GEOMETRIC DATA FOR CROSSING			**Remarks**
1. Clear storage distance (CSD, feet)……	1.	0	
2. Minimum track clearance distance (MTCD, feet)……	2.	17	
3. Stop bar setback distance (SBD, feet)……	3.	8	Enter "0" if no stop bar is present
4. Width of receiving approach (B, feet)……	4.	0	
5. Offset distance of left turn stop bar (OSB, feet)……	5.	0	
6. Approach grade. % (0 if approach is on downgrade)……	6.	5.0%	
7. Angle of turn at Intersection (θ, degrees)……	7.	90	

DESIGN VEHICLE DATA			
8. Select Design Vehicle from Dropdown		School Bus	
9. Default design vehicle length (feet)……	9.	40	Based on Selected Design Vehicle
a. Additional vehicle length, if needed (feet)……	9a.	0	Use only if "Other" Selected as Design Vehicle
10. Total design vehicle length (DVL, feet)……	10.	40	L9 + L9a
11. Centerline turning radius of design vehicle (R, feet)……	11.	35.4	Based on Selected Design Vehicle
12. Passenger car vehicle length (LV, feet)……	12.	19	Default Value

Page 1

SECTION 7: SUMMARY OF CONTROLLER PREEMPTION SETTINGS

Preempt Trap Check

			Remarks
69. Duration Time (seconds)	69.	0	Default Value
70. Preempt Delay Time (seconds)	70.	0	Line 13

Right of Way Transfer Phase

			Remarks
71. Minimum Green Interval (seconds)	71.	7	Line 16
72. Pedestrian Walk Interval (seconds)	72.	0	Line 21
73. Pedestrian Clearance Interval (Flashing "DON'T WALK", seconds)	73.	0	Line 22
74. Yellow Change Interval (seconds)	74.	-	Not typically overriden for preemption
75. All Red Vehicle Clearance (seconds)	75.	-	Not typically overriden for preemption

Track Clearance Phase

			Remarks
76. Green Interval (seconds) (in the absence of gate down circuit)	71.	26	
77. Green Interval (seconds) with gate down circuit	72.	16	Line 40
78. Yellow Change Interval (seconds)	73.	-	Not typically overridden for preemption
79. All Red Vehicle Clearance (seconds)	74.	-	Not typically overridden for preemption

Exit Phase

			Remarks
80. Dwell/Cycle Minimum Green Time (seconds)	71.	0	Default Value
81. Yellow Change Interval (seconds)	72.	-	Not typically overridden for preemption
82. All Red Vehicle Clearance (seconds)	73.	-	Not typically overridden for preemption

Remarks:

Figure 2. WisDOT Railroad Preemption Inspection Form 1a
(to be completed by the Traffic Signal Operating Agency)

WisDOT RAILROAD PREEMPTION INSPECTION FORM 1a

(to be completed by the TRAFFIC SIGNAL OPERATING AGENCY)

1. REVIEW TEAM

TRAFFIC SIGNAL INSPECTION COMPLETED BY:		INSPECTION DATE:	
SIGNATURE:		DATE OF LAST INSPECTION:	

2. LOCATION DATA

HIGHWAY INTERSECTION:		MUNICIPALITY:	COUNTY:
TRAFFIC SIGNAL OPERATING AGENCY:	SIGNAL ID:	SIGNAL CONTACT:	SIGNAL CONTACT PHONE:
RAILROAD OPERATING COMPANY:	RR CROSSING ID:	RAILROAD CONTACT:	RR CONTACT PHONE:
TRAFFIC SIGNAL EMERGENCY CONTACT NUMBER:		RAILROAD EMERGENCY CONTACT NUMBER:	

3. TRAFFIC SIGNAL DATA

CABINET TYPE:	CONTROLLER MAKE & MODEL:	TYPE OF PREEMPTION:	OTHER TYPE OF PREEMPTION:
☐ TS1 ☐ TS2		☐ Advanced ☐Simultaneous	☐ Emergency ☐ Bus/Transit
AVAILABLE CIRCUITS:		USED CIRCUITS:	
☐ APP ☐ AP ☐ GD ☐ HC ☐ SIM ☐ SUP ☐ XR		☐ APP ☐ AP ☐ GD ☐ HC ☐ SIM ☐ SUP ☐ XR	
VEHICULAR PHASES PRESENT:		PEDESTRIAN PHASES PRESENT:	OTHER PHASES PRESENT:
☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ 8		☐ 2 ☐ 4 ☐ 6 ☐ 8	
DOES RR PREEMPT HAVE PRIORITY?	BLANKOUT SIGNS PRESENT?	BATTERY BACKUP PRESENT?	
☐ Yes ☐ No ☐ N/A	☐ Yes ☐ No	☐ Yes ☐ No	

4. DESIGN RAILROAD PREEMPTION PHASING SEQUENCE

WORST CASE PHASES:	TRACK CLEAR PHASE(S):	PREEMPT DWELL PHASES:	PREEMPT CYCLE PHASES:
Veh: Ped:			

5. TRAFFIC SIGNAL TIMINGS

CONTROLLER SETTINGS	DESIGNED	PROGRAMMED	MEASURED	NOTES
Preempt Delay:	sec.	sec.		
Entrance Min Green:	sec.	sec.	sec.	
(Entrance) Walk + Ped Clear:	sec.	sec.	sec.	
(Entrance) Yellow + Red:	sec.	sec.	sec.	
Max Right of Way Transfer Time:	sec.	sec.		
Track Clear Min Green:	sec.	sec.	sec.	
Track Clear Ext Green:		sec.	sec.	
Track Clear Max Green:		sec.		
Min Dwell:		sec.	sec.	
Dwell Preemption Ext:		sec.	sec.	

6. FIELD TESTING AND INSPECTION

		NOTES
Are the blankout signs working properly?	☐ Yes ☐ No ☐ N/A	
Does a preempt call trigger a right-of-way transfer?	☐ Yes ☐ No	
Does a protected arrow come up for track clearance?	☐ Yes ☐ No	
Does gate down release the track clearance phase?	☐ Yes ☐ No ☐ N/A	
Do the proper cycle & dwell phases operate?	☐ Yes ☐ No ☐ N/A	
Is the preempt call released as expected?	☐ Yes ☐ No	
Does the signal exit to the proper phase(s) after preempt?	☐ Yes ☐ No	
Does preempt reservice activate?	☐ Yes ☐ No	
Is emergency contact information posted in the cabinet?	☐ Yes ☐ No	

7. OTHER INFORMATION/NOTES

Figure 3. WisDOT Railroad Preemption Inspection Form 1b
(to be completed by the Railroad Operating Company)

WisDOT RAILROAD PREEMPTION INSPECTION FORM 1b

(to be completed by the RAILROAD OPERATING COMPANY)

1. REVIEW TEAM

RAILROAD INSPECTION COMPLETED BY:		INSPECTION DATE:	
SIGNATURE:		DATE OF LAST INSPECTION:	

2. LOCATION DATA

HIGHWAY INTERSECTION:		MUNICIPALITY:	COUNTY:
TRAFFIC SIGNAL OPERATING AGENCY:	SIGNAL ID:	SIGNAL CONTACT:	SIGNAL CONTACT PHONE:
RAILROAD OPERATING COMPANY:	RR CROSSING ID:	RAILROAD CONTACT:	RR CONTACT PHONE:
TRAFFIC SIGNAL EMERGENCY CONTACT NUMBER:		RAILROAD EMERGENCY CONTACT NUMBER:	

3. RAILROAD DATA

ACTIVE WARNING DEVICES:	☐ 3 or 4-Quadrant Gates ☐ 2-Quadrant Gates	☐ Flashing Light Signals ☐ None	
MAXIMUM TRAIN SPEED (MPH):		SPEED RANGE OVER CROSSING (MPH):	
NUMBER OF TRAINS PER DAY:		NUMBER OF TRACKS:	
AVAILABLE CIRCUITS:		USED CIRCUITS:	
☐ APP ☐ AP ☐ GD ☐ HC ☐ SIM ☐ SUP ☐ XR		☐ APP ☐ AP ☐ GD ☐ HC ☐ SIM ☐ SUP ☐ XR	

4. RAILROAD EQUIPMENT TIMING

RAILROAD SETTINGS	DESIGNED		MEASURED (sec.)			NOTES
			MIN	AVG	MAX	
Equipment Reaction Time (ERT):		sec.				
Advance Pedestrian Preemption Time (APPT):		sec.				
Advance Preemption Time (APT):		sec.				
Minimum Warning Time (MWT):		sec.				
Clearance Time (CT):		sec.				
Buffer Time (BT):		sec.				
Total Warning Time (MWT + CT):		sec.				
Total Time (APPT + APT + MWT + CT):		sec.				
TOTAL TRAIN MOVEMENTS ANALYZED:		DATE RANGE FOR TRAIN MOVEMENTS:				

5. FIELD TESTING AND INSPECTION

		NOTES
Do the flashing light signals operate as expected?	☐ Yes ☐ No ☐ N/A	
Do the railroad gates operate as expected?	☐ Yes ☐ No ☐ N/A	
Is emergency contact information posted in the bungalow?	☐ Yes ☐ No	

6. OTHER INFORMATION/NOTES

4-7-9 Emergency Vehicle Preemption and Traffic Signal Priority April 2025

The following applies to the installation and operation of emergency vehicle preemption (EVP) and traffic signal priority (TSP) systems involving traffic control signals owned and operated by the department.

POLICY

Statutory Provisions

Traffic control signal preemption and priority devices. (2m) An authorized emergency vehicle *may* be equipped and operated with lamps designed and used, or with any other transmitter designed and used, to activate traffic control signal preemption devices. (2r) A snow removal vehicle equipped with oscillating, rotating, or flashing lights that is actively engaged in snow removal activities *may* be equipped and operated with lamps designed and used, or with any other transmitter designed and used, to activate traffic control signal priority devices (3m) The lamps authorized for use under this section *may* be any color and *may* be flashing, oscillating, rotating or pulsating. (4) No operator of an authorized emergency vehicle *may* use a transmitter, including lamps under sub (2m), except when responding to an emergency call, when pursuing an actual or suspected violator of the law, or when responding to, but not when returning from, a fire alarm.

The above does not preclude actuation by means of devices other than lamps.

Eligibility

Any local government unit, agency, or organization having responsibility for providing emergency and snow removal services is eligible to request an EVP or TSP system.

Request Procedure

The local unit **shall** make the request in writing to the department. The following information *should* be included in the request:

1. Location of proposed EVP / TSP systems
2. Location of emergency facilities (fire station, police station, etc.) where vehicles will be departing from and description of the route to be provided with a preemption system
3. Listing or estimate of number of vehicles to be outfitted
4. Brand/model of equipment being requested.

Approval

1. The department **shall** review each request and respond in writing to the local unit as to the approval or denial of the request.
2. The department *may* deny any request that it deems would have an overall negative impact on the traveling public.
3. If the local agency is requesting a brand/model of EVP / TSP other than the department standard, the request must include a discussion about compatibility with neighboring agencies along the same corridor.
4. For approved requests, an official EVP / TSP System Agreement **shall** be prepared and approved by the department and the local unit. Template is included at the end of this policy. This policy **shall** be included as a supplement to the agreement. Any special terms or conditions beyond the scope of this policy **shall** be included as a supplement to the agreement. Any special terms or conditions beyond the scope of this policy **shall** be stipulated in the agreement.
5. The department *may* allow an indicator light that is intended to confirm o the driver of an emergency vehicle that the preemption signal has been received. The use of this device does not preclude the need of the vehicle operator to rely on the signal indications for assigned intersection right-of-way. Requests for EVP / TSP confirmation lights *should* be reviewed on a case-by-case basis, and are subject to the following conditions:
    a. The department *may* deny any request for confirmation lights that it deems would have an overall negative impact on traffic safety or operations.
    b. EVP / TSP confirmation lights **shall** only be installed at signalized intersections where:
        i. Signal(s) on the STH system are embedded in a locally owned system that is also equipped with confirmation lights. This implies consideration for route continuity.

ii. Or, multiple emergency vehicles have the potential to respond on conflicting approaches to and from different points of origin. These conditions will typically exist in large urban areas where there are multiple precincts in the same municipality.

6. If it comes to the attention of the department that the preemption is being misused, such as by unauthorized vehicles, or that the municipality is not using or intends to abandon the system, the department *may* notify the municipality of the situation. If the matter is not resolved and corrected, the department reserves the right to set about removing the equipment. The scheduled date of removal of the equipment is indicated in item 5 below.

<u>Installation & Maintenance</u>

1. Department forces **shall** perform the installation, maintenance, modification, or removal of the EVP / TSP system equipment that is located at the traffic signal. Generally, this equipment would include the receiving device (mounted on the mast arm or signal head), the phase selector (in the control cabinet), confirmation light, and any miscellaneous cables and wiring needed to operate and power the portion of the EVP system located at the signal.
2. The local unit will be responsible for the installation of the emitting devices in authorized vehicles.
3. The department **shall** maintain a reasonable inventory of spare parts for the department's selected standard equipment to service the EVP / TSP system equipment located at the traffic signal. If the local agency is requesting equipment other than the standard equipment, the local agency **shall** be responsible for maintaining and providing a reasonable inventory. Specify which in the agreement.
4. When notified, department forces will respond to correct suspected failures or breakdowns or perform requested modifications in the EVP / TSP system equipment at the traffic signal.
5. Upon the department's request, the local unit will be responsible for verifying the working status of the EVP / TSP system by performing a field test using an emergency vehicle equipped with an EVP emitter device and/or snow removal vehicle equipped with a TSP emitter device. The local unit is responsible for periodically checking the EVP / TSP equipment.
6. In the event of a construction project, EVP / TSP service **shall** be maintained at any intersection with permanent EVP / TSP agreements. In addition, EVP / TSP equipment *may* be installed, if requested by a local unit, at any additional signals within the construction project itself, or on a designated detour route in the event of a road closure.

<u>Operation/Phase Timing</u>

1. The department **shall** determine the phasing and timing of the preemption sequencing with input from the local unit. There are three key features that must be considered when determining how the preemption will operate:
    a. Left turn phasing (protected, protected/permissive, or permissive only)
    b. Signal head configuration for left-turning movement (shared vs. exclusive head)
        i. Shared heads: include both circular indications and arrow indications (used by through and turning vehicles)
        ii. Exclusive heads: arrow indications only (used solely by turning vehicles)
    c. Style of preemption / priority sequencing (common greens vs. exclusive greens)
        i. Common greens: indicates opposing through phases both have a green ball. The corresponding left turn phases are permissive only.
        ii. Exclusive greens: indicates only one through movement and its corresponding left turn phase have the green ball/arrow.
2. The department offers the following operational guidance based upon the combination of those three key features identified above:
    a. Protected only left turns
        i. Exclusive head **shall** operate with exclusive greens for the safety and ease of turning of the preempting vehicle
    b. Permissive only left turns

i. Shared head
   1. Common greens *may* be used
   2. Exclusive greens *may* be used if an all-red period is introduced, or a W25-2 sign is installed.
ii. Exclusive head:
   1. **Shall** operate with common greens since a green left turn arrow is not available for use with exclusive greens

c. Protective/permissive left turns
   i. Shared head
      1. Common greens: *may* be used
      2. Exclusive greens *may* be used if an all-red period is introduced, or a W25-2 sign is installed
   ii. Exclusive head
      1. Common greens *may* be used
      2. Exclusive greens *may* be used

3. Any exceptions to the guidance in item 2 above **shall** be included as part of the special terms or conditions of the agreement.
4. If used, the operation of confirmation lights on state- and locally owned signals **shall** be standardized such that the approach being preempted has a steady indication. Approaches with secondary calls **shall** flash. The flash rate **shall not** be between 5 and 30 flashes per second to avoid frequencies that might cause seizures.

Driver Training

1. The local unit **shall** be responsible for training the emergency services and snow removal personnel on the proper operation of the system.
2. This training *should* provide clear understanding of these items:
   a. The definition of an authorized emergency vehicle or snow removal vehicle at the beginning of this policy
   b. The conditions when preemption or priority *may* be used
   c. The use of preemption / priority does not remove the responsibility of the vehicle operator from determining whether it is safe to enter the intersection
   d. The operator cannot assume that the preemption / priority has gone into effect; the operator must rely on the traffic signal indication
   e. The proper operation of the activating device located on the vehicle.

Cost

1. The most common source of funding for a complete EVP / TSP system has been local funds or federal urban funds. However, EVP / TSP equipment at the traffic signal and installation *may* also be funded as part of an improvement project, provided it is incidental to the improvement. Please see Program Management Manual 3-25-5 to determine the most appropriate source of funding.
2. The local municipality **shall** be responsible for all costs associated with the emitting devices for is authorized vehicles.
3. The department **shall** be responsible for all material, equipment, labor, training, and incidental costs associated with maintaining, operating, modifying, or removing the EVP / TSP system at the traffic signal unless nonstandard EVP / TSP system equipment is used. When nonstandard equipment is installed, the local unit **shall** be responsible for maintaining and supplying spare inventory to the department.
4. Any cost associated with the continuance of service of an EVP / TSP system on temporary signals or on a temporary route during a construction project **shall** be borne by the project.

WISCONSIN DEPARTMENT OF TRANSPORTATION

Emergency Vehicle Pre-emption (EVP) and Traffic Signal Priority (TSP) System Agreement

This is a binding agreement between the Wisconsin Department of Transportation and the

____

This agreement stipulates the terms and conditions for use of Emergency Vehicle Pre-

Emption (EVP) and/or Traffic Signal Priority (TSP) systems at the state-owned traffic control signal located at the intersection of

____

in the ______________________ of ______________________

Description of route: ______________________________

____

Listing of estimated number of vehicles to be outfitted: ____________________

____

Inventory of spare EVP / TSP equipment shall be provided by WisDOT/Local Agency.

The Department's Policy for *Use of Emergency Vehicle Pre-emption (EVP) and Traffic Signal Priority (TSP) Systems at State-Owned Traffic Control Signals is hereby* made a part of this agreement (copy attached). The following special terms or conditions also apply to this agreement:

ACCEPTED FOR THE ______________________________

Local Government

BY ______________________ DATE ______________________

TITLE ______________________

APPROVED BY THE WISCONSIN DEPARTMENT OF TRANSPORTATION

BY ______________________ DATE ______________________

TITLE ______________________

4-8-1 Vehicle Detection April 2025

DETECTOR/CONTROLLER FUNCTIONS

As it affects signal timing & operations, the signal designer *should* understand the modes of operation for both detectors and controllers. The scope of this manual does not cover guidelines for determining intersection signal timing; however, the following discussion provides a brief overview of various modes of operation, which are directly related to signal timing. The selection of the detector/controller mode of operation is dependent on the location and desired objective of the loop layout. It *should* be noted that certain loop layout strategies require specific detector/controller functions to be utilized.

DETECTOR BASED OPERATIONS

Pulse and Presence

There are two basic modes of vehicle detection, pulse and presence. In pulse detection, the detector amplifier sends a pulse call to the controller upon detection of a vehicle. This is a call of short duration, and it does not depend upon the speed of the detected vehicle, its length, its continued presence over the loop, or the length of the loop. In presence detection the detector amplifier issues a continuous call to the controller for as long as any portion of the vehicle remains over the loop. The length of the call is, therefore, dependent on the speed of the vehicle, the length of the vehicle, and the length of the loop. Default is to use presence-based detection.

Extension Stretch

Extension stretch is used when the passage interval feature is set at a low value. Extension stretch allows an increment of time to pass while a vehicle travels from one point of detection to some other position. The interval *may* be used to extend the green, allowing a vehicle to pass the dilemma zone, or allow a vehicle to enter or clear the intersection. The various detector placements have different passage and extension stretch intervals associated with them. The designer *should* select the passage intervals which fulfill the requirements of the loop detector layout selected.

Delayed Call

Using the delayed call mode, the output is deferred until the detection zone has been occupied for a preset time. This has two common uses. First: at near detection in shared through and right-turn lanes or right only lanes, vehicles turning right on red *may* occupy the near detection for a short period without unnecessarily calling the controller to the respective phase. Second, at near loops that *may* be driven over by cross street left turning vehicles, especially tractor-trailer combinations.

Detector Disconnect

The detector disconnect feature allows a chosen detector(s) to be disconnected when the indicated phase is active.

OTHER CONTROLLER MODES OF OPERATION

There are several other modes of operation related to detection, which can be programmed directly within the controller. Some more commonly used modes at signalized intersections include minimum green time, maximum green time, passage interval, non-locking detection memory, phase recall, etc. Phase recall is discussed below; other controller functions are included in the glossary.

Phase Recall Mode of Operation

Use of these features is common for major route intersections with heavy traffic or pedestrian volumes. The phase recall function allows a phase (vehicle or pedestrian) to be displayed during each cycle whether demand exists or not.

The MIN recall setting will force its respective PHASE NUMBER (column 1 of the Detector Logic Chart) to be serviced, each cycle, for the established minimum green time. The MAX recall setting will force its respective PHASE NUMBER to be serviced, each cycle, for its maximum green time. The SOFT recall setting will return to its respective PHASE NUMBER when the controller goes to green rest in all other phases. The PED recall setting will force its respective PHASE NUMBER pedestrian walk display to be serviced during each cycle.

At isolated intersections the mainline is generally put on MIN recall bringing the green back to dwell on the mainline phases.

Locking and Non-Locking Mode of Operation

All calling detectors can function as locking or non-locking. Locking detectors hold a call when a vehicle is at rest on the detector and after the vehicle passes over the detector when in the red interval. The non-locking detection mode requires the vehicle to occupy the detector for a call to be issued to the controller. The call would be dropped if the vehicle moves off the detector. All detectors for each phase must be set to locking or non-locking; controllers do not allow individual detector settings within a phase.

DETECTOR TYPES

Inherent to modern signal design and operations is vehicle detection. Proper consideration must be given to providing vehicle detection that will result in efficient and safe signal operations. The primary goal is to be able to detect vehicles and transmit this data back to the controller as input for controlling signal indications.

There are two general types of loop detector placements. The first type is referred to as "advance" or "far" detection and is used generally for mainline through traffic detection and side road extensions. It is located well in advance of the stop line. The second type is "near" or "stop line" detection. It is usually located near the stop line. Detectors are typically operated in presence mode, which means if a vehicle is within the zone of detection; it will continue to be detected, until it leaves the zone of detection.

It *should* be noted that efficient signal operations and timings are directly related to all detector placement strategies and methods. As with all traffic control devices, adjustments to loop placement and size *may* be necessary depending on actual field conditions and *should* be verified in the field by the maintaining authority prior to installation.

This section covers the various loop layout strategies, which can be used for left turn lanes, advance detection, and near detection. In addition, the loop types, inductance calculation, construction considerations, and detector/controller modes of operation are also discussed.

WisDOT generally recommends using standard inductive, loop detectors. These detectors are cost effective, reliable, require little maintenance and last indefinitely when installed properly. (See FDM Chapter 16, Standard Detail Drawings).

Any detection technology that is selected **shall** first be discussed with the Region Traffic Signal Engineer due to long term operations and maintenance considerations.

INDUCTIVE LOOP DETECTORS

The vast majority of State-owned signals are fully actuated and use inductive, in-pavement loop detection to adjust local timing at an intersection. This type of detection consists of a loop installed in the pavement, a separate lead-in cable, and a detector amplifier located in the controller cabinet. When energized, the loop configuration creates a magnetic flux field. When a vehicle passes over the loop it causes that flux to change, which the detector amplifier can sense. This disruption is interpreted as the presence of a vehicle and will generally place a call to the signal controller for a certain phase. Ultimately, programming in the controller dictates what actions *may* occur based on a vehicle call, but other functions *may* also include phase extensions, preemption, or other features.

Detector loops *may* be configured in many ways depending upon the application. This manual will discuss primarily rectangular loop configurations for all applications. The technology associated with today's modern loop detector amplifiers, particularly digital amplifiers, allows for a variety of motor vehicles to be detected successfully with typical rectangular configurations.

MICROLOOP

Microloops are small, cylindrical probes typically buried beneath the roadway surface. The installation time for Microloops is much shorter than for installation of standard loop detectors. Microloops *may* be wired or wireless, depending on the product used.

Microloops *may* be used on bridge decks where it is not practical to implement other loop types. Microloops for permanent installations are generally recommended only under special conditions such as poor pavement structure and bridge decks. Their use **shall** be discussed with the maintaining authority.

VIDEO DETECTION

Video detection makes use of a camera and video monitor to detect vehicles on the roadway. The camera is placed at a location above the intersection and directed toward the approach; typically, one camera is required for each approach. The image is transmitted onto a video monitor where the user graphically draws the detection zone(s). Different sizes of detectors can be selected, and detection zones can be placed anywhere within the camera's field of view. This detection method is very flexible in that the detector locations can be modified easily using the mouse and video monitor.

Video detection is expensive but *may* have benefits in temporary or construction applications. Their use *should* be discussed with the maintaining authority.

MICROWAVE/RADAR DETECTION

Radar detection is based on the Doppler principle. A transmitter directs microwave beams toward the roadway. Any vehicle passing through the beam reflects the microwaves back to an antenna at a different frequency. The detector senses the change in frequency.

Like video detection, microwave detectors are expensive but *may* have benefits in temporary or construction applications. Their use *should* be discussed with the maintaining authority.

CONSTRUCTION CONSIDERATIONS FOR IN-ROADWAY LOOPS

The construction staging of road projects *may* have a direct influence on the loop size used for detection. For example, construction of a three-lane approach *may* be staged for the placement of two lanes first and the third lane in a different pour. Advance detector placement *may* be one 6’ x 20' loop covering the first construction stage and a single 6' x 6’ for the second construction stage. Loop placement *should not* cross asphalt to concrete, or concrete-to-concrete joints, unless detectors are placed in the base below the pavement. Construction staging *may* also make it practical to install other types of detection. The use of these other types of detection *should* be discussed with the maintaining authority.

In-Roadway Loops (including lead--in) *should* be placed below the pavement into the base course to avoid pavement joints that can cause loops to fail, to be out of conflict with pavement milling operations.

Loops *may* be installed in two general methods. See the Standard Detail Drawings in the FDM for the specific information on each type.

<u>Loops in Conduit:</u>

Pavement Overlaid Loops – Used anyplace where the entire loop will be within an area of new, overlaid, milled and replaced, or seal-coated pavement. The excavation and patching required are easily covered by the pavement work. When properly installed, loop failure is very minimal.

Saw cut Loops – Used if the loop or any part of the loop would end up in an existing pavement that will not be modified by any of the methods above. When properly installed, loop failure is minimal.

Below Pavement Loops – Used at locations where entire pavement is new or rebuilt construction. Loops are generally placed in base course.

<u>Loops Not in Conduit:</u>

Saw cut Loops – Loops are installed directly into saw cut and then sealed with an approved loop sealer. Loop life for this type of loop is shorter compared to the conduit encased loops. Although not recommended by WisDOT for long-term installations, signals under local jurisdiction *may* use saw cut loops. Uses of saw cut loops include temporary signals, intersections scheduled for reconstruction, and permanent signals under <u>local jurisdiction.</u>

ADVANCE OR FAR DETECTION

The methods associated with advanced detection design must be compatible with signal timing objectives and intended operations. Detector placement strategies which require high values of allowable gap for safety can affect efficiency. For example, a long allowable gap *may* cause unnecessary delay to waiting vehicles or routinely extend the controller to maximum green even under moderate traffic. Conversely, strategies that allow for lower values of allowable gap *may* not provide adequate dilemma zone protection.

Depending on vehicle speeds and roadway geometrics, advance detection *may* be augmented by the placement of intermediate and/or stop line detection. Additional near detection is commonly used on low volume side street approaches and main street approaches that do not use phase recall.

There are a variety of strategies that can be employed for advance detection. However, primarily there are two which provide the most efficient and safe operation. These are single point detection and dilemma zone detection.

SINGLE POINT DETECTION (FOR LOW-SPEED APPLICATIONS)

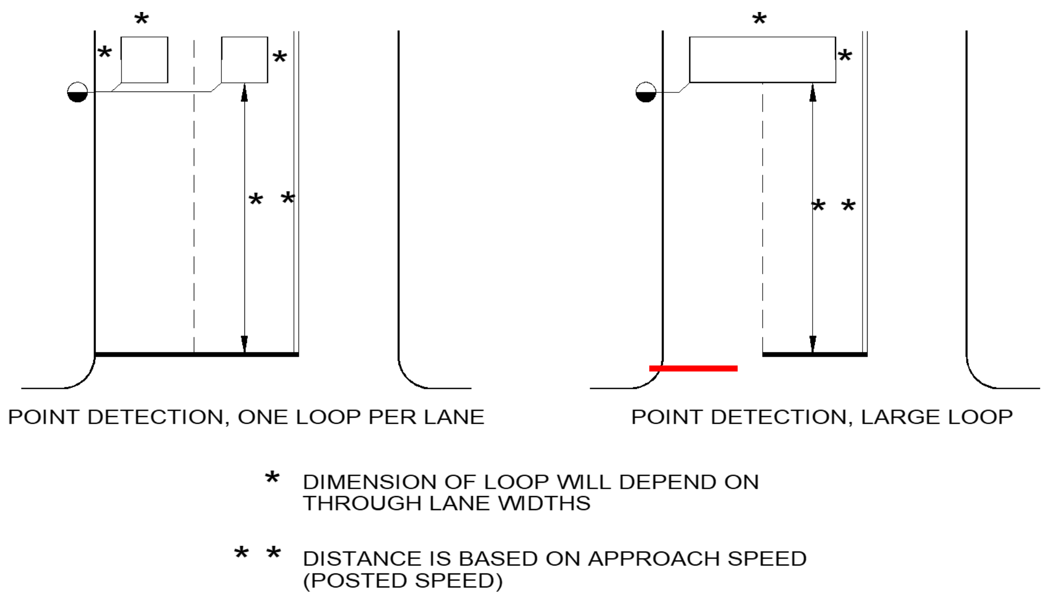
Single point detection consists of a single detection zone located two to five seconds of travel time in advance of the stop line. Single point detection is typically used where vehicle speeds are ≤35 mph or if the opposing volumes are such that it is inefficient to extend the green for sporadic arrivals.

Signal timing for this type of detector application is based on the distance from the stop line to the location of the advance detection. The minimum green time is commonly set for approximately 6 to 10 seconds. Variable initial time *may* be used to add green time beyond the minimum green value if the minimum green would not otherwise accommodate queue clearance back to the detector for additional extensions. While this type of detection can also be used for higher speeds, ≥35 mph, it is recommended that the second type, dilemma zone detection, be employed where speeds exceed 35 mph.

This loop layout *may* be used for extending the green time for a side street approach, and for left turn lanes. If extend only detection is installed without recall, it must be supplemented with near detection. This is required since extend only detection will not place a call from a passing vehicle when a red phase is being timed.

Figure 1.1 illustrates two commonly used layouts for Single Point Detection.

Figure 1.1. Advance Detection Loop Layout



DILEMMA ZONE DETECTION (FOR HIGH-SPEED APPLICATIONS)

The dilemma zone is defined as that portion of the roadway in advance of the intersection within which a driver is indecisive regarding stopping prior to the stop line or proceeding through the intersection at the termination of that approach's green interval. Detection designed to minimize driver decisions in this area is called dilemma zone detection.

The dilemma zone is generally identified in the area from 2- to 5-secs in advance of the intersection for a given speed. Empirical data suggest that at 2-secs from the intersection, it's 90% probable the vehicle will continue through. At 5-secs from the intersection, it's 90% probable the vehicle will stop. Based on kinematic principals, vehicles travelling at higher speeds will have a dilemma zone that physically begins further from the intersection than vehicles travelling more slowly.

For purposes of establishing the dilemma zone and advance loop placement, the 85th-percentile speed *should* be used. This value can be measured in the field using standard spot-speed study techniques, or it can be estimated by using the posted speed, plus 5-mph. In higher speed environments (≥55-mph), or locations were either greater speed variability or a higher percentage of heavy vehicles exist, consideration for placing advance detection at 6-secs from the stop line *should* be considered.

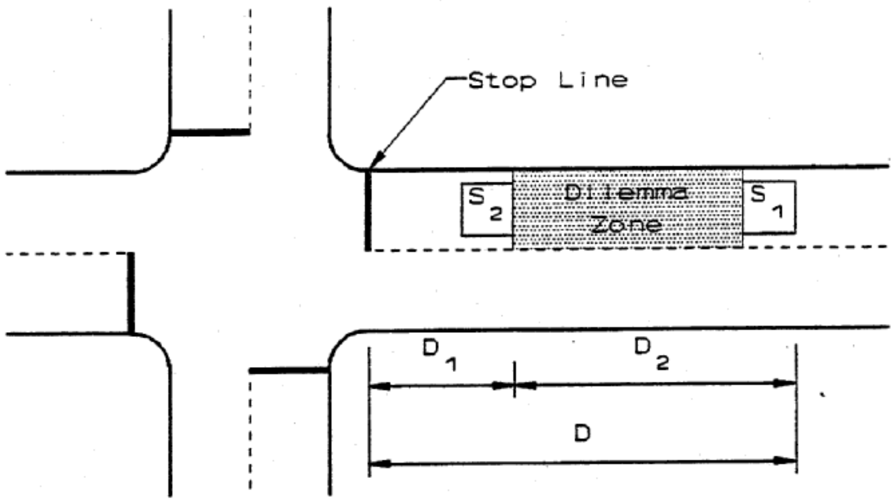
Any new or reconstructed WisDOT-owned, permanent signals located on ≥40 mph facilities **shall** incorporate considerations for dilemma zone protection. While there *may* be other ways of accommodating dilemma zone protection, the techniques discussed here are traditional methods.

The three primary dilemma zone detection methods described below are: 1) green extension system, 2) extended call detector system, and 3) single point. It *should* be noted that regardless of the method employed, vehicles *may* still be caught in the dilemma zone if traffic conditions, or timing parameters cause the respective phase to max out.

1) GREEN EXTENSION SYSTEM

The green extension system utilizes two loops per lane. The concept is to detect a vehicle as it enters the dilemma zone and then extend the green until the vehicle clears the dilemma zone. The advance loop (S_1) acts to extend the green time for a vehicle to reach the near loop (S_2). The near loop maintains the green time long enough to allow the vehicle to enter or clear the intersection. Figure 1.2 illustrates the Green Extension Detector system layout.

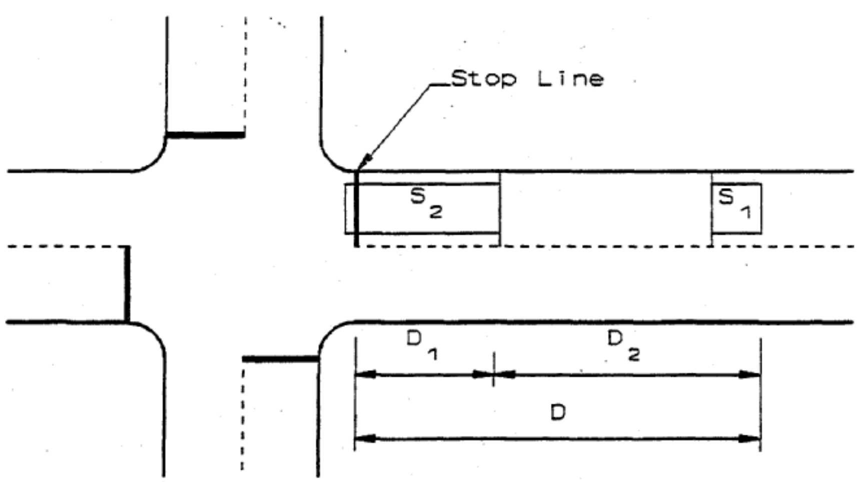
Figure 1.2. Green Extension System



2) EXTENDED CALL SYSTEM

The extended call detector system also utilizes two loops. However, under this method a long loop or series of long loops is placed at or near the stop line for presence detection, and a single extended call detector loop is placed upstream of the stop line. The advance loop (S_1), located at the beginning of the dilemma zone, extends the green time, allowing a vehicle to reach a point just prior to the stop line, but through the dilemma zone. The stop line loop (S_2, presence loop) ensures that vehicles queued at the intersection can enter the intersection without triggering a premature gap out in the case there are no subsequent calls from vehicles on the advance loops. Modern signal controllers allow for varied detector functions that can extend for the queued vehicles and shut off, such that the phase can be extended from approaching vehicles only, lending to more efficient gap reduction. Figure 1.3 illustrates the Extended Call Detector system layout.

Figure 1.3. Extended Call Detector System



3) SINGLE POINT DETECTION

One of the most straight forward conventional designs for “high-speed” approaches uses a controller with a volume-density mode. Based on a single advance point detector (S1) with the controller set on “Min Recall” and in “Locking Memory” this actuated operation can count waiting vehicles beyond the first because of the “Added Initial” feature. It also includes a timing adjustment to reduce the allowable gap based on the time vehicles have waited on the red on a conflicting phase. More efficient operation can be achieved with this controller mode than is possible with the normal full-actuated control because of these features and because detection is further back on the approaches (Up to and over 400-ft is possible when over 50 mph).

The basic concept for dilemma zone protection with this detection / controller strategy is to have the single advance detector (S1) detect a vehicle just prior to it entering the dilemma zone. Early in the cycle the detector would use the full passage time and would extend vehicles all the way to the stop line. Further into the cycle, after full “Gap Reduction”, the lowest extension setting would be timed to just clear the vehicle through the defined dilemma zone (Defined by the 90% GO Curve). If vehicles are separated by more than this Minimum Gap, then the phase will “Gap Out” at that point.

The Single Point Detection System layout is similar that shown in Figure 1.3 above but will have different spacing for the intersection.

REFERENCE CHARTS

There have been several tables published regarding the dilemma zone location for various design speeds. For the purpose of providing guidance, Chart 1.1 and Table 1.1 have been reprinted from a Northwestern University Traffic Institute course manual. Table 1.1 shows the dilemma zone response curves by vehicle speed and distance from intersection. The 90% Go and 90% Stop probability ranges have been marked for reference during design. Table 1 shows passage distances based on speed and time. The numbers shown in Table 1 are directly related to the curves shown in Chart 1.1. Chart 1.2 has been reprinted from the Federal Highway Administration Detector Manual. This chart shows various dilemma zone response curves by vehicle based on vehicle speed and percentage probability of stopping. The 90% and 10% probability ranges have been identified for reference during design. Chart 1.3 *may* be used to determine passage times for advance detection. Using the design speed and proposed passage distance, the passage time can be determined. It is the responsibility of the signal designer to determine the appropriate passage distance. The passage time *should* allow the vehicle to enter into the intersection; however, each case *should* be evaluated separately. Table 1.2 indicates loop placement options for the Green Extension System described above.

These tables and charts are provided only as a reference. In all cases the signal designer is responsible for selecting the appropriate design speed, passage time, and percentage probability of stopping.

Chart 1.1. Dilemma Zone Response Curves

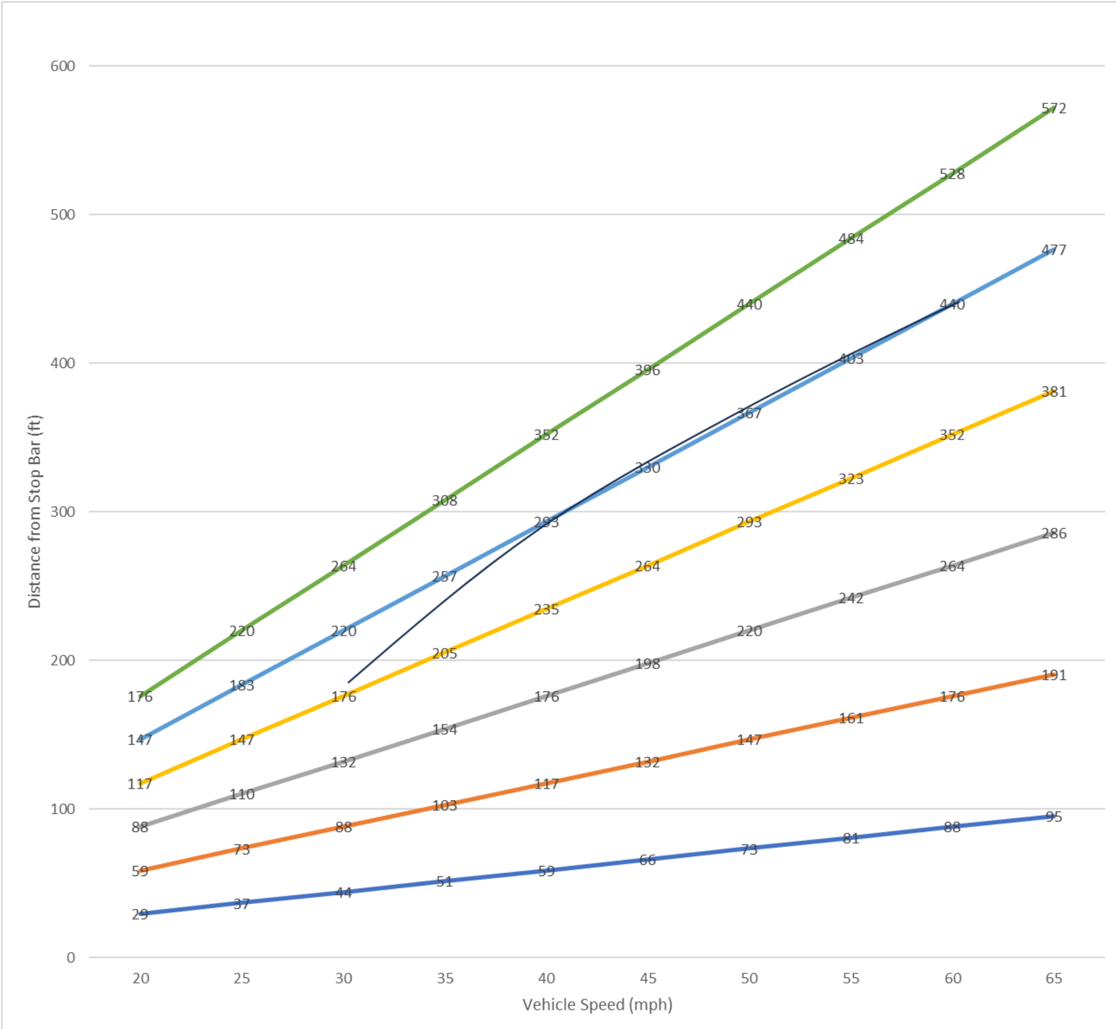


Table 1.1. Dilemma Zone Values

Passage/Travel Time from Detector to Stop Bar (Seconds)

Approach Speed (Miles per Hour)	1	2	3	4	5	6	7	8	9	10	11	12
20	29	59	88	117	147	176	205	235	264	293	323	352
25	37	73	110	147	183	220	257	293	330	367	403	440
30	44	88	132	176	220	264	308	352	396	440	484	528
35	51	103	154	205	257	308	359	411	462	513	565	616
40	59	117	176	235	293	352	411	469	528	587	645	704
45	66	132	198	264	330	396	462	528	594	660	726	792
50	73	147	220	293	367	440	513	587	660	733	807	880
55	81	161	242	323	403	484	565	645	726	807	887	968
60	88	176	264	352	440	528	616	704	792	880	968	1056
65	95	191	286	381	477	572	667	763	858	953	1049	1144

Density values (for reference)

Legend: Variable Initial only; Dilemma Zone

Chart 1.2. Dilemma Zone Response Curves

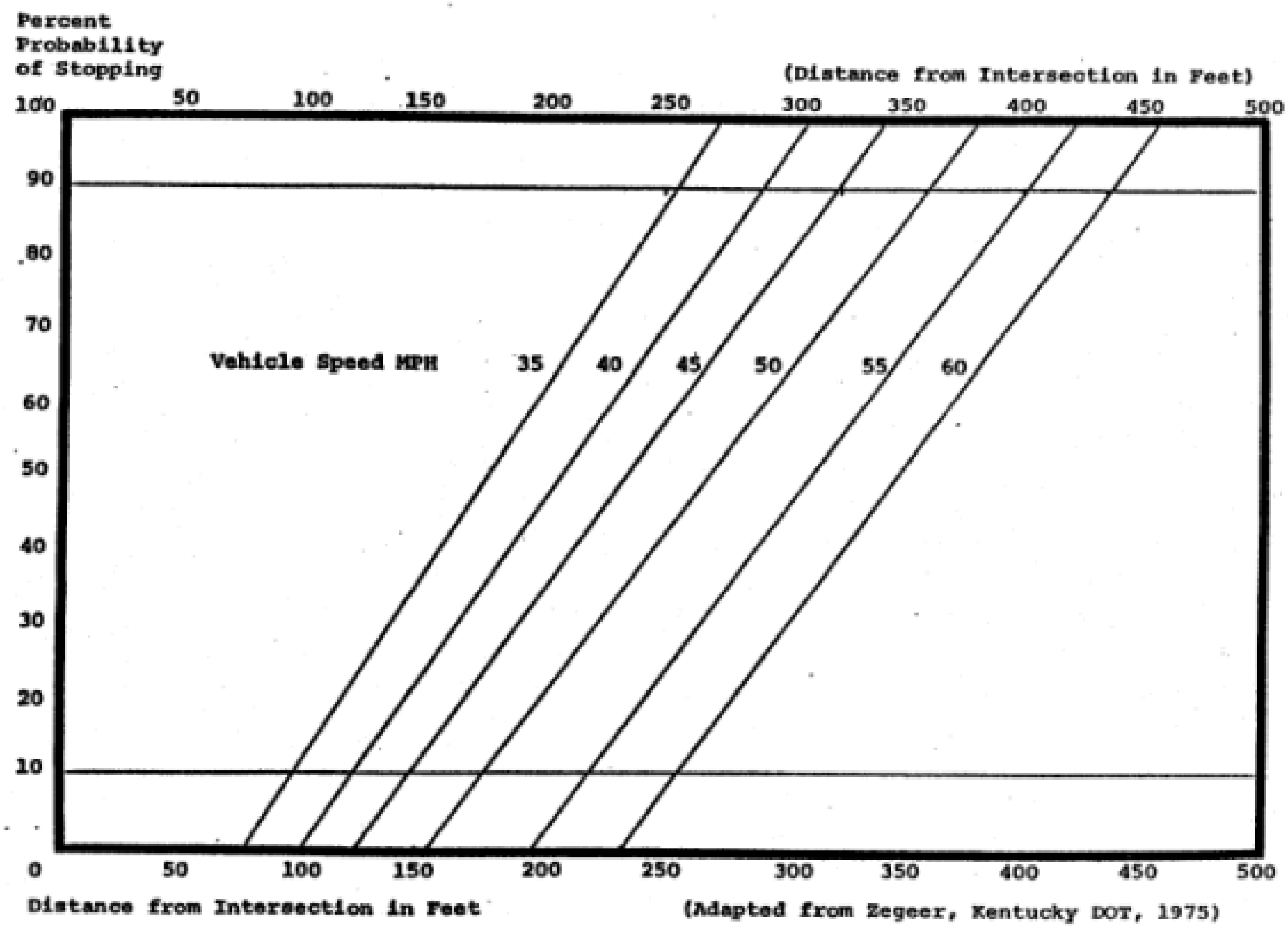
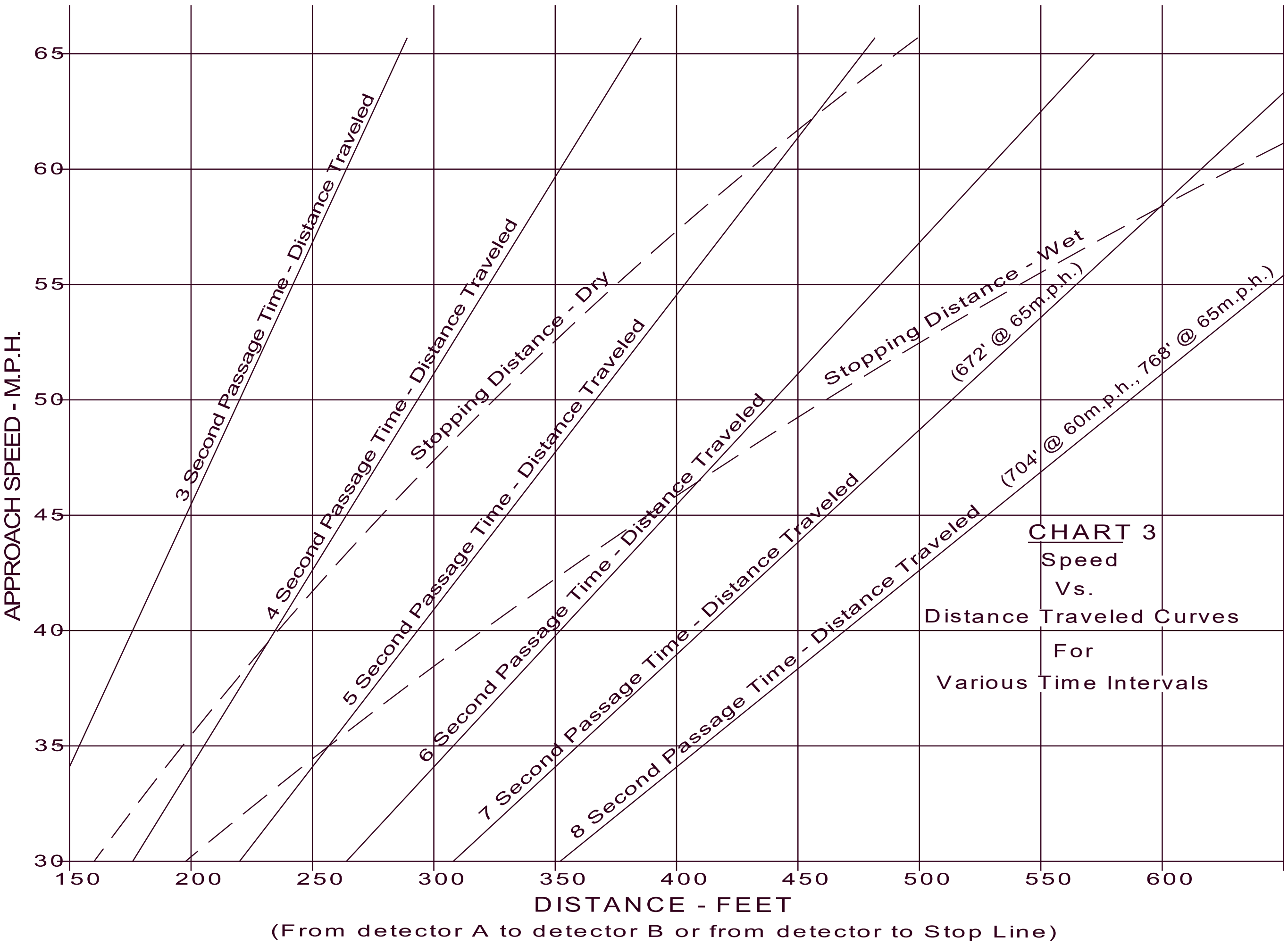


Table 1.2. Green Extension System Loop Placement Options

Advanced Detector Placement based on 90% Stop Probability (Measured from front of detector to near right signal)			
Vehicle Speed		Advance	Near
25-mph	37-fps	185-ft	---
30-mph	44-fps	220-ft	---
35-mph	51-fps	255-ft	---
40-mph	59-fps	295-ft	120-ft
45-mph	66-fps	330-ft	130-ft
50-mph	74-fps	370-ft	150-ft
55-mph	81-fps	405-ft	160-ft
60-mph	88-fps	440-ft	175-ft

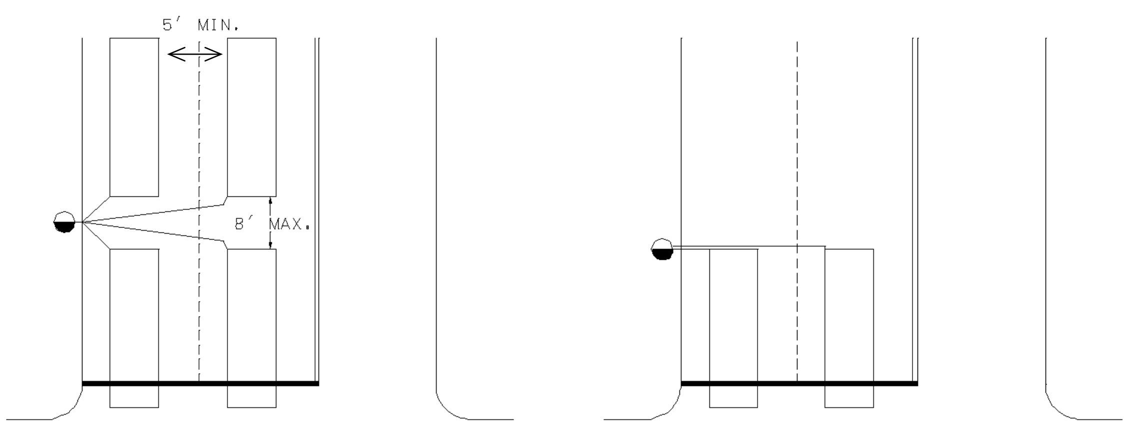
Chart 1.3. Passage Time Design Curves



NEAR DETECTION

Unless physical or operational characteristics are atypical, near detection for through movements *should* be placed at the stop line. The detector amplifier mode *should* be set to presence detection. However, detectors in the right lane and detectors that *may* be driven over by left turning vehicles *should* be set to a delay mode to allow those movements to occur without registering false calls. Figure 1.4 below illustrates common near detection layouts.

Figure 1.4. Near Detection



In many cases a set of loops is installed to provide a larger detection area and for redundancy in case of detector failure. This is especially important for detection on a single lane approach where loop failure (if only one loop is installed, and the phase is not set for recall) *may* cause failure of the corresponding phase.

Historically, motorcycles, bicycles, and/or small vehicles *may* have had problems with not being properly detected by large ($\geq$ 6' x 20') loops at certain locations. While modern loop amplifiers have remedied issues related to missed calls, if concerns or issues at specific locations persist, other loop configurations *may* be considered. For example, smaller 6' x 6' loops turned 45-deg can result in increased sensitivity in locations where smaller vehicles need to be detected. Careful consideration *should* be given to using smaller detection zones due to their restricted ability to detect high bed trucks. WisDOT does not typically use quadrupole loops.

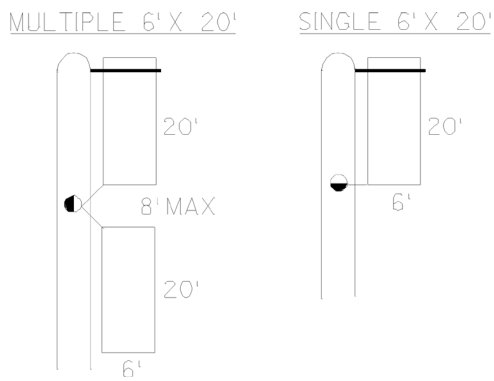
LEFT-TURN DETECTION

Several variations of detection *may* be used for left turn lane detection. The specific type of configuration that *should* be used is dependent upon many factors, including signal phasing, geometrics, vehicle classification, and turning volumes. All these factors must be considered when designing the detection scheme.

Alternative No. 1: Protected only or protected/permissive operation.

Detector loops are placed beginning at the stop line to call and extend the phase. This *may* be used for protected only or protected/permissive left turn operations. The detector amplifier is set to presence mode and controller logic to nonlocking memory. This allows for more efficient operation in that once a vehicle leaves the zone of detection the call is dropped, and the controller can begin to service other calls. This type of operation is often used for left turns where the opposing through volume is relatively high, and the left turn demand is constant. Figure 1.5 below illustrates two commonly used layouts.

Figure 1.5. Protected-Only or Protected/Permissive Left Turn Loop Layout



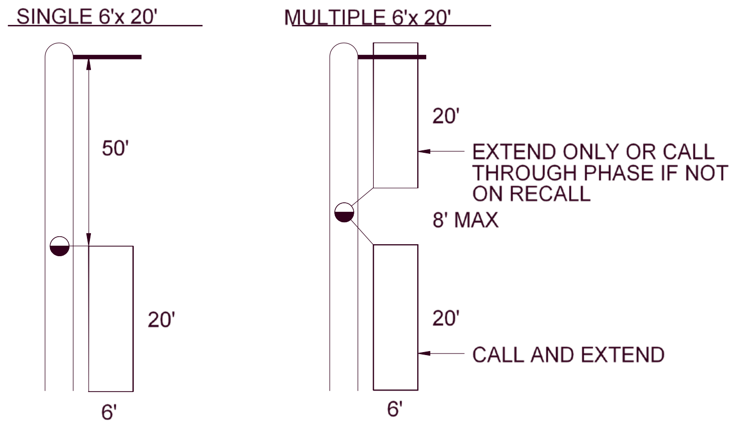
Alternative No. 2: Third vehicle detection. Protected/permitted operation only.

The detector is placed in advance (upstream) of the stop line such that the first one or two vehicles in the left turn lane will not place a call in the protective phase. This *should* not be used for protected only left turn operation. Figure 1.5 illustrates two commonly used layouts.

Sufficient gaps, particularly during non-peak hours, are usually available to permit vehicles to turn on a green ball. This alternative *may* be used only for approaches with minimum recall or approaches with stop line detection. The detector amplifier is set to presence mode and controller logic to non-locking memory. This type of operation allows for more efficient use of the green time for mainline traffic.

Detector layouts illustrated in Alternative 1 *may* be used for third-vehicle detection by programming the front loop for extend only. This layout allows for the flexibility of changing operations from third car to protected detection.

Figure 1.6. Third-Vehicle Detection Loop Layout



Alternative No. 3: Left-turn extension detection.

Long left turn lanes or high left turn volumes *may* require the use of advance detection for extending the green. Generally, an advance loop installed in the left turn lane *may* extend the left turn phase, the through movement, or both. Loop layout for left turn lane extension *should* follow the guidelines outlined in this subject.

Figure 1.7. Left Turn Extension Detection

INDUCTANCE CALCULATIONS

The ability to detect vehicles is primarily a function of the loop's inductance and sensitivity, not its shape. The advent of digital detector amplifiers and electronics has eliminated many problems associated with older loop detector amplifiers. These problems included splash over, crosstalk, and difficulty in detecting smaller vehicles with standard detector configurations.

The total inductance of loop detector systems is related to loop size, the number of turns in the loop and the length of lead-in cable. These elements will influence inductance associated with them. As a rule, the actual loop *should* have approximately twice the inductance as the lead-in cable to ensure good detection efficiency. Lead-in cable has approximately 23 microHenries of inductance per 100 feet. For the detector loop to have a 2:1 ratio of inductance compared to the lead-in cable, the loop must have a certain number of turns. The longer the lead-in the greater the number of turns. A commonly used formula for determining the loop inductance is shown below.

Inductance = $(N^2 \times 5 \times P) / (10 + N)$ Where: N = Number of turns in loop

P = Perimeter of loop

If two or more loops are wired in series, their inductances are additive (total inductance: $L = L_1 + L_2 + ... + L_n$). When several loops are installed, maximum inductance is obtained by wiring the loops in series. The total inductance for a single detector amplifier *should* not exceed 800 to 1000 mH.

If two or more loops are wired in parallel, the combined inductance is reduced (total inductance: $1/L = 1/L_1 + 1/L_2 + ... + 1/L_n$). When using parallel connections, the designer *should* calculate the total loop inductance to be sure it is approximately two (2) times that of the lead-in cable inductance. Often a combination of parallel and series connections is used to keep the total inductance below 800 to 1000 mH and to aid in installation.

An effort *should* be made to avoid installing loops of equal size, side by side with the same number of turns. Such installations are potential sources of trouble (cross-talk, false calls). If, for example, one loop (closest to the cabinet) has 3 turns, then the farther one *should* have 4 turns.

Table I can be used as a quick reference for <u>single loop</u> inductance for various loop sizes. Inductance for this table is determined by the formula stated above.

It is the responsibility of the signal designer to determine the proper loop size and number of turns. The designer is not restricted to the loop sizes shown in the following table.

However, loops with greater than 5 turns are generally not easily constructed or maintained in 1” conduit. If loops need 5 or more turns in accommodate 2:1 inductance relative to lead-in cable, 1-1/2” conduit *should* be considered.

Table 1.3. Single-Loop Inductance Calculations

Loop Size	INDUCTION					
	1 turn	2 turns	3 turns	4 turns	5 turns	6 turns
2’ x 6’	7.3	26.7	55.4	91.4	133.3	180.0
2’ x 8’	9.1	33.3	69.2	114.3	166.7	225.0
2’ x 10’	10.9	40.0	83.1	137.1	200.0	270.0
2’ x 12’	12.7	46.7	96.9	160.0	233.3	315.0
2’ x 14’	14.5	53.3	110.8	182.9	266.7	360.0
2’ x 16’	16.4	60.0	124.6	205.7	300.0	405.0
2’ x 18’	18.2	66.7	138.5	228.6	333.3	450.0
2’ x 20’	20.0	73.3	152.3	251.4	366.7	495.0
3’ x 6’	8.2	30.0	62.3	102.9	150.0	202.5
3’ x 8’	10.0	36.7	76.2	125.7	183.3	247.5
3’ x 10’	11.8	43.3	90.0	148.6	216.7	292.5
3’ x 12’	13.6	50.0	103.8	171.4	250.0	337.5
3’ x 14’	15.5	56.7	117.7	194.3	283.3	382.5
3’ x 16’	17.3	63.3	131.5	217.1	316.7	427.5
3’ x 18’	19.1	70.0	145.4	240.0	350.0	472.5
3’ x 20’	20.9	76.7	159.2	262.9	383.3	517.5
4’ x 4’	7.3	26.7	55.4	91.4	133.3	180.0
4’ x 6’	9.1	33.3	69.2	114.3	166.7	225.0
4’ x 8’	10.9	40.0	83.1	137.1	200.0	270.0
4’ x 10’	12.7	46.7	96.9	160.0	233.3	315.0
4’ x 12’	14.5	53.3	110.8	182.9	266.7	360.0
4’ x 14’	16.4	60.0	124.6	205.7	300.0	405.0
4’ x 16’	18.2	66.7	138.5	228.6	333.3	450.0
4’ x 18’	20.0	73.3	152.3	251.4	366.7	495.0
4’ x 20’	21.8	80.0	166.2	274.3	400.0	540.0
4’ x 30’	30.8	113.5	235.7	388.8		
5’ x 6’	10.0	36.7	76.2	125.7	183.3	247.5
5’ x 8’	11.8	43.3	90.0	148.6	216.7	292.5
5’ x 10’	13.6	50.0	103.8	171.4	250.0	337.5
5’ x 12’	15.5	56.7	117.7	194.3	283.3	382.5
5’ x 14’	17.3	63.3	131.5	217.1	316.7	427.5
5’ x 16’	19.1	70.0	145.4	240.0	350.0	472.5
5’ x 17’	20.0	73.3	152.3	251.4	366.7	495.0
5’ x 18’	20.9	76.7	159.2	262.9	383.3	517.5
5’ x 20’	22.7	83.3	173.1	285.7	416.7	562.5
5’ x 30’	31.8	116.7	242.3	400.0	583.3	787.5

Table 1. Single-Loop Inductance Calculations (continued)

Loop Size	INDUCTION					
	1 turn	2 turns	3 turns	4 turns	5 turns	6 turns
6’ x 6’	10.9	40.0	83.1	137.1	200.0	270.0
6’ x 7’	11.8	43.3	90.0	148.6	216.7	292.5
6’ x 8’	12.7	46.7	96.9	160.0	233.3	315.0
6’ x 10’	14.5	53.3	110.8	182.9	266.7	360.0
6’ x 12’	16.4	60.0	124.6	205.7	300.0	405.0
6’ x 14’	18.2	66.7	138.5	228.6	333.3	450.0
6’ x 15’	19.1	70.0	145.4	240.0	350.0	472.5
6’ x 16’	20.0	73.3	152.3	251.4	366.7	495.0
6’ x 17’	20.9	76.7	159.2	262.9	383.3	517.5
6’ x 18’	21.8	80.0	166.2	274.3	400.0	540.0
6’ x 20’	23.6	86.7	180.0	297.1	433.3	585.0
6’ x 22’	25.5	93.3	193.8	320.0	466.7	630.0
6’ x 24’	27.3	100.0	207.7	342.9	500.0	675.0
6’ x 25’	28.2	103.3	214.6	354.3	516.7	697.5
6’ x 26’	29.1	106.7	221.5	365.7	533.3	720.0
6’ x 28’	30.9	113.3	235.4	388.6	566.7	765.0
6’ x 30’	32.7	120.0	249.2	411.4	600.0	-
6’ x 32’	34.5	126.7	263.1	434.3	633.3	-
6’ x 34’	36.4	133.3	276.9	457.1	666.7	-
6’ x 36’	38.2	140.0	290.8	480.0	700.0	-
6’ x 38’	40.0	146.7	304.6	502.9	733.3	-
6’ x 40’	41.8	153.3	318.5	525.7	766.7	-
6’ x 42’	43.6	160.0	332.3	548.6	800.0	-
6’ x 44’	45.5	166.7	346.2	571.4	-	-
6’ x 46’	47.3	173.3	360.0	594.3	-	-
6’ x 48’	49.1	180.0	373.8	617.1	-	-
6’ x 50’	50.9	186.7	387.7	640.0	-	-
6’ x 60’	60.0	220.0	456.9	754.3	-	-
6’ x 70’	69.1	253.3	526.2	-	-	-
6’ x 80’	78.2	286.7	595.4	-	-	-
7’ x 16’	20.9	76.7	159.2	262.9	383.3	517.5
7’ x 18’	22.7	83.3	173.1	285.7	416.7	562.5
7’ x 20’	24.5	90.0	186.9	308.6	450.0	607.5
8’ x 8’	14.5	53.3	110.8	182.9	266.7	360.0
8’ x 10’	16.4	60.0	124.6	205.7	300.0	405.0
8’ x 12’	18.2	66.7	138.5	228.6	333.3	450.0
8’ x 14’	20.0	73.3	152.3	251.4	366.7	495.0
8’ x 16’	21.8	80.0	166.2	274.3	400.0	540.0
8’ x 18’	23.6	86.7	180.0	297.1	433.3	585.0
8’ x 20’	25.5	93.3	193.8	320.	466.7	630.0

ASCT & TR DETECTION CONSIDERATIONS

Some traffic signal designs *may* need to include considerations for Adaptive Signal Control Technologies (ASCT) and/or Traffic Responsive (TR). ASCT allows for near real-time changes to coordinated signal offset and splits settings. TR allows for changes between timing plans (i.e,. cycle length and sequencing adjustments). Both forms of control require communication back to a central system, as well as an increased amount of detection.

Detection for ASCT systems will need to include by-lane stop line detection on each intersection approach for split adjustments. While mainline advance detection *should* likely be accounted for within the design at some level, both advance and exit *may* be required for offset adjustments. Ideally, advance and exit detection for ASCT are also by-lane.

Detection needs for TR systems are not far beyond those required to operate an isolated intersection. The primary additional needs are likely limited to mainline exit detection for measuring system volumes associated with timing plan changes vs. running a similar set of plans via time-of-day schedule.

4-8-2 Detector/Controller Logic Chart April 2025

The Detector Logic Chart is located on the Sequence of Operations Sheet. There are several columns, which supply information regarding the detector location, mode of operation, and several other optional settings.

TS1 DETECTOR LOGIC CHART

A blank Detector Logic Chart for a TS1 signal cabinet with shelf-mounted loop amplifiers is shown below.

Figure 2.1. Detector Logic Chart

DETECTOR LOGIC

DETECTOR NUMBER	AMPLIFIER CHANNEL NUMBER	DETECTOR OPERATION			PHASE CALLED	PHASE EXTENDED	DETECTOR DISCONNECT PHASE	CALLING DELAY	EXTENSION STRETCH	LOOP SIZE	NUMBER OF TURNS
		CALLS & EXTENDS	CALLS ONLY	EXTENDS ONLY							
Column 1	2	3	4	5	6	7	8	9	10	11	12

Column 1: DETECTOR NUMBER - Indicate the detector number for all detectors at the signalized intersection. Detectors are numbered according to the phase they are associated with (first digit) and the order in which they would be encountered (second digit). Detectors adjacent to one another are numbered from the centerline to the outside.

Column 2: AMPLIFIER CHANNEL NUMBER - The second column indicates the amplifier channel corresponding to each detector or detector group. Every effort *should* be made to group detectors performing like functions. Do not wire more than two loops per amplifier channel.

Column 3-5: DETECTION OPERATION - Place an "X" in the cell to indicate a specific operation. Only one of the three columns *should* have an "X".

Column 6: PHASE CALLED - Indicate which phase is called when a vehicle arrives at a CALLS & EXTENDS or CALLS ONLY detector. This column must be filled out if the detector operation is set for CALLS & EXTENDS or CALLS ONLY: otherwise, it *should* be left blank.

Column 7: PHASE EXTENDED - Indicate which phase will be extended. This cell must be filled out if the detector operation is set to CALLS & EXTENDS or EXTENDS ONLY; otherwise, it *should* be left blank.

Column 8: DETECTOR DISCONNECT PHASE - Indicate which detectors use the detector disconnect feature by placing an "*" in the column. A note is also needed to explain when the detector(s) are disconnected.

Column 9: CALLING DELAY - Indicate which detectors use the calling delay feature by placing an "X" in the column.

Column 10: EXTENSION STRETCH - Indicate which detectors use the extension stretch function by placing an "X" in the column.

Column 11: SIZE - Enter the dimensions of the detector (e.g. 6'x 6').

Column 12: NUMBER OF TURNS - Indicate the number of turns required for the detector.

TS2 DETECTOR LOGIC CHART

A blank Detector Logic Chart for a single TS2 signal cabinet detector rack with rack-mounted loop amplifiers is shown below.

DETECTOR INPUT	3	1	7	5	11	9	15	13	Row 1
DETECTOR No.									2
PHASE CALLED									3
PHASE EXTENDED									4
CALLING DELAY									5
EXTENSION STRETCH									6
LOOP FUNCTION									7

DETECTOR INPUT	4	2	8	6	12	10	16	14
DETECTOR No.								
PHASE CALLED								
PHASE EXTENDED								
CALLING DELAY								
EXTENSION STRETCH								
LOOP FUNCTION								

Row 1: DETECTOR INPUT – NEMA defined assignment that corresponds to controller-based detector settings.

Row 2: DETECTOR NUMBER - Indicate the detector number for all detectors at the signalized intersection. Detectors are numbered according to the phase they are associated with (first digit) and the order in which they would be encountered (second digit). Detectors adjacent to one another are numbered from the centerline to the outside.

Row 3: PHASE CALLED - Indicate which phase is called when a vehicle arrives at a detector. This column must be filled out if the detector operation is set for CALLS & EXTENDS or CALLS ONLY: otherwise, it *should* be left blank.

Row 4: PHASE EXTENDED - Indicate which phase will be extended. This cell must be filled out if the detector operation is set to CALLS & EXTENDS or EXTENDS ONLY; otherwise, it *should* be left blank.

Row 5: CALLING DELAY - Indicate which detectors use the calling delay feature by placing an "X" in the column.

Row 6: EXTENSION STRETCH - Indicate which detectors use the extension stretch function by placing an "X" in the column.

Row 7: LOOP FUNCTION – Only intended to indicate the special or unique use of a detector. Data in this field *may* vary depending on the type controller. For example, some controller types allow detectors channels to be used to collect system data (such as volume and occupancy). Check with the Regional Traffic Signal Engineer for questions regarding specific locations.

CONTROLLER LOGIC CHART

The Controller Logic Chart is also located on the Sequence of Operations Sheet. The columns on this chart supply information regarding various controller operations. The designer **shall** show all phases in the controller logic box, and where appropriate, leave spaces for the unused phases (i.e. if phase 1 is not used, leave the first-row blank). A blank Controller Logic Chart is shown in Figure 2.2.

Figure 2.2. Controller Logic Chart

CONTROLLER LOGIC

PHASE NUMBER	PHASE LOCKING	DUAL ENTRY w / Ø	PHASE RECALL	PHASE ACTIVE
1				
2				
3				
4				
5				
6				
7				
8				
Column 1	2	3	4	5

Column 1: PHASE NUMBER - Enter the used phases associated with the controller logic settings.

Column 2: PHASE LOCKING - Indicate with an “X” which phases **shall** have locking memory.

Column 3: DUAL ENTRY - Enter which phase number will be permitted to be serviced concurrently with the phase number designated in column 1. This mode of operation requires two phases to be serviced concurrently even in the absence of vehicle demand. Single-entry operation will be programmed if no entry is made.

Column 4: PHASE RECALL - Indicate use of the phase recall function by listing MIN, MAX, or PED; otherwise, leave blank.

Column 5: PHASE ACTIVE - Indicate use of the phase active function. Dummy phases *may* be required in the case of EVP use with LC-8000 controllers and at T-intersection locations. The Regional Traffic Engineer **shall** be contacted regarding the use of the phase active function.

4-9-1 Cable Type/Information/Connections **April 2025**

GENERAL

This section presents information, some of which has been previously printed from in such documents as the Standard Specifications for Road and Bridge Construction, Standard Detail Drawings, and the *Wisconsin Electrical Code*.

Refer to the Construction Materials Manual, Section 6-55 Electrical Construction for checklists that pertain to the inspection of installation of these units.

CABLE TYPE/INFORMATION

All wiring, cable, and connections **shall** be installed according to the Standard Specifications and the Wisconsin Electrical Code.

Detector Lead-in Cable

The loop detector lead-in cable **shall** be continuous from the loop detector splice to the loop detector input terminal strip in the controller cabinet.

Each loop **shall** have a separate lead-in cable from the cabinet to the loop detector splice.

Signal Cable

All traffic signal cable **shall** be installed in accordance with the Standard Specifications.

An as-built intersection wiring diagram **shall** be developed in accordance with the wiring as it was installed in the field and placed inside the controller cabinet upon completion of electrical work at the signalized intersection.

Due to the differences in cable size and wiring schemes, signal designers *should* contact the respective maintaining authorities to determine the proper wiring guidelines.

Spare Conductors

Where future pedestrian movements or left turn signal heads are anticipated, electrical cable with spare conductors *may* be routed from the controller cabinet to the quadrant or pole on which they would be installed. Due to the relatively low cost, spare conductors *should* be provided for possible future equipment. Spare conductors, if desired, *should* be shown on the plans and identified as such. *Should* questions arise, contact the maintaining authority for proper direction.

CABLE CONNECTIONS (SPLICES)

All cable splicing **shall** be installed in accordance with the Standard Specifications.

Underground splicing is not acceptable, except for the loop detector wire to its loop detector lead-in cable, which is spliced in an acceptable pull box or junction box.

4-10-1 Temporary Signal Plan **April 2025**

TEMPORARY SIGNAL PLAN

Once the decision to install temporary signals on the state trunk highway system has been made, a temporary signal plan **shall** be developed. The temporary signal plan set **shall** include construction staging plan, temporary pavement marking and signing plan, temporary timing plan, placement of lane control devices (barrel or wands), a temporary signal plan, and an abbreviated sequence of operation sheet for the temporary signal.

Temporary signals, as part of a construction project, are installed and maintained by the contractor for the length of the project. The Regional Traffic Unit or consultant *may* provide signal timing. Contact the Regional Traffic Unit to determine the responsible party for providing the temporary signal timing plans. The temporary signal timing plan *may* be included in the plan set and *may* be included in the PS&E submittal.

Decisions regarding the design and operation of temporary signals on the local system, including connecting highways, are at the discretion of the local municipality.

General Plan Development

1. Temporary signal plans for construction do not contain signature blocks indicating approvals or revision history. To show changes made to temporary signals caused by construction staging, individual plan sheets *should* be developed. Complex staging projects, which are likely to be field modified, can develop a single plan sheet which details pole placement and standard head quantities and locations. A note on the plan sheet **shall** define proper head placement based on the requirements. The signal plan for each stage **shall** indicate:
   - North arrow
   - Route designations
   - Symbol legend
   - Cabinet location (if known)
   - Signing & marking
   - Supports
   - Signal indications
   - Lighting
   - Detection (if used)
   - Signal timing
   - Temporary roadway geometrics
   - Roadway geometrics
   - Right-of-way lines
   - Reference lines
   - Access points (temporary & permanent)
   - Utilities
   - Lane assignments
   - Work zone areas
   - Work zone traffic control devices

   EVP Detection (if used)
   Pedestrian Crossings
   Pedestrian Detection (if used)
2. The STH *should* be designated as the mainline.
3. NEMA phasing convention **shall** be used. Typically, NEMA phase 6 is in the Cardinal direction (Northbound/Eastbound).
4. Show right-turn control. STOP or YIELD if separated by an island and not controlled by the signal.
5. Configuration of each individual head **shall** be shown (3-v, 5-v, etc., **shall not** be used). The State signal cell library **shall** be used for signal design. Each signal head **shall** have a number.
6. It is the policy of the Department to provide intersection lighting with temporary signals per TEOpS 11-05-01.
7. If used, each detector **shall** be assigned a two-digit number, the first digit of the number being the phase number with which it is associated.
8. Signal plans **shall** be printed at 1"=40' scale on an 11"x17" (D-size) number 2 tab plan sheet. For signal plans to be included in a PS&E submittal, refer to FDM Chapter 15, Plan Preparation.
9. The Department has a cell library specifically to aid in the creation of signal and lighting plans. All temporary signal plans **shall** use the latest signal cell library.

Cabinet Numbering

If a temporary cabinet is shown on the plan, it **shall** be labeled "TCB#".

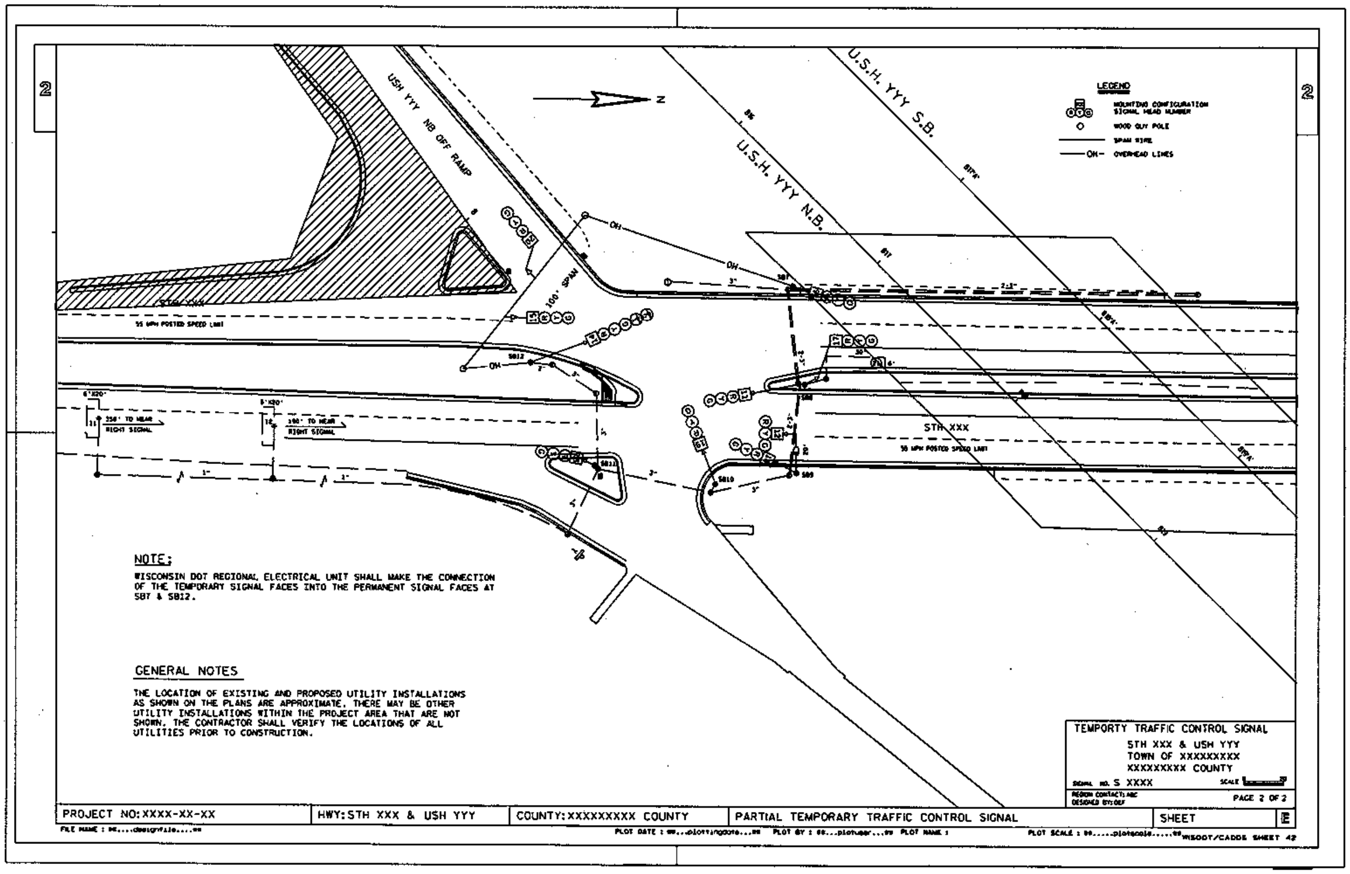
PARTIAL TEMPORARY SIGNAL PLAN

Partial-temporary signals are generally used at an existing signal when only one approach is to be reconstructed. The signal is a hybrid of existing permanent signal equipment (standard bases, poles, mast arms, etc.) and temporary supports (wood poles, span wire, etc.). The use of these types of installations are generally dependent on the type of improvement project or construction staging that will be performed.

Since the partial-temporary signal will be wired into an existing, permanent signal, the Regional Traffic Signal Engineer **shall** be contacted prior to plan development. When partial-temporary signal indications will be connected to the state-owned signal, the final wiring connections **shall** be performed by state-forces.

The partial-temporary signal plan **shall** indicate the entire signalized intersection. Existing signal equipment **shall** be gray-shaded. Temporary equipment **shall** be shown in standard line weights. The required plan elements **shall** be used. Refer to Figure 1.1 for an example of a partial-temporary signal plan.

Figure 1.1. Partial-Temporary Signal Plan Example



TEMPORARY BRIDGE SIGNAL PLAN

According to the WMUTCD 4D.11 Temporary and Portable Traffic Control Signals:

Option:

Temporary or portable traffic signals associated with one lane, two-way facilities in temporary traffic control zones, may use a minimum of 2 signal faces per direction.

Standard:

*For temporary or portable traffic signals associated with one lane, two-way facilities in temporary traffic control zones, one of the two heads **shall** be located at least 50 feet, but not more than 100 feet beyond the stopping point. If both heads are located more than 50 feet beyond the stopping point, at least one of the indications **shall** extend out over the roadway.*

Standard detail drawings (SDD 9G1 sheet a through g, 9G2 sheet a through c, and 15D33) for temporary or portable traffic signals are available in the FDM. There is only need to develop a signal plan for these applications if the design will be substantially different from that indicated by the SDD.

4-10-2 Signal Infrastructure Design - Temporary Signals — April 2025

The design of temporary traffic signal installations have many interrelated elements. Uniformity in the design of those elements promotes efficient traffic operations and reduces the potential for driver confusion and crashes. Temporary traffic signals must be designed and installed to convey clear and positive guidance to drivers and pedestrians. This subject contains discussions, illustrations, and examples of the design elements that are necessary to achieve this.

In addition to the information contained in this subject there are several standard references that *may* prove valuable to the designer.

4-10-3 Temporary Signal Head Design/Layout April 2025

SIGNAL HEAD DESIGN/LAYOUT

If the reconstruction of an existing signalized intersection does not require major shifting of the traffic due to lane reconstruction, such as replacement of underground conduits and rewiring, then the temporary signal heads **shall** be positioned to mirror the placement of those same heads on the permanent signal plan.

If the reconstruction project requires all the traffic to be on one side of the median while the other lanes are being reconstructed, then the span wire mounted temporary signal heads *should* be positioned over the driving lanes that they control. This type of installation provides better visibility and direction for the motorists during the reconstruction project.

Before developing a temporary signal plan, consult with the Regional Traffic Unit concerning placement of the temporary signal heads.

4-10-4 Temporary Signal Detection April 2025

Due to product improvements, the practice of using vehicle detection at temporary signal installations has become more common. Reasons that detection at temporary signals *may not* be considered feasible include: relatively short duration, construction staging, and cost of non-intrusive detection technologies. Detection for specific movements that experience high variability *may* be considered (i.e. a left-turn movement that exhibits excessive queuing by time-of-day). Verify the type of operation for temporary signals with the Region Traffic Signal Engineer.

Requests for pedestrian detection and emergency vehicle preemption are allowable. However, because of conditions associated with construction zones, these types users *should* ideally consider other routes.   For example, due to lane reductions, delay through a work zone for an emergency vehicle *may* be greater than using an alternate route.

Factors that *may* influence the type and amount of detection for a temporary signal include:

- Type and location of supports used to mount non-intrusive detection (that *may* be prone to movement depending on construction activities),
- Variability in traffic volumes (this *may* be accounted for by time-of-day plans),
- Duration of the construction project,
- Type of construction being performed,
- Construction staging plans,
- Route significance to pedestrians and emergency vehicles,
- Availability of alternate routes.

4-11-1 Pedestrian and Bicyclist Crossings — April 2025

Once the determination to install pedestrian signals is made, the next step is to determine where to install the pedestrian signal faces and detection (push buttons) if applicable. The designer **shall** consult the WMUTCD, Section 4E for Pedestrian Control Features and Chapter 9, Traffic Controls for Bicycle Facilities.

Pedestrian push buttons **shall** be shown on the signal plan, mounted approximately perpendicular and in advance of the crossing as required by the WMUTCD.

All pedestrian push buttons **shall** be accessible from the sidewalk to be able to be reached by walkers or people in a wheelchair. This *may* require the installation of a separate pedestrian pushbutton standard. Attempts to locate the pedestrian push buttons as shown in the WMUTCD and per ADA requirements **shall** be made.

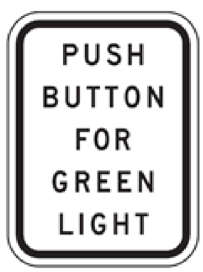
The R10-3E, 3H, 3I, and 3J series pedestrian signs **shall** be mounted on the same poles or standards as the pedestrian push buttons for pedestrian signals with countdown displays. The countdown display style of pedestrian signals **shall** be used on all state-owned traffic signals.

All pedestrian signal faces *should* be conspicuous and recognizable to pedestrians at all distances from the beginning of the controlled crosswalk to a point 10 feet from the end of the controlled crosswalk during both day and night. Sometimes this can be accomplished by attaching the pedestrian signal faces to traffic signal poles or standards. But, to meet the above requirement, a 10-foot pedestrian signal standard *may* need to be installed with just the pedestrian signal face and push button. If the pedestrian signal face can be installed on the traffic signal pole or standard, a 3.5-foot standard *may* still need to be used for a pedestrian push button to comply with the accessible requirements.

The pedestrian phasing *should* be shown adjacent the vehicular phasing on the sequence of operations sheet, shown by a double half arrow on the appropriate side of the vehicular phase arrow.

To accommodate bicyclists who want to cross a highway, a push button accessible to the bicyclist and sign stating, “Push Button for Green Light” (R10-3) as shown in Figure 1.1, *may* be installed. In this case, pedestrian signal faces are not installed; activation of the push button will call and time the pedestrian phase intervals or the bike minimum green interval.

Figure 1.1. R10-3 Sign for Bicyclist



ANIMATED EYES SYMBOL

Reference is made to the WMUTCD 4I.02.

The animated eyes symbol is a dynamic display that supplements standard pedestrian signal indications within the same section. This symbol consists of illuminated eyes that scan from side to side and is meant to prompt pedestrians to be aware of approaching vehicles.

POLICY

Pedestrian signal heads **shall** not incorporate the animated eyes symbol at state-owned signal installations.

SUPPORT

WisDOT supports the use of technologies that address a distinct need related to highway safety & traffic operations. Animated eyes are expected to have a limited effect on improving intersection safety but would require an increase in capital, operations, and maintenance costs. Benefits are not expected to outweigh additional resource expenditures.

IN-ROADWAY WARNING LIGHTS AT PEDESTRIAN CROSSINGS

Reference is made to the WMUTCD Chapter 4U.

In-roadway warning lights (IRWLs) are special types of highway traffic control devices installed in the roadway pavement to warn road users that they are approaching a condition on or adjacent to the roadway that *may* not be clear and might require the road users to slow down and/or yield.

IRWLs are actuated devices with flashing indications that provide real-time warning of a specific condition. In-pavement lights that supplement pavement markings by operating in a steady burn state **shall** also require WisDOT approval but are not the focus of this policy.

On the STH system in Wisconsin, IRWLs are limited to situations warning of: marked school crosswalks, marked mid-block crosswalks, marked crosswalks on uncontrolled approaches, and other roadway situations involving pedestrian crossings that are not associated with other types of traffic control.

POLICY

IRWLs, as defined herein, *may* be used on the Wisconsin STH system provided the local jurisdiction:

1. Applies for a permit
2. Agrees to fund the installation, operation, and maintenance of the device
3. Agrees to be responsible for any corresponding damage to the roadway or damage to highway maintenance equipment, and
4. Properly cites appropriate locations based on the conditions of this policy.

The municipality *should* understand that the permit *may* be revoked, especially in the event of safety or operational issues. In such a situation, the original costs and costs to restore the pavement are the obligation of the permit holder.

When allowed by permit, IRWLs **shall** be installed perpendicular to the direction of travel on the roadway and used to supplement crosswalk markings. IRWLs placed along the centerline of a highway, parallel to the direction of travel, **shall not** be used. IRWLs **shall not** be allowed on freeways or expressways.

Prior to the use of IRWLs, adequate trail of standard remedial measures **shall** be used to warn motorists of pedestrian crossings. IRWLs will be used only to supplement typical warning devices such as signs, markings, and crossing guards. Other strategies, such as providing a median refuge roadway lighting in advance of the crossing, or enforcement campaigns, are more universally recognizable methods of warning motorists of these conditions and *should* also be implemented when practicable.

<u>Location Criteria</u>

It is recognized that the use of IRWLs *may* affect STH traffic operations by increasing delay and reducing mobility, especially if used near existing signalized or stop-controlled intersections. The following criteria **shall** be met:

1. Location is an uncontrolled pedestrian crossing.
2. Location is an established school route, accommodates a minimum pedestrian volume of 100 pedestrians/day, or location has experienced pedestrian crashes in the past 3 years.
3. Subject crossing is in municipal (non-rural) limits.
4. There exists a minimum of 300 feet between the subject crossing and the nearest uncontrolled pedestrian crossing, or intersection traffic control device on the STH.
5. There exists a minimum of 1200 feet between the subject crossing and the nearest uncontrolled pedestrian crossing supplemented with in-roadway warning lighting unless exceptional conditions exist.
6. Roadway has a maximum of four travel lanes with a maximum single-stage crossing distance of 50 feet.
7. Approach speed is posted at less than 50 mph.
8. Adequate stopping sight distance exists based on the following approach speeds:
    a. 15 or 25 mph = 200 ft
    b. 30 mph = 250 ft
    c. 35 mph = 300 ft

   d. 40 mph = 400 ft
   e. 45 mph = 500 ft

Design Requirements

In the interest of uniformity, reliability, and consideration for other highway users, the following minimum design requirements for IRWLs **shall** be met:

1. Number/positioning of lights:
   a. For two-lane undivided roadways: 5 IRWLs per direction
   b. For four-lane undivided roadways: 7 IRWLs per direction
   c. For four-lane divided roadways: 5 IRWLs per direction.
2. IRWLs **shall** be actuated and **shall not** flash continuously.
3. If pedestrian push buttons are used to actuate the IRWLs, a PUSH BUTTON TO TURN ON WARNING LIGHTS (R10-25) sign **shall** be mounted adjacent to or integral with each pedestrian push button.
4. For four-lane divided roadways with median widths equal to or exceeding 6 feet, pedestrian actuation in the median **shall** be provided to allow for a two-stage crossing of the roadway.
5. Lights **shall** be evenly spaced across the entire traveled way. Lights *should* be positioned outside of vehicle wheel paths and *should* also consider bicyclist routes adjacent the traveled way. Lights placed near the centerline of the roadway *should* be offset slightly to minimize interference with pavement marking operations.
6. Electrical wire **shall** be cast in a minimum of 8-inch concrete pavement. If IRWLs are being installed with an improvement project that requires a pavement section greater than 8 inches, then the pavement at the crossing *should* be made to match that of the adjacent roadway. Pavement reinforcement *may* not be required, but this decision will reside with the regional pavement design unit. Doweling to adjacent concrete pavement will also be required at the direction of the regional pavement engineer. A minimum 2 feet of clearance to the edge of the concrete **shall** be maintained. Pavement structure **shall** be installed according to WisDOT Standard Specifications. Installation in existing pavement by sawing or coring is not permissible. Minimal width of the concrete, measured longitudinally in the direction of traffic, **shall** be 12 feet.
7. Roadway profile **shall** be appropriately maintained by milling or wedging the approach to the crossing, as required.
8. IRWLs **shall** flash for the entire calculated pedestrian clearance time. Pedestrian clearance *should* be calculated based on a 3.5 ft/sec walking speed. Locations frequented by children and elderly users *may* have a pedestrian clearance based on a slower walking speed. A brief time extension of 3 to 7 seconds *may* be added to allow for vehicle/pedestrian response and separation.
9. Features meant to accommodate impaired pedestrians such as actuator buttons with locator tones, supplemental braille signing, etc., *should* be considered at individual locations on a case-by-case basis. If used, these devices **shall** be furnished and maintained by the municipality that requests the IRWLs.
10. Other design criteria **shall** conform to the manufacturer’s recommendations.

SUPPORT

There are several general points of concern regarding the use of these devices:

1. IRWLs do not ensure that motorists will appropriately yield the right of way to pedestrians in the crossing.
2. A public awareness and education campaign *may* be required to educate the public prior to operating IRWLs.
3. IRWLs *may* cause rear-end collisions similar to a signal installation.
4. Placement of IRWLs between coordinated traffic control signals *may* cause progression problems.
5. Any improperly installed electrical equipment *may* pose a hazard to the public.
6. In Wisconsin, IRWLs *may* be susceptible to premature failure due to moisture buildup and/or snow removal operations.

7. The type of actuation used for IRWLs needs to be considered. Active detection (i.e. pushbutton) *may* create a false sense of security for pedestrians who are not familiar with the use of such devices or the rules of the road. Because of these factors, passive detection (i.e. infrared) is considered more appropriate for these types of applications, especially in crosswalks associated with school zones. In either case, an informational plaque *should* be used to briefly describe proper crossing behavior while using IRWLs. These are similar to informational plaques used at signalized pedestrian crossings (R10 series).
8. In IRWLs will be placed outside of existing connecting highway limits within a municipality, consideration *should* be given to extend those limits to include the installation location.

4-11-2 Pedestrian Phasing April 2025

Due to the impacts on the geometric design, ADA requirements, signal placement, and potential impacts on capacity analysis, system analysis and signal timing, accommodating pedestrians *should* be explored early in the scoping process. The geometrics of signalized intersections **shall** be designed to accommodate pedestrian traffic now and in the future; however, discretion *should* be exercised when determining where to install pedestrian phases. The surrounding area *should* be surveyed for schools, elderly and disabled housing, multipurpose trails, parks, and developments which *may* generate pedestrian traffic to help identify the need for pedestrian signals.

If it is determined that pedestrian phasing will be installed, early consideration *should* be given to the manner in which the pedestrian movement will be called. In most instances, a pedestrian push button *should* be installed to allow for on-demand call of a pedestrian phase. This is typically applicable to pedestrian movements across the mainline street and *may* also be applicable to pedestrian movements across the side street, especially at an isolated intersection. Calling pedestrian phase by push button increases the efficiency and decreases the delay and driver frustration by minimizing the number of times that the pedestrian phase is activated.

It is also possible to call the pedestrian phase each cycle by putting the phase on pedestrian recall. Typically, pedestrian recall is the preferred application in downtown areas or where there is high transit usage where the pedestrian volumes are high and consistent. It is usually a function of pedestrian demand and the ability or need to implement the necessary timing parameters to accommodate pedestrians on a constant call basis.

Pedestrian clearance time, FLASHING DON'T WALK (FDW) time, *should* always be sufficient for pedestrians to cross the entire approach especially at fully actuated isolated signals with push buttons. When pedestrian phase(s) are being added to an existing signal that operates in coordination or a new signal that will operate in coordination, it is important to assess the impact of the FDW interval on the cycle length. If a signal is pre-timed or operates in coordination, there *may* be some constraints against providing the entire pedestrian clearance every cycle. Ideally, the cycle length *should* be long enough to accommodate all ped phases every cycle. However, at large intersections this *may* lead to extremely long cycle lengths, excessive delays, long queues and a decrease in LOS.

Depending on the coordination settings used, the timing can be set up to allow the controller to go out of coordination when a pedestrian phase is actuated. This allows for the full pedestrian clearance to be provided and a feasible cycle length. However, this *may* not be desired since it can take several cycles to get back into coordination. Routine pedestrian actuations at a signal in a coordinated system *may* not allow for proper coordination.

An exclusive pedestrian phase (Barnes Dance) is <u>not</u> typically used. If an exclusive pedestrian phase is being considered for use, it **shall** be approved by the Regional Traffic Signal Engineer.

<u>Channelized Right-turns</u>

If a pork chop island exists, the recommended practice is to cross pedestrians from the radius to the pork chop island, then cross the mainline or side street.

For single lane channelized right turns that are not signalized (STOP, YIELD or free-flow conditions), pedestrian signals **shall not** be used. Pedestrian signals *should* be considered at crossings of single lane channelized right turns movements that are signalized. In that case, attention *should* be given to the placement of vehicular signal indications and whether those signals are readily viewable for the benefit of the pedestrian. Pedestrian signals **shall** be used at crossings of dual lane channelized right turn movements that are signalized.

<u>Two-stage Crossings</u>

Per WMUTCD 4I.06, where the pedestrian clearance time is sufficient only for crossing from the curb or shoulder to a median of sufficient width for pedestrians to wait, median-mounted pedestrian signals (with pedestrian detectors if actuated operations is used) **shall** be provided and signing such as the R10-3e sign **shall** be provided to notify pedestrians to cross only to the median to await the next WALKING PERSON (symbolizing WALK) signal indication. A median of sufficient width to accommodate two-stage crossings are generally considered a minimum of 6-ft in total width for pedestrians and a minimum of 8-ft in total width for bicyclists if the crossing is associated with a path.

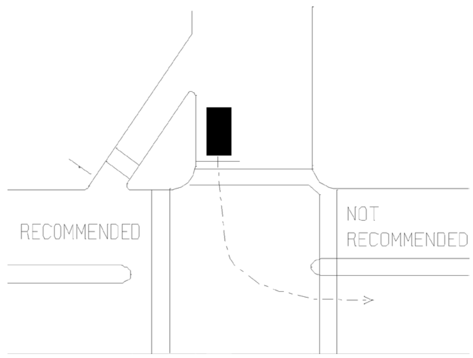
ADA requirements **shall** be considered when designing two-stage pedestrian crossings.

At any intersection with medians where a pedestrian could become stranded pedestrian push buttons *should* be placed in the median.

T-Intersections

It is recommended to place pedestrian crossings on the right side of a T-intersection to reduce the likelihood of left turning vehicles conflicting with pedestrians occupying the crosswalk on the receiving approach, as shown in Figure 2.1.

Figure 2.1. Pedestrian crossings at T-intersection



Visually Impaired Pedestrians

An engineering study *should* be conducted upon request for special accommodations for visually impaired pedestrians. Wide streets, right turn on reds, and complex signal operations are some of the factors that make it hard for visually impaired pedestrians to cross signalized intersections. Refer to WMUTCD 4K for guidance on when to install Accessible Pedestrian Signals (APS) for visually impaired. In general, APS devices are reserved for use at crossings that are part of a route, along which the pedestrian with visual disabilities who is requesting the device, typically travels.

Bicycle Phasing

Bicycles *should* be treated as pedestrians or vehicular traffic depending on the type of user. If bicyclists that use pedestrian facilities request detection, then other pedestrian devices such as pedestrian signal heads, *should* be installed.

4-11-3 Beacons — April 2025

Reference is made to the WMUTCD Chapter 4S.

Flashing beacons (a.k.a. flashers, warning flashers, beacons) are a special type of signal indication used to supplement standard regulatory and warning signs. According to the WMUTCD, flashing beacons have the following applications:

1. Intersection control beacon
2. Stop beacon
3. Speed limit sign beacon
4. Warning beacon (includes Rectangular Rapid Flashing Beacons)

Warning beacon includes Rectangular Rapid Flashing Beacons (RRFB). Flashing beacons are part of a sign, as it pertains to the provisions for allowing the installation of the beacons on highway right-of-way. Statutes 84.02 (4)(c) and 86.19 (3) convey exclusive authority for signs and warning devices on the state trunk system to the department.

This policy contains provisions for proper application, design, and permitting of flashing beacons on the STH system.

POLICY

General

The following general criteria apply to all flashing beacon installations on the STH system:

1. There are two types of flashing beacons:
    a. Red—only to be used with STOP signs
    b. Yellow—to be used with any yellow warning (W-series) signs, speed limit, speed limit reduction, pedestrian warning and school speed limit signs

    Flashing beacons **shall** only be associated with the sign installations referred to above.
2. Flashing beacons are supplementary to signs. When used, they **shall** be mounted on the same support as the sign which the beacon supplements in accordance with WMUTCD 4S.01.
3. Activated flashing beacons **shall not** be approved on the STH system for use in conjunction with train crossings.
4. Emergency vehicle entrances *may* have activated flashing beacons, which will cancel after a pre-timed period of flash.
5. State-owned and permitted installations
    a. The department *may* determine that flashing beacons are needed and *may* install and maintain them at specific sites. In this case, the regional traffic engineer **shall** make a final determination regarding the use of these devices on behalf of the department.
    b. At locations where, local authorities determine that the use of flashing beacons is desirable, a permit *may* be issued for the installation and maintenance of flashing beacons. Permitted installations are subject to the approval of the department and the conditions of this policy. Additionally, permits are revocable at the discretion of the department.

Application of Flashing Beacons

The following sections highlight policy items for flashing beacons that *may* be different from those represented in WMUTCD Chapter 4S.

Intersection Control Beacon: Used at intersections where traffic or physical conditions do not justify conventional traffic control signals, but crash rates indicate the possibility of a special need, generally located over the center of an intersection. Refer to WMUTCD 4S.02.

Stop Beacon: Refer to WMUTCD.

Speed Limit Sign Beacon: Refer to WMUTCD 4S.04. The department rarely, if ever, would install and maintain flashing beacons with speed limit signs or school speed limit signs. Local authorities **shall** follow the permit requirements stated below.

Warning Beacon: Refer to WMUTCD 4S.03.

Flashing Beacon Design & Installation

The following provisions pertain to the installation, operation, and maintenance of flashing beacons other than rectangular rapid flashing beacons (RRFBs) on the state trunk highway system.

1. Location
    a. Ground mount: Flashing beacons *may* be ground mounted, where they will be approximately one foot above the sign they supplement. The sign *should* be in the lateral and vertical location as specified in the WMUTCD Chapter 2. Illustrations of typical ground-mount installations are in Figure 3.1 below.
    b. Overhead mount: A flashing beacon *may* be mounted on one or both sides of an overhead sign. It *may* be mounted above the sign if the entire assembly including the sign has a minimum clearance of 17 feet.
2. For state-maintained installations, the standard size of flashing beacons is 12 inches in diameter. At the discretion of the regional traffic engineer, permitted (not state-maintained) installations that are in areas with a posted speed less than 30mph *may* use 8-inch diameter beacons.

3. Ground-mounted supports **shall** be the same as are normally used to support the sign, and of the same cross-section as normally used. These **shall** be 4 x 4 or cross-drilled 4 x 6 posts, or in urban areas signal posts on concrete footings, or light poles or wood poles where speeds are low. Usage of any kind of pole **shall** be in conformance with the offsets specified in highway lighting permit policy, FDM 11-15-1.
4. The installation of two posts, one for the sign and the other for the flashing beacon, is not permissible within the clear zone because of the unpredictable behavior of the combination of two posts when struck.
5. Service poles must be offset to the right-of-way line or in conformance with offsets in FDM 11-15-1.
6. Service *may* drop to the top of the support, which would be extended to maintain an 18-foot minimum wire-to-ground clearance as per Wisconsin electrical code. Service *should* preferably be installed underground. In the latter case, the conduit **shall** be run up and attached to the post or pole. The control box *may* be mounted on the post or pole.
7. At the discretion of the regional traffic engineer, solar-powered flashing beacon installations *may* be allowed on the STH system provided the installation meets applicable electrical and crash standards.
8. According to TEOpS 2-1-8, flashing beacons and STOP or STOP AHEAD signs that incorporate flashing displays (e.g. blinker signs) **shall not** be used at the same intersection approach.

Warning Beacon (i.e., RRFBs) Design & Installation

Yellow flashers are to be used with any yellow warning (W-series) signs and school speed limit signs. Actuated blinker signs are supplementary to warning signs. When used, they **shall** be mounted on the same support as the sign which the beacon supplements in accordance with WMUTCD 4S.03.

At locations where it is determined that the use of warning sign enhancements signs is desirable, a permit *may* be issued for the installation and maintenance of these blinker-type signs. Permitted installations are subject to the approval of the Department and the conditions of this policy. Additionally, permits are revocable at the discretion of the Department.

It is recognized that the use of warning sign enhancements *may* affect STH traffic operations by increasing delay and reducing mobility, especially if used near existing signalized or stop controlled intersections. The following location criteria *should* be met prior to approval:

1. The location is an uncontrolled pedestrian crossing.
2. A minimum volume of 20 or more pedestrians during a single hour (any four consecutive 15-minute periods) of an average day *should* be met. Young (<12), elderly (>85) and disable pedestrians count 2 times toward volume thresholds. Additionally, seasonal day volumes can be used in place of average day volumes if the crossing is in a known tourist area.
3. A minimum vehicular volume of 1,500 vehicles per day.
4. Maximum of four lanes crossed, unless there is a raised median, in which case it can be six lanes.
5. There exists a minimum of 300 feet between the subject crossing and the nearest controlled pedestrian crossing or intersection traffic control device on the state trunk highway system. Consideration *should* be given to extending this distance beyond 300 feet if the proposed crosswalk location falls within an auxiliary turn lane for the nearby intersection or if the standing queue from the intersection extends over the proposed crosswalk location.
6. Adequate stopping sight distance exists based on FDM 11-10-5 or greater than 8 times the posted speed limit.
7. RRFBs **shall** use a much faster flash rate and **shall** provide 75 flashing sequences per minute (except for existing RRFBs that follow FHWA IA-11). According to IA-21, the left and right RRFB indications **shall** operate using the following sequence:

RRFB Flash Pattern												
Beacon	0.05 sec	0.05 sec	0.05 sec	0.05 sec	0.05 sec	0.05 sec	0.05 sec	0.05 sec	0.05 sec	0.05 sec	0.05 sec	0.25 sec
Left	ON	OFF	OFF	OFF	ON	OFF	OFF	OFF	ON	OFF	OFF	OFF
Right	OFF	OFF	ON	OFF	OFF	OFF	ON	OFF	ON	OFF	ON	OFF

The use of warning sign enhancements *may not* be appropriate at locations where there is a combination of both high traffic volumes and high pedestrian volumes. In these situations, there *may* be an increase in crashes and/or delay that make the use of the actuated blinker signs inappropriate. Instead, a traffic signal or Pedestrian Hybrid Beacon (PHB) *should* be considered, if feasible.

Consideration *should* also be given to spacing between pedestrian crossings – both uncontrolled as well as those supplemented with warning sign enhancements. These blinker-type signs are highly visible and therefore can be confusing or distracting to drivers if there are too many within their field of vision at one time. Historically, 1,200 feet has been a rule of thumb for minimum spacing.

Warning beacon types

There are four options that *may* be used to enhance pedestrian and school warning signs:

1. Blinker Sign. Refer to TEOpS 2-1-8 for application criteria.
2. Standard Blinker Beacon. Refer to TEOpS 4-2-3 for application criteria.
3. Rapid Flashing Beacon (Wig-Wag).
4. Rectangular Rapid Flashing Beacon (RRFB). RRFBs can only be pedestrian actuated.

These devices can be pedestrian actuated and/or time-of-day programmed.

Figure 3.1. Warning Sign Enhancement Options

Blinker Sign | Standard Blinker Beacon | Rapid Flashing Beacon (Wig-Wag) | Rectangular Rapid Flashing Beacon

As of March 20, 2018, FHWA has granted interim approval (IA-21) for the optional use of the RRFB as a pedestrian-actuated conspicuity enhancement to supplement standard pedestrian crossing or school crossing signs at uncontrolled marked crosswalks to any jurisdiction that submits a written request to FHWA. WisDOT received statewide approval from FHWA to allow all jurisdictions to install an RRFB. The jurisdiction must agree to furnish a list of locations where RRFBs are installed, acknowledge that FHWA has the right to rescind the interim approval at any time and acknowledge that the interim approval does not guarantee that the provisions will be adopted into the WMUTCD.

PERMITTING OF FLASHING BEACONS

Any improperly installed electrical equipment *may* pose a hazard to the public. As such, the department spells out general and specific conditions, which are part of the permit agreement. These conditions are incorporated into the permit form, DT1877, a copy of which is appended to this policy. The WMUTCD Chapter 4S and specific conditions stated above **shall** also be followed for flashing beacons installed on all state trunk highways. Flashing beacons installed on connecting highways **shall not** require a WisDOT permit.

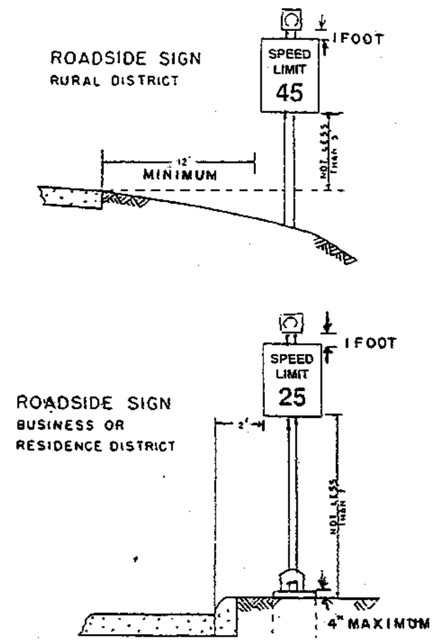
The following information provides conditions and processes related to the issuance of permits:

1. Permit applications **shall** be received, and permits issued, by the appropriate regional office.
2. Permits for flashing beacons *may* only be issued to municipalities, not to private individuals at agencies, or to power companies. This *should* result in working with the most responsible and objective agency associated with the safety problem being addressed.
3. The region *may* rightfully deny the issuance of the permit. Reasons for denial *may* include: lack of need, conflict with other traffic control devices, vulnerable location, lack of confidence in the maintaining ability of the subject agency, or knowledge that the request is due to reaction rather than long term need of commitment.
4. The region *may* revoke the permit for any of the reasons above, especially regarding lack of maintenance, as well as for reasons cited on the permit itself.
5. For permitted flashing beacons installed on signal standards, Standard Detail Drawings 9C2, 9C3, and

9E7 *should* be made part of the permit. SDDs 9C5 and 9D3 for control cabinet installations *may* also apply.

6. In the event of the reconstruction of the highway, reasonable notice *should* be given to the municipality to allow their removal of the equipment and arranging for disconnecting the electrical service.

Figure 3.2. Standard Flashing Beacon Installations for Rural & Urban Districts



6-1-1 Work Zone Policy Statement December 2022

The Wisconsin Department of Transportation (WisDOT) is committed to promoting safety for the traveling public and workers, minimizing congestion and adverse traffic impacts, and providing for improved public satisfaction during construction, maintenance, utility, and all other activities performed on or near the WisDOT highway network. Compliance with this policy will reduce work zone crashes, travel time, and provide benefits to all stakeholders. All regional offices and statewide bureaus are responsible for implementing the portions of this policy affecting their operations.

GOALS AND OBJECTIVES

The goals and objectives of this policy are to:

- Reduce crashes in work zones.
- Provide a conducive environment for safety and mobility for workers and the traveling public.
- Minimize work zone related delays not to exceed 15 minutes above normal recurring traffic delays.
- Provide traveler information to minimize delays and improve mobility, efficiency and safety.
- Clearly define stakeholder responsibilities.
- Develop work zone training for WisDOT staff.
- Evaluate and continuously improve work zone safety and mobility performance.

APPLICABILITY

This policy is applicable to all work, including contracts for highway construction, railroad crossings, maintenance, and utility projects on state trunk highways, and Federal and State funded local roads improvement projects. These activities must have a Transportation Management Plan (TMP).

WisDOT will submit all TMPs to the Federal Highway Administration (FHWA) for their concurrence on all projects subject to federal oversight, both on and off the National Highway System (NHS) per the WisDOT/FHWA Federal-Aid Oversight Agreement. WisDOT must approve projects not subject to Federal Oversight, both on and off the NHS.

It is WisDOT's policy to consider work zone impacts in all phases of project development and construction. Incorporate specific mitigation strategies in the TMP during the project development process to address the characteristics of a project and its associated work zone impacts. Work zone data and annual project reviews will be used to evaluate work zone processes and procedures. The changes made to the TMP during construction will facilitate improvements at the project level and system-wide. Personnel involved in project development and construction *should* receive appropriate training periodically.

This policy supplements existing Department wide policies, standards, guidelines, processes, and practices as detailed in the FDM, Standard Specifications, Construction and Materials Manual (CMM), Traffic Engineering Operations and Safety Manual (TEOpS), Wisconsin MUTCD, etc. Refer to FDM 11-50-5 for TMP preparation process.

RESPONSIBILITIES

Bureau of Highway Traffic Operations (BTO) and Bureau of Project Development (BPD) Directors and Regional Directors

- Advocate for compliance with TMP guidelines and lane closure policies, and approve corridor and project variances to established guidelines.
- Maintain awareness of the cumulative impacts of multiple projects along a corridor.
- Advocate for funding support for mitigation strategies included in TMPs.

Bureau of Traffic Operations (BTO)

- Review and approve TMP that have the following criteria:
    - Type 3
    - Federal Oversight
    - Innovative Contracting (lane rental, enhanced liquidated damages, etc.)
    - Speed Declarations on 65 or 70 mph routes
    - Nonstandard mitigation strategies
    - Law Enforcement mitigation

- Two weeks will be given for the review period. Approval will be contingent on comments being addressed, use of temporary speed zones and traffic mitigation strategies selected.
- Develop and maintain work zone traffic control standards and guidelines.
- Develop work zone traffic control specifications and standardized special provisions (STSP) in coordination with the Bureau of Project Development (BPD) and regional WisDOT offices.
- Review continually the effectiveness of work zones, improve and update work zone processes, procedures and policies to ensure quality and statewide consistency.
- Review and comment on work zone traffic control and mobility exceptions for TMP type 3.
- Develop work zone training program. The training program will provide appropriate levels of detail for supervisors, project managers, project engineers, inspectors, flaggers and workers.
- Review/approve speed zone declarations when reducing speed limit for all interstates and for facilities with a normal posted speed of 65 mph and 70 mph facilities.
- Review/approve traffic mitigation strategies used.

Bureau of Project Development (BPD)

- Review Design Study Reports (DSR) for work zone TMP and identified TMP type.
- Coordinate with BTO and Region for review of TMP Type 3, and for exceptions to TMP and lane closure guidelines.
- Participate with BTO in reviewing work zone effectiveness and updating work zone processes and policies.

Regional WisDOT Offices

The project manager in collaboration with traffic operations at the Region is responsible for developing and implementing TMP. The TMP is developed according to TMP guidance, the FDM, TEOpS, WisMUTCD, and other supplemental policies, directives, and applicable project specific contract documents including handbooks and special Traffic Control Plans.

Project Development Chief

- Support the consideration of work zone impacts and development of TMPs early in the project development process for all projects.
- Support coordination of TMPs along corridors and between adjacent regions and neighboring states.
- Support resource availability for TMP development, mitigation strategy measures and activities.
- Inform Regional Director of all projects with significant traffic impacts.
- Approves non-local program TMPs in the region

Operations Chief

- Maintain awareness of corridor and project variances that exceed the allowable limits.
- Maintain awareness of project-specific exceptions to work zone mobility policy.
- Advocate for resource availability for TMP development and strategies measures and activities.

Regional Planners

- Identify TMP type during scoping process in collaboration with PDS and Traffic Unit.
- Identify potential strategies in scoping document.
- Identify funding needs and issues associated with the TMP.
- Coordinate scheduling of projects to minimize repetitive construction projects or activities along a segment of roadway and to minimize conflicting projects on parallel/alternate routes.

Regional Traffic/Work Zone Engineers

- Provide input into type of TMP during scoping process.
- Provide input during TMP development, implementation and conflict resolution. Two weeks will be given for the review period. Approval will be contingent on comments being addressed,
- Provide input for all traffic impact assessment and mitigation decisions during project initiation, scoping, design, construction and evaluation.
- Provide input on project reviews, approval, and modification of all TMP strategies.
- Verify that traffic control measures are in conformance with WisMUTCD, SDDs, TEOpS, WisDOT Standard and Supplemental specifications.
- Verify that traffic delays are minimized and do not exceed allowable limits. If exceeded consult with TMP team and / or project staff about possible modifications to the TMP.
- Review implementation plan with the project engineer before construction.
- Verify with project staff that the contractor is complying with TMP as it relates to the handling of traffic.

- Review changes made by the contractor or project engineer during construction.
- Review traffic control measures as needed to address field conditions pertaining to traffic flow, visibility, and safety.
- During TMP development review criteria in TEOpS 13-5-6 to determine if a temporary speed limit reduction is appropriate. If so, ensure that a temporary speed declaration is completed prior to implementing the reduced limit.

Project Manager/Squad Leader

Project managers and staff will ensure appropriate action is taken to reduce work zone impacts to workers and the traveling public. Responsibilities include:

- Ensure project activities conform to the TMP.
- Designate a trained person at the project level, whose responsibilities include oversight of TMP implementation.
- Determine resource needs associated with the TMP development and implementation.
- Ensure traffic control measures are in conformance with WisMUTCD, SDDs, WisDOT Standard and Supplemental Specifications and project-specific plans.
- Ensure contingency plans are implemented if necessary.
- Facilitate project reviews, approval, and modification of all TMP strategies.
- Ensure traffic delays are minimized and do not exceed allowable limits. If exceeded consult with TMP team or Regional Work Zone Engineer about possible modifications to the TMP.
- Verify contractor complies with the TMP as related to their performance of work.
- Review changes made by the contractor or project engineer during construction.
- Notify Regional Communication Managers of significant project traffic impacts due to incidents.

Project Designer/ Leader

- Confirm scoping TMP type based on project needs and constraints.
- Develop content of TMP components, address mitigation and contingency plans based on needs of the project.
- Develop traffic control measures in conformance with WisMUTCD, SDDs, TEOpS, WisDOT’s Standard and Supplemental Specifications.
- Minimize traffic delays during plan development, and ensure allowable limits are not exceeded. If exceeded consult with TMP team, Project Manager/Squad Leader or Regional Traffic Engineer/ Work Zone Engineer about possible modifications to the TMP.
- Notify Project Manager and Regional Work Zone Engineer of traffic impacts during TMP and TCP development.
- Develop contract requirements to ensure contractor complies with the TMP as related to their performance of work.
- Analyze changes requested or made by the contractor during construction.
- Work to ensure necessary TMP measures are planned and implemented by the contractor.
- Coordinate with nearby projects to minimize conflicting construction activities as needed.
- Coordinate with Regional Traffic Engineer/Work Zone Traffic Engineer and regional freight coordinator to evaluate the TMP, highlight problem areas, successes and changes to the original TMP. A formal TMP follow-up evaluation report is not required on TMP type 1 projects but highly recommended on all TMP type 2 and required for all type 3 projects.

Other Stakeholders

It is advisable to have clear communication channels among all staff in the region to facilitate implementation of the Public Information and Outreach Plan (PIOP) and the Incident Management Plan (IMP).

- Regional Permit personnel
- Regional Maintenance personnel
- Regional Utilities personnel
- Regional Communications Manager
- FHWA
- Law enforcement
- Counties and local officials
- Industry

Contractor - Responsibilities

It is the contractor’s responsibility to:

- Designate a trained person, whose responsibility is to ensure compliance with the traffic control plan and other contractual provisions related to the TMP.
- Ensure contractor personnel are trained in traffic control to a level commensurate with their responsibilities.
- Work with the project engineer to ensure lane closures and / or disruptions to the traveling public are minimized according to the contract.
- Perform quality control of work zones to promote consistency and ensure compliance with contract documents and guidelines.
- Recommend traffic control improvements to the project engineer to address field conditions pertaining to visibility, traffic flow, worker, and motorist safety.

Law Enforcement

Responsibilities for law enforcement include:

- Providing active and passive enforcement of traffic laws according to work zone law enforcement mitigation contracts, to promote safety and mobility in work zones.
- Identifying unsafe traffic conditions.
- Taking appropriate measures (in coordination with the project engineer) to clear work zone incidents quickly.
- Understanding of work zone traffic control and operation and additional TMP components.
- Documenting work zone incidents for future assessment of work zone impacts and process improvements.

6-2-55 Portable Changeable Message Sign Use in Construction & Maintenance Projects December 2022

PURPOSE

The MUTCD section 6F.60 provides standards and options for the usage of Portable Changeable Message Signs(PCMS). This policy provides requirements and guidance on the proper use of PCMS in work zones on state highways.

See TEOpS 17-2-1, Portable Changeable Message Signs (PCMS) Policies & Procedures, for information regarding procurement, use of PCMS for special events, adverse weather, and other non-work zone related events, sign control, and training.

APPLICATIONS

Since they are dynamic signs, PCMS must only be used to display real-time or changing traffic condition or traffic control information. They *may* also be used provide advance notice prior to projects or events expected to cause congestion or that will require drivers to use alternate routes.

PCMS *should not* be used to replace static warning or regulatory signs; they *may* be considered as a supplemental device to a required static sign. In the case of a ramp or lane closure, the PCMS would supplement the static warning signs informing motorists of the closure.

Nonstandard words such as DANGER, HAZARDOUS, or CAUTION **shall not** be used. These words do not contribute any information and *may* overly concern drivers as they approach the work zone.

PCMS **shall not** be used to display generic safety messages or any other messages not necessary for specific driver action at the site. Examples of generic messages not to be used are BUCKLE UP, WELCOME TO WISCONSIN, or DRIVE SAFELY. Use of these types of generic messages tends to lead to motorist disregard of critical messages and unnecessarily distracts driver attention from the roadway.

Improvement/Maintenance Projects

For improvement projects, designers must include a PCMS message plan with the Temporary Traffic Control Plans. PCMS *may* be include in an improvement project for the following reasons:

1. Provide up to 7 days advance notice to drivers of closures. These signs *should* be provided by the contractor, but when contract timing is an impediment, they *may* be provided by the department or county,
2. Advise travelers of alternate routes around construction,
3. Supplement static sign messages for changes in roadway alignment for up to 7 days,
4. Advise drivers of a change in speed,
5. On Pilot Cars to advise traffic to follow them. This is up to the contractor to used and does not need to be specified in the plans,
6. Use in smart work zone systems for queue warning, dynamic late merge, travel time information, truck entering warning.

When PCMS are used as part of a smart work zone system the costs are normally included in the cost of the system and do not need to be a separate bid item.

Do not include PCMS on improvement projects solely for the use of incident management. Consider smart work zone systems to reduce the potential of an incident instead. PCMS that are included on a project for other reason with the exception of a smart work zone, *may* be used for incident management. Primarily consider PCMS that are on freeway and expressway projects to have PCMS with communications.

All messages displayed must be preapproved by the project engineer. Any subsequent changes to messages due to changing traffic conditions or construction operations **shall** also require approval from the project engineer, except during off-hours incidents or emergencies when the project engineer is not reachable. In general, improvement projects *should* provide for project-specific contractor supply of desired portable work zone management systems such as PCMS, subject to compliance with JamLogic or other standardized communications interface standards. Accessibility and operation control by the TMC *should* be accommodated, but not committed without their involvement and concurrence. When communications with the TMC is desired include the bid item (Item 643.1051, Traffic Control Signs PCMS with Cellular Communications) with the contract.

The department reserves the right to use/deploy signs from its inventory on an improvement project to improve safety and optimize the operational efficiency of a construction work zone. Contractor-provided signs *should* be used for aforementioned purposes if they can be made available and deployed expeditiously and cost-effectively. The department also reserves the right to remove department owned signs deployed to improvement projects as needed for incident response or higher priorities elsewhere.

Signs owned by the department and counties **shall** be used for the purposes of temporary traffic control for maintenance work, incident management, and adverse weather road condition advisories.

A PCMS that is used to simulate an Arrow Board **shall** only be used to indicate a lane closure and must meet all the visibility requirements of an Arrow Board in the MUTCD section 6F.61. PCMS messages shall not mix arrows and words on either a single frame or the same operation.

DEVICE OWNERSHIP

Signs for highway improvement projects **shall** be supplied and maintained by the contractor as part of the contract similar to flashing arrow boards, drums, and barricades. The department would not assume any ownership of these signs. There is to be no additional state-owned PCMS purchased by regions through improvement projects or otherwise, including implementation in smart work zone systems. If it proves absolutely necessary to procure new WisDOT-owned equipment, BTO will coordinate any procurement of this equipment and provide it for use by regions as needed.

See TEOpS 17-2-1 for provisions on the purchase of PCMS for highway maintenance work and other uses.

MAINTENANCE

A memorandum of understanding (MOU) **shall** be developed for any county highway department operating state-owned PCMS on the state highway system. A sample MOU is included in TEOpS 17-2-1.

For state- or county-supplied signs, arrangements *should* be made using state or county forces to maintain the signs while in use. For newly purchased signs, a warranty period is usually provided, requiring the supplier to repair any failures or breakdowns of the sign. When the county performs maintenance work on state-owned signs, charge project number 00XX-01-07 (non-interstate) or 00XX-01-08 (interstate), activity code 032. When the county provides county owned PCMS, all maintenance responsibility rests with the county and is covered under the rental rate.

On an improvement contract, the maintenance is included in the changeable message sign bid item in the contract (Item 643.1050 Traffic Control Signs PCMS). The contractor would be required to check the sign at regular intervals.

PCMS USAGE

For PCMS placed on the STH, the PCMS **shall** either be:

1. Owned and placed by WisDOT
2. Owned and placed by contractors under contract with WisDOT
3. Owned, rented, or borrowed and placed by county highway departments under contract or permit with WisDOT.

County sheriff's departments and other local agencies **shall** work with the county highway departments to place the signs and display proper messages consistent with WisDOT policy. This includes any PCMS purchased by a county sheriff's department and other local agencies through funds received from the Bureau of Transportation Safety (BOTS).

ACCEPTABLE MESSAGES FOR WORK ZONES

The signs are generally capable of sequencing up to six frames. However, for driver comprehension, messages **shall** be limited to two frames (see MUTCD Section 6F.60). Blank or other filler frames between the two frames of text **shall not** be used. It is desirable for the driver to be able to read the entire message sequence twice as they pass by the sign. For an interstate highway application, the total viewing time is about seven seconds. Each frame is usually displayed for 2.0 seconds or less. Using more than two frames makes it difficult for drivers to read the entire message sequence twice. Do not flash any part of a message.

It is recommended that the first frame describe the traffic condition or problem ahead, which the motorist *may* encounter. The second frame would be used to advise the driver of an appropriate action. Examples are:

1st Frame	2nd Frame
ROAD CLOSED 2 MILES	USE EXIT #394

See the message list that follows for more examples.

MESSAGE EXAMPLES

EVENT	PANEL 1	PANEL 2	PANEL 1 Example	PANEL 2 Example	Duration	Reference
Project Prewarn (Long term)	ROAD WORK BEGINS	XXXXDAY XX/XX	ROAD WORK BEGINS	MONDAY 4/10	1 week prior	
Road Closure Prewarn (Long term)	ROAD TO CLOSE	XXXXDAY XX/XX	ROAD TO CLOSE	TUESDAY 10/8	1 week prior	L28
Freeway Closure Prewarn(Overnight)	FREEWAY TO CLOSE	XXXXDAY XXPM-XXAM	FREEWAY TO CLOSE	WED 11PM-9AM	3 days prior	
Bridge Closure Prewarn(Long term)	BRIDGE CLOSED BEGINS	XXXXDAY XX/XX	BRIDGE CLOSED BEGINS	THURS 6/1	1 week prior	
Rolling Closures Prewarn(Overnight)	ROLLING CLOSURES	XXXXDAY XXPM-XXAM	ROLLING CLOSURES	FRIDAY 11PM-4AM	3 days prior	
Ramp Closure Prewarn (Long term)	RAMP CLOSED BEGINS	XXXXDAY XX/XX	RAMP CLOSED BEGINS	SAT 9/12	1 week prior	
Ramp Closure (Overnight)	RAMP TO CLOSE	XXXXDAY XXPM-XXAM	RAMP TO CLOSE	SUNDAY 8PM-6AM	3 days prior	L67, L68, 15c2 15D16, 15d49
System Ramp Closed	HWY XX RAMP CLOSED	USE ALT ROUTE	HWY 67 RAMP CLOSED	USE ALT ROUTE	During work	15D49
Moving Work	MOVING LANE CLOSURES	NEXT XX MILES	MOVING LANE CLOSURES	NEXT 8 MILES	During work	L37, L45, L47, 15d43
Bridge Deck Curing	BRIDGE DECK CURING	DRIPPING WATER				
Concrete Repair	CONCRETE CURING	LANE REOPENS XX/XX	CONCRETE CURING	LANE REOPENS 7/3	During work	
Shoulder work	SHOULDER WORK AHEAD	NEXT XX MILES	SHOULDER WORK AHEAD	NEXT 10 MILES	During work	L7
2-way Left Turn Lane Closure	CENTER LANE CLOSED	NEXT XX MILES	CENTER LANE CLOSED	NEXT 1/4 MILE	DURING WORK	L32
New Traffic Pattern	NEW TRAFFIC PATTERN	LANES SHIFT (LEFT/RIGHT)	NEW TRAFFIC PATTERN	LANES SHIFT LEFT	Up to 1 week after	
New Traffic Pattern	NEW TRAFFIC PATTERN	LANES NARROW			Up to 1 week after	
New Traffic Pattern	NEW TRAFFIC PATTERN	AHEAD XX MILES	NEW TRAFFIC PATTERN	AHEAD 3 MILES	During work	L36
New Traffic Signal	NEW TRAFFIC SIGNAL	BE PREPARED TO STOP			Up to 2 weeks after	
New Stop Sign	NEW STOP SIGN	STOP AHEAD			Up to 2 weeks after	
Straddle Rumble Strips	LANE SHIFT (LEFT/RIGHT)	STRADDLE RUMBLE STRIPS	LANE SHIFT RIGHT	STRADDLE RUMBLE STRIPS	Up to 2 weeks after	
Lane Closures (Overnight)	NIGHTLY LANE CLOSURES	BEGIN XXXXDAY XXPM-XAM	NIGHTLY LANE CLOSURES	BEGIN MONDAY 8PM-7AM	1 week prior	

Lane Closures (Weekly)	WEEKLY LANE CLOSURES	BEGINS XXXXDAY XX/XX	WEEKLY LANE CLOSURES	BEGINS SUNDAY 5/19	1 week prior	
Lane Closure	(LEFT/RIGHT) LANE CLOSED	AHEAD XX MILES	RIGHT LANE CLOSED	AHEAD 2 MILES	During work	L35, L38, L39, L41
Freeway Closure	FREEWAY CLOSED	EXIT AHEAD			During work	15d42
Roundabout Flagging	ONE LANE ROAD AHEAD	BE PREPARED TO STOP			During work	L82
Night Flagging	FLAGGER AHEAD	BE PREPARED TO STOP			During night work only	
Multilane Closure	2 (LEFT/RIGHT) LANES CLOSED	AHEAD XX MILES	2 RIGHT LANES CLOSED	AHEAD 4 MILES	During work	L54
Oversize Vehicles	OVERSIZE TRUCKS	MUST EXIT			During work	
Ramp Closed	RAMP CLOSED AHEAD				During work	L48, L49, L50
Detour (Overnight)	HWY XX (DIRECTION) CLOSED	USE (ROUTE) XXX	HWY 60 EAST CLOSED	USE HWY P SOUTH	During work	
Detour Routing (Overnight)	HWY XX DETOUR TRAFFIC	USE (ROUTE)	HWY 60 DETOUR TRAFFIC	USE SHERMAN RD EB	During work	
End Detour (Overnight)	HWY XX DETOUR END	HWY XX AHEAD	HWY 60 DETOUR END	HWY 60 AHEAD	During work	
Dynamic Late Merge #1	STOPPED TRAFFIC AHEAD	USE BOTH LANES			During speeds 0 to 39 mph	15d12c
Dynamic Late Merge #2	STAY IN LANE	DO NOT MERGE			During speeds 0 to 39 mph	15d12c
Dynamic Late Merge #3	MERGE HERE	TAKE TURNS			During speeds 0 to 39 mph	15d12c
Queue Warning System	STOPPED TRAFFIC AHEAD	EXPECT DELAYS			During speeds 0 to 19 mph	15d12e
Queue Warning System	SLOW TRAFFIC AHEAD	PREPARE TO STOP			During speeds 20 to 39 mph	15d12e

When creating messages for state or county highways, it is recommended that the abbreviation HWY is used. For interstates either I-XX or HWY XX maybe used.

The Reference column lists either the Standard Detail Drawing or the Work Zone Field Manual Layout number the message is currently used on.

6-3-4.5 Width Restrictions

May 2022

Some highway construction projects require temporary lane width restrictions that cause problems for over-width load movements. Many of these moves are operating under annual permit and the permittees are unaware of the width restrictions. To help prevent inconvenience and the prospect of damage, signs are used to warn and direct the movers.

Multiple trip or annual permits for mobile homes are issued for loads up to 15 feet wide. Loads over 15 feet travel under single trip permits, and prior to permit issuance the route is checked. When loads up to 15 feet wide (plus one foot for shyness) cannot be accommodated through the work zone the signs described in this guideline are used. Therefore, signs are used when the effective width is less than 16 feet.

The width to be used on the signing is calculated by measuring laterally from centerline to object or object to object subtracting one foot for shyness. Drums, barricades, barriers and parapets also constitute lateral objects. Examples 1-5 at the end of this subject illustrate when width signing is required.

Post the W12-52, showing the numerical width in feet, in advance of one or more intersections or interchanges which will provide the mover an alternate route around the restriction. Check the adequacy of a logical alternate route when selecting the point at which the diversion is posted. Place a supplemental distance sign, WO57-52, installed beneath the W12-52. Post another W12-52 in advance of the restriction, generally along with the other construction warning signs. Install on both sides of a divided highway to enhance visibility

Post an R12-70 sign, Wide Loads Exceeding XX Ft, at the intersection or ramp where the diversion occurs, especially if the restricted highway is a freeway or expressway. An appropriate directional arrow is an acceptable supplement to this sign

Detour signing from the point of diversion to return to the highway is normally not needed. This is similar to a low clearance warning situation, where no alternate route is signed.

To avoid unnecessary signing and diversion of wide loads, accurate information must be obtained about the actual restriction. This information is entered into Lane Closure System (LCS) by Regional field staff. The information is used to update 511.

Projects having more than one lane open in a given direction, even though each lane might be somewhat narrowed, over-width traffic is often not diverted. Most multi-lane highways have shoulders that can be used temporarily to accommodate wide loads. An overhang from one lane to another can be tolerated for short distances such as ¼ mile. Therefore, width restriction signs are typically not necessary for restrictions on short stretches of multi-lane highways. Although, there may be higher volume segments where overhang from one lane to another is not desirable or longer stretches of multi-lane highways (1/4 mile or more) where adequate shoulders are not available, width restriction signs *may* be desirable. In these circumstances where the intent is to divert over width traffic, ensure LCS reflects what is represented on the width restriction signing.

There may be staging situations where off-peak lane closures are utilized on multi-lane highways with closed shoulders. Width restriction signing is required during off-peak operations. Cover or remove width restriction signing during peak operations.

On roadways where one lane is open in each direction, width restriction signs are not needed if the available width including shoulder (including at bridges and crossovers) is more than 16 feet.

On 2-lane, 2-way roadways where only one lane is open with a flagging operation, width restriction signs are not required.

Figure 1. Width Restrictions and Lane Closure System

Width Restrictions and Lane Closure System Example 1

2 Lanes Open

LCS Entry → (1′ + 11′ + 11′ + 1′) – 1′ buffer = **<u>23′ effective width</u>**

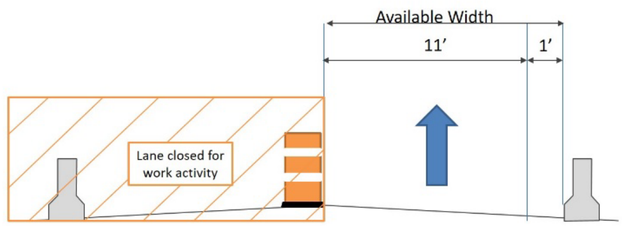
Available Width

(LCS auto-calculates effective width by subtracting 1′ buffer)

Available width ≥ 16′: No width warning sign required.

Width Restrictions and Lane Closure System Example 2

1 Lane Open



LCS Entry → (11′ + 1′) – 1′ buffer = **<u>11′ effective width</u>**

Available Width

(LCS auto-calculates effective width by subtracting 1′ buffer)

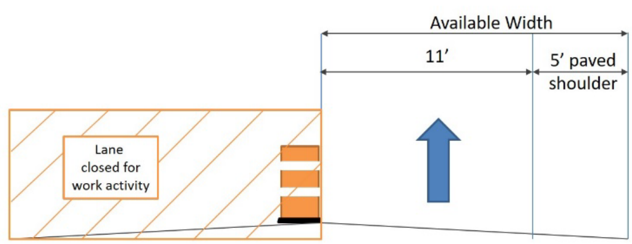
Width Signing → <u>11′ Max Width</u>

Available width < 16′:
Width warning sign(s) required.

Recommend 2 Locations:
- One in WZTC advanced warning area
- One at location where a wide load could exit with supplemental XX AHEAD sign below

Width Restrictions and Lane Closure System Example 3

1 Lane Open



LCS Entry → (11′ + 5′) – 1′ buffer = **<u>15′ effective width</u>**

Available Width

(LCS auto-calculates effective width by subtracting 1′ buffer)

Available width ≥ 16′: No width warning sign required.

Width Restrictions and Lane Closure System Example 4

LCS Entry → (12’ + 12’ + 5’) – 1’ buffer = **<u>28’ effective width</u>**

Available Width

(LCS auto-calculates effective width by subtracting 1’ buffer)

Available width ≥ 16’: No width warning sign required.

Not changing the typical width available for this facility.

Width Restrictions and Lane Closure System Example 5

SB LCS Entry → (12’) – 1’ buffer = **<u>11’ effective width</u>**

Available Width

(LCS auto-calculates effective width by subtracting 1’ buffer)

Width Signing → <u>11’ Max Width</u>

Available width < 16’:
Width warning sign(s) required.

Recommend 2 Locations:
- One in WZTC advanced warning area
- One at location where a wide load could exit with supplemental XX AHEAD sign below

6-3-6 Freeway Service Team Policy and Procedure January 2015

GENERAL

The Freeway Service Team (FST) provides expedited relocation of disabled and crashed vehicles made possible by the presence of FST vehicles continuously patrolling designated segments of interstate and state highways during designated hours and through designated work zones. This continuous patrol will facilitate a quick response time to non-recurring traffic incidents such as breakdowns and traffic crashes, thus reducing the total time needed to clear the incident from the highway and restore normal traffic flow. Other examples of situations where FST services *may* be utilized include special events, inclement weather, and other highway emergencies. The primary goal of the service is safe, quick clearance of traffic incidents thereby improving safety and minimizing traffic delays and congestion. FST are frequently used as part of a project’s work zone mitigation strategy and identified in the Transportation Management Plan (TMP). Please refer to FDM 11-50-5 Attachment 5.4: “Example TMP Type Mitigation Strategies and Elements” and FDM 11-50-30.8.

<u>Goals and Objectives</u>

The goals and objectives of FST are to:

1. Maintain capacity in work zones and high volume freeway segments
2. Provide assistance free of charge to disabled motorists

3. Maintain consistent service
4. Minimize work zone delay
5. Provide scene safety
6. Clear traffic incidents
7. Provide traffic control
8. Provide scene management (law enforcement FST only)
9. Detect and verify incidents
10. Remove debris.

Applicability

Law enforcement FST operates during specified hours of the day all year round. Work zone FST contracts will be for the duration of construction projects. If FST efforts are showing that traffic is moving better when they are providing service in peak hours than in non-peak hours, the project team could extend the FST hours of operation. FST contracts include language for accommodating changing hours of service and mileage. Project managers must be aware of financial impacts as scope changes are developed.

The FST service will provide towing services to relocate a disabled vehicle to the designated drop-off locations of the highways or freeways. This service will enhance the safety and efficiency of subsequent operations by private towing service providers that remove vehicles from the designated drop-off locations.

All FST assistance and relocation services are provided free of charge to the motorist.

RESPONSIBILITIES

Bureau of Traffic Operations (BTO)

1. Management of the FST program via FST program manager
2. Procurement of FST services
3. Notify project teams of contractor and hourly rates

Regional Project Development Section

Funding to cover FST charges must be included in budget and have a chargeable project ID.

Regional Traffic Engineers

Notify contractor of project start dates and required meetings. Some meetings that *may* be required are:

1. Preconstruction
2. Incident management
3. First responders.

Other Stakeholders

1. Regional communications manager
2. Law enforcement, fire, and EMS
3. Counties and local officials
4. Towing contractors
    a. Patrolling contract work zones
    b. Attending required meetings listed in 42.2.3

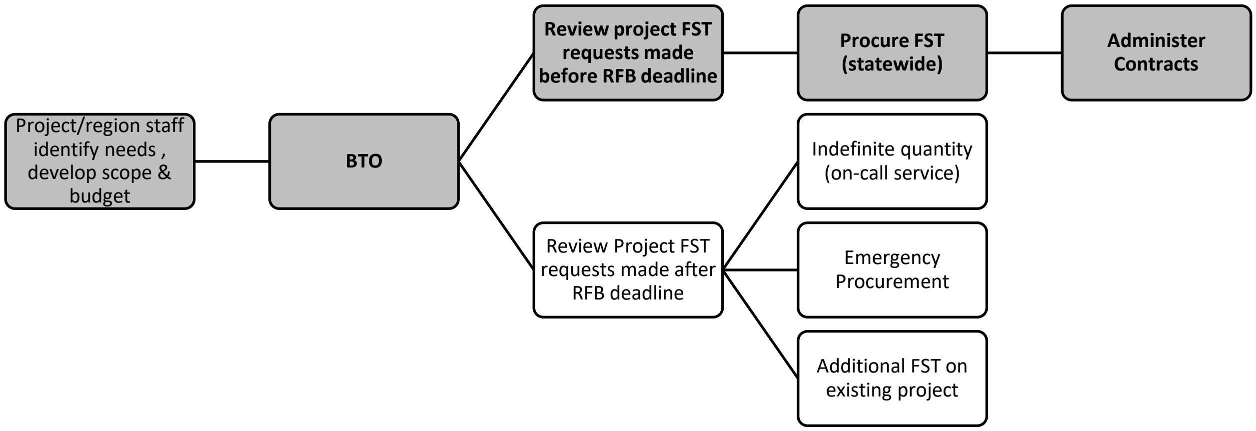
WORK ZONE FST

Project design staff will work with regional traffic operations to identify and quantify the need for FST for work zone mitigation. FST expense is paid from the project mitigation budget. Requests for work zone FST are made by December 15th of the year prior to construction via email to the FST program manager. All FST contracts are bid together in a statewide Request for Bids (RFB).

1. December 15: FST requests due for next construction year
2. February: RFB issued
3. March: RFB selections made for construction season

Figure 1 shows the flowchart for implementing work zone FST.

Figure 3. Work Zone FST Flowchart



Services to be Provided – General

The FST assists motorists whose vehicles have mechanical failure or have been involved in traffic crashes. The FST is responsible for clearing the highway of automobiles, motorcycles, small trucks, (vehicles with a gross vehicle weight of 8,000 pounds or less), and small nonhazardous debris. The FST relocates all cleared vehicles to the nearest drop-off location designated by the Contract Administrator. When responding to incident scenes, the FST provides assistance with traffic control as directed by law enforcement.

Assistance to Law Enforcement, Including Emergency Traffic Control

FST *may* be requested to lend assistance to law enforcement, specifically to assist with emergency traffic control at an incident scene. FST follows the instructions of the officer at the scene of any incident. Once temporary traffic control devices are established and it is determined that law enforcement does not need an immediate tow, the FST *should* continue to patrol the route until contacted by law enforcement for towing services or to remove the traffic control devices.

6-3-7 Freeway Service Team Sponsorship — November 2016

GENERAL

The department initiated the Freeway Service Team (FST) Sponsorship Program as an innovative source of revenue. The Sponsorship Program is intended to improve the transportation system and benefit the traveling public by increasing their awareness of available services. Additional revenues further enable WisDOT to provide necessary services and enhance the safety and efficiency of the State's highway system.

FST sponsorships offer recognition to a business or other entity for supporting FSTs that improve work zone safety. Sponsorship agreements *may* include sponsor recognition placed on FST vehicles under contract with the department and or signs as outlined in MUTCD 2H.08.

GOALS AND OBJECTIVES

The goals and objectives of FST Sponsorship are to:

- Create a public/private partnership to provide FST services
- Increase public awareness of program
- Provide sponsors an opportunities to promote traffic safety

RESPONSIBILITIES

Bureau of Traffic Operations (BTO)

- Management of the FST program via FST Program Manager
- Procure FST services
- Procure FST sponsorship(s)

Regional Traffic Engineers

Notify BTO of preconstruction meetings and project start dates

Other Stakeholders

- Regional Communications Manager
- Law enforcement
- Counties and local officials
- Towing contractors

ELIGIBLE SPONSORS

Eligibility for participation in the sponsorship program is limited to individuals, businesses and organizations that abide by state and federal laws that prohibit discrimination based on race, religion, color, age, sex, national origin, or sexual orientation, that do not promote illegal products or activities, and that do not harm the public image of the state or department.

SPONSORSHIP RECOGNITION

Vehicle marking, registered trademarks and lettering

A. The Sponsorship Contractor *may* apply markings and trademarks onto the FST trucks operated by Operator Contractors. The sponsor **shall** submit a design to WisDOT for approval.

B. No other markings *may* be placed on or in the FST vehicles, unless otherwise approved by WisDOT.

C. Any painting, placing, maintaining, repairing, adding or removing Vehicle Markings, Logos and Lettering must be conducted in such a manner as to not reduce the FST Operator Contractor's contractually required level of performance and availability.

D. Operator Contractors are required to have backup trucks to be used in the event the primary truck is damaged. When the backup truck is in use the Sponsorship Contractor *may* provide magnetic markings to indicate that the truck is part of the FST. The sponsor **shall** submit a design to WisDOT for approval.

E. WisDOT will determine when FST Operator Contractor contracts will end.

F. The sponsor is responsible for removal of all markings, logos and lettering from operator vehicles within two weeks of notification by WisDOT.

G. The Sponsorship Contractor is responsible for any damage to Operator Contractor vehicles as a result of graphics placement or removal.

ROADSIDE SIGNAGE

The Sponsorship Contractor *may* indicate its sponsorship of the FST program through roadside signage placed at certain designated locations within or approaching work zones where FST Operator Contractor vehicles are operating.

A. All Sponsorship Contractor signage **shall** be approved by WisDOT inclusive of design and placement. WisDOT reserves the right to require in certain circumstances signs to be removed, or placed in other locations at WisDOT's sole discretion.

B. All signs **shall** comply at all times with Federal Highway Administration (FHWA) guidelines, and all applicable Federal and Wisconsin rules, regulations and laws in effect at the present and in the future.

C. Acknowledgement signs **shall** be designed and installed as follows:

    i. No more than two signs per direction along a single work zone, in locations approved by WisDOT.

    ii. Signs (in one direction) *may* be spaced no closer than 3 miles apart except where approved by WisDOT.

    iii. Sign logo, layout, size and design **shall** be in accordance with the requirements of the MUTCD.

    iv. Signs shall be considered temporary and will be mounted on wooden posts. Sign size will be approved by WisDOT.

D. WisDOT will approve all sign locations. The standard sign location will be 800' in advance of the "Road Work Ahead" sign.

E. The minimum spacing between sponsorship acknowledgement signs and other signs should be:

i. 150’ on roadways with posted speed limits of 25 MPH or less.

ii. 200’ on roadways with posted speed limits of 30 MPH to 45 MPH

iii. 500’ on roadways with posted speed limits greater than 45 MPH

F. WisDOT will determine when FST Operator Contractor contracts will end.

G. Placing, replacing, maintaining, repairing, removing, covering or relocating signs must be done in accordance with WisDOT specifications. For questions contact the State Signing and Marking Engineer.

OPERATOR UNIFORMS

The Sponsorship Contractor *may* choose to provide uniforms to FST Contractor Operator drivers. Uniforms must comply with the following:

A. ANSI Class III compliant safety vests and pants. Vests **shall** have the Sponsors logo worn above the left chest pocket. Contractor **shall** provide enough sets of vests and pants such that each vehicle operator has clean sets of pants and vests.

B. Sponsor colored baseball type hat. The hat **shall** be made entirely of fabric (no mesh style hats) and will have the Sponsor’s logo on the front of the hat above the brim. Contractor **shall** provide enough hats such that the Operator Contractor *may* provide clean, legible hats as needed. FST Operator Contractor operators are not required to wear hats.

C. Sponsorship Contractor supplied sponsor logo patches/embroideries/prints for the uniforms, **shall** be approved by WisDOT prior to ordering.

6-3-10 Work Zone Incident Management Plans (IMPs) — December 2011

INTRODUCTION

An incident management plan is a set of strategies used to manage work zone traffic operations. These strategies include monitoring traffic conditions within the work zone and adjusting traffic operations based on changing conditions. IMPs address unplanned events or incidents for TMP project type 2 on freeways/expressways, and all TMP type 3 projects to ensure effective management of responses within the work zone. Formal IMP documents are not required for TMP type 2 projects on conventional highways, but if the project has detours or other temporary access restrictions, coordinate with emergency service providers regarding incident and access planning. Modify and update the IMP to address field issues as they occur. An IMP helps the contractor and the department to respond appropriately to incidents during construction within a reasonable timeframe in order to maintain traffic flow through the work zone safely. The IMP is part of the TMP and shall be submitted along with the TMP at the time of the completion of the draft PS&E. the draft IMP should be submitted along with the TMP worksheet at the time of the design study report (DSR).

It is the intent of WisDOT to minimize impacts and delays to motorists and to promote safety in work zones. Planning for traffic incidents that occur within work zones is a critical component of reducing delay and increasing the safety, mobility, and reliability of the highway system. The level of complexity of the IMP reflects the duration and complexity of the project and its impacts in the corridor/network. Long-term, complex reconstruction projects, such as the Marquette Interchange, necessitate comprehensive effort with procedures and processes to support the project. Short-term projects on lower-volume roads may simply require a meeting and/or some ongoing coordination with the appropriate local or regional emergency response agency.

Each project presents unique problems for emergency responders and the management of incidents that occur in the work zone. The intent of an IMP is to provide guidance and assistance in selecting mitigation strategies that meet the needs of WisDOT, the contractor, and emergency responders, while enhancing safety and mobility.

Answers to the questions listed below may help identify appropriate elements in the IMP.

1. How will this project impact emergency responses in this corridor?
2. Are there access issues for responding to incidents within the work zone?
3. If an incident closes the highway in one or both directions, how will traffic be rerouted?
4. Are there strategies to minimize project impacts on response agencies?
5. Are there strategies to minimize incident impacts on the public?

6. How will project personnel coordinate and assist emergency responders?

If it is determined that additional strategies are needed to ensure stakeholders' needs are met during construction, the strategies should be identified, documented, and implemented. They may include:

1. Contact lists for construction and utility personnel (include with IMP documentation when the contact lists become available)
2. Procedures for communicating with the contractor during an incident (include with IMP documentation when the procedures become available)
3. Procedures for updating response agencies on traffic control damages
4. Emergency access requirements
5. Variable message signs or other traveler information strategies
6. Detour routes to be used in the event of a long-term incident.

On more complex project where there is no traffic incident management in place, project staff and the contractor should meet with response agencies in the area to identify concerns and consider a full range of strategies to address these concerns. On project with multiple phases, it may be necessary to develop a plan for each phase of the project. The procedures and recommended strategies should be documented and distributed to all response agencies and construction personnel. Strategies that require implementation (e.g. signing, ITS devices, traffic management center, service patrol, etc.) should be planned and budgeted as part of the project and implemented at the start of the project. Training and follow-up sessions will be necessary to ensure that all agencies and construction personnel are familiar with the procedures in the plan. These should also be reviewed, revised, and updated as necessary throughout the life of the project.

Some of the tools that might be documented in the documentation include:

1. Incident levels and associated actions
2. List of response agencies
3. Roles and responsibilities of response agencies
4. Contact information and procedures
5. Scene management guidelines
6. Predetermined alternate routes
7. Resource information.

On any project, the minimum requirement should be to identify whether there is an existing program and determine the role of the contractor in implementing the program. Project staff or the contractor should also contact appropriate response agencies in the corridor to discuss their concerns with the proposed work zone and agree to procedures and strategies that will support traffic incident management. This communication and coordination is essential for any work zone. On more complex projects, this coordination will become more formalized and require the involvement of more stakeholders. It will necessitate a greater commitment of time and resources on the part of the contractor.

IMP REQUIREMENTS

<u>Identity Stakeholders</u>

In order to ensure work zones are safe and minimize the impact and delay to the traveling public, the plan should be developed in a collaborative effort with the emergency response and public safety community and incorporated into the transportation management plan. Planning for incidents that occur within work zones is a critical component for reducing delay and increasing the safety and reliability of the transportation system. Identify special events that may occur during the construction and may affect work times. Acquire special event coordinator contact information.

The regional project development section (PDS) is responsible for developing a project's TMP. The IMP should be developed by the regional PDS in coordination with the regional traffic section and Traffic Management Center (TMC).

<u>Costs</u>

Determining the costs to procure and deploy certain traffic control devices and types of mitigation strategies need to be identified during the scoping of the project. At the latest, the costs should be determined with the TMP.

<u>Work Zone Incident Management Plan Standard Format (i.e., Incident Response Guide)</u>

Each work zone IMP should include an incident response guide that provides a quick, in-the-field reference to response personnel. This ensures fast, effective, and consistent responses to incidents. The format listed below in Figure 1 is the standard table of contents that should be used when developing each IMP. The requirements of each section are described more in depth within this document.

Figure 5. Work Zone Incident Management Plan Outline

Project Summary
Checklists
- TMC Checklist
- Law Enforcement Checklist
- Project Leader Checklist
- Regional Incident Management Coordinator (RIMC) Checklist
- Regional Duty Officer (RDO) Checklist

Emergency Contact Information (when it becomes available)
Alternate Routes
Available Barricade Locations for Ramp Closures
Activation of Traveler Information Systems
- Normal Configuration
- Operational Backups (No Incident)
- Backups (Incident)
- Closed Highway

Appendices
- A. Alternate Route Maps (develop or insert if already available)
- B. Queue Backup and Work Zone Location Maps
- C. Emergency Access, Pullout and Traveler Information Equipment Location Map
- D. Project Location Map
- E. Traffic Volume Charts

Project Summary

The project summary and description should be described in the IMP. It may simply be the description used in the TMP document. The project summary should describe the location and type of project, the number of construction stages including where the closures will occur and anticipated dates and special events that may affect the work zone. Also include a brief description of traffic volumes and any extraordinary circumstances that need to be accounted for.

Checklists

Checklists are provided for use by the TMC, law enforcement, project leader, regional incident management coordinator (RIMC), and regional duty officer (RDO) in the event of an incident on the freeway/expressway system. Regular check-ins and after action reviews are recommended for all involved.

During an incident involving a work zone on the highway system, the TMC *should* follow the checklist below in order to collect the necessary information regarding the incident which occurred, contact the response team, and update the traveler information systems with appropriate up-to-date information.

TMC Checklist:

1. When receiving the call from law enforcement, ensure they provide the following information:
   a. Location of incident
   b. Whether it is located in a work zone
   c. Affected lanes
   d. Incident type
   e. Approximate incident duration
   f. Extent of backup
2. Must have immediate contact with:
   a. RIMC when there is a full highway closure in one or both directions that is expected to last greater than two hours
   b. RIMC whenever backups with or without an incident reach 3 miles or greater
   c. PIO, if available
   d. After incident and/or backup, ensure message boards are returned to lower level or normal configuration
   e. RDO if contractor or project staff assistance is needed in a work zone

  f. SINS email sent for an incident blocking 50% or more of the highway lanes and/or a system ramp
  g. Freeway Service Team (if available)
3. Once alternate routes are implemented, TMC will refer to the alternate route guide
4. Change traveler information in the following order:
   a. Message boards
   b. Message on highway advisory radio
   c. Place 511 message if necessary
5. Regular check-ins

During an incident involving a work zone on the highway system, the responsible law enforcement agency should follow the checklist listed below in order to report the necessary information regarding the incident which occurred, identify the severity of the incident, and deploy traffic control.

Law Enforcement Checklist:

1. Contact dispatch to report any incident or backups and the following information:
   a. Incident type
   b. Location of incident
   c. Best route to incident
   d. Extent of backup
   e. Establish a field command post
   f. Whether incident is located in a work zone
   g. Affected lanes
2. Identify incident classification
   a. Minor – less than 30 minutes duration
   b. Intermediate – 30 minutes to 2 hour duration
   c. Major – duration greater than 2 hours
3. Initiate traffic control as appropriate
   a. If traffic message boards are required, contact TMC
4. Inform media of highway incident (TIA)
5. State Patrol dispatch will contact TMC and advise the above information
6. If assistance is needed in work zone, contact TMC
7. If specialized equipment is needed in work zone, see contact list or list contacts:
   a. Equipment type: _____ Contractor Contact: _____
      (Example: crane to move barrier wall)
   b. At the conclusion of the incident, make appropriate demobilization notifications

The WisDOT project leader will follow the necessary steps during an incident.

Project Leader Checklist:

1. Project leader will contact event incident commander or State Patrol duty officer as situation warrants
2. Project leader will function as liaison for contractors
3. Project leader will contact project manager and/or project supervisor at backups of 5 miles or as situation warrants

The WisDOT regional incident management coordinator (RIMC) will follow the necessary steps during an incident.

RIMC Checklist:

1. RIMC will contact project leader as situation warrants
2. RIMC will contact event incident commander or State Patrol duty officer as situation warrants
3. RIMC will function as liaison for county highway departments
4. RIMC will contact DTSD regional duty officer at backups of 5 miles or as situation warrants

5. RIMC will perform regular check-ins

The WisDOT regional duty officer (RDO) will follow the necessary steps during an incident.

RDO Checklist:

1. RDO will coordinate project resources with contractor or regional staff as situation warrants
2. RDO will coordinate media release as situation warrants
3. RDO will mitigate traffic displays if possible

Emergency Contact Information

This table should be a complete list of contacts that may be notified during an incident within the work zone and completed at the time of the pre-construction meeting or as soon as the contact information is known. Additional persons may be identified.

*=Indicates number can be used 24 hours

AGENCY	CONTACT	OFFICE	CELL/OTHER
TRAFFIC MANAGEMENT CENTER (TMC)			
TMC	Main Number	800-375-7302*	414-227-2166 (Office)
LAW ENFORCEMENT			
Wis. State Patrol Emergency			
State Patrol Dispatch			
State Patrol Officers			
_____ County Sheriff			
_____ County Sheriff			
_____ Police Dept.			
_____ Police Dept.			
_____ Police Dept.			
_____ Police Dept.			
_____ Police Dept.			
_____ Fire Dept.			
_____ EMS			
DOT REGION MANAGEMENT			
Regional Duty Officer			
RIMC			
DOT Supervisor – PDS			
DOT Manager – PDS			
Regional Director			
Maintenance Supervisor			
Traffic Supervisor			
COUNTY PERSONNEL			
_____ County Commissioner			
_____ County Commissioner			
PROJECT STAFF			
Project Field Office			
Project Leader			
Project Manager			
PRIME CONTRACTOR			
Specialized Equipment Contractor			
TRAFFIC CONTROL - GENERAL			
General _____			
Message Boards _____			
OTHER TRAFFIC/EMERGENCY CONTACTS			
DOT Public Information Officer			
Freeway Service Team			
Special Events Coordinators			

Alternate Routes

If the corridor does not already have alternate routes established, project-specific alternate routes should be identified with each work zone on the highway system. Consistency in selecting alternate routes is an important aspect of the program. The following criteria provide a common starting point for evaluating potential alternate routes.

1. Use state highways whenever possible.
2. Consider long truck routes when available.
3. Avoid alternate routes with weight restrictions.
4. Avoid height restrictions imposed by bridge clearances, power lines, etc.
5. Avoid routes that require traffic to make 90-degree turns.
6. Avoid at-grade railroad crossings, especially those with a high number of trains.
7. Avoid four-way stops.
8. Select routes that carry traffic in the same general direction as the Interstate.
9. Minimize length of alternate routes.
10. Consider routes with coordinated signal timing plans or avoid routes with multiple uncoordinated signals.
11. Avoid traversing residential areas and school zones.
12. Carefully consider all routes options and closure requirements at interchanges, especially system interchanges.

Based on these criteria, a preliminary list of emergency alternate routes can be identified for freeway segments within a given study area. Potential routes should be evaluated to ensure that the roadway can handle freeway-type traffic volumes. A field review of potential emergency alternate routes should be conducted to confirm route selection. For further guidance in determining appropriate alternate routes, contact the TMC.

Provide a brief explanation of alternate routes. For example, “The preferred alternate routes for I-94 are the existing frontage roads. These provide quick access by traffic and limit the amount of adverse travel. If traffic backups extend beyond the listed access points, longer alternate routes can be implemented.

Explain alternate routes in detail below and provide alternate route maps in an appendix. For example, “For SB: Traffic can be diverted west on WIS 100 (Ryan Rd) to WIS 36, southwest on WIS 36 to US 45 to WIS 20 back to I-94. For NB: Traffic can be diverted west on WIS 20 to US 45, north on US 45 to WIS 36 to WIS 100 (Ryan Rd) and then east on WIS 100 back to I-94.”

If traffic backups extend beyond the access points of the barricade locations listed, longer alternate routes can be implemented.

Provide information on who needs to be contacted for each alternate route option. For example, “Contact TMC, State Patrol, Racine County, Village of Caledonia when alternate routes are implemented. See contact list.”

See appendix for alternate route map to be used for this project.

<u>Available Barricade Locations for Ramp Closures</u>

The IMP shall identify a list of the available barricade locations. During an incident, the incident commander organizes the ramp closures. Locations of barricades shall be included on the specialized equipment location map in the appendix.

Available Barricade Locations

Highway Ramp & Direction	Number of Barricades	Distance from Work Zone
Ex. Hwy KR to I-94 East (SB) ramp	*1 ramp gate*	*1 mile*

<u>Activation of Traveler Information Systems Scenario Examples</u>

Contact the TMC for activation of traveler information systems. Choose the sample messages below for use on traveler information devices.

<u>Normal Configuration</u>

Contact TMC

<u>Operational Backups (No Incident)</u>

Radio Message:

There are significant delays affecting motorists heading <direction> on <mainline highway> between <highway> and <highway> in <county> County. Motorists are encouraged to use alternate routes to avoid delays.

Message Board # _____ at _____:

Traffic Delay Ahead/Alternate Route Exit ##

Traffic Delay Ahead/Use Alternate Route

Delays XX Miles Ahead/Tune to AM ####

Additional message boards can be placed along the highway to notify the motorist.

Backups (Incident)

Radio Message:

As of <date/time>, law enforcement is reporting that a traffic incident is adversely impacting motorists heading <direction> on <mainline highway> between <highway> and <highway> in <county> County. Motorists are encouraged to use alternate routes to avoid delays.

Message Board # _____ at _____:

Incident Ahead Use/Alternate Route Exit ##

Incident Ahead/Use Alternate Route

<Left/Right/Center> Lane Blocked/Expect Delays

<Left/Right/Center> Lane Blocked/Use Alternate Route

Delays XX Miles Ahead/Tune to AM ####

Additional message boards can be placed along the highway to notify the motorist.

Blocked Highway

Radio Message:

As of <date/time>, law enforcement has closed <mainline highway> between <highway> and <highway> in <county> County to <direction> traffic. Motorists traveling <direction> must exit <mainline highway> and use alternate routes.

Message Board #_____ at _____:

Incident Ahead Use/Alternate Route Exit ##

Highway Closed Ahead/Exit at <highway>

Highway Closed Ahead/Follow Alternate Route

Highway Closed Ahead/Tune to AM ####

Additional message boards can be placed along the highway to notify the motorist.

Regularly review and revise the IMP to monitor current practices, identify and resolve issues to minimize frequency of incidents and severity. Assign an individual(s) on complex projects with the responsibilities of ensuring the IMP is up to date.

6-6-20 One-Lane Bridges June 2004

PURPOSE

The purpose of this subject is to provide some general guidelines for the selection of traffic signal control vs. stop sign controls at long-term (non-flagging) one-lane bridge construction sites. Since each one-lane bridge site is unique, a site-specific investigation of the factors affecting the selection *should* be done. A number of variables can influence the selection, so a definitive breakpoint between the two options cannot be defined. This subject will provide a discussion of the variables which *should* be analyzed and provide some general guidelines on the selection process.

FACTORS INFLUENCING THE CONTROL SELECTION

The following factors *should* be considered when evaluating the type of control at one-lane bridge sites.

1. Average Daily Traffic (ADT). This is a good general indicator in the selection process. Below 1,000 ADT or 100 vehicles per hour, a STOP sign control can usually be used without experiencing operational problems. Above 3,000 ADT, a traffic signal is usually a better choice for more efficient operation. These ADT values are not absolute and the other factors must be considered in the selection process.
2. Peak-Hour Traffic. If the bridge site is located near a larger city or on a recreational travel route or carries special event traffic, the peak-hour traffic will be a greater factor than the ADT. The bridge control must be able to accommodate the peak-hour traffic within a reasonable amount of time delay.
3. Directional Traffic Distribution. This again will be a factor if the bridge site is located just outside a large city on a route which is a major radial commuting route, or is a major recreational route.
4. Width Restriction. The width *may* influence the speed of traffic, increasing the clearance time necessary for a single vehicle to cross the bridge. The additional clearance time will reduce the capacity of both a stop-control and signal-control bridge site.
5. Time Duration of Project. For shorter projects (1-2 weeks), it *may* be acceptable to tolerate slightly oversaturated stop-control conditions, rather than implement a signal-control scheme.
6. Distance between Stoplines. This will greatly affect the one-lane capacity because it will dictate the clearance time necessary for a vehicle to cross the bridge. The stoplines *should* be kept as close as possible to the ends of the bridge allowing for necessary storage of construction equipment and placement of traffic control devices. Typically, each stopline *should* be placed about 150-250 feet from the end of the bridge. This allows workspace (usually less than 100 feet) for the contractor off the end of the bridge and a taper for the single-lane transition. With this constraint, the typical stopline-to-stopline distance is 300-500 feet, plus the length of the bridge. See SDD 15D33 (Traffic Control, One Lane Road with Temporary Signals) and 15D32 (Traffic Control, One Lane Road Stop Condition) for more details on dimensions and traffic control layout.

   On projects which involve bridge approach resurfacing of several hundred feet, the bridge work involving the one-lane controls *should* be staged first, thus allowing the closest stopline-to-stopline distance possible. Then, after the bridgework is completed, the one-lane bridge controls can be removed. The approach resurfacing can be completed by using a flagging operation. Further discussion is found under Special Cases.
7. Sight Distance between Stoplines. This factor in itself could dictate the control type. If adequate sight distance is not available (if bridge is an overpass on a sharp crest, or construction equipment or temporary concrete barrier is expected to block site), then traffic signal control must be used to assign right-of-way across the one-lane bridge. The stop-control situation, which is self-regulating, would fail without adequate sight distance, because it relies on motorists to see each other in order to determine which vehicle has the right-of-way.

GENERAL

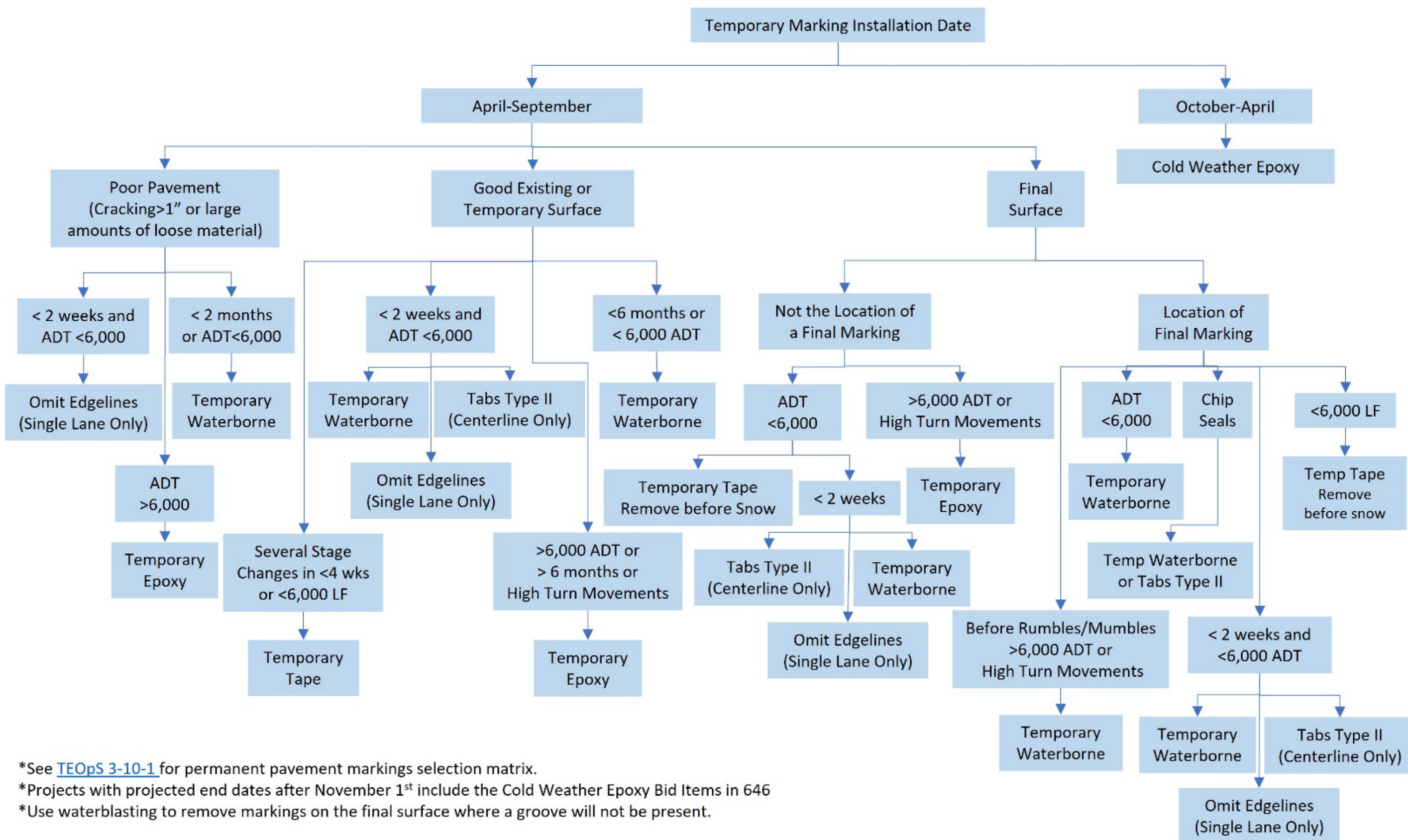
Temporary Pavement Markings help delineate the roadway during a construction project.

POLICY

Temporary Pavement Markings **shall** resemble the width and color of the permanent pavement markings. Temporary Pavement Markings can be one of the markings listed below:

1. Transition Areas, Lane Shifts, and Crossovers *may* use the following marking for emphasis:
   - Contrast lane lines (removable tape)
   - Type I temporary raised pavement markers
   - Solid lines (any product)
2. Same Day Marking
   - When the final marking needs to be placed quickly because the roadway is open to traffic.

Temporary Marking Selection



*See TEOpS 3-10-1 for permanent pavement markings selection matrix.
*Projects with projected end dates after November 1st include the Cold Weather Epoxy Bid Items in 646
*Use waterblasting to remove markings on the final surface where a groove will not be present.

6-10-20 Signing and Marking – Local Roads December 1992

GENERAL

When a local or county road is used as a STH detour route, the geometric characteristics of that route such as shoulder or pavement width or alignment often times are less than the characteristics of the STH route. Despite these conditions, the local road has been chosen as a detour route because it is the best alternative. Although the geometric standards *may* not be able to be upgraded, traffic control devices such as signing and marking *should* be upgraded to the same standards as the STH system. Exceptions are outlined below.

SIGNING

Concern has been expressed that local jurisdictions will incur some liability if signs are placed on their routes as an upgrade of their current standards during a STH detour and then removed. WisDOT General Counsel has determined that temporarily upgrading the signing along the local route does not place a liability upon the local municipality. (See attached December 3, 1991)

WARNING AND REGULATORY SIGNING

The signing along the detour route, Stop Signs, No Passing zone pennants, Curve, Turn and other warning and regulatory signs **shall** be installed along the route as if the detour route were a state trunk highway. If the detour will be in place less than two weeks, the Region will determine to what extent, if any, the signing will be upgraded. In the case of an emergency detour, the signing will be upgraded as soon as possible depending on the anticipated duration of the detour.

JUNCTION AND REASSURANCE ASSEMBLIES

Orange auxiliary arrows and detour auxiliary plaques **shall** be used in route marker assemblies in advance of and along the detour route. Reassurance markers **shall** be placed after every major intersection or at a spacing not to exceed two miles in rural areas and two blocks in urban areas.

QUALITY OF SIGNS

The condition of the signs used along the detour route **shall** be such that the signs have good daytime visibility and nighttime reflectivity. Care must be taken to ensure the signs are in good enough condition to command the respect and attention of motorists. This is especially important on detour routes since typically motorists who are unfamiliar with the route are depending on these signs for guidance.

REMOVAL OF DETOUR SIGNING

Some of the signs along the route *may* have been added to upgrade the route to STH signing standards. The local Jurisdiction *may* not wish to have these signs retain in place after the detour is no longer in place. Sign removal *should* be dependent on the wishes of the local Jurisdiction.

PAVEMENT MARKING

The condition of the marking *should* be such that it provides daytime and nighttime visibility and *should* be approximately equal in quality to that prevalent on State Trunk Highways.

CENTER LINE AND EDGE LINE MARKING

Unless the detour will be in place less than two weeks, the edge line and center line marking along the detour route *should* be in general agreement with WisDOT policy for marking on the STH System. If the detour will be in place less than two weeks, the Region will determine which, if any, markings need to be upgraded.

NO PASSING ZONE MARKING

Since local jurisdictions do not have the same No Passing zone criteria as the STH System, in some cases, the No Passing zones *may* need to be relocated using STH criteria. The Region is responsible for determining if the difference between local and STH criteria used when locating the zones differs enough to warrant remarking of the zones.

REMOVAL OF DETOUR PAVEMENT MARKING

If the marking along the route has been upgraded it is up to the Region and the local jurisdiction to determine if the marking *should* stay in place. Marking removal can be accomplished by contract or by resurfacing the roadway upon the completion of the detour.

Wisconsin Department of Transportation
Office of General Counsel

MEMORANDUM

To: Lee F. Crook
From: Jim Thiel Jim Thiel
Date: December 3, 1991
Subject: Policy on Detour No Passing Marking; OGC 91-456

You asked whether the policy of marking state trunk highway detours on local roads with the yellow and black NO PASSING ZONE warning pennants causes a legal problem of liability for the local agency when the detour is removed and the pennants are removed.

It is my opinion that the answer is NO, if the pennants are removed at the request of the local agency when the detour is removed. The reason is that installation of the NO PASSING ZONE pennant is a discretionary, policy decision on local roads by local governments. The local government traffic engineers can most appropriately decide what they want, i.e. no-passing zone pavement markings or black and white DO NOT PASS signs or combinations of the above and the NO PASSING ZONE pennants.

The Manual on Uniform Traffic Control Devices (MUTCD), paragraph 2C-38 deals with the NO PASSING ZONE sign (W14-3). It says the NO PASSING ZONE sign "should be used on two-lane roads to warn of the beginning of no-passing zones identified by either conventional pavement markings or DO NOT PASS signs or both." Our Wisconsin supplement to the MUTCD says "The W14-3 No Passing Zone sign shall be used on State Trunk Highways to designate no-passing zones." Paragraph 1A-5 of the MUTCD defines "shall" as a "mandatory condition. Where certain requirements in the design or application of the device are described with the "shall" stipulation, it is mandatory when an installation is made that these requirements be met." It defines "should" as "an advisory condition. Where the word "should" is used, it is considered to be advisable usage, recommended but not mandatory." Therefore use of the NO PASSING ZONE pennant is discretionary by local governments on local roads.

In considering whether to ask WISDOT to remove the pennants when the detour is removed, the local government is in the best position to make the policy decision whether uniformity of marking on the local system outweighs any marginal benefit of retention and maintenance of NO PASSING ZONE pennants when the STH detour is removed. There is no statutory requirement imposed on local governments to install or maintain NO PASSING ZONE pennants. There is no ministerial, mandatory duty for local governments to install them on local roads under the MUTCD. The local government may decide to retain the signs and maintain them as a safety precaution to the traveling public. Although there is no local, legal duty to erect them in the first instance, if the local government decides to keep them after the detour is removed, a court might decide there is a local, common law duty to maintain the signs in good condition if the court decides the public has developed a right to rely on their continued presence.

cc: Pete Rusch, Julie Neebel, Chuck Spang, Gerry Roth

8-2-2 Grade Crossing Sign Installation — February 2018

PURPOSE

Railroad corporations have unique legal abilities and responsibilities. Due to this fact, some signage responsibility for highway traffic falls to the railroad. These requirements are listed in various sections of the Wisconsin State Statutes. This policy will clarify installation and maintenance responsibilities for traffic signs at at-grade crossings.

DEFINITIONS

Passive Grade Crossings are defined as at-grade highway-railroad crossings without automatic gates or flashing-light signals.

Maintaining Authority is defined as the unit of government with the responsibility for roadway maintenance at a given crossing.

POLICY AND GUIDELINES

The following table summarizes the installation and maintenance responsibilities of various sign installed in conjunction with at-grade railroad crossings. See the text following the table for further details.

SIGN	INSTALLED BY	MAINTAINED BY
R15-1	Railroad	Railroad
R15-2P	Railroad	Railroad
R1-2	Railroad	Railroad
R1-1	Maintaining Authority	Maintaining Authority
R15-3P	Maintaining Authority	Railroad
R8-9	Railroad	Railroad
W10-1	*	Maintaining Authority
W10-1A	Maintaining Authority	Maintaining Authority
Other W10 series signs	Maintaining Authority	Maintaining Authority
I-13	Railroad	Railroad

REGULATORY SIGNS

R15-1 (Crossbuck) signs: These signs **shall** be installed and maintained by the Railroad at all at-grade crossings, per State Statute 192.29(5)(a). The railroad **shall** also install and maintain an R15-2P (Number of Tracks) sign below the R15-1 at all non-gated grade crossings with multiple tracks.

R1-2 (Yield) signs: These signs **shall** be installed and maintained by the Railroad at all non-stop controlled passive grade crossings, per State Statute 192.29(5)(b).

R1-1 (Stop) signs: These signs *may* be installed at at-grade crossings when deemed necessary for the public safety. If installed, these signs **shall** be installed and maintained by the maintaining authority, per State Statute 349.085.

R15-3P (Exempt): These signs **shall** be installed underneath the R15-1 sign (or R15-2P sign, if present) at crossings declared Exempt by the Office of the Commissioner of Railroads. The initial furnishing and installation of these signs **shall** be the responsibility of the maintaining authority, but **shall** be maintained by the Railroad. See State Statutes 195.285 and 346.45(3)(d).

R8-9 (Tracks Out of Service) signs: These signs should be used in place of crossbucks when railroad tracks have been taken out of service as described in the 2009 Wisconsin MUTCD Section 8B.10. These signs **shall** be installed and maintained by the Railroad.

WARNING SIGNS

*W10-1 (Grade Crossing Advance Warning) sign: These signs **shall** be installed at all at-grade highway crossings, unless specifically not required in the 2009 Wisconsin MUTCD Section 8B.06. When used, these signs (and any needed replacements) **shall** be furnished, upon request, by the Railroad for at-grade crossings of county or township maintained roadways, and by the maintaining authority for at-grade crossings of state, city, or village maintained roadways. These signs **shall** be installed by the maintaining authority. See State Statute 195.286(1).

W10-1A (Exempt) sign: These signs **shall** be installed underneath the W10-1 sign at crossings declared Exempt by the Office of the Commissioner of Railroads. These signs **shall** be installed and maintained by the maintaining authority. See State Statutes 195.285 and 346.45(3)(d).

All other W10 series signs – If used, these signs **shall** be installed and maintained by the maintaining authority.

OTHER SIGNS

I-13 (Emergency Notification Sign): These signs **shall** be installed and maintained by the Railroad at all at-grade highway crossings. These signs **shall** also be installed by the Railroad at all private at-grade crossings, by request of the landowner, per State Statute 192.29(6).

8-2-29 Dynamic Envelope Markings — November 2015

PURPOSE

The MUTCD Section 8B.29 defines dynamic envelope pavement markings as a 4-inch solid white line, placed parallel to and 6 feet away from the nearest rail of an at-grade crossing. The MUTCD further defines a supplemental marking consisting of 12-inch solid white lines, placed at a 45-degree angle and 5 foot spacing between the 4-inch solid lines. This policy will define when a dynamic envelope pavement marking installation *may* be desirable.

POLICY AND GUIDELINES

Between the 4-inch parallel lines, dynamic envelope markings fully cover 20 percent of the driving surface. This broad coverage area presents a potential safety hazard to bicycles and motorcyclists, as pavement marking material offers significantly less surface friction than unmarked pavement. In addition, this large amount of marking creates a maintenance issue for the department. For these reasons, the following policies **shall** apply to dynamic envelope marking installations on state maintained roadways:

1. Dynamic envelope pavement markings **shall not** be permanently installed on state maintained roadways. They **shall** only be used at at-grade crossings along detours of State, US, or Interstate highways on non-state maintained roadways.
2. Dynamic envelope pavement markings **shall not** be installed without prior approval from DTIM Rails and Harbors Section.
3. If used, dynamic envelope markings **shall** conform to the attached details (Figures 1-7).
4. Dynamic envelope markings **shall** be supplemented by appropriate signs, such as R8-8 DO NOT STOP ON TRACKS or W10-11-A Storage Space sign.
5. If installed along a detour route, the markings **shall** be either temporary paint or temporary epoxy. After construction, the department will not remove the markings. The maintaining authority of the roadway *may* remove the markings, maintain the markings, or allow the markings to fade away.

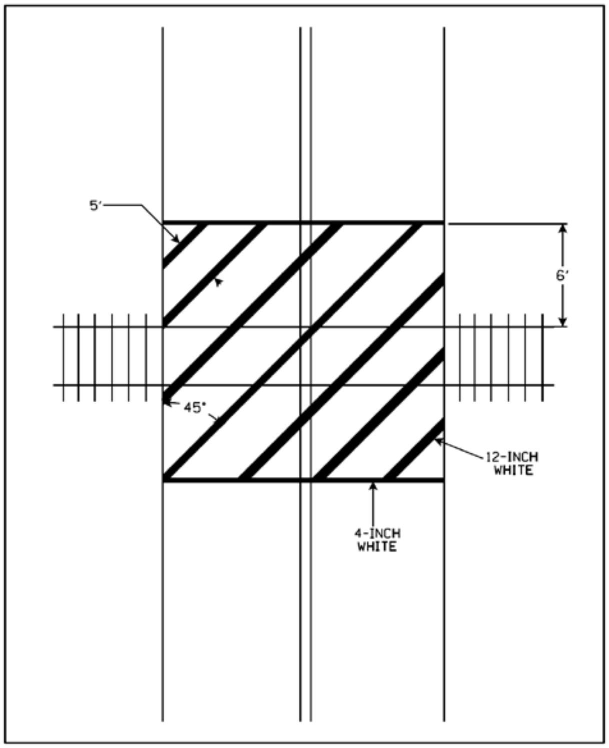


FIG. 1 90° CROSSING

DYNAMIC ENVELOPE MARKING

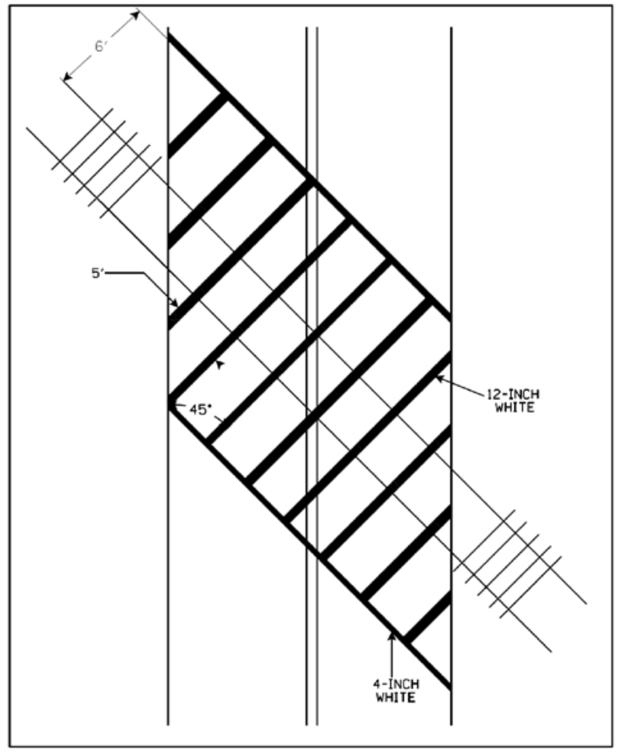


FIG. 2 LHF SKEW

DYNAMIC ENVELOPE MARKING

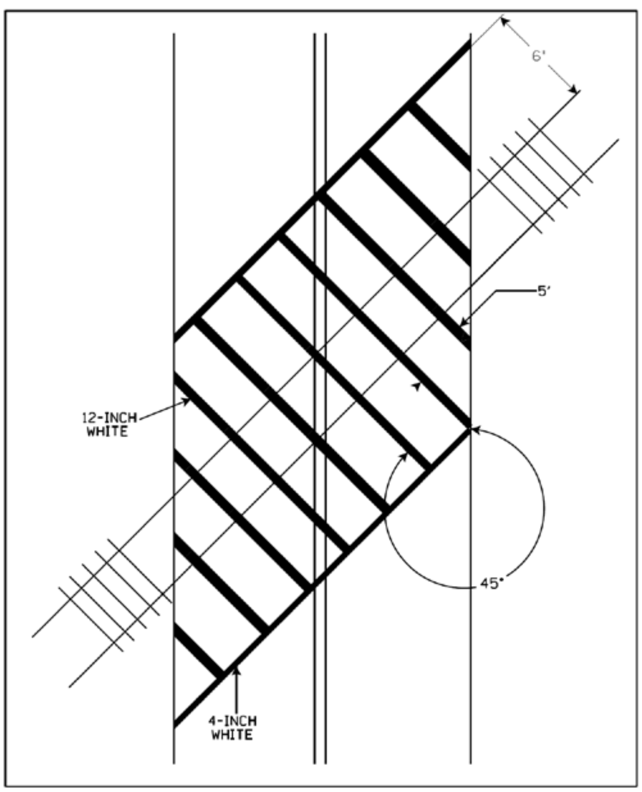


FIG. 3 RHF SKEW

DYNAMIC ENVELOPE MARKING

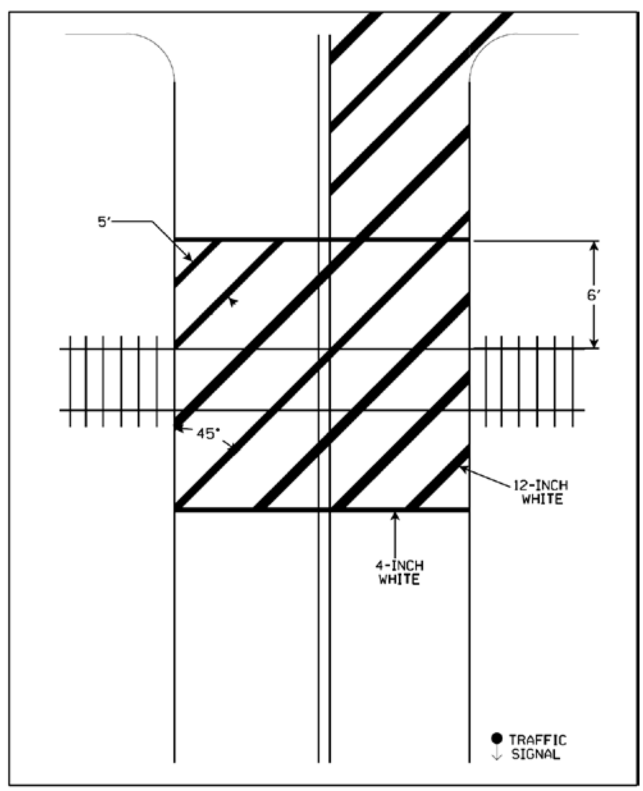


FIG. 4 90° CROSSING

SUPPLEMENTAL DYNAMIC ENVELOPE MARKING

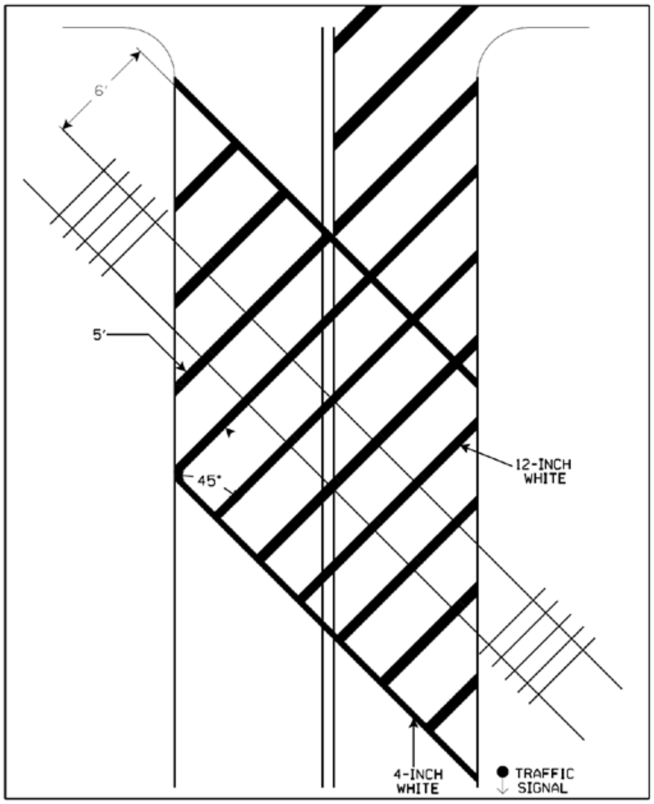


FIG. 5 LHF SKEW

SUPPLEMENTAL DYNAMIC ENVELOPE MARKING

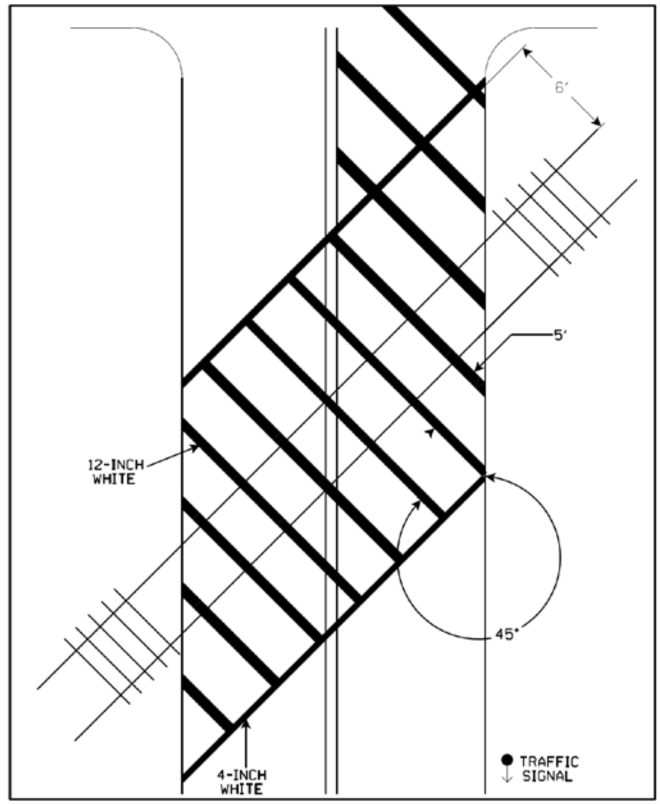


FIG. 6 RHF SKEW

SUPPLEMENTAL DYNAMIC ENVELOPE MARKING

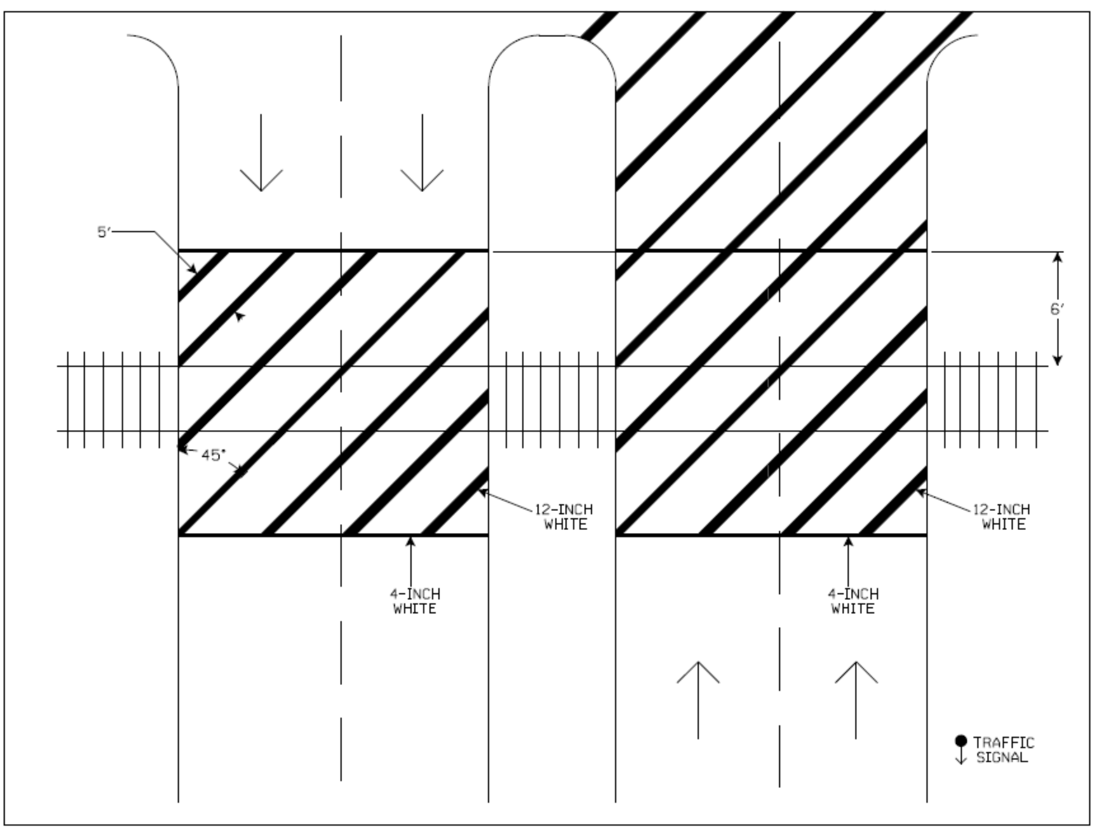


FIG. 7 4 LANE DIVIDED

SUPPLEMENTAL DYNAMIC ENVELOPE MARKING

9-2-18 SHARE THE ROAD Bicycle Warning Signs — April 2010

GENERAL

The MUTCD Section 9B.18 gives guidance on the usage of several types of bicycle warning signs. One warning sign mentioned is the SHARE THE ROAD (W16-1) plaque, which may be used in conjunction with the Bicycle Warning (W11-1) sign. The MUTCD states that the sign combination may be used to warn motorists to watch for bicyclists along the highway. However, the MUTCD guidance is general and does not specifically address problem areas. As a result, this sign combination has the potential to be overused and misused, which can result in motorist non-compliance of the signs in general. This policy will provide specific guidance as to where this sign combination may be used and restrict usage to areas where motorists may not be aware of bicyclists entering the roadway.

POLICY

The SHARE THE ROAD (W16-1) plaque **shall** only be used provided the following requirements are met:

1. Locations where there is a geometric change that would direct a bicyclist from a dedicated bikeway or paved shoulder into the travel lane.
2. The SHARE THE ROAD (W16-1) plaque shall not be used for roundabout locations. For roundabouts, it is expected that bicyclists and pedestrians will enter the roadway. If there are problem areas for roundabouts, the standard pedestrian crossing (W11-2) sign should be installed with supplemental arrow plaque (W16-7) sign.
3. In locations where the SHARE THE ROAD (W16-1) plaque is used, it **shall** be mounted below the standard Bicycle Warning (W11-1) sign or other appropriate warning sign (i.e. Narrow Bridge (W5-2) sign). The SHARE THE ROAD plaque **shall not** be mounted by itself on a post.
4. For locations requiring the usage of the SHARE THE ROAD (W16-1) plaque, and Bicycle Warning (W11-1) sign, WisDOT will pay for the installation and maintenance of the signs on the state highway system.

9-2-19 Bicycle Signing — June 2014

BACKGROUND

At times, the Department receives requests for the installation of signing pertaining to bicycle routes and bicycle lanes. These signs are often requested for areas where there are designated bicycle routes or lanes that run concurrent with State maintained roadways. The MUTCD Section 9B provides guidance on the placement of regulatory and guide signs for bicycles in order to provide guidance of decision points and reassurances along established bike routes. The intent of this policy is to clarify the MUTCD language and to establish a policy as to where WisDOT will allow the usage of bicycle route signs on State maintained roadways.

GENERAL POLICY

Bike Route signs *may* be used on the State highway system provided the following criteria are met:

1. The bike route would need to be an official, continuous route that is part of a national, local, or regional bike route system and would generally be considered a good candidate (adequate shoulder width on roadway and/or lower than 1000 ADT) for signage. Guide sign requests for bicycle routes *should* be coordinated between the Region Traffic Engineer and Region Bike/Pedestrian Coordinator.
2. The Region Traffic Engineer will review the request with the Region Bike and Pedestrian Coordinator. If the proposed bike signing is approved, a permit **shall** be issued to the local unit of government that is accepting long-term maintenance of the signing. Permit Form DT2500, is attached to this policy. A copy of the approved permit **shall** be sent to the local government and a copy **shall** be filed in the Region Office.
3. For installation of the signs, WisDOT will determine the locations of the signs. For communities requesting the signs, the appropriate county highway department, municipality or a WisDOT approved

signing contractor **shall** be contacted to install the signs. For counties requesting the signs, the county highway department *may* perform the installation following approval from the traffic operations engineer at the WisDOT Regional Office.

4. As part of the permit, the community or county would agree to pay all costs associated with initial installation and long-term maintenance of the signs. Installation *may* be included as part of an Improvement Project, however long-term maintenance of the signs would be the responsibility of the community or county.
5. If the bike route is removed or moved, the signs **shall** be adjusted accordingly.
6. Bike trail map kiosks **shall** be located outside the state highway right-of-way, off of the state trunk highway system. Prior to development or placement of a kiosk, coordination **shall** be made with the Region Outdoor Advertising contact.

INSTALLATION POLICY FOR BICYCLE ROUTE GUIDE SIGNS

1. Bicycle route guide signs (D11-1 signs with supplemental M7 series arrow plaque) **shall** only be used at decision points where the bike route turns off of the state trunk highway. Reassurance markers (confirmation signs) *may* be allowed on the state trunk highway for longer bike route sections or after major intersections.
2. The D11-1, bike route sign *may* utilize a supplemental D1 series name plaque. Street names **shall not** be utilized on the D1 series name plaque, only the official bike route name. If the D1 series name plaque is used, it *should* be mounted below the D11-1 sign.
3. When installed on roadways, D1 series signs **shall** only be installed as a supplement to the D11-1 sign.
4. The M1-8 or M1-8a bicycle route sign *may* be used in lieu of the D11-1 sign if the state or local bicycle route is identified by a unique route designation number. The D1 series name plaque *should not* be used with the M1-8 or M1-8a bicycle route sign.
5. If the M1-8a bicycle route sign is used, the pictograph **shall not** contain any commercial advertising. Colors of the pictograph *should* meet the requirements defined in TEOpS 2-15-6.
6. The M1-9 bicycle route sign **shall** only be used for a bicycle routes that travels through multiple states (interstate route) that is identified by a unique route designation number. This interstate bike route number is assigned by AASHTO. The D1 series name plaque *should not* be used with the M1-9 interstate bicycle route sign.

INSTALLATION POLICY FOR BICYCLE LANE REGULATORY SIGNS

1. The R3-17 Bike Lane sign **shall** only be installed at the beginning and ends of the bike lane and after major intersections or periodically along the route (refer to Figure 9C-6 in the MUTCD). The R3-17 Bike Lane sign is intended for locations where the bike lanes are continuous along the roadway. The R3-17 Bike Lane sign *should not* be used where the shoulder is the bike accommodation or where bike lanes are only provided at intersections.
2. If the R3-17 Bike Lane sign is used at the beginning or end of the bike lane, then the R3-17aP AHEAD or R3-17bP supplemental plaques **shall** be used.
3. The R4-4 Begin Right Turn Lane Yield to Bikes *may* be used for weave areas where there are demonstrated problems with motorists weaving across bicycle traffic upon entering an exclusive right turn lane. The R4-4 sign is typically not installed as part of an Improvement Project unless there were demonstrated problems with weaving prior to construction. The R4-4 sign *may* also be utilized in these locations as a replacement to the R3-20RR Begin Right Turn Lane Sign.

APPLICATION/PERMIT FOR BIKE LANE MARKING AND SIGNING

Wisconsin Department of Transportation
DT2500 5/2011 s.86.07(2) Wis. Stats.

When approved, this permit documents the terms and conditions for use by the Municipality for installation and/or maintenance of bike lane marking and signing on highways under the jurisdiction of the Wisconsin Department of Transportation. The applicant must obtain this approved permit prior to marking and signing the bike lane.

Submit the completed application to the WisDOT Regional Office that has maintenance jurisdiction of the state trunk highway in the county where the marking will be located. A single application will be made for each continuous bike lane segment.

Applicant – Municipality	County
Mailing Address	Area Code – Telephone Number FAX Number
Type of Project ☐ Improvement Project Agreement ☐ Maintenance Permit ☐ Retrofit Agreement	**Project ID** ☐ Yes, Project #__________ ☐ No ☐ N/A
Location: On Highway / Local Street Name	**Intersecting Street** From: To:
Type of Bike Lane Marking (design/dimensions) ☐ Other (attach detail & reason) (material) ☐ Paint ☐ Epoxy ☐ Preformed Plastic ☐ Preformed Thermoplastic ☐ Other, (specify)	**Speed Limit** mph
Operational Features ☐ Yes ☐ No Edge Line ☐ Yes ☐ No Symbols ☐ Yes ☐ No Words ☐ Yes ☐ No Signs	**Description/Type of Marking and Signing**
Reasons for Bike Lane Marking and Signing	

Marking and Signing Installation Conditions

1. By entering into this agreement, the Municipality agrees to the terms and cost arrangements in this policy document.
2. The design, installation and operation shall comply with Chapter 9 of the Wisconsin Manual of Uniform Traffic Control Devices.
3. During the installation and/or maintenance, the permittee shall follow all pertinent provisions for work zone traffic control as provided in Part 6 of the Wisconsin Manual of Uniform Traffic Control Devices.
4. The permittee shall coordinate the installation with the WisDOT Regional Office and other right-of-way users (i.e., utilities, adjacent property owners, etc.), unless other arrangements have been made.
5. The permittee shall repair any damage to the pavement and/or right-of-way caused by installation or maintenance of equipment. Failure to do so promptly will result in permit revocation.
6. The permittee shall notify WisDOT after layout of the authorized work has been completed, but prior to the installation of any markings.
7. Permitted facilities shall be located as defined within this permit. Any part of the facility found to be otherwise located shall be subject to correction by and at the cost of the applicant to such extent as the WisDOT Regional Office may specify.
8. The permittee should be aware that future upgrading of the highway will remove the permitted marking and signing. A future permit will be needed to replace the marking and signing.
9. Right of way permit

It is understood and agreed that approval is subject to the applicant's full compliance with the pertinent Statutes, as well as any codes, rules, regulations, and permit requirements of other jurisdictional agencies. The applicant shall also comply with all permit conditions, superimposed notes, and detail drawings, which may be added by WisDOT. Any alteration of this form by the applicant is prohibited and may be cause to revoke this permit.

The undersigned certifies that he/she is authorized to sign this application on behalf of the named unit of government.

X
(Authorized Representative) (Title) (Date)

Approved for the Wisconsin Department of Transportation

Permit Number = Region (NC, NE, NW, SE, or SW) – County Number – Three-digit, consecutive permit number

Permit Number	
- -	X (Regional Authorized Representative) (Area Code - Telephone Number) (Date)

INDEMNIFICATION

The Applicant shall save and hold the State, its officers, employees, agents, and all private and governmental contractors and subcontractors with the State under Chapter 84 Wisconsin Statutes, harmless from actions of any nature whatsoever (including any by Applicant itself) which arise out of, or are connected with, or are claimed to arise out of or be connected with any of the work done by the Applicant, or the construction or maintenance of facilities by the Applicant, pursuant to this permit or any other permit issued by the State for location of property, lines or facilities on highway right-of-way, (1) while the Applicant is performing its work, or (2) while any of the Applicant's property, equipment, or personnel, are in or about such place or the vicinity thereof, or (3) while any property constructed, placed or operated by or on behalf of Applicant remains on the State's property or right-of-way pursuant to this permit or any other permit issued by the State for location of property, lines or facilities on highway right-of-way; including without limiting the generality of the foregoing, all liability, damages, loss, expense, claims, demands and actions on account of personal injury, death or property loss to the State, its officers, employees, agents, contractors, subcontractors or frequenters; to the Applicant, its employees, agents, contractors, subcontractors, or frequenters; or to any other persons, whether based upon, or claimed to be based upon, statutory (including, without limiting the generality of the foregoing, worker's compensation), contractual, tort, or whether or not caused or claimed to have been caused by active or inactive negligence or other breach of duty by the State, its officers, employees, agents, contractors, subcontractors or frequenters; Applicant, its employees, agents, contractors, subcontractors or frequenters; or any other person. Without limiting the generality of the foregoing, the liability, damage, loss, expense, claims, demands and actions indemnified against shall include all liability, damage, loss, expense, claims, demands and actions for damage to any property, lines or facilities placed by or on behalf of the Applicant pursuant to this permit or any other permit issued by the State for location of property, lines or facilities on highway right-of-way in the past or present, or that are located on any highway or State property or right-of-way with or without a permit issued by the State, for any loss of data, information, or material; for trademark, copyright or patent infringement; for unfair competition or infringement of personal or property rights of any kind whatever. The Applicant shall at its own expense investigate all such claims and demands, attend to their settlement or other disposition, defend all actions based thereon and pay all charges of attorneys and all other costs and expenses of any kind arising from any such liability, damage, loss, claims, demands and actions.

Any transfer, whether voluntary or involuntary, of ownership or control of any property constructed, placed or operated by or on behalf of the Applicant that remains on the State's property or right-of-way pursuant to this permit shall not release Applicant from any of the indemnification requirements of this permit, unless the State is notified of such transfer in writing. Any acceptance by any other person or entity, whether voluntary or involuntary, of ownership or control of any property constructed, placed or operated by or on behalf of the Applicant that remains on the State's property or right-of-way pursuant to this permit, shall include acceptance of all of the indemnification requirements of this permit by the other person or entity receiving ownership or control.

Notwithstanding the foregoing, a private contractor or subcontractor with the State under Chapter 84 Wisconsin Statutes, that fails to comply with sections 66.047 and 182.0175 Wisconsin Statutes (1985-1986), remains subject to the payment to the Applicant of the actual cost of repair of intentional or negligent damage by the contractor or subcontractor to any property, lines or facilities placed by or on behalf of the Applicant pursuant to this permit or any other permit issued by the State for location of property, lines or facilities on highway right-of-way, and remains subject to payment to the Applicant for losses due to personal injury or death resulting from negligence by the contractor or subcontractor.

Notwithstanding the foregoing, if the State, or its officers, employees and agents, fail to comply with sections 66.047 and 182.0175 Wisconsin Statutes (1985-1986), the State or its officers, employees and agents, remain subject to the payment to the Applicant of the actual cost of repair of willful and intentional damage by the State, or its officers, employees and agents, to any property, lines or facilities placed by or on behalf of the Applicant pursuant to this permit or any other permit issued by the State for location of property, lines or facilities on highway right-of-way, and remain subject to payment to the Applicant for losses due to personal injury or death resulting from negligence by the State, its officers, employees and agents.

No indemnification of private contractors or subcontractors with the State under Chapter 84 Wisconsin Statutes, shall apply in the event of willful and intentional damage by such private contractors or subcontractors to the property, lines and facilities of the Applicant located on the highway right-of-way pursuant to this permit or any other permit issued by the State for the location of property, lines or facilities on highway right-of-way.

9-3-4 Bicycle Lanes April 2023

PURPOSE

WisDOT encourages bicycling by adding or utilizing space on roadways for use of bicyclists. This is done in one of three ways - paved shoulders, wide curb lanes and bicycle lanes. Of those three, only bicycle lanes are designated “bikeway” facilities as defined by AASHTO and the MUTCD. This chapter presents the appropriate markings for bicycle accommodations including bicycle lanes.

It *should* be noted that due to costs associated with maintaining bicycle lane markings and a significantly reduced maintenance budget, WisDOT has adopted the following policy to give guidance for both design and maintenance. This policy does not pertain to the connecting highway system. Connecting highways are maintained by local governments and aids are provided to cover the costs to maintain these facilities.

MARKING GUIDANCE AND POLICY

Paved Shoulders

Edge line markings for shoulders are maintained by the department along state highways. Bicyclists are the only vehicular user to be permitted to use shoulders under Wisconsin Statute 84.01 and will most often use that space when the condition of the pavement is satisfactory. When edge lines are added in urban cross-section streets to define shoulder segments or curb offsets, those markings will be maintained by the authority charged with the maintenance of the facility and will be considered part of our standard maintenance practice. These edge lines are added to prevent motorists from deviating from the travel lane or doubling up in an otherwise wide lane. Secondarily they also help define the space that bicyclists will use.

Occasionally at some intersections, markings will be added to the left of the right turn lane, for a separate bike slip lane as shown in SDD 15C 29 a and b and Table 1. These markings will also be maintained as part of the standard WisDOT practice if the rest of the street is not marked with bicycle lanes. If the rest of the facility is marked with bicycle lanes, the local community will be responsible for maintaining these markings along with all of the other markings.

Wide Curb Lanes

Wide curb lanes do not require markings of any kind to differentiate space for bicyclists. However, when lanes are 14’ or greater there *may* be operational reasons why an edge line is desired. Whenever a 6” edge line is added per TEOpS 3-10-1 for urban curb and gutter sections, WisDOT **shall** maintain these markings on WisDOT maintained facilities. A 6” edge line requires a permit when there is no operational reason for placement.

Bicycle Lanes

1. Rural Applications

Bike lane markings define preferential space for bicyclists and are considered bikeways. Bike lanes are rarely marked on rural highways.

Exception will be when **a highway is designed with 5 feet or wider paved shoulders or bike lanes to accommodate bicyclists per Wisconsin Statute 84.01(35) and Trans 75.**, then intersection treatments found in SDD 15C 29 a and b **shall** follow what is prescribed in the following table:

Table 1. Type A2, B1 and B2 Rural Intersection Treatments When Side road ADT exceeds 250 for design year *

	2 Lane w/ signals or signed or marked for right turn only	**2 Lane without signals or signed or marked for right turn only**	**4 Lane Divided with signals or signed or marked for right turn only**	**4 Lane Divided without signals or signed or marked for right turn only**
	SDD 15C 29 Drawing Detail Title, sheets a and b			
Posted Speed > 45mph	Bike Slip Lane	Wider Turn Lane or Bike Accommodations on Shoulder	N/a	Wider Turn Lane or Bike Accommodations on Shoulder
Posted Speed ≤ 45 mph	Bike Lane with symbols	Bike Slip Lane or Wider Turn Lane	Bike Lane 4 Lane Divided with Right Turn Lane	Bike Slip Lane or Wider Turn Lane

* All intersections types are found in SDD 9A 1 and FDM 11-25, Attachment 1.1

For A-1, C, and D intersection types no special intersection designs are necessary to accommodate bicyclists. Whenever a bike lane is marked to an intersection, it must be to the left of a right turn only lane as shown in these details.

2. Urban Applications

SDD 15C 29 c and d are urban type bike lane diagrams shown with and without parking and right turn lanes. The bike lane markings shown at the intersections are part of a continuous bike lane. However, it is permissible to use the bike lane intersection markings (bike slip lanes) independent of continuous bike lane markings if there is space at an intersection and the Region Traffic Engineer believes it will better serve bicyclists and motorists at an intersection through improved lane delineation.

If bike lane markings and symbols designating the preferential space are appropriate and the need approved by the Region Traffic engineer, permit DT2500 for symbols **shall** be issued to the local unit of government that is accepting long-term maintenance of the markings. WisDOT **shall** pay to initially mark them as part of a reconstruction or resurfacing project. All costs associated with subsequent maintenance will be borne by the participating local unit of government.

Refer to SDD 15C 29e for layout of the marking symbols and words.

PERMIT PROCESS/REQUIREMENTS

The Region Traffic Engineer will review the request with the Region Bike and Pedestrian Coordinator. It is recommended developing a maintenance agreement no later than the time of design study report (DSR). This will ensure that the local unit of government will clearly have knowledge of what they are to maintain. This is important for when local jurisdictions decide to add bike lane markings. If edge lines or bike lane markings are approved, a permit **shall** be issued to the local unit of government that is accepting long-term maintenance of the markings. Permit Form DT2500, is attached to this policy. A copy of the approved permit **shall** be sent to the local government and a copy **shall** be filed in the Region Office.

Existing markings *should* be evaluated with the community, based on need and safety, individually and collectively within the community.

The permit **shall** be officially signed and approved prior to any marking of new edge line or bike lane markings. Subsequent remarking will not require a new permit.

Under “Type of Project” on the permit form, use the following guidance:

- If the bike lane marking (existing or new) is to be marked as part of an improvement project, check the “Improvement Project Agreement” box.
- If the bike lane marking is to be first-time marked on existing pavement by the local government, check the “Retrofit Agreement” box.
- If an existing bike lane marking is to be remarked on existing pavement by the local government, check the “Maintenance Permit” box.

Failure to comply with the permit provisions **shall** void the permit and the bike lane markings **shall** be removed at the local government’s expense.

SUPPORTING THOUGHTS

Adding bicycle lanes is most practical and cost-effective at the time of reconstruction. There are likely to be many more opportunities for bike lane markings on the connecting highway system (590 miles) than on non-connecting state highways. This is especially true in the metropolitan areas of the state. Although there are approximately 1,175 miles of urban state highways (municipal extensions), hundreds of miles are categorized as freeways or are higher-speed rural cross-section highways at the edges of urban areas where shoulders are appropriate, but not bike lanes. While some municipal extensions of state highways will be good candidates for bicycle lanes, right of way constraints will likely limit prospects for many bike lanes on these highways. In some cases, wide curb lanes *may* still be possible candidates for these streets.

APPLICATION/PERMIT FOR BIKE LANE MARKING AND SIGNING

Wisconsin Department of Transportation
DT2500 5/2011 s.86.07(2) Wis. Stats.

When approved, this permit documents the terms and conditions for use by the Municipality for installation and/or maintenance of bike lane marking and signing on highways under the jurisdiction of the Wisconsin Department of Transportation. The applicant must obtain this approved permit prior to marking and signing the bike lane.

Submit the completed application to the WisDOT Regional Office that has maintenance jurisdiction of the state trunk highway in the county where the marking will be located. A single application will be made for each continuous bike lane segment.

Applicant – Municipality	County
Mailing Address	Area Code – Telephone Number FAX Number

Type of Project ☐ Improvement Project Agreement ☐ Maintenance Permit ☐ Retrofit Agreement	**Project ID** ☐ Yes, Project #________ ☐ No ☐ N/A
Location: On Highway / Local Street Name	**Intersecting Street** From: To:

Type of Bike Lane Marking (design/dimensions) ☐ Other (attach detail & reason)	(material) ☐ Paint ☐ Epoxy ☐ Preformed Plastic ☐ Preformed Thermoplastic ☐ Other, (specify)	**Speed Limit** mph

Operational Features ☐ Yes ☐ No Edge Line ☐ Yes ☐ No Symbols ☐ Yes ☐ No Words ☐ Yes ☐ No Signs	**Description/Type of Marking and Signing**

Reasons for Bike Lane Marking and Signing

Marking and Signing Installation Conditions

1. By entering into this agreement, the Municipality agrees to the terms and cost arrangements in this policy document.
2. The design, installation and operation shall comply with Chapter 9 of the Wisconsin Manual of Uniform Traffic Control Devices.
3. During the installation and/or maintenance, the permittee shall follow all pertinent provisions for work zone traffic control as provided in Part 6 of the Wisconsin Manual of Uniform Traffic Control Devices.
4. The permittee shall coordinate the installation with the WisDOT Regional Office and other right-of-way users (i.e., utilities, adjacent property owners, etc.), unless other arrangements have been made.
5. The permittee shall repair any damage to the pavement and/or right-of-way caused by installation or maintenance of equipment. Failure to do so promptly will result in permit revocation.
6. The permittee shall notify WisDOT after layout of the authorized work has been completed, but prior to the installation of any markings.
7. Permitted facilities shall be located as defined within this permit. Any part of the facility found to be otherwise located shall be subject to correction by and at the cost of the applicant to such extent as the WisDOT Regional Office may specify.
8. The permittee should be aware that future upgrading of the highway will remove the permitted marking and signing. A future permit will be needed to replace the marking and signing.
9. Right of way permit

It is understood and agreed that approval is subject to the applicant's full compliance with the pertinent Statutes, as well as any codes, rules, regulations, and permit requirements of other jurisdictional agencies. The applicant shall also comply with all permit conditions, superimposed notes, and detail drawings, which may be added by WisDOT. Any alteration of this form by the applicant is prohibited and may be cause to revoke this permit.

The undersigned certifies that he/she is authorized to sign this application on behalf of the named unit of government.

X

(Authorized Representative) (Title) (Date)

Approved for the Wisconsin Department of Transportation

Permit Number = Region (NC, NE, NW, SE, or SW) – County Number – Three-digit, consecutive permit number

Permit Number - -	**X** (Regional Authorized Representative) (Area Code - Telephone Number) (Date)

INDEMNIFICATION

The Applicant shall save and hold the State, its officers, employees, agents, and all private and governmental contractors and subcontractors with the State under Chapter 84 Wisconsin Statutes, harmless from actions of any nature whatsoever (including any by Applicant itself) which arise out of, or are connected with, or are claimed to arise out of or be connected with any of the work done by the Applicant, or the construction or maintenance of facilities by the Applicant, pursuant to this permit or any other permit issued by the State for location of property, lines or facilities on highway right-of-way, (1) while the Applicant is performing its work, or (2) while any of the Applicant's property, equipment, or personnel, are in or about such place or the vicinity thereof, or (3) while any property constructed, placed or operated by or on behalf of Applicant remains on the State's property or right-of-way pursuant to this permit or any other permit issued by the State for location of property, lines or facilities on highway right-of-way; including without limiting the generality of the foregoing, all liability, damages, loss, expense, claims, demands and actions on account of personal injury, death or property loss to the State, its officers, employees, agents, contractors, subcontractors or frequenters; to the Applicant, its employees, agents, contractors, subcontractors, or frequenters; or to any other persons, whether based upon, or claimed to be based upon, statutory (including, without limiting the generality of the foregoing, worker's compensation), contractual, tort, or whether or not caused or claimed to have been caused by active or inactive negligence or other breach of duty by the State, its officers, employees, agents, contractors, subcontractors or frequenters; Applicant, its employees, agents, contractors, subcontractors or frequenters; or any other person. Without limiting the generality of the foregoing, the liability, damage, loss, expense, claims, demands and actions indemnified against shall include all liability, damage, loss, expense, claims, demands and actions for damage to any property, lines or facilities placed by or on behalf of the Applicant pursuant to this permit or any other permit issued by the State for location of property, lines or facilities on highway right-of-way in the past or present, or that are located on any highway or State property or right-of-way with or without a permit issued by the State, for any loss of data, information, or material; for trademark, copyright or patent infringement; for unfair competition or infringement of personal or property rights of any kind whatever. The Applicant shall at its own expense investigate all such claims and demands, attend to their settlement or other disposition, defend all actions based thereon and pay all charges of attorneys and all other costs and expenses of any kind arising from any such liability, damage, loss, claims, demands and actions.

Any transfer, whether voluntary or involuntary, of ownership or control of any property constructed, placed or operated by or on behalf of the Applicant that remains on the State's property or right-of-way pursuant to this permit shall not release Applicant from any of the indemnification requirements of this permit, unless the State is notified of such transfer in writing. Any acceptance by any other person or entity, whether voluntary or involuntary, of ownership or control of any property constructed, placed or operated by or on behalf of the Applicant that remains on the State's property or right-of-way pursuant to this permit, shall include acceptance of all of the indemnification requirements of this permit by the other person or entity receiving ownership or control.

Notwithstanding the foregoing, a private contractor or subcontractor with the State under Chapter 84 Wisconsin Statutes, that fails to comply with sections 66.047 and 182.0175 Wisconsin Statutes (1985-1986), remains subject to the payment to the Applicant of the actual cost of repair of intentional or negligent damage by the contractor or subcontractor to any property, lines or facilities placed by or on behalf of the Applicant pursuant to this permit or any other permit issued by the State for location of property, lines or facilities on highway right-of-way, and remains subject to payment to the Applicant for losses due to personal injury or death resulting from negligence by the contractor or subcontractor.

Notwithstanding the foregoing, if the State, or its officers, employees and agents, fail to comply with sections 66.047 and 182.0175 Wisconsin Statutes (1985-1986), the State or its officers, employees and agents, remain subject to the payment to the Applicant of the actual cost of repair of willful and intentional damage by the State, or its officers, employees and agents, to any property, lines or facilities placed by or on behalf of the Applicant pursuant to this permit or any other permit issued by the State for location of property, lines or facilities on highway right-of-way, and remain subject to payment to the Applicant for losses due to personal injury or death resulting from negligence by the State, its officers, employees and agents.

No indemnification of private contractors or subcontractors with the State under Chapter 84 Wisconsin Statutes, shall apply in the event of willful and intentional damage by such private contractors or subcontractors to the property, lines and facilities of the Applicant located on the highway right-of-way pursuant to this permit or any other permit issued by the State for the location of property, lines or facilities on highway right-of-way.

9-3-7 Shared Lane Markings — August 2011

PURPOSE

WisDOT encourages bicycling by adding or utilizing space on roadways, for use of bicyclists. When this cannot be done, this policy gives guidance for when both bicyclist and motorist are sharing the roadway so to minimize motorist and bicyclist crashes.

Due to costs associated with maintaining shared lane markings and a significantly reduced maintenance budget, WisDOT has adopted specific maintenance provisions as part of the following policy.

This policy does not pertain to the connecting highway system. Connecting highways are maintained by local governments and aids are provided to cover the costs to maintain these facilities.

POLICY

Shared Lane markings

- Assist bicyclists with lateral positioning in a shared lane with on-street parallel parking in order to reduce the chance of a bicyclist's impacting the open door of a parked vehicle.
- Assist bicyclist with lateral positioning in lanes that are too narrow for a motor vehicle and a bicycle to travel side by side within the same traffic lane.
- Alert road users of the lateral location bicyclists are likely to occupy within the traveled way.
- Encourage safe passing of bicyclists by motorists
- Reduce the incidence of wrong-way bicycling.

These markings *should not* be placed on roadways that have a speed limit above 35 mph. They **shall not** be used on shoulders or in designated bicycle lanes. When used, the marking *should* be placed immediately after an intersection and spaced at intervals not greater than 250 feet thereafter.

Refer to SDD 15C 29f for layout of the marking.

PERMIT PROCESS/REQUIREMENTS

The Region Traffic Engineer will review the request with the Regional Bike and Pedestrian Coordinator. If shared lane markings are approved, a permit **shall** be issued to the local unit of government that is accepting long-term maintenance of the markings.

The form DT 2137 is attached to this policy. A copy of the approved permit **shall** be sent to the local government and a copy **shall** be filed in the Region Office.

The permit **shall** be officially signed and approved prior to any marking of new shared lane markings. Subsequent remarking will not require a new permit except after upgrading of the highway.

Existing markings *should* be evaluated with the community, based on need and safety, individually and collectively within the community.

Under "Type of Project" on the permit form, use the following guidance:

- If the shared lane marking (existing or new) is to be marked as part of an improvement project, check the "Improvement Project Agreement" box.
- If the shared lane marking is to be first-time marked on existing pavement by the local government, check the "Retrofit Agreement" box.
- If an existing shared lane marking is to be remarked on existing pavement by the local government, check the "Maintenance Permit" box.

Failure to comply with the permit provisions **shall** void the permit and the shared lane markings **shall** be removed at the local government's expense.

APPLICATION/PERMIT FOR SHARED LANE MARKING

Wisconsin Department of Transportation
DT2137 5/2011 s.86.07(2) Wis. Stats.

When approved, this permit documents the terms and conditions for use by the Municipality for installation and/or maintenance of shared lane markings on highways under the jurisdiction of the Wisconsin Department of Transportation. The applicant must obtain this approved permit prior to marking a shared lane symbol.

Submit the completed application to the WisDOT Regional Office that has maintenance jurisdiction of the state trunk highway in the county where the marking will be located. A single application will be made per continuous segment of shared lane markings. A map with corresponding details is required for all applications.

Applicant – Municipality	County
Mailing Address	Area Code – Telephone Number FAX Number

Type of Project ☐ Improvement Project Agreement ☐ Maintenance Permit ☐ Retrofit Agreement	**Project ID** ☐ Yes, Project #________________ ☐ No ☐ N/A
Location: On Highway / Local Street Name	**Intersecting Street** From: To:

Type of Shared Lane Marking (material) ☐ Paint ☐ Epoxy ☐ Preformed Plastic ☐ Preformed Thermoplastic ☐ Other, (specify)	**Speed Limit** mph	**List supplemental signing to be used**
Operational Features ☐ Yes ☐ No Recognized Bike Route ☐ Yes ☐ No Parking ☐ Yes ☐ No Curbs Available	**Width of Travel Lane**	**Width of Parking Lane** (if present)

Shared Lane Marking Installation Conditions

1. By entering into this agreement, the Municipality agrees to cover all costs related to the placing and maintaining of permitted shared lane markings.
2. The design, installation and operation shall comply with Chapter 9 of the Wisconsin Manual of Uniform Traffic Control Devices.
3. During the installation and/or maintenance, the permittee shall follow all pertinent provisions for work zone traffic control as provided in Part 6 of the Wisconsin Manual of Uniform Traffic Control Devices.
4. The permittee shall coordinate the installation with the WisDOT Regional Office and other right-of-way users (i.e., utilities, adjacent property owners, etc.).
5. The permittee shall repair any damage to the pavement and/or right-of-way caused by installation or maintenance of equipment. Failure to do so promptly will result in permit revocation.
6. The permittee shall notify WisDOT after layout of the authorized work has been completed, but prior to the installation of any markings.
7. Permitted facilities shall be located as defined within this permit. Any part of the facility found to be otherwise located shall be subject to correction by and at the cost of the applicant to such extent as the WisDOT Regional Office may specify.
8. The permittee should be aware that future upgrading of the highway will remove the permitted marking. A future permit may be needed to replace the marking.

It is understood and agreed that approval is subject to the applicant's full compliance with the pertinent Statutes, as well as any codes, rules, regulations, and permit requirements of other jurisdictional agencies. The applicant shall also comply with all permit conditions, superimposed notes, and detail drawings, which may be added by WisDOT. Any alteration of this form by the applicant is prohibited and may be cause to revoke this permit.

The undersigned certifies that he/she is authorized to sign this application on behalf of the named unit of government.

X

(Authorized Representative) (Title) (Date)

Approved for the Wisconsin Department of Transportation

Permit Number = Region (NC, NE, NW, SE, or SW) – County Number – Three-digit, consecutive permit number

Permit Number - -	**X** (Regional Authorized Representative) (Area Code - Telephone Number) (Date)

INDEMNIFICATION

The Applicant shall save and hold the State, its officers, employees, agents, and all private and governmental contractors and subcontractors with the State under Chapter 84 Wisconsin Statutes, harmless from actions of any nature whatsoever (including any by Applicant itself) which arise out of, or are connected with, or are claimed to arise out of or be connected with any of the work done by the Applicant, or the construction or maintenance of facilities by the Applicant, pursuant to this permit or any other permit issued by the State for location of property, lines or facilities on highway right-of-way, (1) while the Applicant is performing its work, or (2) while any of the Applicant's property, equipment, or personnel, are in or about such place or the vicinity thereof, or (3) while any property constructed, placed or operated by or on behalf of Applicant remains on the State's property or right-of-way pursuant to this permit or any other permit issued by the State for location of property, lines or facilities on highway right-of-way; including without limiting the generality of the foregoing, all liability, damages, loss, expense, claims, demands and actions on account of personal injury, death or property loss to the State, its officers, employees, agents, contractors, subcontractors or frequenters; to the Applicant, its employees, agents, contractors, subcontractors, or frequenters; or to any other persons, whether based upon, or claimed to be based upon, statutory (including, without limiting the generality of the foregoing, worker's compensation), contractual, tort, or whether or not caused or claimed to have been caused by active or inactive negligence or other breach of duty by the State, its officers, employees, agents, contractors, subcontractors or frequenters; Applicant, its employees, agents, contractors, subcontractors or frequenters; or any other person. Without limiting the generality of the foregoing, the liability, damage, loss, expense, claims, demands and actions indemnified against shall include all liability, damage, loss, expense, claims, demands and actions for damage to any property, lines or facilities placed by or on behalf of the Applicant pursuant to this permit or any other permit issued by the State for location of property, lines or facilities on highway right-of-way in the past or present, or that are located on any highway or State property or right-of-way with or without a permit issued by the State, for any loss of data, information, or material; for trademark, copyright or patent infringement; for unfair competition or infringement of personal or property rights of any kind whatever. The Applicant shall at its own expense investigate all such claims and demands, attend to their settlement or other disposition, defend all actions based thereon and pay all charges of attorneys and all other costs and expenses of any kind arising from any such liability, damage, loss, claims, demands and actions.

Any transfer, whether voluntary or involuntary, of ownership or control of any property constructed, placed or operated by or on behalf of the Applicant that remains on the State's property or right-of-way pursuant to this permit shall not release Applicant from any of the indemnification requirements of this permit, unless the State is notified of such transfer in writing. Any acceptance by any other person or entity, whether voluntary or involuntary, of ownership or control of any property constructed, placed or operated by or on behalf of the Applicant that remains on the State's property or right-of-way pursuant to this permit, shall include acceptance of all of the indemnification requirements of this permit by the other person or entity receiving ownership or control.

Notwithstanding the foregoing, a private contractor or subcontractor with the State under Chapter 84 Wisconsin Statutes, that fails to comply with sections 66.047 and 182.0175 Wisconsin Statutes (1985-1986), remains subject to the payment to the Applicant of the actual cost of repair of intentional or negligent damage by the contractor or subcontractor to any property, lines or facilities placed by or on behalf of the Applicant pursuant to this permit or any other permit issued by the State for location of property, lines or facilities on highway right-of-way, and remains subject to payment to the Applicant for losses due to personal injury or death resulting from negligence by the contractor or subcontractor.

Notwithstanding the foregoing, if the State, or its officers, employees and agents, fail to comply with sections 66.047 and 182.0175 Wisconsin Statutes (1985-1986), the State or its officers, employees and agents, remain subject to the payment to the Applicant of the actual cost of repair of willful and intentional damage by the State, or its officers, employees and agents, to any property, lines or facilities placed by or on behalf of the Applicant pursuant to this permit or any other permit issued by the State for location of property, lines or facilities on highway right-of-way, and remain subject to payment to the Applicant for losses due to personal injury or death resulting from negligence by the State, its officers, employees and agents.

No indemnification of private contractors or subcontractors with the State under Chapter 84 Wisconsin Statutes, shall apply in the event of willful and intentional damage by such private contractors or subcontractors to the property, lines and facilities of the Applicant located on the highway right-of-way pursuant to this permit or any other permit issued by the State for the location of property, lines or facilities on highway right-of-way.

11-1-1 Initial System Approval — April 2024

PURPOSE

This policy describes the requirements for approval to install WisDOT owned and maintained roadway lighting facilities on the Wisconsin State Highway System.

POLICY

All lighting on the State Trunk Highway system that is owned and maintained by WisDOT **shall** require approval in accordance with this policy.

PROCEDURAL REQUIREMENTS

The State Lighting Systems Engineer in the Bureau of Traffic Operations **shall** approve all proposed new roadway lighting system installations on the State Trunk highway system except for systems as described in FDM 11-50-60 that do not require approval. When there is a possibility a project *may* include the installation of roadway lighting, the WisDOT project manager for design **shall** work with the Region Lighting Engineer in the traffic section to submit a DT1198 Roadway Lighting System Approval Request, supported by an investigation report, to the State Lighting Systems Engineer. These documents **shall** be submitted and approved before any commitments are made concerning the installation of roadway lighting systems. Roadway Lighting Systems Approval Requests *should* be completed and approved prior to the 60% design level of completion and the submittal of the Design Study Report (DSR) for a project.

The investigation report provides an objective description and analysis of the roadway/project for the State Lighting Systems Engineer to use in recommending installing and maintaining a roadway lighting system.

The report **shall** include (as applicable):

- DT1198 Roadway Lighting System Approval Request.
- Description/discussion of the project and plan drawing(s) of the roadway project under consideration.
- Data pertinent to determine the need for roadway lighting that includes, but not limited to:
  - Traffic volumes minimally broken down into day vs. night, but more specific time periods when pertinent to the investigation.
  - Crash history on the existing road including type of crash and if darkness was a pertinent factor.
  - Evaluation of other crash avoidance measures (geometric, signing, striping, etc.) being considered and/or implemented and how roadway lighting relates to this overall safety evaluation.
  - Analysis based on the minimum warranting conditions as minimum thresholds for further consideration of roadway lighting as described in the current AASHTO Roadway Lighting Design Guide.
  - Other factors such as pedestrian and bike use, adjacent land uses, environmental conditions, and other pertinent aspects of the project area for determining whether roadway lighting is appropriate.
- Installation cost and maintenance/energy costs.
- Discussion, correspondence, recommendations from local jurisdictions, and any written agreements relating to roadway lighting on the project.
- Preliminary design criteria, classification data, and recommended lighting levels.
- Alternative analysis *may* be appropriate if multiple layout configurations are being considered.
- A recommendation with supporting discussion based on the above evaluation.

Roadway lighting warrant thresholds established by AASHTO and IES have been classified based on geometric, operational, environmental conditions, and accident history, which address existing facilities only. Roadway lighting warrants do not provide sufficient guidance for determining the requirement for roadway lighting on new facilities. Designers **shall** apply engineering judgement when using warrants to justify installing roadway lighting.

The State Lighting Systems Engineer will evaluate the proposal based on the information in the investigation report along with consideration of any additional items pertinent to the specific project and provide approval for acceptable projects.

Regardless of the need for approval, all WisDOT maintained roadway lighting systems **shall** follow the design process described in other TEOpS sections.

EXEMPTIONS

Roadway lighting on connecting highways and permitted roadway lighting maintained by local municipalities on State Trunk highway system are exempt from submitting a DT1198 request for approval. However, in these cases a separate approval process *may* be required, and the project manager **shall** work with the Regional Lighting Engineer to accommodate coordination and oversight of the design.

APPLICABLE FORMS

- DT1198 – Roadway Lighting System Approval Request

11-1-2 Roadway Lighting System Design Approval — April 2024

PURPOSE

The purpose of this policy is to prescribe guidelines and procedures that will help ensure consistent roadway lighting system designs statewide and clarify the review requirements.

POLICY

All WisDOT maintained Roadway Lighting System designs **shall** follow the process described in this document.

PROCEDURAL REQUIREMENTS

For all Projects covered under this policy, after receiving the necessary Roadway Lighting System Approval described in TEOpS 11-1-1.

The designer **shall** send a copy of all submittals to the Regional Lighting Engineer.

LOCALLY OWNED ROADWAY LIGHTING SYSTEMS

All locally owned and maintained roadway lighting systems on the State Trunk Highway system **shall** be based on Connecting Highway agreements, or otherwise will require a permit in accordance with TEOpS 11-2-1.

APPLICABLE FORMS

- DT1886 – Continuous Lighting Illumination Application
- Signalized Intersection Illumination Form (see TEOPS 11-4-2)
- Roundabout Illumination Form (See TEOPS 11-4-3)

CONTINUOUS LIGHTING ILLUMINATION APPLICATION

DT1886 4/2015 s.84.02(4)(c) Wis. Stats.

~~Wisconsin Department of Transportation~~

State Project Number

Submit to the Regional Office of the Wisconsin Department of Transportation, including:

- ☐ This completed DT1886 Continuous Lighting Form. Provide additional forms as necessary when there are multiple Roadways and/or Roadway Types.
- ☐ Engineering drawing of the Roadway Plan, or typical section, showing edge of pavement, curb lines, shoulders, etc.
- ☐ Brief description of the project

Design Information (Provide additional forms as necessary for multiple roadways and/or roadway types)

Highway	Lighting Limits
Project Lighting Engineer Name, Mailing Address and Telephone	

County	Posted Speed Limit	ADT	Cross Section	Roadway Width
	mph		Rural Urban	ft

Road Class	Area Class	Pavement Class
☐ Major ☐ Minor Arterial ☐ Collector ☐ Other	☐ Commercial ☐ Residential ☐ Intermediate	☐ R1 ☐ R3 ☐ R2 ☐ R4

Based on Roadway information above, provide Design Criteria Values in accordance with AASHTO 2005 Roadway Lighting Guide, Table 3-5a.

Luminaire LED Category	Mounting Height Above Pavement

Target Illuminance Values		Target Luminance Values		
Average FC	Uniformity Ave/Min	Average cd/m sq	Veiling Luminance Ratio Lv(max)/Lavg	Uniformity Ave/Min Max/Min

The designated engineer requests permission to begin the design of highway lighting within the limits of the right of way of the state trunk highway, all as described above.

X

(Lighting Engineer) (Date – m/d/yy)

APPROVAL

Permission is granted to begin the highway lighting design as described above and per the attached drawings and specifications.

CONTINUOUS LIGHTING

Approved for Division of Transportation System Development

X

(Signature) (Date Reviewed – m/d/yy)

11-2-1 Permitted Roadway Lighting System Approval — April 2024

PURPOSE
This policy describes the requirements for approval of roadway lighting facilities install and maintained by local agencies (or other entities) within the limits of the public highway rights-of-way on the State Trunk Highway System.

POLICY
All locally owned and maintained roadway lighting systems installed on the State Trunk Highway System **shall** require a permit in accordance with this document.

The provisions of this policy **shall** apply to all cities, villages, counties, and towns (i.e., local agencies) which desire to use or occupy rights-of-way on the State Trunk Highway System for locally owned and maintained roadway lighting and other types of lighting facilities. Public, private, and municipal utilities, cooperatives, and private citizens who desire to use or occupy rights-of-way on the State Trunk Highway System for roadway lighting **shall** apply to the city, village, county, or town in which the State Trunk Highway is located.

This policy does **not** apply to lighting systems proposed for installation on **local roadways or connecting highways**. These are the responsibility of the local municipalities. This document *may* be used as a reference for the design of such systems.

PROCEDURAL REQUIREMENTS
For all Projects covered under this policy, an application for approval to install roadway lighting **shall** be submitted to the WisDOT Regional Office by or on behalf of the local agency that will be paying for the maintenance and energy costs associated with the lighting system. Funding and participation limits between the local agency and WisDOT region *should* be defined prior to submitting any permit documents in accordance with the WisDOT Program Management Manual (PMM).

The application **shall** be submitted on the appropriate current forms and **shall** include all items outlined in this document. The forms are available on the WisDOT web site and are linked below in the Applicable Forms Section.

Permit applications that require State Lighting Engineer approval **shall** be submitted to the attention of the Regional Office. The WisDOT Regional office will review before forwarding it to the State Engineer for approval.

APPROVAL AUTHORITY
The State Lighting Engineer **shall** review and approve all permits involving new continuous lighting systems, as well as applications on the State Trunk Highway system that include:
- Ornamental street lighting
- Pedestrian and trail lighting
- Underdeck lighting
- Receptacles for Festoon Lighting

New permits are also required any time an agency wishes to upgrade or otherwise modify an existing continuous system, including altering or moving lighting equipment, or altering equipment associated with a lighting transition zone.

The Regional Office has the approval authority to review, and issue permits for isolated lighting on the State Trunk Highway System. This includes the installation of a luminaire and arm added to an existing or new utility pole. The Regional Office *may* review and issue a permit for continuous lighting when an agency wishes to add lighting units to an existing continuous system if the new lighting units match the existing equipment and generate equivalent lighting levels.

MODIFYING A PERMITTED SYSTEM

Any changes to an existing permitted installation that result in the following alterations, **shall not** be made until a new permit authorizing such changes is issued (note: excludes routine maintenance activities):

- Pole locations
- Pole heights and types
- Luminaire and lamp types
- Receptacles for festoon lighting
- Operating conditions such as lighting curfews/dimming
- Other items affected by this policy

ISOLATED LIGHTING PERMIT APPLICATION

The Applicant **shall** contact the Regional Office at project conception to begin the Isolated Lighting permit process. Isolated Lighting typically involves lighting of a single intersection of a non-illuminated roadway, or periodic lighting along a roadway where IES defined light level standards or average Illuminance and uniformity are not applicable. Form DT1885 **shall** be submitted to the WisDOT Regional Traffic Operations Section for review and approval.

CONTINUOUS LIGHTING PERMIT APPLICATION

The applicant **shall** follow the two-part process outlined below for Continuous Lighting permit applications, consisting of a preliminary and a final application form:

1. Prior to the 60% submittal, the Applicant **shall** contact the Regional Office to coordinate the submittal of a preliminary permit application. The name and address of the project electrical and lighting designer **shall** appear on the form. The applicant **shall** provide catalog cut sheets for proposed poles and luminaires. Photometric design and pole layout *should not* be completed until the preliminary application is submitted and approved. The Regional Office *may* review the basic project information and coordinate with the State Lighting Engineer on acceptance of lighting levels, pole locations, and luminaire type.
   As part of this preliminary process, the applicant **shall** describe the purpose for the proposed lighting system, such as:
   a. Roadway safety lighting in accordance with AASHTO requirements
   b. Decorative lighting for urban areas
   c. Public safety for areas with sidewalks and paths
2. Prior to submitting draft PS&E, the Applicant **shall** submit the final permit application to the Regional Office. Lighting and electrical plans, special provisions, photometric and voltage drop calculations, and pole and luminaire cut sheets **shall** be submitted with the final permit application. The name and address of the project electrical and lighting designer and appropriate signatures **shall** appear on the form. After initial review, the Regional Office **shall** forward the application to the State Lighting Engineer for approval.
3. When replacing existing light poles with new light poles to allow for the mounting of other equipment (cameras, small cell antennas) to the poles, the applicant must refer to the applicable section that covers replacing existing lighting poles https://wisconsindot.gov/Documents/doing-bus/real-estate/permits/09-15-41r_0621.pdf.The new light pole must be of the same type of materials to match the adjacent light poles, a WisDOT approved mast arm must be provided with an approved LED luminaire must be mounted to the new pole. The new pole **shall** be installed in the same general location (within 5 feet) as the existing light pole it replaces.

Other required information related to the Final Permit Submittal:

- Summary Tables that include both the design parameter target illumination values and calculated results
- Computer Design Computations for illumination and spacing of completed roadway sections.
- If banners, holiday decorations or festoon receptacles are to be installed or attached to the poles, the dimensions and locations **shall** be included and shown on a detail drawing in the plans (Festoon receptacles **shall** be set up on their own circuits, separate from the lighting)
- The designer **shall** include in the project plans the necessary SPV verbiage that ensures the final luminaires provided on the project will meet the design parameters of the permit.

The Project Electrical/Lighting Engineer and Applicant **shall** sign and date the final permit application.

ISOLATED LIGHTING PERMIT APPLICATION
The Applicant **shall** contact the State Lighting Engineer at project conception to begin the Isolated Lighting permit process. Isolated Lighting typically involves lighting of a single intersection of a non-illuminated roadway, or periodic lighting along a roadway where IES defined light level standards or average Illuminance and uniformity are not applicable. Form DT1885 **shall** be submitted to the WisDOT Regional Traffic Operations Section for review and approval.

APPLICABLE FORMS
- DT1878 – Preliminary Continuous Lighting Permit Application
- DT1879 – Final Continuous Lighting Permit Application
- DT1885 – Isolated Lighting Permit Application
- Signalized Intersection Illumination Form (see TEOPS 11-4-2)
- Roundabout Illumination Form (See TEOPS 11-4-3)

11-2-2 Private Light Trespass on State Right-of-Way April 2024

Privately owned lighting installations adjacent to the State Trunk System *may* require approval from WisDOT if light trespasses beyond the private property and onto State-owned rights-of-way. Locations where light trespass is identified in a significant capacity on a State-owned right-of-way *may* be subjected to evaluation, including the request for photometric measurements and documentation of system justification. Light trespass which creates significant glare on State-owned rights-of-way **shall** be evaluated with respect to the safety of roadway users. Permitting for private lighting sources trespassing on State-owned right-of-way **shall** follow the same approval process as an isolated lighting installation. Form DT1885 **shall** be submitted to the WisDOT Regional Traffic Operations Section.

11-2-3 Other Lighting Categories (Requiring Special Permits) April 2024

Flood lighting for bridges and retaining walls, work with BTO Lighting as this type of lighting is addressed on project-by-project basis. For aesthetic lighting on structures, refer to TEOPS 11-3-8.

When, LED Advertisement Signs are installed in WisDOT right-of-way near or on STH systems, the designer **shall** refer to policy set forth in HMM 9-5-1 Outdoor Advertising,

a. *No sign **shall** contain, include or be illuminated by any moving, flashing or intermittent lights.*
b. *No sign **shall** emit or reflect beams or rays of light on any portion of the traveled way or **shall** emit or reflect light of such intensity or brilliance as to cause glare or to impair or otherwise interfere with a driver's vision.*
c. *No sign **shall** be so lighted as to obstruct or interfere with an official traffic sign, device or signal.*

Refer to TEOPS 11-3-9 for navigation lighting.
Refer to TEOPS 11-3-10 for roadway lighting equipment installed near airports.

11-3-1 Preliminary Design Considerations and Parameters – Roadway Lighting April 2024

POLICY

Unless described otherwise, all roadway lighting designed for the State Trunk highway system that is owned and maintained by WisDOT **shall** follow the preliminary design guidelines described in this section.

TYPES OF ROADWAY LIGHTING

There are several different types of roadways and facilities involving the consideration of lighting, most all of which are covered in more detail in the ANSI/IES RP-8-22 and AASHTO Roadway Lighting Design Guide. In general, the following categories are covered in this document:

- Continuous lighting systems, including continuous (corridor) freeway lighting; complete interchange lighting; partial interchange lighting; and rural interchanges.
- Streets and highways other than freeways, including expressways and urban streets, and rural highways, including spot locations involving special considerations.
- Intersections, including isolated (standalone) intersections; signalized intersections; and roundabouts. These could include transition lighting and/or coordination with a continuous segment lighting system.
- Non-standard interchanges and intersections

Continuous lighting is defined as a lighting system incorporating lighting units with overlapping distribution patterns that meet average and uniformity levels as defined by IES for the appropriate roadway area classification and use.

Isolated lighting is defined as lighting at the intersections of non-illuminated roadways or periodic lighting along a roadway where IES defined light level standards for average and uniformity are not applicable.

Transition lighting is defined as a gradual increase or reduction in lighting levels when entering or leaving a lighting system, most typically at freeway ramps, isolated systems, and roundabouts, when the roadway is not continuously illuminated.

PRELIMINARY DESIGN PARAMETERS AND CALCULATIONS

The following design parameters pertain to all “standard” roadway lighting systems:

1. Lighting systems **shall** be designed in accordance with ANSI/IES RP-8-22 and AASHTO’s Roadway Lighting Design Guide, October 2018.
2. Pavement classifications of R1 (concrete) or R3 (asphalt) *should* be used depending upon the permanent roadway surface.

The most restrictive and/or applicable policy, code, standard, or guide **shall** govern. Bureau of Traffic Operations will make the final decision on the interpretation of conflicting policies, codes, or standards.

ROADWAY AND LAND USE (AREA) CLASSIFICATIONS

There are numerous documents that define roadway classifications. Roadway classifications used to determine lighting standards **shall** reference the applicable section(s) of the following guidelines:

- ANSI/IES RP-8-22 (Lighting Roadway and Parking Facilities)
- AASHTO Policy on Geometric Design of Highways and Streets (Green Book)
- WisDOT Facilities Development Manual (FDM) 4-1-15
- FHWA Highway Functional Classifications

WisDOT policy specifies using the ANSI/IES guide RP-8-22 and AASHTO Roadway Lighting Design Guide. However, it is the responsibility of the designer to use the available resources to evaluate the section of roadway where the proposed lighting system will be installed. The functional classifications used to design the road do not necessarily address the issues that are important for lighting. Evaluation metrics include:

- Is this section of roadway primarily used for through traffic or access, or more to local properties?
- What is the speed limit and volume of traffic?
- What is the level of development and access to the surrounding area?
- What is the pedestrian conflict?
- Any unique roadway geometry or complex intersections/interchanges?

This type of basic evaluation will help determine which of the IES Table classifications provides the best fit for the project.

Table 1 below contains some of the key points from the ANSI/IES RP-8-22 and AASHTO Roadway Lighting Design Guide as an example to the designer. AASHTO utilizes similar roadway classification nomenclature under varying parameters. The designer **shall** refer to the appropriate reference manual as selected for use with the project.

Table 1. Classification Descriptions

Highway Classifications	**Description**
Freeway	A divided highway with full control of access. *Freeway Class A:* Roadways with great visual complexity and high trafic volumes. This type of freeway will usually be found in major metropolitan areas in or near the central core, and will operate at or near design capacity through some of the early morning or evening hours of darkness. *Freeway Class B:* All other divided roadways with full conrol of access.
Expressway	A divided highway with partial control of access.
Roadway Classifications	**Description**
Major (Arterial) Street	That part of the roadway system that serves as the principal network for through-traffic flow. These routes connect areas of principal traffic generation and important roadways entering and leaving the city. They are sometimes subdivided into primary and secondary classications; however, such distinctions are not necessary for the purpose of street lighting. These routes primarily serve through-traffic and secondarily provide access to abutting property.
Collector Street	A road servicing traffic between major and local streets. These are streets used mainly for traffic movements within residential, commercial, and industrial areas. Collector streets may be used for truck or bus movements and give direct service to abutting properties.
Local Street	Local streets are used primarily for direct access to residential, commercial, industrial, or other abutting property. They make up a large percentage of the total street system but carry a small proportion of vehicular traffic.
Pedestrian Activity Classifications	**Description**
High Pedestrian Activity Areas	More than 100 pedestrians during the highest nightly average one-hour volume period. For example, this would include downtown areas with dense urban development (typically over 3,000 pedestrians per square kilometer), areas around major arenas.
Medium Pedestrian Activity Areas	Between 11 and 99 pedestrians during the highest nightly average one-hour volume period.
Low Pedestrian Activity Areas	10 or fewer pedestrians during the highest nightly average one-hour volume period. In low activity areas, it is recommended that the jurisdiction define whether sidewalk lighting is required, as lighting will typically have lower value in this application.

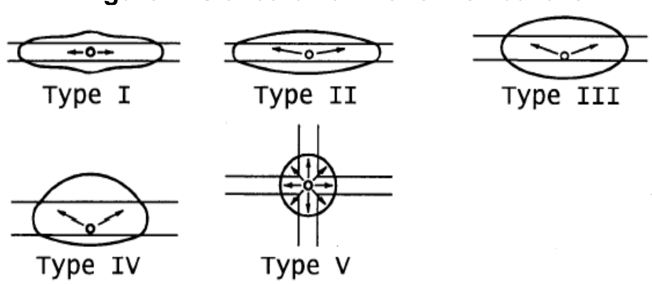
GENERAL REQUIREMENTS FOR LUMINAIRES

LED Luminaires **shall** be used for WisDOT maintained lighting systems and **shall** be selected from the

Department's Electrical Qualified Product List (QPL) whenever possible. The QPL provides products that contain a Type 3 light distribution only. Any other distribution types would need to be approved before use and require a modification to the standard specification.

Understanding the characteristics of the luminaires used on the project is critical when laying out lighting to ensure proper coverage is provided while maintaining a cost-effective approach. For permitted locally maintained systems, the luminaires **shall** be selected based on their distribution characteristics as they apply to the roadway geometry to ensure adequate illumination and minimum glare. They **shall** meet the roadway illumination requirements specified in this document. Type 2 or 3 roadway lighting distribution patterns **shall** be used for all standard applications. See typical distribution patterns in Figure 1.

Figure 1. Standard Luminaire Distributions



WisDOT QPL approved luminaires also adhere to predetermined criteria for control of light trespass for **B**ack-light, **U**p-light, and **G**lare (B.U.G). For permitted locally maintained systems, the luminaires *should* be selected based on their B.U.G. rating performing within the limits specified by the [WisDOT LED Luminaire Material Specification](). B.U.G. ratings are a required performance metric specified by the manufacturer for nearly all modern luminaires. These metrics are calculated based on the different distribution of light within each zone.

WisDOT currently permits the use of 4K luminaires. Luminaires with significantly different color temperatures **shall** be approved before use. For permitted locally maintained systems, the color temperature **shall** be selected based on coordination with the local agency. For example, urban districts will often utilize lower color temperatures to maintain a warmer and less stark setting.

No luminaire **shall** be proposed for use on the State Trunk Highway System that cannot meet the Illuminance and/or Luminance criteria or the Veiling Luminance Ratio required for the lighting system unless approved by the Regional and State Lighting Engineer.

A Light Loss Factor (LLF) **shall** be applied to initial lamp lumen output to calculate maintained illumination as prescribed in this section.

- The LLF for Luminaires on WisDOT's QPL **shall** be the value indicated on the List. This value includes an adjustment for luminaire dirt depreciation.
- When luminaires other than those identified on the QPL are specified for permitted locally maintained systems, the designer **shall** identify the proposed LLF and furnish justification for it with the permit application.

POLICY REVISIONS

The requirements of this policy *may* be updated to reflect changing technology or other conditions appropriate at the time. Such additions, revisions, and modifications will not be made retroactive to lighting installations covered by existing permits.

WisDOT *may* require the updating of all or part of an existing installation to conform to the latest criteria in the event damage to an installation, highway reconstruction, or other reasons requiring the replacement or relocation of all, or part of an existing lighting installation offers an opportunity to upgrade the installation.

CURFEWS

Curfews are defined as the switching off or dimming of lights during certain off-peak hours. WisDOT does not currently utilize curfews of lighting systems on WisDOT maintained lighting installations. The Department will consider allowing curfews of a permitted lighting system if the maintaining agency can demonstrate that it will not violate the AASHTO table lighting levels. This would include:

- Evaluation of the conditions during the proposed curfew hours showing that the roadway/area is different than the normal hours such that a reduction in illumination is justified if dimming is proposed. Such an evaluation typically would include such items as reductions in traffic volume and/or pedestrians.
- A statement from the local agency supporting that full illumination is not necessary during the proposed curfew hours.

11-3-2 Photometrics and Illumination Modeling — April 2024

PHOTOMETRIC MODELING

The calculation of roadway lighting levels for WisDOT projects *should* be performed using Lighting Analysts AGI32 software. This will enable the designer to share the design files generated by the software with the Department for in-depth review when necessary. Unless indicated otherwise, the following methods of calculation **shall** be used:

- The Luminance Method of calculation **shall** be used to determine the average maintained luminance (in candelas per meter squared), the average-to-minimum (average uniformity), and the maximum-to-minimum (maximum uniformity) lighting levels for straight roadway segments with continuous lighting.

- The Illuminance Method of calculation **shall** be used to determine the average maintained illumination (in footcandles) and the average-to-minimum (uniformity) lighting levels for intersections and roundabouts. This can also be used on curved roadway segments with continuous lighting, but the luminance method **shall** govern when applicable.

- The designer/engineer **shall** also perform the Maximum Veiling Luminance Ratio calculation for all continuous lighting systems. The specified Maximum Veiling Luminance Ratio *should not* exceed that defined in the ANSI/IES guide RP-8-22 and AASHTO Roadway Lighting Design Guide.

The designer *should* be prepared to provide the WisDOT Regional Lighting Engineer with a technical summary of the photometric modeling, including:

- Classification of all lighting segments within the project limits according to ANSI/IES guide RP-8-22 and/or AASHTO's Roadway Lighting Design Guide
- Other lighting design criteria according to the specified classifications and roadway characteristics
- Luminaires used in modeling and their defining characteristics:
    - Mounting height
    - Arm length
    - Maximum wattage
    - Lumen output
    - Light Loss Factor
- Photometric output and performance results for all segments of a project.

11-3-3 Standard Overhead Roadway Lighting (Intersections and Continuous Segments) April 2024

POLICY

Unless described otherwise, all standard overhead lighting installations on the State Trunk highway system **shall** follow the design guidelines described in this section.

FEASIBILITY CONSIDERATIONS

Standard overhead lighting **shall** be installed at all locations as specified in FDM 11-50-60, and as approved according to TEOpS Chapters 11-1 and 11-2. Exceptions include alternative systems as described in the following subchapters and decorative lighting as requested by the local maintaining authority.

MATERIALS

Designers **shall** refer to the QPL for a list of multiple luminaires that are pre-approved for use on WisDOT facilities. Designers *should* also consider which QPL luminaire to use for photometric design, and they *should* consult with the Regional Lighting Engineer to confirm whether specific luminaire(s) from the QPL are preferred. Designers *should* select the luminaire model and distribution type based on the WisDOT Region's typical practices and the type that is most efficient and best performing overall to provide the necessary lighting levels with the fewest number of poles.

Table 2. Lighting Infrastructure Compatibility

Concrete Base	Compatible Poles	Compatible Luminaire Arms	Compatible Luminaire Types	Typical Applications
Type 2	Type 3 (30-Ft) Type 4 (30-Ft)	Truss Type 4-Inch Clamp 10-15 FT Single Member 4-Inch Clamp 6-8 FT	A, B, C	Traffic Signals - Standard
Type 5	Type 5 (30-Ft)	*Aluminum:* Single Member 4 ½-Inch Clamp 4-8 FT Truss Type 4 ½-Inch Clamp 10-15 FT	A, B, C	Intersections / Continuous
		Steel: Single Member 4-Inch Clamp 6-8FT Truss Type 4-Inch Clamp 10-15 FT		Intersections / Continuous
Type 6	Type 6 (35-Ft)	*Aluminum:* Single Member 4 ½-Inch Clamp 4-8 FT Truss Type 4 ½-Inch Clamp 10-15 FT	B, C, D	Intersections / Continuous
		Steel: Single Member 4-Inch Clamp 6-8 FT Truss Type 4-Inch Clamp 10-15 FT		Intersections / Continuous
Type 7	Type 17 (40-Ft)	*Aluminum and Steel:* Single Member 6-Inch Clamp 4-15 FT Truss Type 6-Inch Clamp 10-20 FT	B, C, D	Milwaukee Freeway
Type 10 Type 10 Special	Type 10 Type 10 Special Type 10-Over Height	Steel 6-15 FT Steel Type 10 Pole Clamp 15 FT*	A, B, C	Traffic Signals - Monotube
Type 11	Lighting Units Walkway	NA – Post top style unit		Rest Areas / Waysides / Pedestrian Areas
Type 13	Type 13 Type 13-Over Height	Luminaire Arms Steel 6-15 FT Steel Type 13 Pole Clamp 15 FT*	A, B, C	Traffic Signals - Monotube
Freeway Median Barriers & Structural Parapets	Type 7 (35'-10")	Single Member 6-Inch Clamp 4-10 FT Truss Type 6-Inch Clamp 10-20 FT	B, C, D	STH Median / Side Mount
Freeway Median Barriers & Structural Parapets	Type A (47'-6")	Single Member 6-Inch Clamp 4-10 FT Truss Type 6-Inch Clamp 10 FT	C, D	Freeway Median Ground / Structure Mount
Freeway Median Barriers & Structural Parapets	Type E (49'-0")	Single Member 6-Inch Clamp 4-15 FT Truss Type 6-Inch Clamp 10 FT	C, D	Freeway on/off Ramp; Slope Mount
Freeway Median Barriers & Structural Parapets	Type F (46'-0")	Single Member 6-Inch Clamp 4-15 FT Truss Type 6-Inch Clamp 10-20 FT	C, D	Freeway Barrier Wall Median Mount
** This luminaire arm type is only intended for use with traffic signal detectors and cameras*				

Lighting units and compatible infrastructure **shall** be verified with the WisDOT standard specifications and Standard Detail Drawings (SDD's) to ensure compatibility.

Specification of lighting infrastructure **shall** be verified with the respective WisDOT Regional Lighting Engineer. Acceptable mounting heights are generally dictated by the reach of available maintenance equipment in the respective Region. In general, a taller pole height provides greater coverage and a more efficient design than shorter poles. The luminaire arm length *should* be as short as possible, except when the offset to the roadway requires a longer arm to aim the light where needed. Evaluating the performance of twin luminaires and single luminaires *should* be compared when lighting a divided roadway and for intersections with channelizing islands. Twin luminaires are rotated 180 degrees from each other and cannot be adjusted.

WisDOT's list of standard bid items and QPL include both aluminum and steel pole types for some categories. Aluminum poles **shall** be used as standard practice with exceptions for steel in cases where a more rigid pole type is required. Poles combined with freeway ramp gates are one example.

Refer to Table 2 above for multiple potential combinations of concrete bases, poles, and luminaire arms available for use on WisDOT projects.

LOCATING LIGHTING UNITS

The following criteria **shall** be used to ensure that the placement of poles and other lighting appurtenances adjacent to the roadway will provide an acceptable degree of safety to the public and comply with good illumination practices. The selection of pole types and their offsets from the traveled portions of the roadway is of considerable importance in minimizing the number and severity of fixed object collisions by errant vehicles. Light poles installed along curves *should* be located on the inside of the radius of curvature unless not possible due to unique circumstances. As much as possible, the number of poles *should* be as limited as possible to decrease impact on roadway operations, potential “run-ins”, and maintenance purposes. The TEOPS Chapter 4 and TEOpS 11-4 herein give additional information related to pole locations and co-locations for luminaires, etc.

Lighting poles *should* be located to minimize conflict with utilities, including both underground and overhead. Special consideration *should* be given to overhead lines, as the survey is not always accurate to the actual envelope created by multiple lines stacked horizontally. Furthermore, utility companies will have minimum offsets that must be maintained from their lines to ensure stray voltage does not become a safety concern for installation or maintenance crews. Establishing safe offsets to high voltage transmission lines is especially critical.

Where lighting projects are being considered near an active airfield or airport, consider the impact the height of the light tower has on navigable airspace during and after construction. Any need for aviation obstruction warning luminaires on highway structures will be coordinated with the Federal Aviation Administration (FAA).

POLE BREAKAWAY REQUIREMENTS

Poles permitted on the rights-of-way of the State Trunk Highway System for the sole purpose of roadway lighting fall into one of two categories:

1. *Breakaway Poles:* This type of lighting support is defined as a pole and/or foundation which when struck by a vehicle will fracture or slip away under the conditions prescribed by the current edition of AASHTO Standard Specifications for Structural Supports for Highway Luminaires. No portion of the concrete footing **shall** be allowed to protrude above the ground level more than 4 inches.
2. *Non-Breakaway Poles:* Rigid lighting standards are defined as those poles and mountings which under impact conditions do not break away within the criteria specified for breakaway poles. Under normal conditions, the use of lighting pole designs conforming to the breakaway requirements above is required for all lighting installations except in certain circumstances:
    - Salvaging and reinstalling existing non-breakaway poles
    - Poles located on concrete barrier or parapets
    - Where direct bury poles are necessitated by the project
    - High pedestrian traffic areas, such as school zones

MINIMUM LATERAL OFFSET

Table 3 below is attached as a reference for the minimum lateral offset for lighting poles on the State Trunk highway system. The values indicated in Table 3 are based upon the current policy related to objects in clear zones as specified in FDM 11-15-1. All designs **shall** comply with the FDM. Offsets greater than those prescribed *should* be provided where feasible and where special traffic and highway conditions warrant. The designer **shall** coordinate with the Project Manager regarding all pole placement considerations.

Table 3. Minimum Lateral Offsets

Facility Type	Speed Limit (MPH)	Traffic Volume (ADT**)	Minimum Rigid (FEET)	Offset Breakaway (FEET)
Rural				SHOULDER width plus
	35 or less	ALL	12	2
	40	0 - 1,500	14	2
		1,500 - 6,000	16	2
		over 6,000	18	2
	45-50	0 - 1,500	20	2
		1,500 - 6,000	26	2
		over 6,000	28	2
	55	0 - 1,500	24	2
		1,500 - 6,000	30	2
		over 6,000	30	2
Urban				
	40 or less	ALL	2 from face of curb	2 from face of curb
	45 and higher	ALL	Offsets same as rural section	(Measured from the edge of thru lane) the greater of 12 or 2 from face of curb

Offset distances are in feet, from edge of the adjacent through traffic lane to the face of the pole; or as indicated for urban sections.

1. The preceding table is based upon pole location in a flat area or without fill slope steeper than 4:1. If rigid poles are contemplated on a slope of greater steepness and significant width, advice *should* be sought from Bureau of Traffic Operations. Placement of rigid poles in this situation is discouraged.
2. Where the offsets given in the above table would place rigid poles off the highway right-of-way, they *may* be permitted at or as near the right-of-way line as practical if it would not result in a significant added hazard to the public.
3. Where the offsets given in the above table require a pole to be in a ditch line, the pole *should* be located beyond the ditch line, but *may* be permitted in front of the ditch line if it would not result in significantly increased hazard.
4. Where the offsets given in the above table would require a pole to be within a sidewalk area, poles *should*, if conditions permit, be located behind the sidewalk. Locations between the sidewalk and roadway *may* be permitted in the event no other alternative is feasible.
5. Where a tree line exists closer to the roadway than permitted by Table 2 above, lighting poles *may* be placed in that tree line if such poles will not constitute significant additional hazards to the public.
6. Rigid poles *may* be permitted inside the limits shown in the table where they are adequately protected by barriers such as guardrails or retaining walls erected for other purposes. There *should* be at least 4 feet clearance between the guardrail and the pole to allow for deflection at higher speed locations. Designers **shall** avoid placing poles within guardrail end terminal sections.
7. Offset requirements for poles in the medians of divided highways along added left turn lanes **shall** be measured from the edge of the through traffic lane. A right turn lane is not considered a through lane.
8. For pole installation locations where there is a pronounced backslope rising directly from the shoulder, a reduction in minimum offset requirement from the preceding table by as much as 1/3 *may* be followed, no value **shall** be less than 24 feet for 40 mph or more.

11-3-4 High Mast Roadway Lighting — April 2024

POLICY

Unless described otherwise, all high mast lighting installations on the State Trunk highway system **shall** follow the design guidelines described in this section.

FEASIBILITY CONSIDERATIONS

This section is used to differentiate between standard overhead mounting heights (50 feet or less) and high mast lighting (80 feet or more). When deciding whether to use conventional lighting or high mast towers, the following sections **shall** be taken into consideration to compare the advantages and disadvantages of conventional and high mast lighting.:

1. *Installation Cost:* Depending on the application, the cost comparisons between high mast and conventional lighting systems can vary widely. High mast towers to illuminate interchanges are often less expensive to install than conventional lighting. This is due to reducing the installation cost associated with conduit, wiring, and considerably fewer poles required.
2. *Maintenance Cost:* Conventional lighting requires the use of a bucket truck and can require traffic control, such as signs, cones, and lane closures. When poles are mounted on concrete traffic barriers or single slope concrete barriers, the inside lane usually must be closed, resulting in significant traffic disruptions. High mast towers are generally located outside of the roadway footprint and require one or two persons with a pickup truck who can usually perform maintenance on a high mast lighting system.
3. *Safety Considerations:* High mast lighting *may* eliminate the risks involved with having personnel working near high-speed traffic. Generally high mast towers will not require lane closures for maintenance. High mast lighting also removes the opportunity for vehicle collisions with light poles placed within the clear zone.
4. *Accessibility:* High mast poles are commonly located within interchange infield areas. This can become difficult for maintenance vehicles to access the lighting systems. Constructing separate maintenance routes is often required for staff to access high mast towers.

5. *Utility Service:* High mast lighting systems are commonly located far from utility connections. Consideration *should* be given to the proximity of utility connections and the ability to access and connect to the lighting systems.
6. *Land-Use Considerations: Light Trespass can be a disadvantage when considering High Mast Lighting with adjacent residential areas.*

MATERIALS

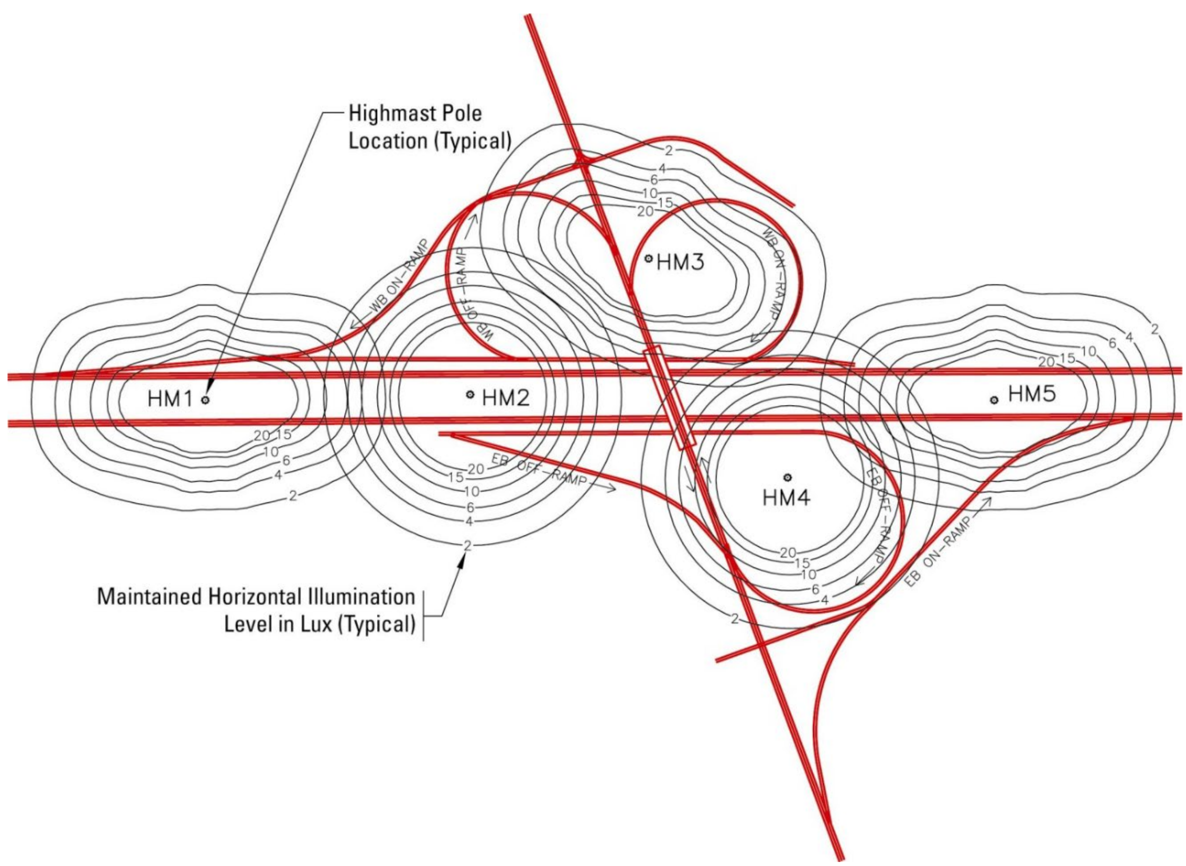
Designers **shall** refer to the QPL for multiple pre-approved luminaires. The number of luminaires required will be determined by the area to be lighted. As a general starting point, for new installations it can be assumed that up to four (4) luminaires will be used at each high mast tower location.

LOCATING LIGHTING UNITS

In determining the location of light towers, review the plan and profile view of the area to determine the critical areas requiring lighting. In selecting tower locations, consider the following:

1. *Critical Areas:* Locate light towers so that the highest localized levels of illumination fall within the critical traffic areas (e.g., freeway/ramp junctions, ramp terminals, merge points).
2. *Roadside Safety:* Locate light towers outside the roadside clear zone and a sufficient distance from the roadway so that the probability of a collision is virtually eliminated.
3. *Signs:* Locate light towers so that they are not within the driver's direct line of sight to highway signs.
4. Where lighting projects are being considered near an active airfield or airport, consider the impact the height of the light tower has on navigable airspace during and after construction. Any need for aviation obstruction warning luminaires on highway structures will be coordinated with the Federal Aviation Administration (FAA).
5. Where lighting projects are being considered near residential land uses, consider the impact of light trespass into the residential areas.
6. For interchange areas, use the typical interchange high mast tower layout shown in Figure 4.

Figure 4. Typical Interchange High Mast Tower Layout



DESIGN CONSIDERATIONS

Mounting heights in high-mast lighting applications range from 80 ft to 160 ft. Heights typically ranging between 100 ft to 150 ft provide the most practical designs. Greater mounting heights generally require more luminaires to maintain illumination levels. However, greater heights will provide a broader light distribution and better light uniformity resulting in fewer towers. As a general starting point, it is a good practice to identify optimal tower height and location to illuminate critical areas before adding additional poles and greater heights to cover the same area.

11-3-5 Underdeck Roadway Lighting — April 2024

POLICY

Unless described otherwise, all underdeck lighting installations on the State Trunk highway system **shall** follow the design guidelines described in this section.

FEASIBILITY CONSIDERATIONS

The decision of whether to include underdeck lighting with a design is typically based on engineering judgement. Generally, these installations are included to maintain continuous lighting throughout a corridor. Other factors to consider include pedestrian utilization and public security.

MATERIALS

WisDOT currently permits the use of 4K wall mounted luminaires for underdeck installations. Designers **shall** refer to the QPL for multiple pre-approved luminaires. Designers *should* also consider which QPL luminaire to use for photometric design, and they *should* consult with the Regional Lighting Engineer. Designers *should* select the luminaire type based on the WisDOT Region's typical practices and the type that is most efficient overall to provide the necessary lighting levels.

Current WisDOT standards and practices are not based on using overhead or ceiling mounted luminaires. Circumstances which require luminaires to be mounted overhead from the ceiling require a special provision for contractor procurement of a unique product. The Regional Lighting Engineer **shall** approve all model(s) of ceiling mounted luminaires specified for projects.

Lighting units and compatible infrastructure **shall** be verified with the WisDOT standard specifications and detail drawings to ensure constructability. Structural characteristics govern the lighting system design and whether the infrastructure will be surface mounted or embedded.

Conduit type for underdeck lighting systems will vary depending on application and **shall** be sized as necessary for wire fill capacity of proposed conductors according to the National Electrical Code.

1. Reinforced Thermosetting Rigid Conduit (RTRC) or Rigid Galvanized Steel (RGS) Conduit are typically used when infrastructure is surface mounted.
2. PVC conduit is typically utilized when the infrastructure is to be embedded in concrete. Schedule 80 *should* be considered where conduit transitions from structure to ground for added strength.

Underdeck bid items are quantified under a single bid item, accounting for all conduit, junction boxes, joints, elbows, brackets, and other miscellaneous items as necessary to complete the installation. Underdeck luminaires and conductors are not included with underdeck lighting bid item. The limits dictating where this quantification begins, and ends **shall** be specified in the plans to ensure accurate estimating and bidding of the completed installation.

LOCATING LIGHTING UNITS

Exact location and orientation for mounting underdeck luminaires will be governed inherently by structure type and ability to route infrastructure to the location. Luminaires *should* be mounted as high as practical for the structure to optimize light dispersion and minimize glare. Luminaires are typically mounted on the abutment of the bridge or on a pier cap for each direction of travel on the roadway. If such mounting would lower light levels to a non-acceptable level, then the luminaire is typically mounted on the bottom of the diaphragm. If luminaire mounting is restricted to overhead, the designer **shall** consult with BOS and BTO to determine the optimal mounting position and electrical routing.

DESIGN CONSIDERATIONS

Luminaires positioned adjacent to the underdeck can often provide adequate lighting without supplemental underdeck lighting. As a rule, for continuously lit roadways, underdeck lighting *should* be installed for structures greater than 50 feet in length. For underpasses that exceed 200 feet in length, the underdeck lighting *should* be on continuously, day and night.

To the best of the designer's ability, the lighting level of the underdeck **shall** match the lighting levels on the adjacent roadways in accordance with ANSI/IES guide RP-8-22 and AASHTO Roadway Lighting Design Guide. Higher lighting levels *may* result due to luminaire mounting height and spacing limitations. The underdeck lighting **shall not** exceed twice the lighting level of roadway adjacent to the underdeck.

Luminaires attached to the structure along the roadside **shall** be wall mounted in a manner that minimizes glare to the drivers. To reduce the amount of glare, the use of several lower output luminaires is generally better than providing one or two high output luminaires. The use of lower output luminaires tends to improve the uniformity of lighting while maintaining lighting levels. Wall mounted luminaires are generally easier to maintain and are less affected by structure vibration. Additional considerations to mounting locations include susceptibility to vandalism and bird nesting.

All underdeck lighting locations are typically unique in design and **shall** require separate installation details. Details **shall** include plan view, elevation views, installation notes and critical dimensions. Details **shall** clearly indicate all conduit, junction box, and luminaire locations. For new underdeck locations, the conduit and junction boxes *should* be embedded in the concrete structures. Lighting installations for existing underpasses **shall** be surface mounted.

11-3-6 Tunnel Roadway Lighting — April 2024

POLICY

Unless described otherwise, all tunnel lighting installations on the State Trunk highway system **shall** follow the design guidelines described in this section.

REFERENCE TO STANDARDS

Tunnel lighting design **shall** comply with the requirements of the latest edition of the following:

- ANSI/IES RP-8-22 (Lighting Roadway and Parking Facilities)
- AASHTO Roadway Lighting Design Guide

FEASIBILITY CONSIDERATIONS

Warranting criteria for the implementation of tunnel lighting is provided in ANSI/IES RP-8-22 and AASHTO Roadway Lighting Design Guide. The decision of whether to include lighting with tunnel structures is unique to each location. Warranting criteria *should* be based on engineering judgement according to the traffic volumes, posted speeds, proposed users, and geometric features of the tunnel. Lighting control technology and managing energy usage **shall** be carefully evaluated when designing tunnel lighting installations. The State Lighting Engineer **shall** approve the design criteria for any tunnel lighting systems.

MATERIALS

The WisDOT QPL does not specify pre-approved luminaires for tunnel lighting. Tunnel lighting installations **shall** require a special provision for contractor procurement of a unique product. Designers *should* select the luminaire based on the WisDOT's typical practices and the type that is most efficient overall to provide the necessary lighting levels while minimizing glare for drivers.

11-3-7 Pedestrian Scale Lighting — April 2024

POLICY

Unless described otherwise, all pedestrian scale lighting installations on State Trunk highway rights-of-way **shall** follow the design guidelines described in this section.

FEASIBILITY CONSIDERATIONS

Pedestrian scale lighting is most often installed for roadside facilities, i.e., rest areas and weight enforcement areas, to illuminate areas accessible to pedestrians. The decision of whether to include pedestrian lighting *should* be based on coordination with the respective WisDOT Regional Lighting Engineer, the respective Bureau of Highway Maintenance (BHM) official, and engineering judgement according to the proposed users and unique features of the site.

MATERIALS

WisDOT currently permits the use of 4K post-top mounted luminaires for pedestrian scale lighting. Designers *should* refer to the QPL for pre-approved luminaires and consider which QPL luminaire to use for photometric design. Designers *should* select the luminaire type based on the WisDOT Region's typical practices and the type that is most efficient overall to provide the necessary lighting levels. Designers **shall** confirm luminaire model(s) with the BHM project manager and Regional Lighting Engineer.

11-3-8 Aesthetic Lighting on Structures April 2024

DEFINITION

This policy applies to decorative lighting on structures for aesthetic purposes using a dynamic lighting system that can be operated and controlled by a central computer using fiber optic and data cable lines and software that can project a variety of colors and patterns on bridges and other transportation structures. The colors can be changed at an interval or remain constant. The intensity of the lighting fixtures can be controlled from 0 to 100 percent. Typical systems have the capability to be pre-programmed so that the lighting color selections and color schemes can be approved and controlled. These systems do not provide roadway lighting and **shall not** negatively impact the illumination level of the roadway.

POLICY

Aesthetic lighting *may* be installed only under conditions referenced in the WisDOT Bridge Manual and Division of Transportation Investment Management cost-share policies in the Program Management Manual 3-25-15. The provisions of this policy **shall** apply to all cities, villages, counties, and towns (i.e., local agencies) which desire to use or occupy rights-of-way of the State Trunk Highway System for locally owned and maintained lighting and electrical facilities. Public, private, and municipal utilities, cooperatives, and private citizens who desire to use or occupy rights-of-way of the State Trunk Highway System for roadway lighting **shall** apply to the city, village, county, or town in which the State Trunk Highway is located.

FEASIBILITY CONSIDERATIONS

Aesthetic lighting is not typically installed or maintained by WisDOT and would be completely at the discretion/desire of the project sponsor with agreement from the Department. The decision of whether to include aesthetic lighting **shall** be based on coordination with the WisDOT State Lighting Engineer and engineering judgement according to the proposed aesthetic function and features of the site.

MATERIALS

The installation, including all wiring, supports, equipment, and roadway clearance **shall** be in accordance with pertinent statutes, codes, and regulations as well as good trade and engineering practice and **shall** be properly maintained.

DESIGN CONSIDERATIONS

All electrical components of the system, including conduit, cabling, and pedestals, **shall** be separate physically from WisDOT electrical system infrastructure. All electrical systems **shall** be designed under the oversight of the State Lighting Engineer and **shall** be documented as under the operational control of WisDOT Bureau of Traffic Operations.

The operation and maintenance of the lighting system **shall** be at the expense of the maintaining agency. Removal of the system or alterations in any part of the installation that are required at any time by WisDOT **shall** be made by the maintaining agency at no expense to the Department. Immediate action will be required if a hazardous aspect to the lighting system arises.

Construction and maintenance operations **shall** be performed without closing the highway to traffic except as *may* be specifically authorized by authorized representatives of the agency maintaining the highway. A work on right-of-way permit will be required from the appropriate regional office prior to any work being done on the right-of-way.

Aesthetic lighting schemes **shall not** present a distraction to the traveling public. The lighting system **shall** be designed to minimize light trespass. When programmed to do so, the colors will remain fixed for no less than 10 seconds. When lighting is near the traveling public, certain colors (i.e., red, blue, amber), text, or images *may* be prohibited. At no time **shall** the lights or colors flash or blink. WisDOT will require field testing and validation prior to securing full approval to operate the lighting system.

Any requests from the public for change in operation of the aesthetic lighting system **shall** be approved by

WisDOT's Bureau of Traffic Operations.

WisDOT *may* require the aesthetic lighting be turned off under conditions or circumstances of adverse weather like heavy snow, fog or accidents which could have a negative impact on the traveling public.

11-3-9 Navigation Lighting April 2024

POLICY

Bridge navigation lighting systems **shall** be installed under State Trunk highway system bridges over navigable waters to delineate the structure and provide guidance for vessels traversing the waterway. Unless described otherwise, all navigation lighting installations **shall** follow the US Coast Guard standards and the design guidelines at the following path https://www.ecfr.gov/current/title-33/chapter-I/subchapter-J/part-118

MATERIALS

The installation, including all wiring, supports, equipment, clearance, etc. **shall** be in accordance with pertinent statutes, codes, and regulations, as well as good trade and engineering practice and **shall** be properly maintained. All bridge navigational lighting system materials **shall** follow and be approved by the US Coast Guard Bridge Lighting and Other Signals as included in the following path https://www.dco.uscg.mil/Portals/9/DCO%20Documents/5pw/Office%20of%20Bridge%20Programs/Lighting.pdf

DESIGN CONSIDERATIONS

The bridge navigational lighting system installation **shall** conform to all standards and requirements set forth by the US Coast Guard, Office of Bridge Administration.

11-3-10 Roadway Lighting Equipment Installed Near Airports April 2024

State Trunk highway system roadway lighting equipment installed near airports **shall** be installed per the Federal Aviation Administration (FAA) Advisory Circular for Obstruction Marking and Lighting - AC_70_7460-1L located at the following path. https://www.faa.gov/documentLibrary/media/Advisory_Circular/AC_70_7460-1L_-_Obstuction_Marking_and_Lighting_-_Change_2.pdf

11-4-1 Design Applications – Roadway Lighting — April 2024

POLICY

Unless described otherwise, all roadway lighting designed for the State Trunk highway systems that is owned and maintained by WisDOT **shall** follow the design application guidelines described in this section.

All luminaires on state-maintained highway systems **shall** be LED and selected from the WisDOT's Qualified Electrical Products List (QPL) except in special cases.

REFERENCE TO STANDARDS

The design of highway roadway lighting **shall** conform to applicable provisions of Chapter 11, Section 50 of the WisDOT Facilities Development Manual (FDM), except as modified herein. In addition, the highway roadway lighting design **shall** comply with the requirements of the latest edition of the following:

- WisDOT Standard Specifications
- WisDOT Standard Detail Drawings
- WisDOT Standard Bid Items
- Wisconsin Bicycle Facility Design Manual
- Wisconsin Guide to Pedestrian Best Practices
- ANSI / IES Roadway Lighting RP-8-22 (Lighting Roadway and Parking Facilities)
- AASHTO Roadway Lighting Design Guide
- AASHTO Guide for Park and Ride Facilities
- National Electrical Code
- Wisconsin Electrical Code
- Local codes and ordinances

11-4-2 Roadway Lighting – Signalized Intersections — April 2024

APPLICATION

This policy and the related information apply to all WisDOT maintained signalized intersections, including single point interchanges (SPI), double diverging diamond interchanges (DDI), and other non-standard signalized intersections and interchanges on the State Trunk highway systems.

POLICY

All WisDOT maintained signalized intersections **shall** include roadway lighting in accordance with this document.

Power for the roadway lighting of WisDOT maintained signalized intersections *should* be fed from circuits from the signal cabinet. If the total amperage and/or number of circuits of the proposed intersection roadway lighting exceeds the capacity of the traffic signal cabinet, installing a separate roadway lighting cabinet **shall** be evaluated.

When slotted left turn lanes and other complex signalized approach geometry are illuminated, these *should* be considered part of the intersection and be fed from the signal cabinet, subject to coordination with WisDOT or locally maintained continuous roadway lighting where applicable.

DESIGN CONSIDERATIONS

Several factors can affect the design of roadway lighting for signalized intersections. The required illumination level and the constraints of pole locations are the most important factors and are sometimes incompatible. he designer is responsible for balancing all the design considerations and applying engineering judgment to produce a safely illuminated, fully operational, and constructable system.

The decision to signalize an intersection is based on the results of a signal investigation study of safety and operational factors. These factors typically relate to important visual tasks, and to conflicts with other vehicles and pedestrians. These are important when considering roadway lighting and are discussed in IES RP-8-22 and AASHTO Roadway Lighting Design Guide, which is a reference for this document.

Often signalized intersections are in urban areas along continuously illuminated streets. Intersections of roadways with continuous roadway lighting are considered full intersections. The IES recommended illuminance levels for full intersections of continuously illuminated urban streets are the sum of the recommended values for the intersecting roadways. Intersections of roadways without continuous roadway lighting are considered partial (isolated) intersections and follow a separate set of criteria as defined by IES RP-8-22 and AASHTO Roadway Lighting Design Guide. Table 1 below, based on roadway and pedestrian classifications, summarizes these values for full intersection lighting of continuously illuminated roadways. Table 2 summarizes these values for partial (isolated) intersection lighting.

Note: AASHTO refers to the pedestrian area classifications as commercial, intermediate, and residential land uses (Versus "High / Medium / Low" Pedestrian Activity, respectively).

Table 1. Pavement Illuminance Criteria for Full Intersection Lighting (Lux/Fc)

Functional Classification	Pedestrian Activity Level Classification			E_{avg}/E_{min}
	High	Medium	Low	
Major/Major	34/3.2	26/2.4	18/1.7	3:1
Major/Collector	29/2.7	22/2.0	15/1.4	3:1
Major/Local	26/2.4	20/1.9	13/1.2	3:1
Collector/Collector	24/2.2	18/1.7	12/1.1	4:1
Collector/Local	21/2.0	16/1.5	10/0.9	4:1
Local/Local	18/1.7	17/1.3	8/0.7	6:1

Table 2. Pavement Illuminance Criteria for Partial (Isolated) Intersection Lighting

Road Classification	Pavement Classification			Uniformity Ratio
	R1 lux/fc	R2 & R3 lux/fc	R4 lux/fc	E_{avg}/E_{min}
Major	6/0.6	9/0.8	8/0.7	3.0
Collector	4/0.4	6/0.6	5/0.5	4.0
Local	3/0.3	4/0.4	4/0.4	6.0

CALCULATION BOUNDARIES

Engineering judgement **shall** be used when designating calculation boundaries for intersections. In general, calculation boundaries *should* be drawn to include the footprint of all intersecting movements, bicycle and pedestrian crossings, and areas with merging/diverging/conflicting movements. The calculation boundary shown in the figures below are the areas to which the intersection illumination levels apply. This boundary area includes at a minimum the area bound by the far side of the pedestrian crosswalks on all approaching roadways. If a pedestrian crosswalk is not present, the calculation area **shall** be the area enclosed by the intersection stop bars extending across the departure lanes. In the absence of both pedestrian crosswalks and stop bars, the calculation area **shall** be the area enclosed by the connection of the radius return of each intersection leg, like that identified in the figures below.

Figure 1. Signalized Intersection Illumination Calculation Boundary

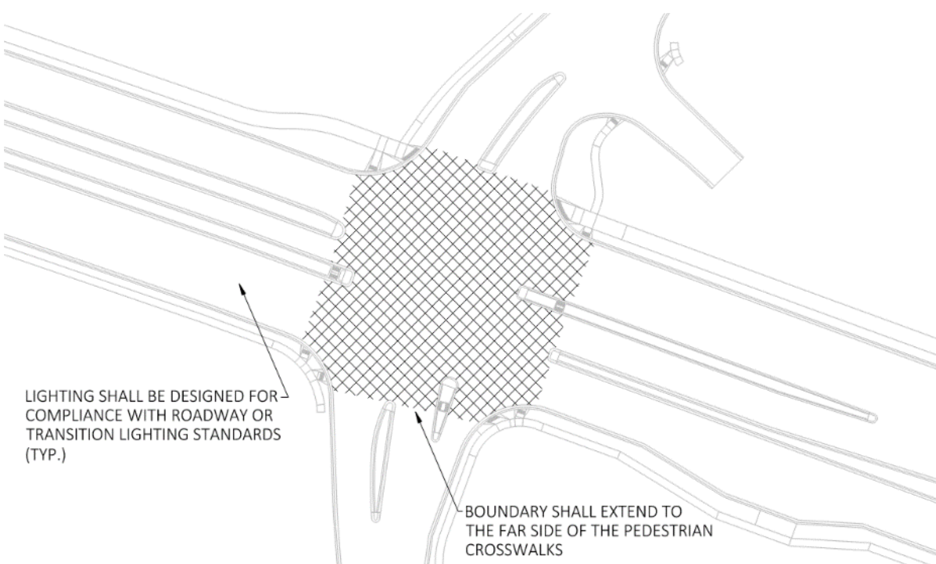


Figure 2. Single Point Urban Interchange (SPUI) Illumination Calculation Boundary

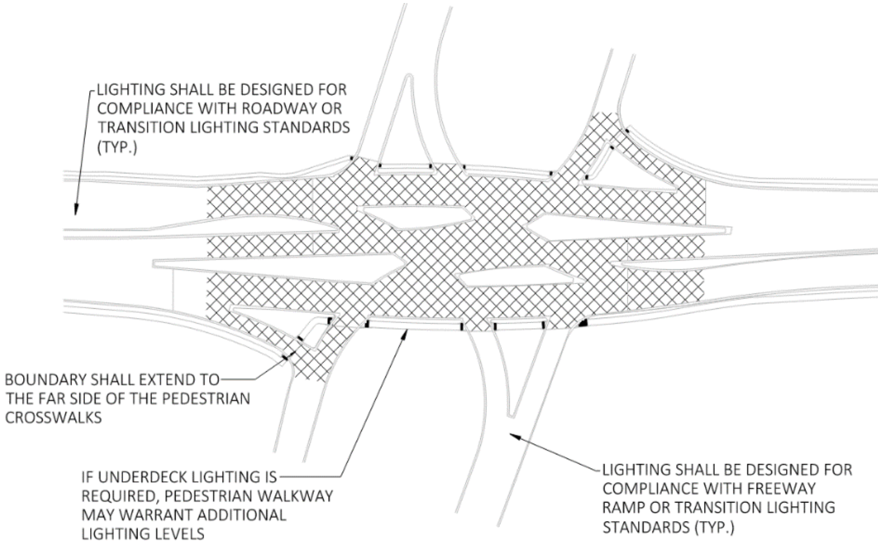
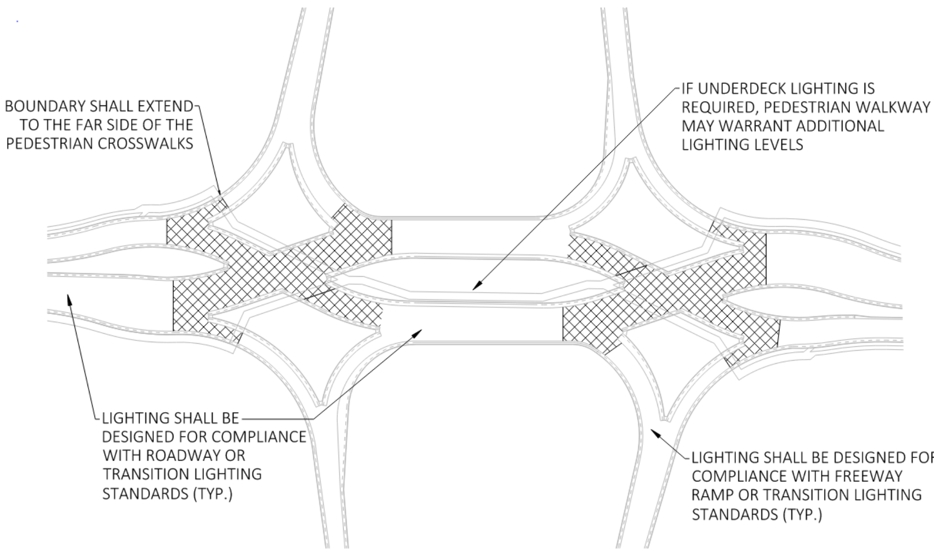


Figure 3. Diverging Diamond Interchange (DDI) Illumination Calculation Boundary



LIGHTING LAYOUT

WisDOT's best practices have illustrated the importance of minimizing poles within the intersection boundary. For this reason, the lighting designer **shall** install luminaires on traffic signal poles whenever possible. The designer **shall not** begin the roadway lighting layout before obtaining the signal plan.

Particularly for large or otherwise complex intersections, it *may* be difficult to achieve the illumination and uniformity levels recommended without additional poles beyond those required for the signals. Use engineering judgment to add stand-alone poles when supplemental illumination is a priority. In such cases, the designer **shall** consider and prioritize the following design considerations:

- Poles **shall** be combined whenever possible to reduce the number of objects near the roadway.
- Poles *should* meet the design criteria as presented in TEOpS 11-3.
- Prioritize illuminating the far side of the intersection to help clearly identify fixed elements in the path of the vehicle, whether turning or continuing straight.
- Pedestrians in crosswalks are dark objects and difficult to see, particularly when the vehicle is making a right turn. Illuminating crosswalks is a high priority, providing positive contrast whenever possible.
- Horizontal lighting levels *should* be considered for pedestrian crosswalks and movements, especially on roadways with high speeds or high pedestrian activity.

- Designers **shall** avoid placing light poles where prone to over tracking of freight movements and potential off tracking by errant vehicles and in slippery conditions.
- Designers *should* evaluate access management, sight distance, transitions to adjacent intersections, and other pertinent factors when determining whether to include roadway lighting for approaches to signalized intersections. This is especially true in high-speed environments.
- For large intersections it *may* be difficult to achieve uniformity due to large offsets to light poles. Non-standard uniformity results *may* be justified by excluding small and hard to reach areas near the middle of large intersections.
- For divided roadways, designers *should* consider using both twin luminaires located in medians and channelizing islands instead of using single luminaires on the roadside to determine the optimum design.
- Where illumination of slotted left turn lanes is included, the poles *should* be located in the raised median on the driver's side.

DESIGN PROCEDURAL REQUIREMENTS

The designer **shall** contact the Regional Lighting Engineer to verify roadway and pedestrian/land use classifications prior to beginning the design for signalized intersection illumination.

A Signalized Intersection Illumination Form is included to assist in identifying the appropriate roadway and pedestrian/land use classifications and subsequent light levels.

The designer *should* prepare intersection illumination calculations using AGI32 software and the calculation boundaries described in this document.

SIGNALIZED INTERSECTION ILLUMINATION FORM

(To be completed prior to design)

GENERAL INFORMATION:	
Location: ______________________________	
Street 1: ______________________	ADT: ______________
Street 2: ______________________	ADT: ______________
Pedestrian Count (1Hr): ______________	

ROADWAY AND AREA CLASSIFICATION:
Street 1: ______________________
Street 2: ______________________

DETERMINATION OF ILLUMINATION VALUES:	
Use values from Illuminance Levels for Intersections Table in 11-4-2	
Illuminance Value: __________	**Avg/Min Value**: ______________

11-4-3 Roadway Lighting – Roundabouts April 2024

APPLICATION

This policy and the related information apply to all WisDOT maintained roundabouts on the State Trunk highway systems.

POLICY

All WisDOT maintained roundabouts **shall** include roadway lighting in accordance with this document.

Any local requests for special roadway light poles or fixtures will be reviewed by the Department. If allowed, the roadway lighting **shall** be operated and maintained by the local government through the Standard Lighting Permit Process.

DESIGN CONSIDERATIONS

The roundabout intersection illumination area **shall** be calculated by using the illuminance method.

TEOpS 11-3-1 explains roadway and pedestrian area classifications used to determine the recommended illuminance levels outlined below in Table 1. Note: AASHTO refers to the pedestrian area classifications as commercial, intermediate, and residential land uses (Versus "High / Medium / Low" Pedestrian Activity).

The recommended illuminance levels at roundabouts are, essentially, the sum of the recommended values for continuously illuminated approaching roadways.

Table 1. Illuminance Levels for Roundabouts (Lux/Fc)

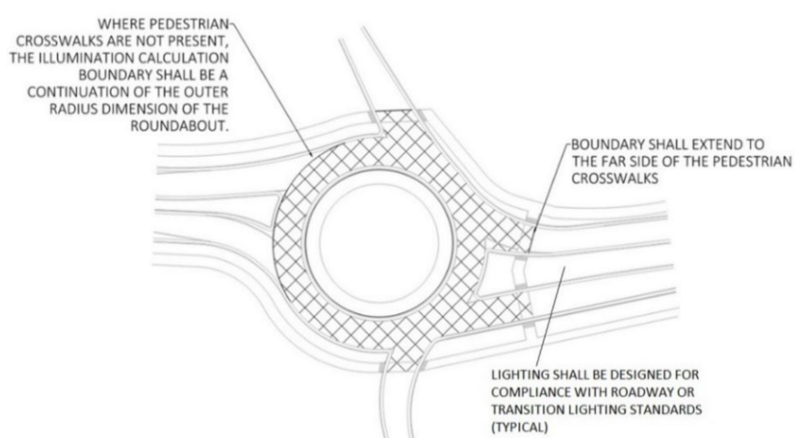
Functional Classification	Pedestrian Activity Level Classification			E_{avg}/E_{min}
	High	Medium	Low	
Major/Major	34/3.2	26/2.4	18/1.7	3:1
Major/Collector	29/2.7	22/2.0	15/1.4	3:1
Major/Local	26/2.4	20/1.9	13/1.2	3:1
Collector/Collector	24/2.2	18/1.7	12/1.1	4:1
Collector/Local	21/2.0	16/1.5	10/0.9	4:1
Local/Local	18/1.7	17/1.3	8/0.7	6:1

For roundabouts along low-volume roadways with low pedestrian activity that are not continuously illuminated, the values for Local/Local *should* be used. Special consideration *should* be given to roundabouts in rural areas and in areas where roadway lighting was not present prior to an intersection improvement project. Coordination with local officials and property owners *may* be required to address concerns with light trespass and glare.

CALCULATION BOUNDARIES

Engineering judgement **shall** be used when designating calculation boundaries for roundabouts. The calculation boundary is the area to which the illumination levels in Table 1 apply. This boundary *should* include the traffic conflict area extending to the far side of the pedestrian path on each of the approaching roadways. If a pedestrian path is not present, the calculation area extends to the outside radius of the roundabout entrance and exit including the entire traffic conflict area. Refer to the figure below for a visual depiction. When bypass lanes are used, they *should* be included within the calculation boundary.

Figure 1. Roundabout Illumination Calculation Boundary



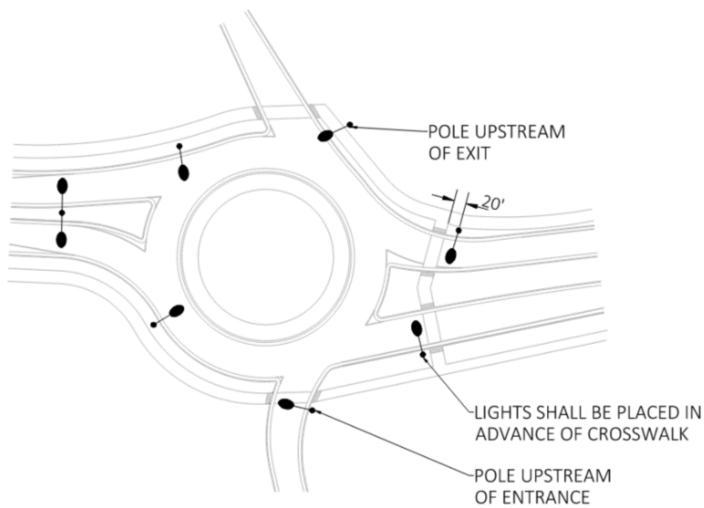
ROADWAY LIGHTING LAYOUT

The designer **shall** consider and prioritize the following design considerations:

- Poles **shall** meet the design criteria as presented in TEOpS 11-3.
- Minimize the impedance of roundabout approach signage sight lines.
- Place roadway light poles on the right-hand perimeter just upstream of entrance and exit points.
- Pedestrians in crosswalks are dark objects and difficult to see, particularly when the vehicle is making a right turn. Illuminating crosswalks is a high priority, providing positive contrast whenever possible.
- Horizontal lighting levels *should* be considered for pedestrian crosswalks and movements, especially on roadways with high pedestrian activity.
- Designers **shall** avoid placing light poles where prone to over tracking of freight movements and potential off tracking by errant vehicles and in slippery conditions.
- For large multi-lane roundabouts, it *may* be difficult to achieve uniformity due to large offsets to light poles. Non-standard uniformity results *may* be justified by excluding small and hard to reach areas near the middle of large roundabouts.

For divided roadways, to determine the optimum design, designers *should* consider using both twin luminaire poles located in medians and bypass islands instead of using single luminaire poles on the roadside.

Figure 2. Roundabout Typical Lighting Layout



DESIGN PROCEDURAL REQUIREMENTS

The designer **shall** contact the Regional Lighting Engineer to verify the classifications for the roadway and pedestrian/land use prior to beginning the roadway lighting design.

The designer *should* prepare illumination calculations using AGI32 software using the calculation boundaries described in this document.

A Roundabout Illumination Form is included to aid in identifying the appropriate roadway and pedestrian classifications and subsequent light levels. The designer **shall** complete this form and submit it to the Regional Lighting Engineer for approval prior to beginning the lighting design for a roundabout on the state highway system.

ROUNDABOUT ILLUMINATION FORM
(To be completed prior to design)

GENERAL INFORMATION:	
Location: ______________________________	
Street 1: ______________________	ADT: ______________
Street 2: ______________________	ADT: ______________
Pedestrian Count (1Hr): ______________	

ROADWAY AND AREA CLASSIFICATION:
Street 1: ____________________
Street 2: ____________________

DETERMINATION OF ILLUMINATION VALUES:	
Use values from Recommended Illuminance Levels at Roundabouts, Table 1 in 11-4-1	
Illuminance Value: __________	**E**avg/**E**min **Value**: ____________

11-4-4 Roadway Lighting – Restricted Crossing U-Turn (RCUT) April 2024

APPLICATION

This policy and the related information apply to all WisDOT-maintained RCUTs on the State Trunk highway and US highway systems.

POLICY

All WisDOT-maintained RCUTs **shall** include roadway lighting in accordance with this document.

DESIGN CONSIDERATIONS

The FHWA provides the following guidance on roadway lighting for RCUT intersections:

Roadway lighting standards and specifications outlined in AASHTO's Street Lighting Design Guide, FHWA's Lighting Handbook, and the Illuminating Engineering Society (IES) publications including American National Standard Practice for Street Lighting can be used to determine optimal roadway lighting for RCUT intersections.

Based on national roadway lighting guidance, agencies establish street lighting design guidelines along their facilities based on the road functional classification and pedestrian conflict area classifications. Intersection lighting is typically 1.5 times the street lighting levels along the approaches, or the street lighting levels of the two crossing streets are added together to determine the roadway lighting guidelines for the intersection.

Generally, signalized RCUT intersections are constructed on streets with high traffic volumes likely meeting the corridor volume criteria for roadway lighting. It is desirable to light the main and crossover intersections according to the determined intersection light levels. Depending on the intersection spacing, the light levels for the road segments between the intersections may *be reduced to street segment light levels. If there is no roadway lighting along the approaches, then transition lighting coming from dark into light and vice versa* may *enhance user experience and performance. Even with sufficient roadway lighting provided for the overall intersection, additional supplemental roadway lighting could be added in the median to illuminate the pedestrian refuge area.*

Roadway lighting at a stop- or merged-controlled RCUT intersection will follow similar roadway lighting criteria as conventional intersections. These types of RCUT intersections are more likely to be located on a street without continuous roadway lighting.

The RCUT intersection area **shall** be calculated by using the illumination method.

TEOpS 11-3-1 explains roadway and pedestrian area classifications used to determine the recommended illuminance levels outlined in TEOpS 11-4-2 Table 2 for Isolated Intersections. Note: AASHTO refers to the pedestrian area classifications as commercial, intermediate, and residential land uses (Versus "High / Medium / Low" Pedestrian Activity).

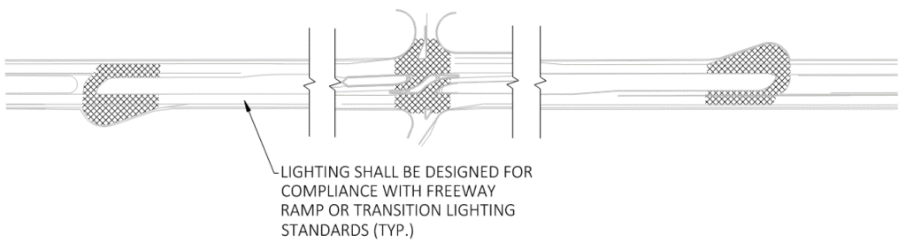
For RCUTs along roadways without pedestrian accommodations and that are not continuously illuminated, the partial (isolated) intersection illumination values for Local *should* be used.

For values along roadways that are continuously illuminated, the values *should* represent the roadway of each direction of travel where the RCUT is installed.

CALCULATION BOUNDARIES

The calculation boundary is the area to which the illumination levels in Table 2 apply. Calculation boundaries for RCUTs *should* be based on the unique characteristics of each location and confirmed with the Regional Lighting Engineer. Refer to the figure below.

Figure 1. RCUT Illumination Calculation Boundary



ROADWAY LIGHTING LAYOUT

Light poles **shall** be located according to these considerations:

- Poles **shall** meet the design criteria as presented in TEOpS 11-3.
- Pole placement **shall** ensure illumination of conflict areas and merge points.
- Minimize the impedance of approach signage sight lines.
- Use engineering judgment to determine appropriate light pole locations to ensure that decision points are illuminated.
- Coordinate all clear zone and roadside sloping issues.

DESIGN PROCEDURAL REQUIREMENTS

The designer **shall** contact the Regional Lighting Engineer to verify the classifications for the roadway and pedestrian/land use prior to beginning the roadway lighting design.

The designer *should* prepare illumination calculations using AGi32 software using the calculation boundaries described in this document.

11-4-5 Roadway Lighting – Freeways and Metered Ramps — April 2024

APPLICATION

This policy and the related information apply to all WisDOT maintained metered ramps, and any freeways and expressways approved by WisDOT for continuous or partial roadway lighting installations on the State Trunk highway, US highway, and Interstate highway systems. The guidance in this section applies to segments of freeway and ramps that have been approved for installation of roadway lighting in accordance with TEOpS 11-1-1.

POLICY

All WisDOT maintained metered ramps and approved freeways or expressways **shall** include roadway lighting in accordance with this document.

DESIGN CONSIDERATIONS

Straight segments of freeways and metered ramps **shall** be calculated using the luminance method, while curved segments **shall** be calculated using the illuminance method. TEOpS 11-3-1 explains roadway classifications used to determine the recommended luminance levels outlined below in Table 1.

Table 1. Lighting Design Criteria for Highways

Highway Classification	Average Luminance L_{avg} (cd/m^2)	Average Uniformity Ratio L_{avg}/L_{min}	Maximum Uniformity Ratio L_{max}/L_{min}	Maximum Veiling Luminance Ratio $L_{v,max}/L_{avg}$
Freeway Class A	0.6	3.5	6.0	0.3
Freeway Class B	0.4	3.5	6.0	0.3
Expressway	1.0	3.0	5.0	0.3

Partial interchange roadway lighting *may* be installed on freeways and highways when continuous roadway lighting is not warranted (per AASHTO warranting conditions). Partial roadway lighting consists of a roadway lighting system that is put in place to provide illumination at points of potential conflict. It is not considered continuous, but some of the rules that apply to continuous roadway lighting will apply in the design of partial roadway lighting, such as pole placement and calculation procedures. Recommended illuminance levels for partial interchange roadway lighting are outlined below in Table 2.

Table 2. Illuminance Criteria for Partial Interchange Roadway lighting

Highway Classification	R1 Lux (fc)	R2, R3 Lux (fc)	R4 Lux (fc)	Uniformity Ratio E_{avg}/E_{min}
Freeway Class A	6.0 (0.6)	9.0 (0.8)	8.0 (0.7)	3.0
Freeway Class B	4.0 (0.4)	6.0 (0.6)	5.0 (0.5)	3.0
Expressway	6.0 (0.6)	9.0 (0.8)	8.0 (0.7)	3.0

For metered ramps along roadways that are not continuously illuminated, transition lighting *should* be considered.

CALCULATION BOUNDARIES

The calculation boundary is the area to which the illumination levels in Table 2 apply. Illuminance calculation zones **shall** be created for reference to the following figures.

Figure 1. Entrance Ramp Illumination Calculation Boundary

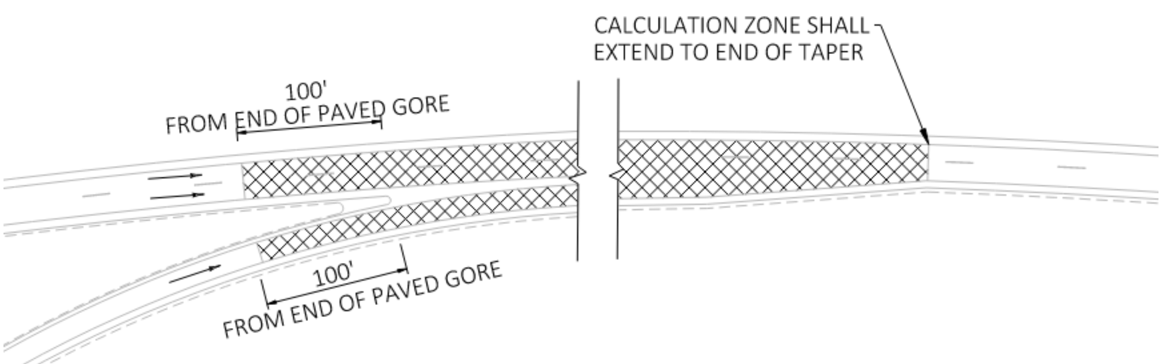


Figure 2. Exit Ramp Illumination Calculation Boundary

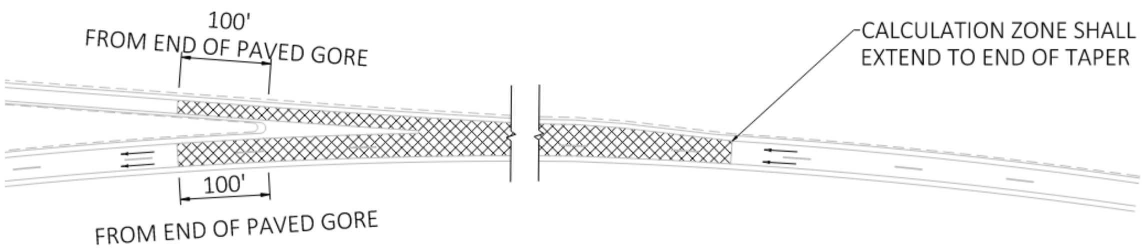


Figure 3. Lane Reduction Illumination Calculation Boundary

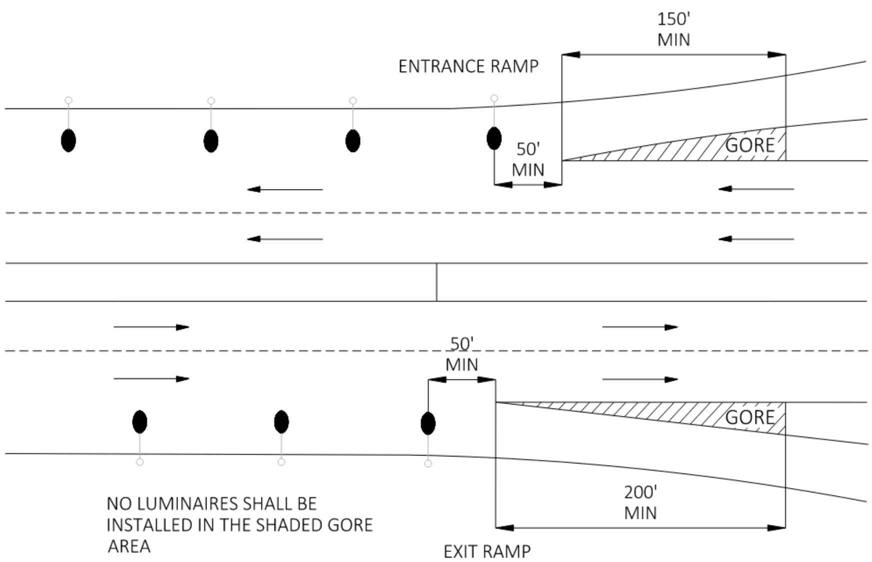
ROADWAY LIGHTING LAYOUT

Light poles *should* be located according to these considerations:

- Poles **shall** meet the design criteria as presented in TEOpS 11-3.
- Pole placement *should* ensure illumination of conflict areas and merge points.
- Minimize the impedance of approach signage sight lines.
- Use engineering judgment to determine appropriate light pole locations that *may* be too close to errant vehicle paths.
- Coordinate all clear zone and roadside sloping issues.

When auxiliary lanes or exit and entrance ramps adjacent to the mainline roadway require additional luminaires, the first luminaire is generally placed within 50 feet from the point of taper from the mainline roadway. The designer *should* avoid locating luminaires inside the gore area of an entrance ramp within 150 ft from the tip of the gore, as well as inside the gore area of an exit ramp within 200 ft of the tip of the gore, see the figure below.

Figure 4. Freeway Typical Roadway lighting Placement at Interchanges



DESIGN PROCEDURAL REQUIREMENTS

The designer **shall** contact the Regional Lighting Engineer to verify roadway and pedestrian/land use classifications prior to beginning the roadway lighting design.

The designer *should* prepare illumination calculations using AGI32 software using the calculation boundaries described in this document.

The designer **shall** submit the completed illumination design to the Regional Lighting Engineer for review and approval. The illumination design **shall** include:

- Design layout
- Photometric calculations with summary information showing compliance with illumination and uniformity criteria.
- Product cut sheets for any luminaires not listed on the QPL.
- Documentation of any alternatives considered.

11-4-6 Roadway & Pedestrian Lighting Roadside Facilities April 2024

APPLICATION

This policy and the related information apply to all WisDOT maintained weigh stations, rest areas, park and rides, crash investigation sites, and waysides on the State Trunk highway systems.

POLICY

All WisDOT maintained roadside facilities **shall** be illuminated.

The designer **shall** coordinate with the WisDOT Bureau of Highway Maintenance (BHM) and Regional Lighting Engineer to determine power supply requirements for the roadway lighting system. Roadside facilities *may* be maintained by multiple WisDOT entities, and an independent power supply for outdoor roadway lighting, buildings, and other uses *may* be necessary.

DESIGN CONSIDERATIONS

The designer **shall** work with the BHM and respective Regional Lighting Engineer to determine whether high mast or conventional roadway lighting *should* be installed at the roadside facility. Larger facilities such as rest areas and weigh stations *may* justify the installation of high mast roadway lighting to illuminate large, paved areas with minimal space for conventional light locations.

Roadside facility illumination areas **shall** be calculated by using the illuminance method. Illuminance calculation areas **shall** be defined separately for parking areas, pedestrian areas, internal circulation routes, and entrance/exit ramps.

There *may* be multiple sources for obtaining illuminance target criteria depending on the facility type. The designer **shall** refer to the appropriate reference manual(s) as selected for use with the project.

Roadside facilities **shall** consider both vehicular and pedestrian traffic with the roadway lighting design. Some facilities *may* necessitate walkway lighting units to provide illumination for pedestrians. Lighting designs **shall** also consider that these facilities are often open to the public 24/7, so pedestrian security must be a factor when determining appropriate lighting levels at each site.

CALCULATION BOUNDARIES

The calculation boundary is the area to which the illumination criteria levels apply. Areas *should* be determined using engineering judgement to define boundaries between parking areas and ramps.

ROADWAY LIGHTING LAYOUT

Light poles *should* be located according to these considerations:

- Pole placement *should* ensure illumination of parking areas, internal roadways, conflict areas and merge points, high pedestrian traffic areas, such as walkways, and building entrances.
- Minimize the impedance of approach signage sight lines.
- Use engineering judgment to determine appropriate light pole locations that *may* be too close to errant vehicle paths.
- Coordinate all clear zone and roadside sloping issues.

DESIGN PROCEDURAL REQUIREMENTS

The designer **shall** contact the BHM and Regional Lighting Engineer to verify roadway and pedestrian/land use classifications prior to beginning the roadway lighting design.

The designer *should* prepare illumination calculations using AGi32 software using the calculation boundaries described in this document and in other pertinent manuals.

11-4-7 Transition Lighting - Roadways April 2024

APPLICATION

This policy and the related information apply to isolated roadway lighting segments on the State Trunk highway systems.

POLICY

Transition lighting *should* be provided at all roundabouts, isolated intersections, and isolated roadway segments requiring illumination where the approach roads are not illuminated, and have posted speeds greater than or equal to 35 mph.

DESIGN CONSIDERATIONS

Transition lighting is implemented to allow the users' eyes to adjust from the non-illuminated to the illuminated roadway surface. This gradual roadway lighting adjustment is accomplished incrementally based on the posted speed of the roadway. Recommended transition lighting distances between illuminated intersections and/or roadway segments *should* be based on Table 1.

Table 1. Transition Lighting Lengths

Posted Speed Limit (MPH)	30	35	40	45	50	55
Minimum Transition Lighting Distance (Feet)	150	175	200	250	275	325

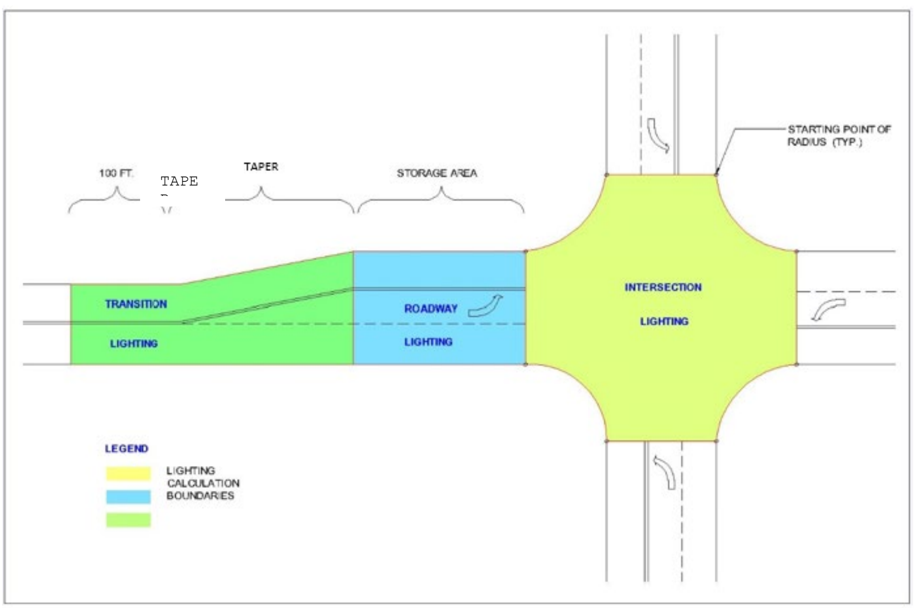
Transition lighting *should* be measured from the outside limits of the intersection and/or roadway calculation boundary when applicable.

Transition lighting for highway on/off ramps *should* be a minimum 275 feet or as dictated by design speed considerations.

Recommended distances for transition lighting can sometimes extend beyond WisDOT right-of-way. Local municipalities electing not to extend transition lighting to the recommended distance *should* address this condition in the local agreement.

Transition lighting levels *should* be designed based on the adjacent roadway lighting levels as summarized in Figure 1.

Figure 1. Intersection with Transition Lighting Calculation Areas



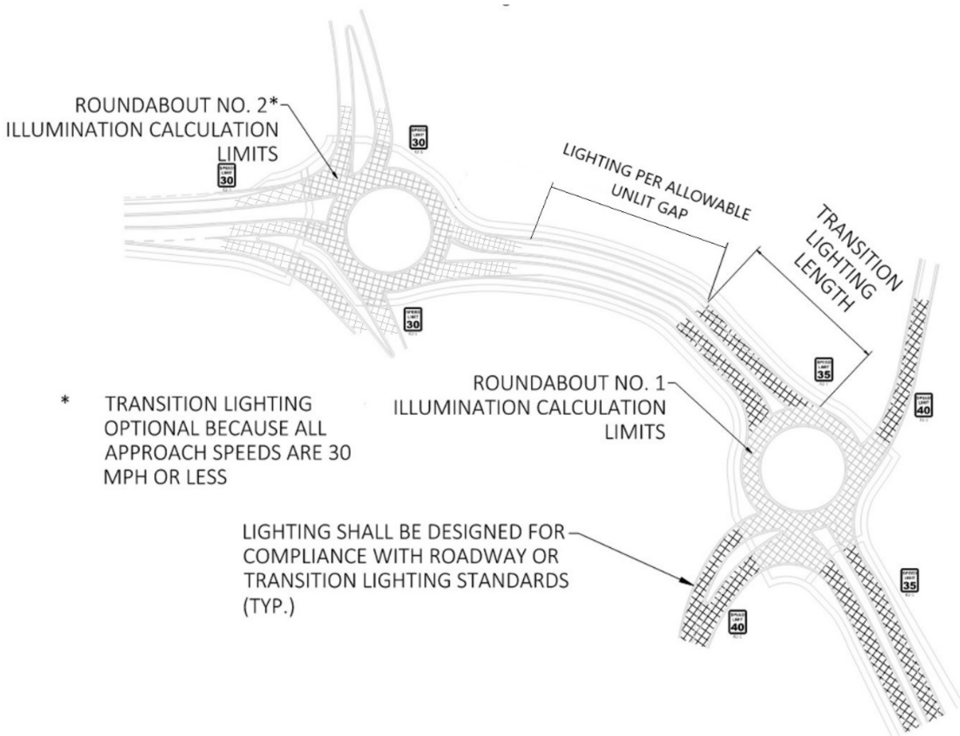
ROADWAY LIGHTING BETWEEN ADJACENT INTERSECTIONS

If multiple illuminated roundabouts or signalized intersections are placed adjacent to each other, e.g., freeway on/off ramps, the area between the intersections *should* be illuminated if the distance is less than or equal to that shown in Table 2. Illumination levels for the span of roadway between the intersections *should* be based on the illumination of the intersections. Include transition lighting if applicable.

Table 2. Allowable Unlit Gap Between Intersections

Allowable Unlit Gap			
Posted Speed Limit (MPH)	≤ 30	30 -45	> 45
Distance (feet)	500	750	1500

Figure 2. Sample Transition and Connection Distance Lighting Areas



11-4-8 Roadway Lighting – Temporary Lighting April 2024

APPLICATION

This policy and the related information apply to roadway segments requested for temporary roadway lighting on the State Trunk highway systems.

POLICY

The designer **shall** identify the need for any temporary roadway lighting as early in the project process as possible. Ideally, requirements for temporary roadway lighting will be identified during the scoping process and not later than during the TMP and be included in the 60% approval process. All temporary roadway lighting **shall** be approved by the Regional Lighting Engineer.

WisDOT generally reserves the use of temporary roadway lighting in work zones for the following cases:

- High volume freeways, roadways, and intersections that are currently illuminated.
- Complex work zones requiring unexpected maneuvers and conflict points.
- Signalized intersections and roundabouts
- Temporary lighting **shall** be provided for roundabouts that are open to traffic during construction staging. If practical, sections of the proposed permanent lighting *may* be installed and used for segments of the temporary lighting system.
- Urban roadways with significant concerns for pedestrian mobility and safety
- Roadside facilities

Temporary roadway lighting design **shall** be coordinated with the construction staging and maintenance of traffic planning for the project. The design **shall** include any temporary roadway lighting and/or relocated luminaires and all wiring required to maintain continuous operation of the existing roadway lighting systems.

DESIGN CONSIDERATIONS

This work **shall** be coordinated with the roadway design team and the maintaining authority. The extent of the proposed temporary roadway lighting system on a project **shall** be addressed as early in the submittal process as possible.

All modifications to the existing roadway lighting systems **shall** comply with WisDOT guidelines and design criteria.

In cases where temporary roadway lighting units on high-speed roadways are not shielded by a guardrail or barrier, the designer *should* consider wiring underground in a raceway to the luminaire location to protect against additional knockdowns from vehicle impact and safety concerns due to downed power lines.

11-5-1 Roadway Lighting Infrastructure — April 2024

POLICY

All roadway lighting designs on the State Trunk highway systems **shall** follow the infrastructure design guidelines described in this section. Exceptions to this policy *may* be required for non-standard installations and unique roadway settings.

WisDOT has prepared standard specifications and standard detail drawings which are available to the designer. These standards include typical details such as electrical service, light standards and bases, underground conduit installations, pull boxes, lighting control cabinets, and wiring diagrams to aid in the preparation of the roadway lighting plans.

Whenever possible, the designer **shall** utilize the standards to provide a consistent installation throughout WisDOT's system. Deviations from the standards *may* require detailed installation drawings and special provisions to be created by the designer and included in the roadway lighting plans and other PS&E documents.

REFERENCE TO STANDARDS

The installation of highway roadway lighting **shall** comply with the requirements of the latest edition of the following:

- National Electrical Code
- Wisconsin Electrical Code
- WisDOT Standard Specifications
- WisDOT Standard Detail Drawings
- WisDOT Standard Bid Items
- WisDOT Electrical Qualified Products List (e.g., Approved Products list)
- Local codes and ordinances as applicable

11-5-2 Conduit — April 2024

PURPOSE

Conduit is necessary in roadway lighting design to provide a raceway for electrical conductors and access to electrical power. Installing wire in conduit versus other direct bury methods allows for easier replacement or re-routing of conductors when required by future maintenance work.

MATERIALS

Conduit installed with standard roadway projects *should* be rigid non-metallic polyvinyl chloride (PVC) unless otherwise justified for special applications. Typically, schedule 80 *should* be specified for areas with heavy loading, such as under roadways with shallow cover.

Conduit installed embedded in structures *should* be rigid non-metallic PVC schedule 40 and be verified with the standard detail drawings created by WisDOT Bureau of Structures (BOS). Rigid metallic conduit is often used at transition points from structure to ground because of its strength and resistance to shearing and settling.

Reinforced thermosetting resin conduit and rigid metallic conduit are typically used when conduit is mounted externally on structures and specialized applications due to their durability. Consult with BOS and the Region Lighting Engineer to confirm which conduit type is preferred for external structural applications.

High-density polyethylene (HDPE) is typically used for intelligent transportation systems applications only.

DESIGN CONSIDERATIONS

Conduit **shall** be sized as necessary for wire fill capacity of proposed conductors according to applicable tables in the National Electrical Code (NEC) Chapter 9.

Designers *should* attempt to maintain some standardization of conduit sizing throughout the project. This practice allows for more cost-effective bid pricing if the contractor has to purchase fewer types of conduits, allows for easier installation/constructability, and provides consistency for maintenance of conduit systems.

Designers *should* consider using a larger conduit size, as well as including empty conduit runs, when exiting control cabinets to allow for future expansion of the branch circuiting.

Conduit **shall** be connected between each light base to the nearest pull box or light base, from pull box to pull box, from pull box to controller cabinet, and wherever the design requires conductors be installed.

Conduit at major intersections *should* be designed in a ring fashion surrounding the intersection, regardless of whether all runs will include live conductors, to provide sufficient raceways for any future work.

Designers *should* consider providing additional redundant conduit routes with pull wire only occasionally throughout the system so future maintenance can more easily troubleshoot failure points and back-feed from adjacent circuits.

Conduit connections **shall not** be provided between systems with separate electrical services to ensure safety of maintenance staff which could be compromised if one of the systems is not properly decommissioned.

When crossing underneath a railroad, designers **shall** coordinate directly with railroad officials during the 60% design to obtain approval and applicable design standards. Permitted conduit installations below rail lines can reach depths of 15’ and greater depending on the standards set forth by the governing rail agency.

Other considerations for conduit design include:

- The proximity to private and other utility facilities.
- Adjustments *may* be needed to avoid guard rail and sign posts.
- Parallel conduit routing with other WisDOT electrical infrastructure (i.e., signals, ITS).
- Sloping of roadway and drainage into pull boxes.
- Conduit depth when crossing roads with sub-base improvements.
- Minimizing conduit bends to less than 360 degrees between pull points.

CONSTRUCTION

Installation methodology **shall** be considered when designing conduit routing. Conduit to be installed under existing pavement, or with minimal ground disturbance, *may* be installed via directional boring under Conduit Special bid items. Designers *should* consider bore pit and rig locations when including directionally bored conduit with a roadway lighting design. In urban settings, a temporary limited easement *may* be required to accommodate boring operations.

11-5-3 Pull Boxes — April 2024

PURPOSE

Pull boxes are necessary in roadway lighting design to serve as pull points between continuous runs of conduit. Pull boxes are also necessary for conductor coiling for future maintenance at poles susceptible to knockdowns and for other various maintenance reasons.

MATERIALS

Roadway lighting designs typically utilize 24” x 42” pull boxes for all applications. If a smaller pull box is desired, sizing must adhere to requirements defined in NEC Article 314. Pull boxes *should* also be sized to ensure compatibility with quantity of entering/exiting conduit, evaluate constructability whenever more than four (4) conduits enter a pullbox, especially with larger conduit sizes, additional pull boxes *may* be required.

Pull boxes are typically non-conductive polymer concrete to eliminate any potential issues with grounding.

Steel pull boxes *may* be used in unique applications per direction from the respective Regional Lighting Engineer. Steel pull boxes must have the ground wire tied into the roadway lighting system ground.

DESIGN CONSIDERATIONS

Along continuous runs of conduit, pull boxes for roadway lighting systems *should* be spaced at a maximum of 300 feet to provide access points to assist with pulling wire. Distance between pull boxes *should* be reduced as wire sizes and conduit bends increase. Significant grade and alignment changes will also warrant closer spacing of pull boxes. Conduit **shall** not turn more than 360° without providing a pull box.

Pull boxes *should* be located to avoid placement in pavement or sidewalk. Final locations *should* attempt to maintain a two-foot minimum clearance from any other infrastructure to allow for compaction after installation, and to provide enough space for grass and landscaping to grow.

Pull boxes *should* be installed in these situations:

- 300-foot maximum intervals along continuous conduit runs.
- On either side of a roadway crossing.
- At the intersection of three (3) or more conduits.
- Immediately exiting a control cabinet.
- For slopes and other areas with non-linear conduit alignment.
- Adjacent to concrete bases for roadway lighting poles susceptible to knock-downs.
- As a provision for future expansion.

11-5-4 Concrete Bases April 2024

PURPOSE

Concrete bases serve as the foundation for above ground electrical infrastructure for light poles and control cabinets.

MATERIALS

Concrete base details and compatible infrastructure are specified in the WisDOT standard specifications, standard detail drawings, and in TEOpS 11-3. Verification of compatibility is essential to ensure structural integrity.

DESIGN CONSIDERATIONS

Standard concrete bases have capacity for two 2-inch conduit and one 1-inch conduit for grounding. Design scenarios with more than 2 or larger conduit than listed above *may* require an adjacent pull box or re-design of conduit routing.

Concrete bases for roadway lighting infrastructure **shall** be located with consideration to the following factors:

- Placed adjacent to the roadway in accordance with all applicable lateral clearance and clear zone standards.
- Designed in accordance with drainage features and grade changes as shown on proposed cross-sections.
- Changes in mounting height on steep slopes.
- Conflicts with utilities.
- Structure mounting attached to bridges, retaining walls, and median barriers.
- Potential rock excavation for shallow bedrock.

Some design scenarios such as restricted geometry, utility conflicts, or bedrock discovery *may* warrant alternative concrete base designs. Any alternative base designs **shall** be approved by the Region and BOS.

11-5-5 Electrical Conductors April 2024

PURPOSE

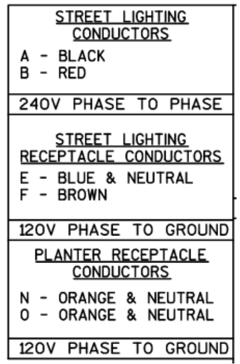
Electrical conductors are necessary to transmit electrical power and operational controls for roadway lighting systems.

MATERIALS

Typical roadway lighting designs **shall** utilize cross-linked polyethylene insulated (XLPE), underground service entrance rated wire as defined in Section 655 of the WisDOT Standard Specifications. Multi-conductor or direct burial cable *may* be required with some design scenarios and *should* be verified with the Regional Lighting Engineer.

Roadway lighting system conductors *should* follow conventional black/red color coding. Subsequent circuiting, such as receptacles, *should* utilize the next available color coding according to the NEC to easily differentiate between circuits. WisDOT Regions *may* have unique preferences for conductor color coding. Figure 1 shows an example of conductor color coding used on a state highway lighting system.

Figure 1. Example Conductor Color Coding



Slack cable **shall** be provided in the following electrical applications per Table 1 below.

Table 1. Cable and Wire Measurement Lengths

CONDUCTOR TYPE	APPLICATION	LENGTH	COMMENTS
SIGNAL CABLE	Cabinet	15'	Vertical rise to enter cabinet, length to terminate cable in cabinet, extra cable as necessary
	Pull Box	15'	2.5' to exit pull box, 2 loops (5' each), 2.5' to re-enter pull box
	Signal Base	8'	5' vertical rise in concrete base to access point, 3' at access point for splicing
	Pole & Arm	8'	3' at access point for splicing, 5' at signal head for termination
LOOP LEAD IN CABLE	Cabinet	15'	Vertical rise to enter cabinet, length to terminate cable in cabinet, extra cable as necessary
	Pull Box	0'	No extra lead in cable required in pull boxes
	Lead in Cable	8'	Slack is only required in the terminus pull box for splicing with loop detector wire
	Loop Detector Cable	8'	Slack is only required in the terminus pull box for splicing with lead in cable
EVP CABLE	Cabinet	15'	Vertical rise to enter cabinet, length to terminate cable in cabinet, extra cable as necessary
	Intermediate Pull Box	0'	No extra EVP cable required in intermediate pull boxes
	Terminus Pull Box	20'	Slack required for potential knockdown
	At EVP	2'	Exiting bracket for termination (pending different types of mounting brackets)
ELECTRICAL WIRE FOR LIGHTING	Cabinet	15'	Vertical rise to enter cabinet, length to terminate cable in cabinet, extra cable as necessary
	Pull Box	15'	2.5' to exit pull box, 2 loops (5' each), 2.5' to re-enter pull box
	Light Base	8'	5' vertical rise in concrete base to access point, 3' at access point for splicing
	Pole & Arm	8'	3' at access point for splicing, 5' at luminaire for termination
	Junction box	Varies	Depends on size of junction box. Typically, 2 times of the largest dimension of the box.

Conductors *should* be minimally sized according to the voltage drop calculations defined in this chapter. Designers *should* attempt to maintain some standardization of conductor sizing throughout the project to allow for more cost-effective bid pricing and to provide consistency for maintenance. If WisDOT is not the maintaining authority, the designer **shall** coordinate with local officials to determine if there is a preferred wire size and circuiting patterns that *may* govern the design.

DESIGN CONSIDERATIONS

The designer *should* consider alternating circuits along each run or branch. This provides a factor of safety in the event of a fault, where every other luminaire *should* remain operable. In providing proper operations of alternate circuiting, 120V circuits *should not* share a neutral, and *should* be terminated on single pole breakers.

Festoon receptacle branch circuits *should* be circuited independently from roadway lighting circuits.

Underground splicing **shall not** be permitted in pull boxes. Splices **shall** be made in poles and/or in aboveground junction boxes.

Wire sizing for roadway lighting circuits *should* be calculated with a target of 3% voltage drop per branch circuit, and a maximum of 5% for the total of service/feeder and branch circuit. Consider any potential for future expansion when calculating voltage drop for a roadway lighting circuit.

The voltage drops and related wire sizing for roadway lighting circuits and festoon receptacles **shall** be calculated in conformance with the NEC, along with any additional requirements of the applicant agency. Designers **shall** maintain documentation of voltage drop calculations of roadway lighting circuits using spreadsheets or other software applications. Use the voltage drop calculation spreadsheet.

Table 2. Voltage Drop Calculations (Example)

VOLTAGE DROP CALCULATIONS

EXAMPLE

Project ID: XXXX-XX-XX
Project Description: Example Voltage Drop
Lighting System # Example L49-2XXX

Date: 8/18/2020
Comps By: Engineer
Checked By:

Note: Example is based on a 250 Watt HPS Fixture in a 240 Volt System (304.8 Watts Input Each Luminaire)

Circuit #	Wire Segment From	Wire Segment To	Conductor Size (AWG)	Adjusted Voltage Through Line (VOLTS)	Total Watts (AT SOURCE)	Length of Cable Run In Segment L (ft)	Current At Source I (AMPS)	M	K	CM	Segment Voltage Drop (VD)	Segment Percentage Voltage Drop (% VD)
1	LCC-A	LP-1	4	240.00	3658	20	15.24	2	12.9	41740	0.19	0.08
1	LP-1	LP-2	4	239.81	3353	175	13.98	2	12.9	41740	1.51	0.63
1	LP-2	LP-3	4	238.30	3048	170	12.79	2	12.9	41740	1.34	0.56
1	LP-3	LP-4	4	236.96	2743	166	11.58	2	12.9	41740	1.19	0.50
1	LP-4	LP-5	4	235.77	2438	173	10.34	2	12.9	41740	1.11	0.47
1	LP-5	LP-6	4	234.66	2134	168	9.09	2	12.9	41740	0.94	0.40
1	LP-6	LP-7	4	233.72	1829	165	7.82	2	12.9	41740	0.80	0.34
1	LP-7	LP-8	4	232.92	1524	175	6.54	2	12.9	41740	0.71	0.30
1	LP-8	LP-9	4	232.21	1219	175	5.25	2	12.9	41740	0.57	0.24
1	LP-9	LP-10	4	231.64	914	170	3.95	2	12.9	41740	0.41	0.18
1	LP-10	LP-11	4	231.23	610	185	2.64	2	12.9	41740	0.30	0.13
1	LP-11	LP-12	4	230.93	305	155	1.32	2	12.9	41740	0.13	0.05
										Totals =	9.20	3.90

Voltage Drop Equation

$$VD = \frac{(M \times K \times I \times L)}{CM}$$

Wire Specifications

Size (AWG)	Area (CM)
4	41740
6	26240
8	16510
10	10380
12	6530

VD = Voltage Drop (- Volts)

M = Phase Multiplier
(Use 2 for Single Phase Alternating or Direct Current)
(Use "Square Root of 3", or 1.732 for 3-Phase Circuit)

K = Direct Current Constant
(Use 12.9 for Copper Wire)
(Use 21.2 for Aluminum Wire)

I = Current of Circuit in (Amps)
(At Source Along Circuit)

L = Length of Circuit (Ft)
(One-Way Length of Segment of Wire - - Source to Source, including anything coiled in Pull Boxes / Bases / Etc)

CM = Cross-Sectional Area of Wire (Circular Mils)
(Circular Mils = kcmil x 1000)

Notes: **1)** The NEC recommends a Maximum of 5% Voltage Drop for a Branch Circuit. It is also suggested in other references to design up to 3% Maximum Voltage Drop, which would then allow for some limited expansion of the Lighting System in the Future.
2) WisDOT's Teops Guide indicates that for Lighting, circuits should be calculated with a Target of 3% Voltage Drop per Branch Circuit, and a Maximum of 5% for the Total of Service / Feeder and Branch Circuits.

11-5-6 Cabinets, Metering and Controls — April 2024

PURPOSE

Control cabinets are necessary to distribute electrical power to the roadway lighting infrastructure. Cabinets also typically house the operational controls for the roadway lighting system.

Meter pedestals are necessary to receive power from the utility company to energize the control cabinet.

MATERIALS

Roadway lighting control cabinets are typically ground mounted enclosures that come in a variety of sizes and capacities as warranted by the project. The roadway lighting designer **shall** coordinate with the WisDOT Region Lighting Engineer for the appropriate cabinet size (24" or 30") and voltage (120V/240V or 240V/480V).

Cabinet size *should* be determined by the requirements of the project and potential for future expansion. Typically, a 480V cabinet would be installed on freeways or expressways when circuits must cover larger distances. The use of a 480V voltage cabinet **shall** be approved by the local and utility authorities.

Meter pedestals *should* be included with new roadway lighting control cabinets and *may* have a main breaker, or main lugs only, depending on the application. Meter breaker pedestals are favored in urban settings because they allow for power to be disconnected from the entire control cabinet for safer working conditions during routine maintenance, as well as afford the flexibility of being able to easily change out control cabinets which involve the utility. Typically, electrical service meter breaker pedestals are installed with 120/240V roadway lighting systems, while electrical service main lugs only meter pedestals are most often installed with 240/480V roadway lighting systems. The designer **shall** coordinate with WisDOT on the appropriate type to install.

DESIGN CONSIDERATIONS

Roadway lighting systems **shall** be photocell controlled unless directed otherwise. Photocells are typically installed with the roadway lighting cabinet and will control each circuit via contactor.

Electrical service meters for roadway lighting systems *should* be located in coordination with the local electric utility company and the respective WisDOT Regional Lighting Engineer, with consideration of the following factors:

- The cabinet *should* be located such that it is not vulnerable to traffic. A distance of 20 feet back of curb or 30 feet off the edge of pavement is desirable for offsetting the control cabinet.
- Proximity to electric utility.
- A maintenance vehicle *should* be able to park close to the cabinet and out of the traveled lanes.
- The cabinet **shall not** be in a drainage ditch or in an area which could be under water.
- The cabinet **shall not** obstruct sidewalks, multi-use trails, curb ramps, or driveways.
- The cabinet **shall** be located in right-of-way and accessible to provide maintenance without entering private property.
- Cabinet **shall** be oriented such that the photocell will sufficiently detect light.
- Snow storage and removal *should* be considered when determining cabinet location and orientation.

The local utility **shall** be contacted early in the design stage. Electrical service locations *should* be established by the DT1078 submittal to ensure the local electrical utility has adequate time to review the proposed locations. Verify with the utility the available fault current at each service location prior to final design and installation.

The electrical service **shall** be provided in accordance with the standard specifications and standard details.

Provide service grounding as detailed in the standard specifications and details unless otherwise noted on plans.

CONSTRUCTION

Meter breaker pedestals are typically installed directly adjacent to the control cabinet to minimize the distance between the service lateral and the main breaker, mitigating potential losses due to voltage drop and resistance.

The utility company will dictate the conductor size of the service lateral based on the service requested and distance from their power source. Conduit from the power source to the meter pedestal is typically provided and installed by the utility company unless directed otherwise to be included as part of the project design.

The contractor **shall** provide roadway lighting circuit identification plaques and roadway luminaire sequence decals suitable for outdoor construction for control cabinets, light poles, sign bridges, underdeck luminaires and high mast lighting as the plans show and per WisDOT Standard Detail Drawings: SDD 09H11, SDD 10A2, SDD 10A3 and SDD 10A4.

11-6-1 Plan Production April 2024

POLICY

Biddable plans for construction **shall** be prepared as set forth by the guidelines in previous TEOpS chapters. The plans and specifications **shall** define the work as complete and accurate as possible, and they **shall** be stamped and signed by the engineer of record. The plans and specifications *should not* leave ambiguity as to bid items used to account for indicated work.

REFERENCE TO STANDARDS

The plan production of roadway lighting **shall** conform to applicable provisions of Chapter 15, Section 1 of the WisDOT Facilities Development Manual (FDM). In addition, the roadway lighting plans **shall** comply with the latest edition of the following:

- WisDOT Standard Specifications
- WisDOT Standard Detail Drawings
- WisDOT Standard Bid Items
- WisDOT Creating Special Provisions Manual
- WisDOT's Electrical Qualified Products List (i.e., Approved Products List)

11-6-2 Plan Production – Roadway Lighting April 2024

GENERAL

Roadway lighting plans **shall** be stamped by a registered professional engineer in the State of Wisconsin on the title page of the plan or on the first page of the roadway lighting plans with an indication of how many pages were designed.

Each sheet in the set **shall** have the appropriate title block correctly indicating the project information.

WisDOT has prepared standard detail drawings (SDD's) which are available to the designer. The designer **shall** carefully review and apply standard details whenever possible to ensure consistent installation. The designer **shall** create and provide any additional construction details as required for a complete installation that are not covered by the SDD's.

Provide "General Notes" to clearly indicate the responsibilities of the installer to minimize questions during the bidding and installation process. Provide any additional notes required for removal, temporary, and final roadway lighting installations. Notes that apply to all sheets *should* be consolidated to a "Notes and Legend" section in the plan set to reduce redundancies. Notes that apply only to a specific sheet *should* be placed on that respective sheet.

A legend and list of abbreviations used **shall** be provided correctly indicating all symbols used on the project.

Plans **shall** indicate the right-of-way boundaries and include any walkways and bike paths.

All roadways **shall** be labeled and include station alignment identification.

All plan sheets **shall** include a scale for reference. A scale of 1:40 is appropriate for urban roadways and intersections. A scale of 1:100 is appropriate for rural and freeway applications and *should* be considered the maximum scale. One scale *should* be used for all sheets in one plan set.

Plan sheets and details **shall** include all critical dimensions.

A sample roadway lighting plan sheet is located in FDM 15-1-20.11 attachment for reference.

ROADWAY LIGHTING REMOVAL PLANS

Plans **shall** detail all required electrical infrastructure to be removed or abandoned and indicate if any infrastructure **shall** be discarded, salvaged, or relocated.

All plan sheets **shall** accurately indicate the existing electrical infrastructure to remain.

Removals *may* be combined with permanent roadway lighting plan for basic systems. More complex roadway lighting systems *should* have separate removal sheets.

TEMPORARY ROADWAY LIGHTING PLANS

If required, plans **shall** detail temporary roadway lighting including fixture types and locations, installation requirements, and temporary power wiring. Temporary roadway lighting plans *should* indicate work zone locations/stages and show any temporary connections to existing roadway lighting infrastructure and controls. Temporary roadway lighting plans **shall** detail any non-standard bid items used with the design.

Temporary roadway lighting plans *may* be combined with permanent roadway lighting plans for basic systems. More complex roadway lighting systems *should* have separate temporary roadway lighting sheets.

PERMANENT ROADWAY LIGHTING PLANS

Plans **shall** identify the electrical service location, including voltage, phase, and size. Special requirements and notes needed for a complete installation **shall** be included.

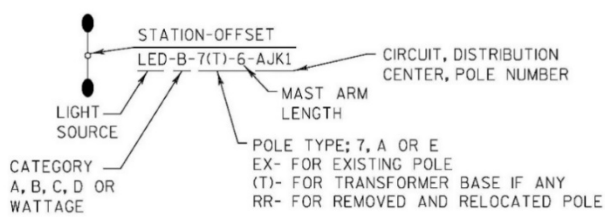
All existing utilities which could pose a conflict with the installation for the proposed roadway lighting **shall** be identified.

All new electrical infrastructure, symbols, conduit and wiring information, right of way lines, and text **shall** be printed in dark black. All other background information **shall** be printed in gray to easily distinguish the electrical information. Designers *should* include background linework for structures, overhead signs, underground pipes, and other pertinent project features.

Plans **shall** show all new roadway light standards, high mast towers, underpass lighting, walkway lighting, and roadway lighting controller locations. Special conduit installation requirements, i.e., installation under existing pavement, **shall** be identified on the plans.

Plans **shall** clearly label all luminaires and pull boxes. See Figure 1 below for an example of luminaire labeling.

Figure 1. Luminaire Labeling Example



Plans **shall** clearly indicate all conduit sizes and locations, and wiring information for each roadway lighting circuit. See Figure 2 below for examples of circuit callouts.

Figure 2. Circuiting Callout Examples

CIRCUIT CALLOUT LEGEND

3 # 2 A,B,N, 1 # 8 GND, CID	PROPOSED CABLE IN DUCT WITH 3 # 2 AWG CONDUCTORS (HOT LEG A, HOT LEG B, NEUTRAL) AND 1 # 8 AWG GROUND CONDUCTOR
2" C, 3 # 6 C,D,N, 1 # 8 GND	PROPOSED 2 INCH CONDUIT WITH PROPOSED 3 # 6 AWG CONDUCTORS (HOT LEG C, HOT LEG D, NEUTRAL) AND 1 # 8 AWG GROUND CONDUCTOR
2" C EXISTING 3 # 4 A,B,N 1 # 8 GND	EXISTING CONDUIT WITH PROPOSED 3 # 4 AWG CONDUCTORS AND 1 # 8 AWG GROUND CONDUCTOR
3 # 8 G,H,N, 1 # 8 GND, CID EXISTING	EXISTING CABLE IN DUCT WITH EXISTING 3 # 8 AWG CONDUCTORS AND 1 # 8 AWG GROUND CONDUCTOR
2" C, 3 # 2 J,K,N, 1 # 8 GND (EXISTING)	EXISTING 2 INCH CONDUIT WITH EXISTING 3 # 2 AWG CONDUCTORS AND 1 # 8 AWG GROUND CONDUCTOR

11-6-3 Special Provision Preparation – Roadway Lighting April 2024

WisDOT has prepared standard specifications which are available to the designer. The designer **shall** carefully review and apply the standard specifications whenever possible to ensure consistent installation. The designer **shall** create and provide any additional special provision (SPV) specifications as required for a complete installation.

Designers *may* encounter scenarios where a standard bid item needs to be modified according to the project requirements. In these instances, the designer is permitted to modify a standard specification rather than create a new SPV. Modifications to standard specifications *should* be coordinated with the Regional Lighting Engineer.

Each SPV **shall** be provided with its own unique name and number, description detailing the equipment/devices to be provided and installed, and all associated work to be performed for that specific pay item. Each pay item **shall** include the following: description of work, materials, construction, units of measurement, and basis of payment.

Specifications **shall** be clear, concise, and complete.

Each SPV name and numbering **shall** match those used in the list of quantities.

11-6-4 Quantities and Cost Estimate Preparation – Roadway Lighting April 2024

Each item to be removed, modified, or installed **shall** be accounted for in a list of standard bid items and SPV item quantities to be included in the plan set.

A complete cost estimate based on the list of quantities **shall** be provided for the project. The designer **shall** use the historical data collected by WisDOT and their best engineering judgment to provide an accurate estimate.

11-6-5 Submittal Requirements – Roadway Lighting April 2024

Electrical design documents **shall** be submitted for review and approval by WisDOT at the following stages: 30%, 60%, 90%, and final. The following sections detail the required materials that are typically submitted for each design development stage.

30% PLAN SUBMITTAL

The designer **shall** submit all appropriate request forms, preliminary permit applications, and roadway lighting investigation report as required in TEOpS 11-1 and 11-2. The designer **shall** obtain all necessary approvals prior to completing the full preliminary design.

Preliminary roadway lighting plans *may not* be required at this stage, but designers *should* develop a preliminary estimate of costs. High mast lighting and plans that will incorporate roadway lighting poles mounted on structure or median barriers *should* be considered at this stage.

Designers *should* submit any roadway lighting alternatives analysis to the Regional Lighting Engineer by the 30% submittal.

60% PLAN SUBMITTAL

Plans **shall** be prepared and include the correct title block, appropriate legends, and preliminary notes. Plans **shall** address any comments made during the 30% review process. The plans **shall** incorporate as much detail as possible.

Temporary roadway lighting requirements **shall** be addressed as part of the Transportation Management Plan (TMP), and preliminary layout included if required.

Plans **shall** be coordinated with underground and overhead utilities in the vicinity of each luminaire to ensure there is no conflict. Provide location(s) for roadway lighting control cabinet(s).

The roadway lighting **plans shall** include luminaire station labels, along with circuit and conduit labeling.

The designer **shall** submit the completed illumination design output to the Regional Lighting Engineer for review and approval. The illumination design **shall** include:

- A copy of the approved illumination form (signals and roundabouts).
- The preliminary design layout showing illumination contours (when appropriate).
- Photometric calculations with summary information showing compliance with illumination and uniformity

criteria.
- Transition roadway lighting calculations (as applicable).
- Verification of luminaire cut sheets and .IES files to be used in the design.

The designer **shall** provide a preliminary list of special provisions, pay items, and an updated construction cost estimate.

UTILITY (DT1078) PLAN SUBMITTAL

Plans **shall** address any pertinent comments made during the 60% review process and at a minimum include locations of all light poles, control cabinets, pull boxes, conduit, and other infrastructure necessary to evaluate utility conflicts.

Electrical service coordination *should* begin during this submittal phase. All potential conflicts with utilities *should* be reviewed, identified, and coordinated.

90% DRAFT PLAN SUBMITTAL

Plans **shall** address any additional comments made during the 60% review process, as well as utility conflicts identified from the DT1078 review.

The designer **shall** submit any final permit applications as required in TEOpS 11-1 and 11-2.

Permit applications *should* be approved prior to completing the 90% plan submittal.

Coordination *should* be done with local agencies for cost sharing when applicable.

Temporary roadway lighting (when applicable) **shall** have been coordinated with the construction staging and maintenance of traffic plan.

The plans **shall** include all plan sheets (removal, temporary, and permanent), miscellaneous quantities, SPVs, construction cost estimate, a list of applicable standard detail drawings, and any unique installation construction details.

Voltage drop calculations as required in TEOpS 11-5 **shall** be submitted for review.

FINAL PLAN SUBMITTAL

All final bidding documents **shall** address any comments made during the 90% review process.

Final plans, miscellaneous quantities, and special provisions **shall** be complete and accurate for the intent of bidding and construction.

The plans **shall** include all plan sheets (removal, temporary, and permanent), miscellaneous quantities, SPVs, final construction cost estimate, list of applicable standard detail drawings, and any unique installation construction details.

AS-BUILT DRAWINGS

As-Built record drawings **shall** be submitted by the installation contractor upon final completion of all electrical installations as required on the plans and specifications prior to final payment. The installation contractor **shall** provide a plan redlining any deviations from construction plans made in the field and provide the GIS coordinate information for the final lighting equipment locations for WisDOT use. Final plans *should* be updated to reflect the red-lined changes and be clean and free of revision clouds and triangles.

SHOP DRAWINGS

Shop drawings **shall** be submitted by the installation contractor and reviewed by the construction oversight engineer in accordance with the guidelines described in the WisDOT Construction and Materials Manual (CMM).

CONSTRUCTION CHECKLISTS

Refer to Figure 655-2 of the Construction and Materials Manual (CMM) for the Lighting Installation Checklist which is to be used to inspect system lighting installations in the field. The contractor is required to perform tests and demonstrate that the completed lighting is acceptable.

11-13-1 Incident Management Protocols **May 2006**

PURPOSE

The purpose of the incident management protocols for Department electrical systems is to provide guidelines for the regional electricians to follow in order to maintain conformity statewide.

The times indicated are the desired Department practices for identified incident response time. It is recognized there *may* be isolated occasions where the Department's ability to meet these guidelines are negatively impacted by certain factors such as: simultaneous calls, inclement driving conditions, and location of the actual incident. On those occasions where the response times are not met, reasons for non-attainment *should* be noted in the service reports.

DEFINITIONS

Response Time – The time from when we receive the initial service request to the time we arrive at the location.

Type 1 (Safety) – Urgent, respond immediately (day, night, weekends, or holidays), within three hours. Safety hazards to the public.

Type 2 (Efficiency) – Repairs *should* be done as soon as practicable or the next business day during normal working hours.

Type 3 (Routine) – Repairs *should* be done as scheduling permits.

QUALIFICATIONS FOR MAINTENANCE AND REPAIR OF SYSTEMS

1. Any and all repairs to the electrical systems **shall** be made by qualified personnel.
2. A qualified person **shall** be an Electrical Journey Person, who has successfully indentured as an apprentice and has completed the required academic curriculum established by DWD. In addition, the Journey must have gained the necessary electrical experience that relates to installation and maintenance of traffic signals, roadway lighting, and structures via on the job training at an established agency.
3. A fourth year DWD indentured apprentice *may* perform repairs under the guidance of a Journey person.

SERVICE CALL GUIDELINES MATRICES

TRAFFIC

Type of call	Primary Response Reason	Procedural Guide	Estimated Response Time
Traffic signal going in and out of flash	Safety		Type 1
Traffic signal on flash	Safety		Type 1
All traffic signal indications dark or out at intersection	Safety	Ask caller to ensure its not just one lamp out where only one signal *may* be without an indication. Check with power company for possible power outage in area. Ask Law Enforcement to call back if signals do not come back on after power is restored in the area.	No response needed if utility power outage. Type 1
Conflicting traffic signal indications on an approach or the same head.	Safety	Ask caller to describe the malfunction	Type 1
Specific/one direction gets too much green time	Efficiency	Ask caller to describe malfunction. Ask caller if it is cycling.	Type 2
Skipping specific traffic movement	Safety	Ask caller to describe malfunction	Type 1
Traffic signal stuck on and/or in single direction	Safety	Ask caller to describe malfunction	Type 1
Too little time to walk across road.	Efficiency	Ask caller to describe malfunction	Type 2
Some traffic signals dim and/or some show multiple indications.	Safety	Ask caller to describe malfunction	Type 1
Traffic signal damage or knockdown	Safety	Ask for the status of damage. Ask caller if the signal is still operating or if it's on flash.	Type 1
Turned signal head.	Safety	Ask caller of the direction and location of signal head.	Type 1
Traffic signal lamp outage	Safety	Ask the caller for specifics on which indication and what color is not working.	

		Red or Yellow not working	Type 1
		Green not working	Type 2
Pedestrian signal lamp outage	Efficiency	Ask caller for specifics on which indication is not working. Ask for the travel direction.	Type 2
Short green time	Efficiency	Ask caller for specifics on what the caller has seen. Ask for the direction of travel.	Type 2
Can't make it from one intersection to another on green. Always get stopped at the next intersection.	Routine	Obtain specifics as to what time of day this problem is noted, the direction of travel at the time.	Type 3

LIGHTING

Type of call	Primary Response Reason	Procedural Guide	Estimated Response Time
Street light (Luminaire) pole damaged or knocked down (if WisDOT maintained)	Safety	Ask the caller for the status of damage. Is the pole still standing or is the pole leaning?	Type 1
All street lights (Luminaires) are out (if WisDOT maintained)	Efficiency	Are the traffic signals still operational? If no, see traffic calls above.	Type 2
Street light (Luminaire) is out (if WisDOT maintained)	Routine	Is it an overhead luminaire outage or a traffic signal indication? If traffic signal, see traffic calls above.	Type 3

FLASHERS

Type of call	Primary Response Reason	Procedural Guide	Estimated Response Time
Traffic signal flasher damage/knockdown	Safety	Ask caller on the status of damage.	Type 1
Traffic signal flasher out	Efficiency	Ask caller if flashers are working.	Type 2

DIGGERS HOTLINE

Type of call	Primary Response Reason	Procedural Guide	Estimated Response Time
Emergency Diggers Hotline locate/repair	Efficiency	If cannot clear via phone, field locate required	Type 2

11-14-1 Electrical Inventory Numbering System Guidelines January 2009

GENERAL INFORMATION

In light of recent inventory tools & new methods of tracking existing equipment, the following outlines the use of installation ID numbers for *state-maintained &/or state-maintained electrical equipment* installed in the field & serviced by WisDOT staff. There are multiple reasons installation numbers are used to track installations internally: plan development, signal timing plan development, management of asset inventories, utility service tracking, service reporting, providing locates, etc.

All electrical installations need to be identified by the appropriate alphanumeric codes. The correct format is indicated in [brackets] & is described for each installation described by this memo. If being viewed electronically, clicking on the specific installation indicated below will direct you to the corresponding section of this memo.

Installation ID's for Traffic Operations	Installation ID's for ITS	Installation ID's for Roadside Facilities
1) Signal ("S") Numbers	10) Closed Circuit TV ("CCTV") Numbers	19) Rest Area ("R") Numbers
2) WisDOT Maint Temp Signal ("T") Numbers	11) Dynamic Message Sign ("DMS") Numbers	20) Seasonal Wayside ("W") Numbers
3) Contractor Maint Temp Signal ("TC") Numbers	12) Portable Changeable Msg Sign ("PCMS") Numbers	21) Safety & Weight Enfmnt ("SWEF") Numbers
4) Underground Signal Facility ("U") Numbers	13) Traffic Gate ("GATE") Numbers	22) Miscellaneous Roadside Facilities ("MRSF") Numbers
5) Signal System ("SS") Numbers	14) Ramp Meter ("RM") Numbers	Other Installations
6) Lighting ("L") Numbers	15) Highway Advisory Radio ("HAR") Numbers	
7) Flashing Beacon ("F") Numbers	16) System Detector Station ("SDS") Numbers	
8) Navigation Lighting ("NB") Numbers	17) Vehicle Classification Site ("VC") Numbers	
9) Portable Bridge Signal ("PBS") Numbers	18) Road Weather Info Sign ("RWIS") Numbers	

Questions regarding information contained within this policy can be directed to the Bureau of Traffic Operations State Traffic Signal Systems Engineer, (608) 261-5845.

ASSIGNMENT & TRACKING

Installation ID's will be assigned for each electrical device that requires utility service. A hierarchy based on the primary function of the cabinet is also used. The assigned installation hierarchy from left (highest) to right (lowest) is:

Signal → Roadside Facility → ITS Install → Lighting → Flasher → Misc. Install

For example, if a signal cabinet provides service for the associated intersection lighting & an advanced warning flasher, they will all be tracked under the same "S" number. In the example above, the advance flasher & intersection lighting are essentially incidental to the traffic signal.

Unless noted otherwise below, the State Electrical Shop in BTO – Electrical creates & assigns all relevant information regarding installation numbers.

INSTALLATION ID's FOR TRAFFIC OPERATIONS

The electrical devices described in this section are considered to be fundamental for traffic control (in addition to signing & marking) on the STH system. The following installations are tracked, designed, operated & maintained by WisDOT BTO & Regional staff.

1) **"S" (Permanent Signal) Numbers** – "S" numbers are used for all permanent traffic control signals.

The format for “S” numbers is…[S0000]. The numbering system, represented here by “0000”, applies statewide & is sequential in the order the Regional staff request them of BTO – State Traffic Signal Systems Engineer.

2) **“T” (WisDOT Maintained Temporary Signal) Numbers** – “T” numbers *may* be applied to state-maintained installations that typically are not associated with a construction project (i.e. an interim improvement until a grade-separation can be constructed). “T” numbers will provide a tracking mechanism for WisDOT facilities that *may* need field-located or for utility charging.

   The format for “T” numbers is…[T0000]. The numbering system, represented here by “0000”, applies statewide & sequential in the order the Regional staff request them of BTO – State Traffic Signal Systems Engineer.

3) **“TC” (Contractor Maintained Temporary Signal) Numbers** – “TC” numbers are applied to contractor-maintained installations that typically are associated with a construction project *on the STH system only* (i.e. as interim intersection traffic control along a detour). “TC” numbers will provide an ID for information to be tracked, specifically related to the appropriate maintenance authority for incident response purposes.

   The format for “TC” numbers is…[TC-00-9999]. The first two-digit number, represented by “00”, is given based on the appropriate county code. The second four-digit number, represented by “9999”, is applies countywide & is sequential in the order Regional staff assign them.

4) **“U” (Underground Signal Equipment) Numbers** – “U” numbers *should* be used when intersections have been constructed with underground equipment such as conduit & pull boxes for future signalization. “U” numbers will provide an ID for WisDOT facilities when responding/referring to locate requests by Diggers Hotline, etc.

   The format for “U” numbers is…[U0000]. The numbering system, represented here by “0000”, applies statewide & is sequential in the order the Regional staff request them of BTO – State Traffic Signal Systems Engineer.

5) **“SS” (Signal System) Numbers** – “SS” numbers are used to track coordinated signal systems. To do so, individual “S” numbers that comprise the system are related to a unique “SS” number. These ID’s are assigned to internally track the quantity & types of coordinated systems, as well as streamlining service reports. For example, if time clocks are checked at five time-based controllers, only a single service report will need to be completed.

   The format for “SS” numbers is…[SS0000]. The numbering system, represented here by “0000”, applies statewide & is sequential in the order the Regional staff request them of BTO – Electrical.

6) **“L” (Lighting) Numbers** – Historically, the convention for lighting numbers has been established differently between Regional offices. Some offices tracked lighting for Park & Ride lots as “L” numbers; others were tracked under a “PR” ID. Tracking of high mast & highway system lighting installations created some additional differences.

   Any stand-alone highway lighting installations are tracked as “L” numbers. Highway lighting associated with other facilities/installations are tracked under the ID of the primary installation based on the installation hierarchy described above. Examples of this logic include:

   - System highway lighting – tracked by “L” number,
   - Isolated intersection lighting – tracked by “L” number,
   - High mast lighting – tracked by “L” number,
   - Roundabout lighting – tracked by “L” number,
   - Park & Ride lot lighting – tracked by “L” number,
   - Rest Area lighting – tracked by “R” number,
   - Signalized intersection lighting (out of same cabinet) – tracked by “S” number,
   - Signalized intersection lighting (out of separate cabinet) – tracked by “L” number,

   The format for “L” numbers is…[L0000]. The numbering system, represented here by “0000”, applies statewide & is sequential in the order the Regional staff request them of BTO – Electrical. Intersection lighting installed under permit to the local city, town or village are not tracked.

   NOTE: *Existing “HL” & “HML” (that represented high mast & highway lighting in some Districts) numbers will be converted to “L” numbers in continued sequential order as described.*

7) **<u>"F" (Flashing Beacon) Numbers</u>** – "F" numbers are be used for all installations of flashing beacons (typically single section signal heads). *Flashing beacons do not include signs with incorporated LED's (i.e. Blinker STOPs).*

   The format for "F" numbers is…[F0000]. The numbering system, represented here by "0000", applies statewide & is sequential in the order the <u>Regional staff request them of BTO – Electrical</u>.

   NOTE: "MF" numbers had been tracked separately due to historic signal maintenance reasons in Milwaukee County (old Transportation District 9). *In the future, flashers in Milwaukee Co. will be tracked as "F" numbers & as described above. Existing "MF" numbers will be converted to "F" numbers in continued sequential order as described.*

8) **<u>"NB" (Navigation Beacon) Numbers</u>** – "NB" numbers are used for all marine & aerial navigation lighting. Typically, this lighting is attached to bridge structures.

   The format for "NB" numbers is…[NB0000]. The numbering system, represented here by "0000", applies statewide & is sequential in the order the <u>Regional staff request them of BTO – Electrical</u>.

9) **<u>"PBS" (Portable Bridge Signal) Numbers</u>** – "PBS" numbers are used for state-owned, trailer mounted, two-way bridge signals.

   The format for "PBS" numbers is…[PBS00]. The numbering system, represented here by "00", applies statewide & is assigned & tracked by <u>BTO – Electrical</u>.

INSTALLATION ID's FOR ITS

The primary responsibility for WisDOT electrical staff related to ITS facilities are for emergency response only. <u>ID's for ITS facilities are assigned & maintained by the Traffic Management Center (TMC).</u> Work performed by WisDOT electrical staff at these locations is tracked based on the installation type, as described:

10) **<u>"CCTV" (Closed Circuit Television) Numbers</u>** – "CCTV" numbers are used to track closed circuit TV installations used for highway surveillance.

11) **<u>"DMS" (Dynamic Message Sign) Numbers</u>** – "DMS" numbers are used to track permanent dynamic message signs installations. These installations are not the same as PCMS devices listed below.

12) **<u>"PCMS" (Portable Changeable Message Sign) Numbers</u>** – "PCMS" numbers are used to track individual portable change message signs (trailer mounted) that are owned by WisDOT & *may* be deployed by State or County crews. These devices are not the same as DMS installations listed above.

13) **<u>"GATE" (Traffic Gate) Numbers</u>** – "GATE" numbers are used to track traffic gates used to perform freeway ramp closures.

14) **<u>"RM" (Ramp Meter) Numbers</u>** – "RM" numbers are used to track individual ramp signal installations at freeway entrance points.

15) **<u>"HAR" (Highway Advisory Radio) Numbers</u>** – "HAR" numbers are used to track equipment related to highway advisory radio functionality. Such equipment *may* include flashing beacon installations (associated with static information signs) or radio transmitters.

16) **<u>"SDS" (System Detector Station) Numbers</u>** – "SDS" numbers are used to track equipment used to collect system traffic data. Such equipment *may* include microwave, video imagining or inductive loops.

17) **<u>"VC" (Vehicle Classification Site) Numbers</u>** – "VC" numbers are used to track equipment used to collect vehicle classification data. Such equipment *may* include overhead microwave detectors or inductive loops.

18) **<u>"RWIS" (Road Weather Information Station) Numbers</u>** – "RWIS" numbers are used to track equipment used to collect & transmit road weather data.

INSTALLATION ID's FOR ROADSIDE FACILITIES

BHM – Maintenance contracts for much of the maintenance activities at roadside locations since they are not critical to highway safety.

The primary responsibility for WisDOT electrical staff at these locations is lighting maintenance only. ID's for roadside facilities are assigned & maintained by BHM – Maintenance. Lighting & any other electrical maintenance performed at roadside facilities are tracked under the following ID's:

19) **"R" (Rest Area) Numbers** – "R" numbers (formerly "RA") are used to track rest area facilities, generally located along freeway routes.

20) **"W" (Seasonal Wayside) Numbers** – "W" numbers (formerly "RSP") are used to track wayside facilities, generally located along conventional highway routes.

21) **"SWEF" (Safety & Weight Enforcement Facilities) Numbers** – "SWEF" numbers (formerly "WS") are used to track weigh scale facilities, generally located along IH routes.

22) **"MRSF" (Miscellaneous Roadside Facility) Numbers** – "MRSF" numbers are used to track work performed by WisDOT electrical staff on other roadside facilities. Examples of these installations include: Welcome Signs, Scenic Overlooks, Tourist Information Centers, etc.

    The format for "MRSF" numbers is…[MRSF-XXX]. The letters, represented here by "XXX", correspond to the regional ID as indicated for "MITS" numbers above. For example, EAU represents the Eau Claire Regional office.

RELEVANT INFORMATION

Relevant information for the various installations described above is collected & tracked in WisDOT database systems. This information will generally include the following data fields:

Installation type	RP Number & offset
Owner/Maintainer (State, County, Local)	Regional Office ID
Date unique ID was requested	Intersection/Location
Unique Installation ID	Municipality
Project ID	County

NON-CONFORMING INSTALLATION ID'S

Existing installation ID's that do not conform the definitions described above will be allowed to remain until that installation is reconstructed or removed from service. These ID's will be included as an alias ID in WisDOT inventory management systems for the purpose of tracking historical information.

INSTALLATION TYPES

To further aggregate an installation by type, WisDOT electrical inventory systems will have a data field to describe the basic device & function, if needed. For example, L0854 *may* be associated with a roundabout installation on the STH system. In that case the Installation Type will be "Lighting – Roundabout". The following installation types are used to further clarify the application of the various installation ID's described above.

12-1-1 Introduction **April 2023**

INTRODUCTION

Transportation safety is a priority of the Wisconsin Department of Transportation (WisDOT) and is rooted within the Department's mission and policies to minimize the number of deaths, injuries and crashes on Wisconsin roadways. The WisDOT mission statement is: *"Provide leadership in the development and operation of a safe and efficient transportation system."* This is accomplished through a comprehensive approach which focuses on:

- Working with partners throughout Wisconsin to identify and resolve safety issues
- Gathering, analyzing, and reporting data on traffic crashes and injuries, and then using that data to inform policies, investments, and enforcement of safe operations on state highways and Interstates
- Managing state and federal funds to build safer infrastructure on our roads, rail system, and at our state's airports
- Conducting public outreach and education campaigns, including those focused on pedestrian and bicyclist safety

These tasks are supported by numerous programs, initiatives, and diverse workgroups across the State with the goal of improving safety for all users. Traffic safety involves all aspects of a transportation system and is not limited to just vehicle crashes. Maintenance items such as winter plowing operations, signing, and marking replacement, mowing operations, and roadside facility improvements are examples of focus areas which lead to a safe and efficient transportation system.

WisDOT takes a multifaceted approach to roadway safety by addressing issues through engineering, education, enforcement, and emergency medical services. These four areas are critical in the development of a safe and efficient roadway system but ultimately it is up to everyone to keep the Wisconsin transportation system safe.

This chapter provides guidance on safety initiatives within traffic safety planning as well as safety analysis methodologies and countermeasure information.

12-2-1 Wisconsin Strategic Highway Safety Plan — August 2023

Wisconsin's Strategic Highway Safety Plan (SHSP) is a statewide, comprehensive, and data-driven plan that implements the framework for supporting the safety goals. This plan identifies and examines a variety of issue areas and provides tasks with the most potential to reduce roadway crashes. By working with community partners such as law enforcement, emergency responders, health care providers, and local County Traffic Safety Commissions, WisDOT is committed to keep travelers safe on our roads. The SHSP examines a variety of factors that affect highway safety in Wisconsin. Goals of the SHSP include:

- Improve Safety Culture, Safety Data, and Safety Technology
- Reduce Driver Distraction/Improve Driver Alertness
- Reduce Alcohol and Drug-Impaired Driving
- Reduce the Incidence and Severity of Motorcycle Crashes
- Improve Driver Performance (Teens, Older and Competent)
- Improve Non-Motorist Safety
- Improve Safety of Intersections
- Increase Occupant Protection
- Curb Aggressive Driving/Reduce Speed-Related Crashes
- Reduce Lane Departure Crashes
- Improve Work Zone Safety

The SHSP provides direction for future safety programs and strategies that are implemented in Wisconsin. This document is a requirement by the Federal Highway Administration. Each plan is developed in a cooperative process with Local, State, Federal, Tribal, and other public and private sector stakeholders.

12-2-2 Zero in Wisconsin — April 2023

In pursuit of the goals identified in Wisconsin's SHSP, WisDOT has advocated for *Zero in Wisconsin*, a program that advocates for safe driving practices and strives to eliminate all preventable traffic-related deaths on Wisconsin roadways. WisDOT does not tacitly accept deaths and injuries; its citizens and state policy makers work together towards achieving zero fatalities and serious injuries on our roadways.

The program provides information and resources about occupant protection, impaired driving, distracted driving, speeding, and aggressive driving, as well as pedestrian and bicycle safety.

Transportation safety involves a multifaceted approach to improve safety. Community Maps was developed to help support and enhance traffic safety planning, resource allocation, and decision support at the local level. This provides the public and local agencies a statewide map of all law enforcement reported motor vehicle crashes.

12-2-3 Safe System Approach — April 2023

The Safe System Approach aims to eliminate fatal and serious injuries for all roadway users. This is accomplished by minimizing the risks involved in using transportation systems. It is a holistic approach that accounts for human mistakes and human vulnerability with redundancies in place to protect users. The Safe System Approach is comprised of the following principles:

- Death and serious injury are unacceptable
- Humans make mistakes
- Humans are vulnerable
- Shared responsibility
- Safety must be proactive
- Redundancy is crucial

The Safe System Approach aims to design and operate our vehicles and infrastructure to anticipate human error to minimize the risk of fatal and serious injuries. This is accomplished by utilizing roadway design or having redundancies in place so that if a crash takes place the impact energy on the human body occurs at a tolerable level. It also seeks to expand the availability of vehicle systems and features that prevent and minimize the impact of crashes. The Safe System Approach also aims to enhance the survivability of crashes with prompt emergency medical care, while also facilitating a safe work environment for first responders via effective incident management practices.

There are five elements to the Safe System Approach that build on one another to create layers of protection for all road users. These are: safe road users, safe vehicles, safe speeds, safe roads, and post-crash care. With each of these elements in place, it creates a holistic approach to minimize fatal and serious injuries.

Figure 1: The Safe System Approach Principals and Elements

Safe Roads Measures: Systematic, Systemic and Spot Infrastructure Improvements, Design, Education, Training, Awareness, Technology, Legislation, Data

Safe Road Users Measures: Education, Training, Awareness, Enforcement, Technology, Data, Legislation

Safe Vehicles Measures: Technology, Legislation, Education

Safe Speeds Measures: Design/Target Speed, Education, Training, Awareness, Enforcement, Infrastructure Improvements, Technology, Data, Legislation

Post-Crash Care Measures: Quick Crash Scene Clearance, Quick Emergency Response, Crash Analysis, Education

12-3-1 Crash Reporting **May 2024**

INTRODUCTION

What is a Reportable Crash?

Crash reports are the primary source of data traffic safety engineers use to gauge the safety performance of roadways. Crashes are reported based on a set of criteria defined by s. 346.70(1).

When a reportable crash occurs, it is documented in a DT4000 form by the responsible law enforcement agency. Beginning on January 1, 2017, Wisconsin migrated to an electronic crash reporting system using a dynamic crash report form. Wisconsin has over 500 law enforcement agencies and most of them transmit crashes electronically to WisDOT using the TraCS (traffic and criminal) software. Examples of this report can be found here.

If the report is not filed by law enforcement, a similar report, the DT4002, is required to be filled out by one of the individuals involved in the crash. Due to the subjectivity and lack of uniformity, the DT4002 is not used for safety analyses.

What is Contained in a Crash Report?

The DT4000 form was created using the Model Minimum Uniform Crash Criteria (MMUCC) Guidelines. MMUCC is a standardized set of motor vehicle crash variables and is designed to generate information necessary to make data-driven decisions for improving highway safety. These elements and attributes include things such as the injury severity, spatial and temporal information, and a number of flags that indicate common or important contextual information. In Wisconsin, the severity of a crash is based on the KABCO injury severity scale. Having a robust and quality dataset provides engineers and analysts valuable information to determine where and if engineering countermeasures *should* be utilized.

How are Crash Reports used?

The information in crash reports is used by engineers to diagnose crashes and identify trends or crashes correctible by an engineering countermeasure. The number and type of crashes at a particular location, the flags, diagrams, and narratives of the crash reports can be used to determine if an engineering countermeasure *may* mitigate future crashes. For instance, if run-off-the-road crashes are observed on a curve in wet conditions, it is likely that location could benefit from a high friction surface treatment. The conditions and crash history at every location is unique and engineering judgement must be used when determining safety improvements.

Crash Report Resources

Crash reports submitted to WisDOT by law enforcement are validated for completeness and made available through the University of Wisconsin Traffic Operations and Safety (TOPS) Laboratory's WisTransPortal system. The WisTransPortal has been developed through ongoing collaboration between the TOPS Laboratory and WisDOT. It provides a central source of traffic operations, safety, and intelligent transportation systems data for Wisconsin highways. The TOPS lab has several videos to assist users in understanding and utilizing crash reports.

The crash data elements and attributes contained in the crash reports can be downloaded for analysis through the WisTransPortal's Crash Data Retrieval Facility.

Community Maps is another WisTransPortal tool to help visualize crashes spatially over a period of time. This mapping tool was developed to provide accessible and timely crash data to aid local agencies in traffic safety planning and help support County Traffic Safety Commissions.

12-3-2 Roadway Safety Management Process **May 2024**

PURPOSE

WisDOT has integrated the Roadway Safety Management Process (RSMP) from the American Association of State Highway and Transportation Official's (AASHTO) Highway Safety Manual (HSM) into the Department's safety processes. This process implements a continuous approach to roadway safety. WisDOT has adapted the RSMP within its safety process. See TEOpS 12-4-1 for information on the Safety Certification Process.

The RSMP has several steps which are outlined below:

Network Screening

Network screening is the step of identifying sites for further investigation and potential treatment across a transportation network. Treatment and countermeasure are used interchangeably throughout this policy and are intended to mean a roadway improvement that could be implemented to reduce the crash frequency or severity, or both, at a site. Those sites identified are analyzed in more detail in the diagnosis step.

Diagnosis

Diagnosis is the second step in the RSMP. Sites identified in the Network Screening step are analyzed in more detail to identify crash patterns and contributing factors. The intended outcome of the diagnosis step is to identify the factors that contributed to the crashes. Diagnosing the underlying safety issues is critical for identifying appropriate countermeasures.

Countermeasure Selection

Once the contributing factors have been identified in the diagnosis step, safety engineers select countermeasures to directly target the correctible crashes or trends and contributing factors. Safety analysts review crash modification factors and other research to identify potential countermeasures. Crash modification factors indicate the expected change in crashes after a particular countermeasure is implemented.

Economic Appraisal

Once potential countermeasures are selected, an economic appraisal is performed to compare their crash reduction benefits to their implementation costs. There are two types of economic appraisal which address projects in different ways: benefit-cost analysis and cost-effectiveness analysis. Both types begin quantifying the benefits of a proposed project, expressed as the estimated change in crash frequency or severity of crashes, as a result of implementing a countermeasure. In benefit-cost analysis, the expected change in average crash frequency or severity is converted to monetary values, summed, and compared to the cost of implementing the countermeasure. In cost-effectiveness analysis, the change in crash frequency is compared directly to the cost of implementing the countermeasure.

WisDOT has selected the benefit-cost analysis (i.e., benefit-cost ratio) method as its primary metric for economic appraisal.

Project Prioritization

Project prioritization refers to the step of developing an ordered list of recommended projects or safety countermeasures that are expected to achieve a certain objective. Prioritization of projects uses optimization methods to balance project benefits compared to the budget and other constraints.

WisDOT has several different roadway improvement programs, and each have specific goals and objectives. Improving safety is one of the goals that is consistent in all of WisDOT's programs.

Safety Effectiveness Evaluation

Safety effectiveness evaluation is the process of evaluating how a treatment, project, or a group of projects has affected crash frequencies or severities. The effectiveness estimate for a project or treatment is a valuable piece of information for future safety decision making and policy development. Safety effectiveness evaluation *may* include:

- Evaluating a single project at a specific site to document the safety effectiveness of that specific project,
- Evaluating a group of similar projects to document the safety effectiveness of those projects,
- Evaluating a group of similar projects for the specific purpose of quantifying a Crash Modification Factor (CMF) for a countermeasure, and
- Assessing the overall safety effectiveness of specific types of projects or countermeasures in comparison to their costs.

The RSMP is depicted in Figure 3.1:

Figure 3.1 Highway Safety Manual Road Safety Management Process

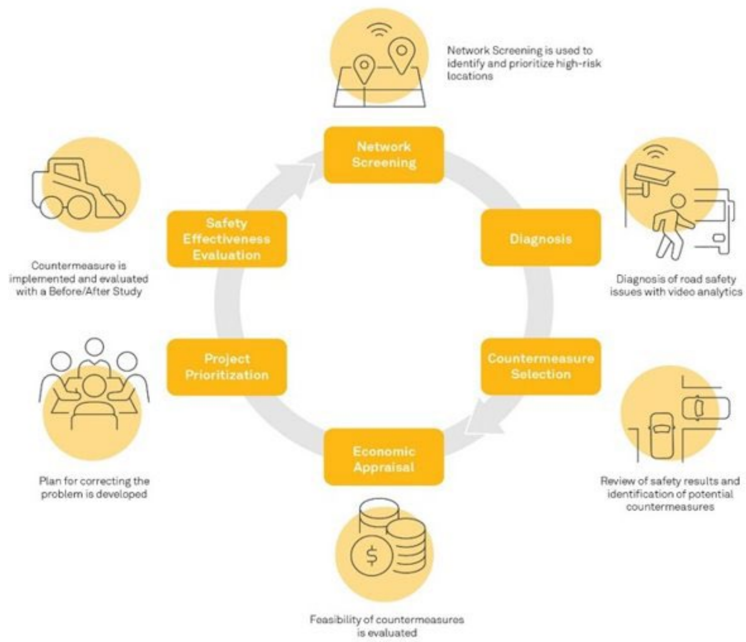


Figure 1: HSM 6-Step Roadway Safety Management Process, AASHTO (2010)

12-3-3 Network Screening **May 2024**

INTRODUCTION

WisDOT utilizes several different network screening metrics that express the safety performance of a roadway as defined in the Highway Safety Manual (HSM), 1st Edition. Key considerations in selecting appropriate performance measures rely on data availability, regression-to-the-mean bias and how the performance measure is established.

Crash Rate

A crash rate expresses the safety performance of a segment of roadway. This performance measure normalizes the frequency of crashes with the exposure, measured by traffic volume. Crash rates are unique for each particular location and are expressed in terms of crashes per hundred million vehicle miles traveled (HMVMT). A crash rate is calculated by the following equation.

$$Crash\ Rate = \frac{C * 100{,}000{,}000}{AADT * L * Y * 365}$$

Where,

Crash Rate = Frequency of crashes (crashes per HMVMT)

C = Number of crashes that occurred within analysis limits (total or severe injury (KAB))

AADT = Annual Average Daily Traffic through segment (vehicles/day)

L = Length of segment (miles)

Y = Years analyzed (typically 5)

Critical Crash Rates

The critical crash rate is a threshold value that allows for a relative comparison among sites with similar characteristics. The critical crash rate depends on the average crash rate at similar sites, traffic volume, and a statistical constant that determines the thresholds which flag locations for consideration of safety improvements. Critical crash rates, commonly referred to as “statewide average crash rates” at WisDOT, are used to flag locations that have worse safety performance than similar sites statewide. Critical crash rates are developed using data collected from similar sites in Wisconsin (e.g., 4-lane freeways, 6-lane freeways with AADT > 90,300 vehicles per day, etc.) to determine the expected level of performance for a given site type. The following equation is an example of how the critical crash rate is determined.

$$Critical\ Crash\ Rate = Crash\ Rate_{Average} + Statistical\ Constant * \sqrt{\frac{Crash\ Rate_{Average}}{AADT * L * Y}}$$

Where:

Critical Crash Rate = Upper control limit (threshold value) for a set of similar facilities (crashes per HMVMT)

Crash $Rate_{Average}$ = the average crash rate for a set of similar facilities (crashes per HMVMT)

AADT = Annual Average Daily Traffic through segment (vehicles/day)

L = Length of segment (miles)

Y = Years analyzed (typically 5)

Crash Terms

Three terms are used to express the number of crashes:

Observed Crash History

The total number of crashes that were reported over a period of time, typically 5 years, and are usually summarized by crash severity and crash type. Shown as $N_{observed}$ in equations.

Predicted Crash Frequency

The result from a crash prediction model (CPM) used to calculate a predicted number of crashes at a given site based on the site's parameters. Shown as $N_{predicted}$ in equations. See TEOpS 12-3-5 for more information regarding CPMs.

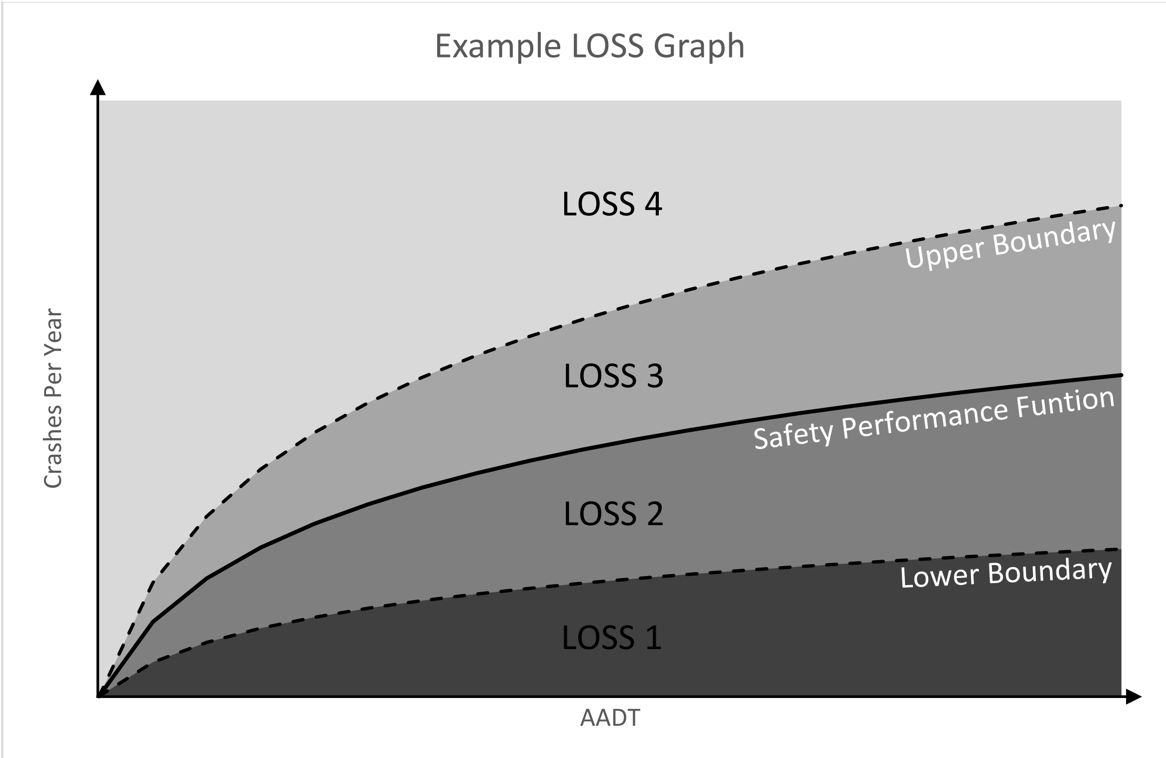
Expected Crash Frequency

The result of using the Empirical Bayes (EB) method to combine the observed crash history and the predicted crash frequency together. This typically yields more robust results than either observed crash history or predicted crash frequency alone. Shown as $N_{expected}$ in equations.

Level of Service of Safety (LOSS) with Empirical Bayes Adjustment

Level of Service of Safety (LOSS) is a performance measure used by WisDOT to separate sites into one of four safety performance classifications. A safety performance function (SPF) calibrated to local conditions is used to predict the average number of crashes for a set of similar sites. This average crash prediction defines the boundary between LOSS classifications 2 and 3, where LOSS 1 & LOSS 2 are classifications with fewer crashes than the average crash prediction and LOSS 3 & LOSS 4 are classifications with more crashes than the average crash prediction. The upper and lower boundaries are determined using an inverse gamma distribution. Figure 3.2 shows an example of the LOSS graph. The specific site is placed into one of the four LOSS classifications based on the expected crash frequency.

Figure 3.2 Level of Service Safety Thresholds



Potential for Safety Improvement (PSI)

The potential for safety improvement (PSI) is also known as *excess expected average crash frequency with empirical bayes adjustment* in the HSM, 1st Edition. It's calculated by subtracting the predicted crash frequency from the expected crash frequency. A positive result indicates there is the potential for safety improvement at that given location. Using the LOSS classifications, LOSS 3 & LOSS 4 will always yield a positive PSI and LOSS 1 & LOSS 2 will always yield a negative PSI. This means LOSS 3 & LOSS 4 locations have the potential for improvement when compared to an average site of the same type. Sites with LOSS 1 or 2 *may* still have clear crash trends that can be targeted with an effective safety countermeasure.

12-3-4 Diagnosis **May 2024**

Crash Diagrams

Crash Diagrams are used in safety analyses to visualize the crash history and easily identify trends. Key components of crash diagrams are the date, time, severity, manner of collision, location, environmental condition as well as any extenuating circumstances. All of these data fields are required to understand the factors contributing to crashes at the site. It is common to use aerial imagery for crash diagrams, but a generic intersection layout is acceptable to convey the intersection geometry. Example crash diagrams are provided in Figures 3.1a-c.

Road Safety Audits

A Road Safety Audit (RSA) is a formal examination of safety performance of an existing or future roadway or intersection by an independent, multi-disciplinary team. RSAs help to promote road safety during any phase of a project such as planning, preliminary engineering, design, and construction. RSAs can also be used to identify potential issues with temporary traffic control. This process promotes awareness of safe design practices, while integrating multimodal safety concerns, and considering human factors. The goal is to identify any safety concerns and document how those concerns can be mitigated.

Figure 3.1a. Example Crash Diagram

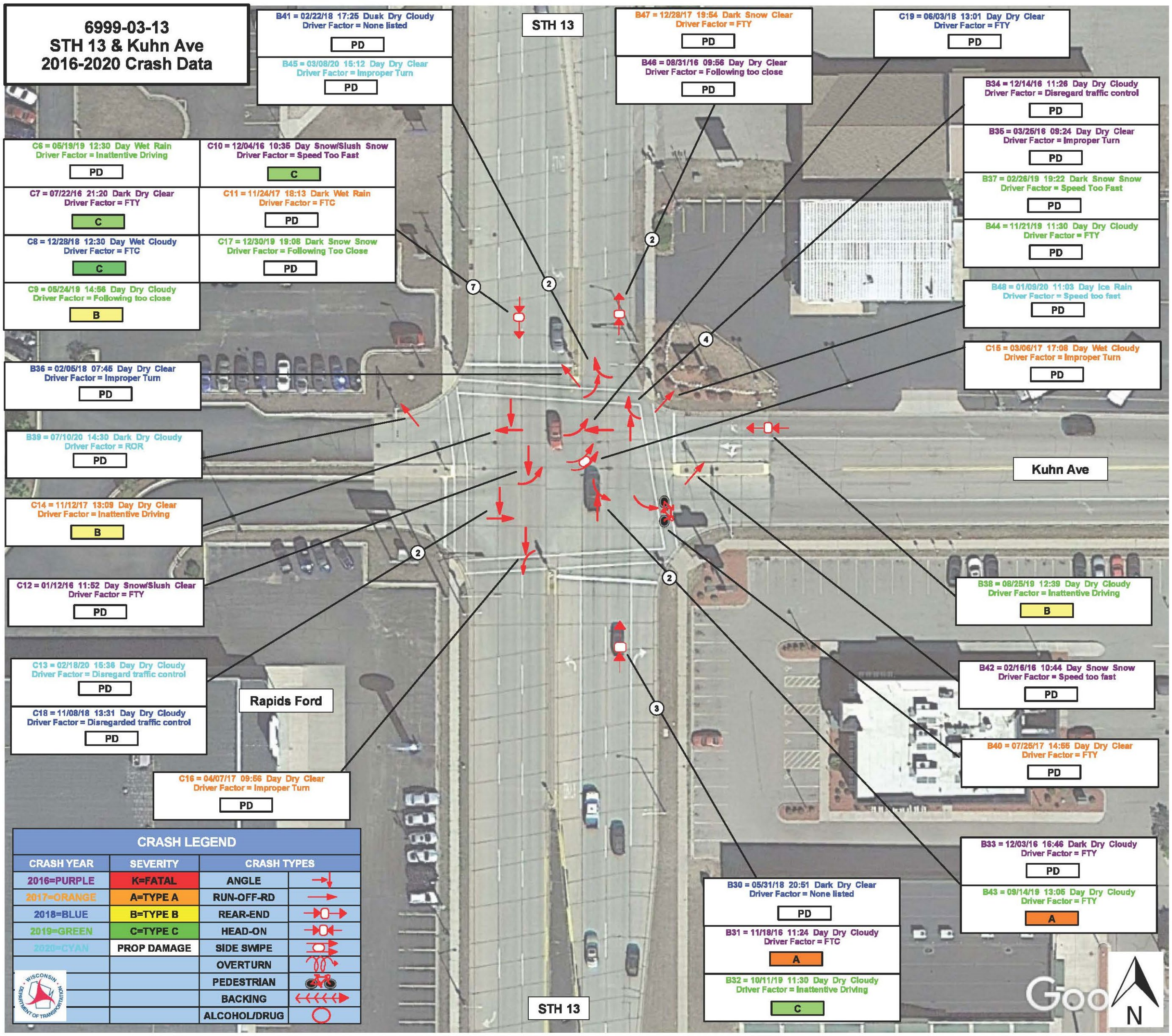


Figure 3.1b. Example Crash Diagram

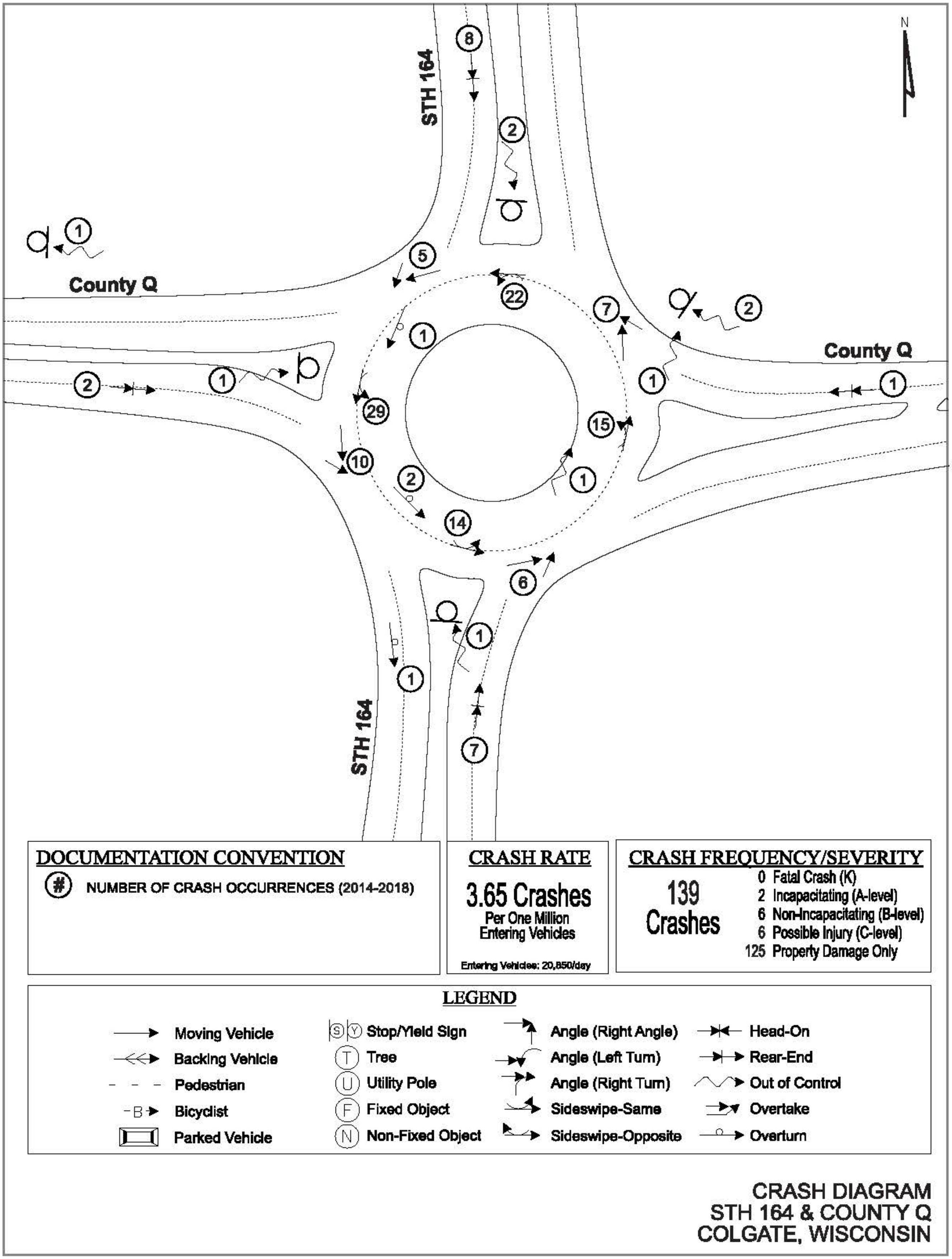


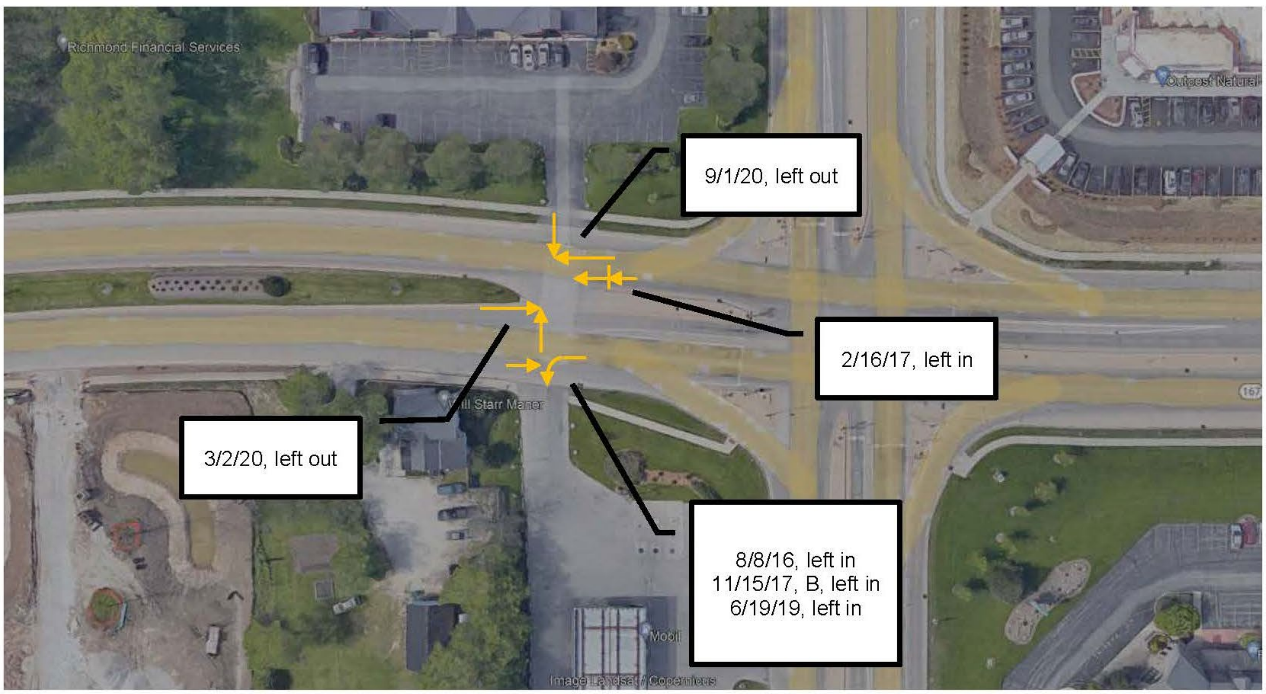
Figure 3.1c. Example Crash Diagram

DTSD – SE Region

Intersection Safety Evaluation

Median opening W of STHs 167 & 181

Ozaukee County — **January 2016-December 2020**



LEGEND

Signal/Sign Post	Bicycle	Right Angle	Out of Control	(S) = SNOW-ICE	K = FATAL
Tree/Utility Pole	Pedestrian	Left Turn	Rear-End	(W) = WET	A = SUS. SERIOUS INJURY
Non-Fixed Object	Non-Contact Vehicle	Right Turn	Head-On	(F) = FOG-MIST	B = SUS. MINOR INJURY
Fixed Object	Backing Vehicle	Sideswipe-Same	Overtake	(DUI) = ALCOHOL	C = POS. INJURY
Parked Vehicle	Moving Vehicle	Sideswipe-Opp.	Overturn	OR DRUG USE	BLANK = PROPERTY

12-3-5 Crash Prediction Models **May 2024**

INTRODUCTION

Crash Prediction Models

Crash prediction models (CPMs) are used to calculate the safety performance of existing or proposed roadways and have the following form:

$CPM_x = SPF_x * (AF_1 * AF_2 * \ldots * AF_N)$

Where:

CPM_x	= The crash prediction model for site type *x*
SPF_x	= The results from the safety performance function (SPF) for site type *x*. This can either be predicted crash frequency or expected crash frequency.
$AF_1 \ldots AF_N$	= Adjustment factors for treatment *n*

There are two different types of CPMs:

1. Network Screening CPMs (HSM Part B)
2. Alternative Analysis CPMs (HSM Part C)

Network Screening CPMs

Network Screening CPMs contain fewer parameters and offer a high-level analysis of a given location. Traffic volume is the primary indicator of crashes and is the primary parameter. These CPMs are used when computing the LOSS and PSI (TEOpS 12-3-3).

Alternative Analysis CPMs

Alternative Analysis CPMs are more detailed models that incorporate crash modification factors for specific design features or elements that are proven to influence crashes at a particular site or facility (e.g., presence of left or right turn lanes at a rural, two-way stop-controlled intersection). These models are used to compare different project-level alternatives. If the models are uncalibrated, only the relative difference between results can be used.

Safety Performance Functions

Safety performance functions (SPFs) are equations that predict the average number of crashes for a given location. Each facility type will have a different equation and will use adjustment factors to adapt a location from the base conditions to site specific conditions. Calibration factors are used in the equations to reflect local influences. WisDOT has calibrated the national models to statewide conditions. If additional crash modification factors are not used, the CPM is the same as the SPF, which is why it is common for people to interchange the terms crash prediction model and safety performance function. These equations have the following form:

$N_{predicted} = (N_{SPFx} * AF_{SPFx1} * AF_{SPFx2} * \ldots * AF_{SPFxN}) * C_x$

Where:

$N_{predicted}$	= The predicted crash frequency for site type *x*
N_{SPFx}	= The predicted crash frequency for site type *x* for the base conditions
$AF_{SPFx1} \ldots AF_{SPFxN}$	= Adjustment factors for site type *x*
C_x	= Calibration factor for site type *x*

If the Empirical Bayes (EB) method is used, then the SPF changes from predicted crash frequency to expected crash frequency. This is done by weighting the observed crash history and predicted crash frequency together.

$N_{expected} = (w * N_{predicted}) + ((1 – w) * N_{observed})$

Where:

$N_{expected}$ = the expected crash frequency for site type *x*

w = the weighted adjustment

$N_{predicted}$ = the predicted crash frequency for site type *x*

$N_{observed}$ = the observed crash history for the location

The weighted adjustment is calculated as follows:

$$w = \frac{1}{1 + \mathrm{k} * N_{predicted}}$$

Where:

w = the weighted adjustment

k = the overdispersion parameter for site type *x*

$N_{predicted}$ = the predicted crash frequency for site type *x*

The Empirical Bayes method requires at least two years of observed crash history without significant changes occurring at the location. This method is typically the most robust crash analysis method.

Crash Modification Factors

A crash modification factor (CMF) is an estimate of the change in crash frequency as a result of a particular safety treatment or design element. CMFs are used to quantify the effectiveness of a safety treatment.

$$CMF = \frac{Crash\ Frequency\ WITH\ Treatment}{Crash\ Frequency\ WITHOUT\ Treatment}$$

The value of a CMF determines whether the treatment has the potential to increase or reduce crashes.

- A CMF < 1.0 indicates that a treatment has the potential to reduce crashes.
- A CMF > 1.0 indicates that a treatment has the potential to increase crashes.
- The percent crash reduction is (1 – CMF) * 100%

CMFs are only a point estimate but do have an associated confidence interval. WisDOT uses the point estimates and not the confidence interval when incorporating CMFs into calculations. There are two common applications for CMFs.

Application 1: Multiply the CMF(s) and the observed crashes to estimate the crash frequency after installation of a safety treatment. This is done when a safety performance function (SPF) is not available for the treated site.

Application 2: Multiply the CMF(s) and the predicted crashes obtained from a SPF. This is done to account for differences between the SPF’s conditions and actual site conditions (e.g., proposed safety treatment). This *should* only be done after verifying that the CMF conditions are consistent with the conditions represented by the SPF. This type of CMF would supplement the adjustment factors associated with the SPFs found in Part C of the HSM.

Calibration

Calibrating the SPFs (and CPMs) to Wisconsin conditions is important to predict the most accurate results. Like the aphorism states: “all models are wrong, but some are useful”. In this context, the number of crashes predicted is not definitive, but rather informative to help make the best decision possible. Since the models/equations were developed with national data (data from different states), it is important to calibrate the models to Wisconsin to account for our specific climate, driver population and driving behaviors, animal populations, and crash reporting practices.

Calibration Factor

A calibration factor is the ratio of observed crashes to expected crashes for the same time period of the same sites. In this way, a calibration factor is like a CMF, where:

- A calibration factor > 1 indicates the number of predicted crashes is greater for the local jurisdiction compared to the model.
- A calibration factor < 1 indicates the number of predicted crashes is lesser for the local jurisdiction compared to the model.

The calibration factor adjusts the total number of crashes predicted.

Crash Distributions

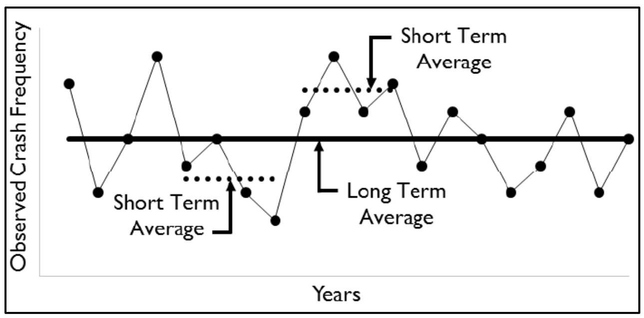
In addition to accounting for the total number of crashes, it is important to calibrate the types and severities of crashes. Calibration for crash types and severities use crash distribution/proportion tables that are then applied to the predicted number of crashes.

12-4-1 Safety Certification Process — April 2023

PURPOSE

Quantifying safety early in the project development process is key to determining safety improvement impacts to projects. Proposed safety improvements in a project must be balanced with other competing fiscal needs such as operational, environmental, and pavement factors. Historically, safety benefits have been assumed inherent, or "built-in", to design policies and practices. The safety treatments were proposed at locations that were identified using the existing (observed) short-term crash data. This method was not representative of the long-term conditions of the subject location as it did not account for the Regression to the Mean (RTM) of crash data. RTM is defined as the natural variation of crash data. A location that was being reviewed could be analyzed when it was seeing a randomly high fluctuation of crashes, but the long-term period saw the location operating within typical safety norms. Likewise, a location could be overlooked from review due to it having a randomly low fluctuation of crashes. Figure 1 displays RTM bias.

Figure 1. Variation in short-term observed crash frequency to illustrate RTM bias



There are methods and tools available to quantify safety benefits in the development and analysis of alternatives in projects while accounting for RTM. This allows WisDOT to employ a PBPD approach. Within the safety evaluation of a project, to facilitate the safety comparison of alternatives, predictive crash modeling and an economic appraisal is used to compare the cost of crashes to the cost of roadway improvements. Predictive crash modeling is used to estimate crash frequencies and severities for alternatives on a project. Economic appraisal techniques are then used to assign average costs to the crashes for each alternative to monetize safety benefits. In this way, safety can be compared with other costs (construction, real estate) to evaluate alternatives. For a discussion on alternative viability, see FDM 11-38-15.1.

The Safety Certification Process (SCP) follows the Highway Safety Manual's (HSM's) Road Safety Management Process (RSMP). This is a step-by-step process of determining whether safety improvements should be included on a project by quantifying alternatives, monetizing the resulting safety benefits, completing benefit-cost comparisons of the alternatives, and documenting decisions and judgements throughout the process.

This requires the analyst to use and document sound engineering judgement and experience based on specific project conditions, context, and modal priorities.

The Safety Certification Process is detailed in FDM 11-38.

12-4-2 Highway Safety Improvement Program — April 2023

The Highway Safety Improvement Program (HSIP) is a core Federal-aid program with the purpose of achieving a significant reduction in fatalities and serious injuries on all public roads. Projects are identified by statewide screenings and WisDOT regional safety engineers on the state-owned system and by local agencies on the local system. All candidate projects must compile crash data and develop a proposed treatment strategy as part of a competitive application process. The applications are considered through a peer review process that involves statewide and regional safety engineering staff, as well as HSIP program management staff.

Federal HSIP guidance can be found on the FHWA HSIP website. Wisconsin-specific HSIP information can be found on the Wisconsin HSIP website. WisDOT HSIP program guidelines are available for internal use only.

12-5-1 General — April 2023

Safety countermeasures are facility improvements that have been proven to reduce the severity of crashes. Countermeasures range from additional signage to complete reconfiguration of roadways. This section does not detail all available countermeasures that WisDOT implements. Many other countermeasures are detailed in WisDOT's Facilities Development Manual (FDM) and throughout the Traffic Engineering, Operations & Safety (TEOpS) manual.

12-5-3 Intersection Conflict Warning Systems — August 2021

BACKGROUND

Intelligent Transportation System (ITS) technologies can be used to provide enhanced warning information to drivers approaching intersections compared to static signing and marking applications. One type of ITS installation that *may* reduce crashes at intersections is an Intersection Conflict Warning System (ICWS). An ICWS is an actuated system which provides advance warning of a condition that may require a vehicle to stop but the condition is not always present. These systems have a broad spectrum of types and applications but are all categorized as ICWSs. An ICWS is a countermeasure intended to address locations that are experiencing crash issues, have unusual geometry, or restricted sight distances. An ICWS *should* only be used where other countermeasures have failed or *may* not be feasible.

GUIDELINES

Three criteria are to be considered when reviewing a location for an ICWS. These criteria are as follows:

1. Demonstrated crash issue
2. Visibility restrictions
3. Unusual geometrics

Due to the long-term maintenance of these systems, other countermeasures *should* be considered first to address safety concerns prior to the installation of an ICWS. These include:

- Improving sight distance (clearing vegetation, obstructions, or brush)
- Installing an advance intersection warning sign (W2 series)
- Increasing sign sizes
- Double-marking signs
- Installing advanced crossroad name signs (D series), if applicable. See TEOpS 2-4-50.
- Installing permanent flags on signs
- Electrical countermeasures (beacons, etc.)

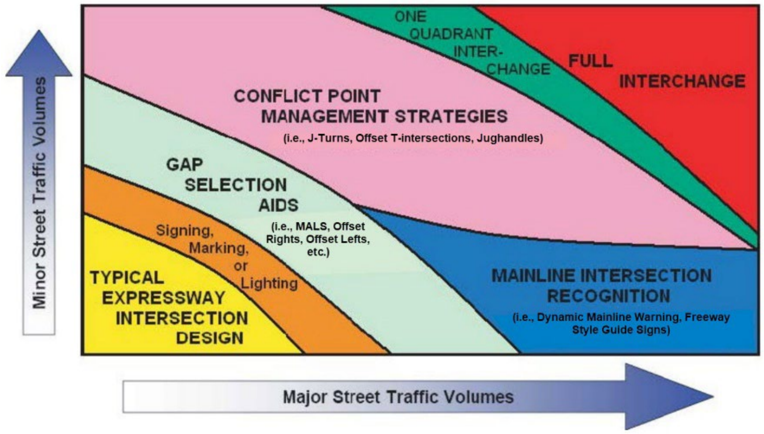
THROUGH ROUTE ACTIVATED WARNING SYSTEMS

Introduction

The frequency of crashes at two-way stop-controlled (TWSC) intersections is typically lower than at signalized intersections; however, the crashes are often more severe. The most common crash type at TWSC intersections is a multi-vehicle angle crash where a vehicle stopped on the minor road enters the intersection without an acceptable gap, resulting in a collision with a through vehicle on the major road. On higher speed roadways, these crashes are often severe because of the nature of the impact. In many cases, a primary factor in these crashes is misjudgment of approaching traffic on the major road by the minor road vehicle, not failure to stop at the minor road approach.

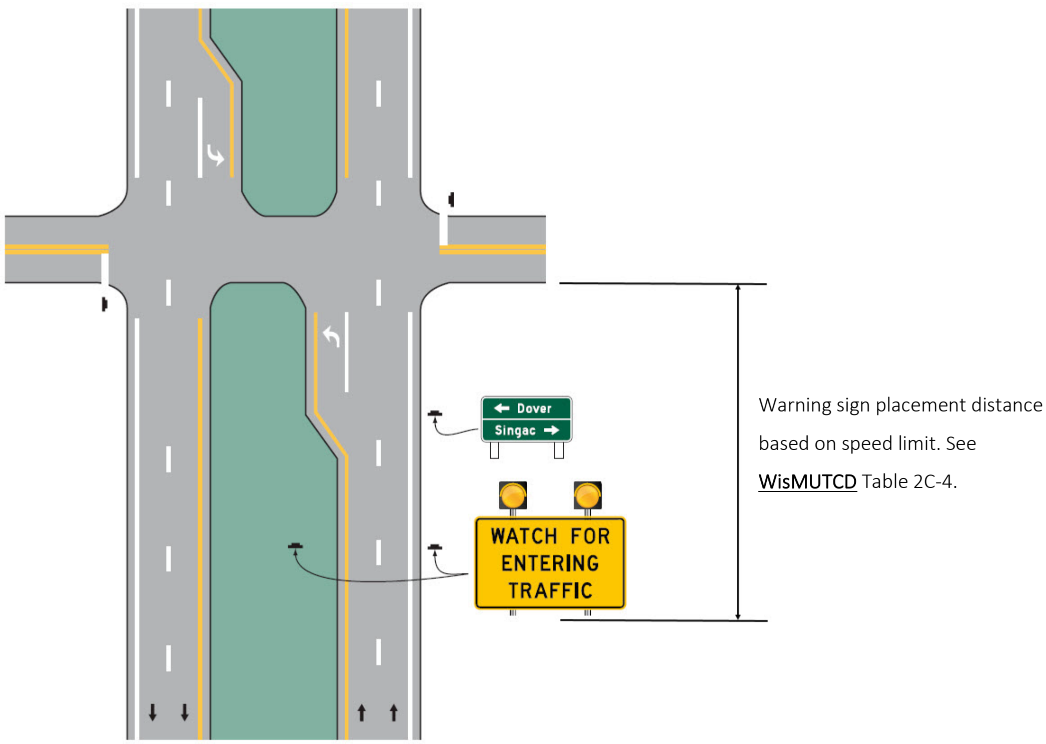
Several countermeasures are available to mitigate these angle crashes with varying costs and effectiveness. Figure 1 shows several categories of countermeasures for reducing crashes at TWSC intersections. Some countermeasures are more appropriate for divided highways and some are more appropriate for undivided highways. The most appropriate countermeasure *should* be based on the crash trends and contributing factors of those crashes at the intersection in question.

Figure 1. TWSC Rural Expressway Intersection Countermeasure Categories



One type of ICWS which has been implemented in several states is a Through Route Activated Warning System (TRAWS). A TRAWS detects vehicles on the minor road of a TWSC intersection to warn traffic on the major road. Detected vehicles activate flashing beacons that are attached to static warning signs. The flashing beacons are activated to warn major road traffic that vehicles on the minor road *may* enter the intersection. An evaluation by FHWA showed that a TRAWS has the ability to reduce right angle crashes at TWSC intersections. Figure 2 shows a conceptual layout of a TRAWS.

Figure 2. Typical Installation of a TRAWS on a multi-lane highway



Policy

This policy contains provisions for proper site selection, application, design, and installation of a TRAWS on the State Trunk Highway (STH) system.

Site Selection Criteria

A TRAWS *should* be considered at an existing TWSC intersection if it meets all the following conditions:

1. Enhanced signing and marking treatments have failed to mitigate crashes
2. Conflict point management strategies such as Restricted Crossing U-Turn (RCUT) intersections or other access restrictions are not appropriate or are too costly to implement
3. Improving sight distance is too costly to implement, if applicable
4. The intersection experienced three or more angle crashes in the previous five years or since the most recent safety improvement, if one was installed, within the previous five years
5. The posted speed limit for the through route is greater than 45 mph

As traffic volumes on the side road increase, the amount of time the beacons are activated increases respectively. The total activation time per vehicle is dependent on several factors. Minor road Average Annual Daily Traffic (AADT) volumes of more than 3,000 vehicles per day *may* cause near continuous activation of the system which can lead to drivers ignoring the dynamic warning and diminish the effectiveness of the system. Average activation times **shall** be considered based on the site conditions and engineering judgement used to confirm the system will activate dynamically for drivers on the major road. To optimize the effectiveness of a TRAWS, the following maximum AADT volumes *should* be considered:

- Major Road AADT typically does not exceed 12,000
- Minor Road AADT typically does not exceed 3,000

Design and Installation

The following provisions pertain to the design and installation of the signing components for a TRAWS on the STH system:

1. Installations **shall** be in compliance with the requirements established in the Wisconsin MUTCD (WisMUTCD)
2. The sign legend **shall** follow WisDOT sign plate W8-75. Sign size varies by facility type. For sizing information, see TEOpS 2-1-35.
3. Number of signs, beacon details and sign installation
    a. The sign and beacon assembly **shall** be ground mounted in the lateral and vertical location as specified in the WisMUTCD
        i. The sign **shall** be located in accordance to WisMUTCD Table 2C-4
        ii. See WisDOT sign plate A4-4 for information on roadway offsets, number of posts and post spacing required
        iii. Warning beacons **shall** be mounted on the same support as the warning sign. See WisMUTCD 4L.01 and 4L.03 for information. The beacon **shall** be mounted, at minimum, one foot above the sign with a maximum of two feet.
    b. The number of signs depends on the facility type and site condition. See Figure 2 for an illustration of a typical installation on a divided, multi-lane highway.
        i. For two-lane undivided highways, one sign **shall** be installed for each direction of travel
        ii. For four-lane divided highways, one sign **shall** be installed on each side of the highway for each direction of travel
    c. Two flashing beacons **shall** be used on all signs. When activated, the beacons **shall** operate with an alternating flashing, "wig-wag", signal indication.

The following provisions pertain to the design and installation of the detection and electrical service for a TRAWS on the STH system:

1. Detection
    a. All stop approaches *should* have advance and stop bar detection. The type of detection *should* be controlled through radar detection. The equipment **shall** be furnished by the Department.
    b. Detection of a vehicle on the stop approaches **shall** be transmitted through a hard-wired connection from a detector to activate the beacons on the system
    c. Any poles needed for mounting detection equipment **shall** be in conformance with the standards in FDM 11-15-1
    d. System timing *should* be based on the operating speeds on the major and minor roads, major road sign placement, major road vehicle perception-reaction time, intersection geometrics, traffic volumes, vehicle mix and type of detection at each site
    e. The need to detect vehicles in the median who are making two-stage crossing maneuvers **shall** be evaluated during design

2. Electrical service
    a. Service **shall** be installed underground. The conduit **shall** run up and be attached to the control cabinet. The control cabinet **shall** be mounted on the pole at least three feet from the ground.
    b. Solar-powered installations **shall** not be allowed on the STH system

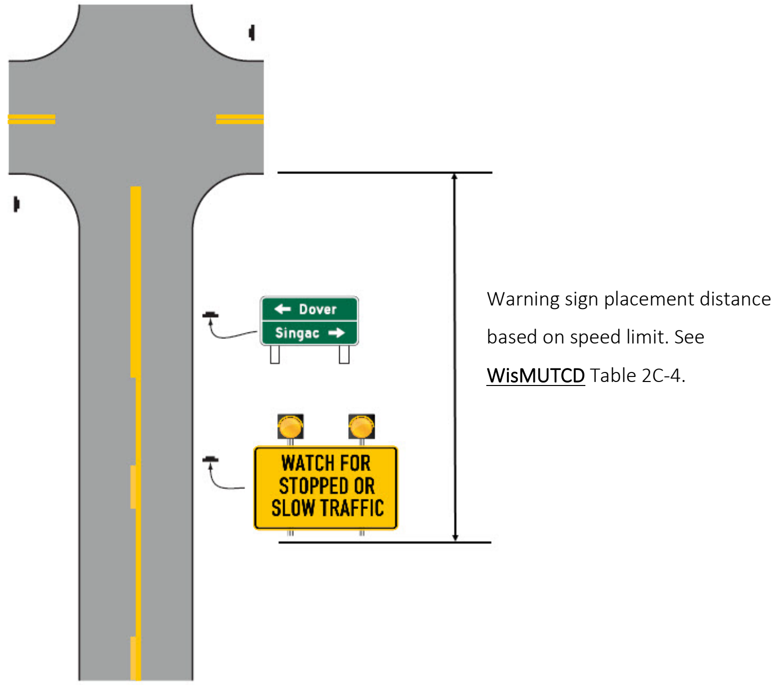
STOPPED OR SLOW TRAFFIC AHEAD WARNING SYSTEM

Introduction

A common crash type at a TWSC intersection where a separated left turn lane doesn't exist is when a vehicle on the mainline slows to perform a turn or is stopped within a queue of vehicles due to turning traffic and is rear-ended by another vehicle. Several factors that could contribute to these types of crashes are restricted sight distance, unusual geometry, and roadway curvature.

A Stopped or Slow Traffic Ahead Warning System is a type of ICWS that detects vehicles on the major road to warn subsequent vehicles of a stopped/slowed vehicle ahead. A vehicle that is slowing prior to the intersection to perform a turn activates flashing beacons that are attached to a static warning sign. Figure 3 displays a typical installation on a two-lane undivided facility.

Figure 3. Typical Installation of a Stopped or Slow Traffic Ahead Warning System on a two-lane highway



Policy

This policy contains provisions for proper site selection, application, design, and installation of a Stopped or Slow Traffic Ahead Warning System on the STH system.

Site Selection Criteria

A Stopped or Slow Traffic Ahead Warning System *should* be considered at an existing TWSC intersection if it meets all the following conditions:

1. Enhanced signing and marking treatments have failed to mitigate crashes
2. The Stopping Sight Distance (SSD) does not meet minimum standards for a category 1 sight distance requirement or the intersection experienced three or more correctable crashes (mainline rear-ends relating to left-turning movements) in the previous five years or since the most recent safety improvement, if one was installed, within the previous five years. See FDM 11-10-5.1.1 for SSD requirements.
3. Installing geometric alternatives (turn lanes, bypass lanes, paved shoulders) is not feasible due to unusual geometrics, existing roadway features, or other factors
4. The posted speed limit for the through route is greater than 45 mph

Design and Installation

The following provisions pertain to the design and installation of the signing components for a Stopped or Slow Traffic Ahead Warning System on the STH system:

1. Installations **shall** be in compliance with the requirements established in the Wisconsin MUTCD (WisMUTCD)
2. The sign legend **shall** follow WisDOT sign plate W8-77. Sign size varies by facility type. For sizing information, see TEOpS 2-1-35.
3. Number of signs, beacon details and sign installation
    a. The sign and beacon assembly **shall** be ground mounted in the lateral and vertical location as specified in the WisMUTCD
        i. The sign **shall** be located in accordance to WisMUTCD Table 2C-4
        ii. See WisDOT sign plate A4-4 for information on roadway offsets, number of posts and post spacing required
        iii. Warning beacons **shall** be mounted on the same support as the warning sign. See WisMUTCD 4L.01 and 4L.03 for information. The beacon **shall** be mounted, at minimum, one foot above the sign with a maximum of two feet.

b. This system *should* only be used for two-lane undivided highways. One sign **shall** be installed for each direction of travel
c. Two flashing beacons **shall** be used on all signs. When activated, the beacons **shall** operate with an alternating flashing, “wig-wag”, signal indication.

The following provisions pertain to the design and installation of the detection and electrical service for a Stopped or Slow Traffic Ahead Warning System on the STH system:

1. Detection
   a. Detection *should* be camera-based in order to detect mainline vehicles slowing to perform a turn. The type of detection *should* be evaluated at each location. The equipment **shall** be furnished by the Department.
   b. Detection of a vehicle **shall** be transmitted through a hard-wired connection from a detector to activate the beacons on the system
   c. Any poles needed for mounting detection equipment **shall** be in conformance with the standards in FDM 11-15-1
   d. Considerations for system timing and system delays *should* be based on conditions at the site such as traffic volumes, vehicle type, vehicle speeds, major road vehicle perception-reaction time, intersection geometrics, and major road sign placement.

2. Electrical service
   a. Service **shall** be installed underground. The conduit **shall** run up and be attached to the control cabinet. The control cabinet **shall** be mounted on the pole at least three feet from the ground.
   b. Solar-powered installations **shall** not be allowed on the STH system

PERMITTING OF INTERSECTION CONFLICT WARNING SYSTEMS

See TEOpS 4-5-1 for provisions on permitting ICWSs.

MAINTENANCE AND RELIABILITY OF INTERSECTION CONFLICT WARNING SYSTEMS

Reliability of an ICWS is critical for public acceptance and successful crash mitigation. The provisions described in this policy have been developed to provide a high level of system reliability commensurate with other ITS devices deployed by the Department. Design of the detection system, electrical service and data transmission, and sign messaging all play a role in how drivers perceive and react to an ICWS during normal and fail-safe conditions. Once a system has been installed, the Region operations section **shall** be the primary caretaker of the system to provide any needed maintenance and repairs that keep the system functional on the STH system. Coordination with local maintenance forces, law enforcement and local stakeholders is needed to identify any system malfunctions so the appropriate personnel can promptly respond to any issues.

REFERENCES

1. Amjadi, R. (2015). TechBrief: Safety Evaluation of Intersection Conflict Warning Systems (ICWS). *Report No. FHWA-HRT-15-076.* Federal Highway Administration, Washington, D.C.
2. Bryer, T. (2011). Stop-Controlled Intersection Safety: Through Route Activated Warning Systems. *Report No. FHWA-SA-11-015*. Federal Highway Administration, Washington, D.C.
3. Crowson, G., & Jackels, J. (2011). Design and Evaluation Guidance for Intersection Conflict Warning Systems (ICWS). *Report No. ENT-2011-1.* ENTERPRISE Transportation Pooled Fund Study TPF-5 (231).
4. Himes, S., Gross, F., Eccles, K., Persaud, B. (2016). Safety Evaluation of Intersection Conflict Warning Systems*. Report No. FHWA- HRT-16-035*. Federal Highway Administration, Washington, D.C.
5. “Planning Guidance for Intelligent Transportation Systems (ITS) Devices. Version 3.1” (2015). ENTERPRISE Transportation Pooled Fund Study TPF-5 (231).
6. Vaughan, I., & Jackson, S. (2016). Intersection Conflict Warning Systems Human Factors: Final Report*. Report No. FHWA-HRT-16-061*. Federal Highway Administration, Washington, D.C.

12-5-4 Friction Surface Treatment — August 2021

BACKGROUND

Maintaining pavement friction is a critical component of vehicles safely navigating a roadway. Almost 20% of all traffic fatalities result from lane departure crashes, while they only account for less than 5% of all traffic crashes. A “lane departure” crash is a “non-intersection crash which occurs after a vehicle crosses an edge line or a center line, or otherwise leaves the travel way.”

One of the primary causes for lane departure crashes is related to poor weather conditions, particularly snow/ice and wet weather conditions.

One method to address lane departure crashes is to provide friction enhancements to the pavement. Wisconsin has several types of surface treatments that are considered friction enhancements to existing roadway or bridge surfaces.

High Friction Surface Treatments (HFST) use a calcined bauxite aggregate with resin binder, which is an aggregate that maintains frictional resistance over time by resisting polishing and wear. A resin binder is applied to the roadway or bridge surface prior to the aggregate application. HFSTs are a proven low-cost countermeasure to reduce lane departure crashes in areas that have an observed crash history related to poor, especially wet, weather conditions.

Enhanced Friction Surface Treatments (EFST) include all other types of friction enhancements to roadway and bridge surfaces.

GUIDANCE

Areas that have vehicles changing lanes or braking excessively *may* experience pavement surfaces becoming prematurely polished which reduces pavement friction. These locations commonly are located on interchange ramps and horizontal or vertical curves. Locations that experience a high number of lane departure crashes that can be considered for friction treatment installation include:

- Interchange Ramps
- Horizontal or vertical curves
- Structures
- Roundabouts

A HFST **shall** be the preferred friction enhancement to mitigate lane departure crashes. Friction surface treatments **shall** be installed as spot treatments or on short segments to mitigate crashes related to pavement friction deficiencies. These treatments are not intended to be applied as a corridor treatment and *should* only be considered when warranted.

<u>Placement and application</u>

Crashes are likely to occur in the area where a driver recognizes an upcoming change of condition and applies the brakes to navigate the roadway feature. These crashes *may* be prevented by providing a HFST prior to the change of condition. Placement of a HFST *should* be based on the characteristics of the roadway and other indications that are specific to each site. These factors *may* include:

- Crash locations
- Presence of skid marks
- Damaged roadside barriers or other objects
- Presence and condition of previous low-cost countermeasures
- Superelevation
- Driver speeds
- Advisory speeds
- Driver behavior
- Point of curvature and point of tangent
- Horizontal and vertical sight distances
- Intersections near or within a curve
- Heavy vehicle use
- Speed differentials
- Presence of horizontal curves, vertical curves, or weaving areas
- Friction levels (if existing pavement will remain)

When applying a HFST to the roadway surface it **shall** be installed in a single layer unless it is being applied to a bridge deck. When applying either a Thin Polymer Overlay (TPO) or a HFST to the bridge deck it **shall** require a two-layer application for deck preservation against chloride infiltration. Additionally, the standard two-layer application provides protection against snowplow and snowmobile operations.

For bridge applications, the standard two-layer TPO consists of a two-component system of epoxy polymer and aggregates for a ¼-inch minimum total thickness. This TPO system does not require use of calcined bauxite aggregates and is considered an EFST. When a HFST is warranted, a two-layer TPO with calcined bauxite aggregates **shall** be applied. The bridge deck (driving lanes and shoulders) *should* be the only feature that receives the treatment. Other considerations *should* be evaluated to determine if the approach slabs or travel lanes prior to the bridge deck need to be treated such as the presence of a curve or areas where heavy weaving may occur. Use of a HFST on bridge decks will require additional coordination and prior approval from the Bureau of Structures. For additional information on friction treatments for bridge decks, refer to the thin polymer overlay section in Chapter 40 of the WisDOT Bridge Manual.

For applications prior to vertical curves and roundabouts, the above factors *should* be taken into consideration at each situation due to the unique properties of the site.

For horizontal curves, the braking distance can be used to provide an approximate location of where to begin placement of a HFST. Table 1 provides general placement guidance for horizontal curves prior to the point of curvature (PC).

Table 1. Recommended HFST placement distances prior to the point of curvature (PC)

Approach Speed (mph)	Curve Advisory Speed (mph)											
	15	20	25	30	35	40	45	50	55	60	65	70
25	100	75	50	-	-	-	-	-	-	-	-	-
30	125	125	100	50	-	-	-	-	-	-	-	-
35	175	150	125	100	50	-	-	-	-	-	-	-
40	200	200	175	150	100	50	-	-	-	-	-	-
45	250	225	225	175	150	100	50	-	-	-	-	-
50	300	300	275	225	200	150	125	50	-	-	-	-
55	375	350	325	300	250	225	175	125	50	-	-	-
60	425	400	375	350	325	275	225	175	125	50	-	-
65	500	475	450	425	375	350	300	250	200	125	50	-
70	575	550	525	500	450	425	375	325	275	200	125	50
75	650	625	600	575	525	500	450	400	350	275	225	150

Note: Recommended values are based on the braking distance with a conservative deceleration rate of 10 ft/s^2. All values include an added 50 feet and are rounded to the nearest 25 feet.

REFERENCES

1. "Frequently Asked Questions – High Friction Surface Treatments (HFST) – 2017" (2018, February). Federal Highway Administration, Washington, D.C. Retrieved from https://safety.fhwa.dot.gov/roadway_dept/pavement_friction/faqs_links_other/hfst_faqs/. Accessed August 9, 2021.
2. "High Friction Surface Treatments" (2018, February). Federal Highway Administration, Washington, D.C. Retrieved from https://www.fhwa.dot.gov/innovation/everydaycounts/edc-2/hfst.cfm. Accessed August 9, 2021.
3. "Horizontal Curve Safety" (2021, February). Federal Highway Administration, Washington, D.C. Retrieved from https://safety.fhwa.dot.gov/roadway_dept/countermeasures/horicurves/. Accessed August 9, 2021.
4. "Wisconsin Strategic Highway Safety Plan 2017-2020" (2017, November). Wisconsin Department of Transportation, Madison, WI. Retrieved from https://wisconsindot.gov/Documents/safety/education/frms-pubs/strategichwy-17-20.pdf. Accessed August 9, 2021.

WISDOT SPECIAL PROVISIONS AND REFERENCES

1. Wisconsin Resin Binder High Friction Surface Treatment
2. WisDOT Bridge Manual: Chapter 40 – Bridge Rehabilitation, 40.5.1.1 Thin Polymer Overlay

13-1-1 Statutory Authority — October 1995

The fundamental principle of the Through Highway Declarations is that no STOP sign **shall** be erected facing traffic on a state trunk highway nor **shall** traffic on any non-state trunk highway be permitted to enter a state trunk highway without stopping, unless specifically provided for in the Declarations.

AUTHORITY

Section 349.07, Wis. Stats., provides the Department with the authority to "...declare any state trunk highway or connecting highway or portion thereof to be a through highway."

A "through highway" is defined in s. 340.01(67), Wis. Stats., as:

> "...every highway or portion thereof which has been declared by the state or local authorities pursuant to s. 349.07 to be a through highway and at the entrances to which vehicular traffic from intersecting highways is required by traffic control signals or stop signs to stop."
>
> On November 30, 1950, the Highway Commission took action pursuant to the existing statutory authority and implemented a systematic method for establishing and documenting all of its declared through highways. This action was as follow:
>
> "The Commission took up for consideration the matter of declaring all state trunk highways to be arteries for through traffic. Attention was directed to the fact that many state trunk highways are now arterials, that it will be necessary to coordinate the old and new arterial declarations, and that all highways cannot immediately be signed as arterials."
>
> "It was moved, seconded, and carried that all state trunk highways and the urban extensions thereof (designated by the statutes as 'connecting streets') be declared arteries for through traffic pursuant to Section 85.68, Wisconsin Statutes, and that arterial STOP signs be erected stopping traffic on all county trunk highways, town roads, and local city and village street entering said state trunk highway routes unless specifically excepted in this or subsequent actions of the Commission."
>
> "It was further moved, seconded, and carried that traffic on any state trunk highway (and connecting street) **shall not** be required to stop at the intersection with any other state trunk highway (or connecting street), or at the intersection with a county trunk highway, town road, or local city or village street unless specifically required to stop at such intersection by this or subsequent actions of the Commission..."

Following these brief introductory paragraphs was the listing of the highways declared as arteries for through traffic and the descriptive paragraphs delineating the exceptions to each. These descriptive paragraphs (the exceptions) defined all instances where traffic on a state trunk highway was required to stop and where traffic on other streets/highways was permitted to enter a state trunk highway without stopping.

On November 13, 1962, the Highway Commission delegated its statutory authority to declare and regulate through highways to the Chief Traffic Engineer, and established the Chief Traffic Engineer as being responsible for maintaining the official records.

Since that time, the title of Chief Traffic Engineer has been changed to Director, Bureau of Traffic Operations. The Director has notified the Regions that, as of October 16, 1995, the approval authority for Through Highway Declarations is delegated to the Regions. The Regional Transportation Directors were requested to appoint an approval authority and inform the Director of BTO as to the appointment.

13-1-2 Approval Process — October 1995

CHANGES TO THE DECLARATIONS

From time to time, it becomes necessary to make changes in the Declarations. Changes *may* be required due to additions to the state trunk system, deletions from the system, rerouting or renumbering of highways, reconstruction of intersections, or changes in traffic conditions.

Since the exceptions are arranged in geographic order it is desirable that the exceptions for concurrent routes be listed under each appropriate highway number, not just the lowest numbered route. Intersecting state trunk highways must be investigated and exceptions corrected where necessary, under each appropriate highway number.

THE APPROVAL PROCESS

Whether a proposal involves creation of a new exception paragraph, or the revision or deletion of an existing paragraph, the Region prepares their recommended exception paragraphs for each through highway route and intersection involved. The authority for approval resides with the designated Region approval authority. A copy of the approved declaration is to be sent to the Central Office of Traffic to serve as information for others, and to provide a backup record.

TEMPORARY CHANGES DUE TO CONSTRUCTION

Where construction activities result in necessary temporary changes in arterial arrangements, it is suggested that the Regional office write the changes in the form of declarations as a memo to file. It is not necessary to send a copy to the Central Office.

13-1-5 Declaration Format April 1996

NUMBERING OF THE DECLARATIONS

The delegation of the authority to approve through highway declarations also carries with it the responsibility for numbering the exception paragraphs in a uniform and sensible manner. The following is a recommendation on a uniform system of numbering which *should* give all the information necessary to find the paragraphs, keep them in order and identify the location to ourselves and others.

An example of the first page of each highway's declarations is given below:

Through Highway Declarations - State Trunk Highway System

Northcentral Region, Waushara County

File: TH 469073

TH-4-69-073.1

Northbound traffic on State Trunk Highway 73 **shall** stop before entering the east junction of State Trunk Highways 73 and 21.

Approved Date: 02/24/85 Installed Date: 03/31/86

TH-4-69-073.2

When the traffic control signal at the intersection of State Trunk Highways 73 - 21 (Main Street) and Saint Marie Street in the City of Wautoma, is not operating, traffic on Saint Marie Street **shall** stop before entering the intersection.

Approved Date: 07/26/89 Installed Date:

The title indicates to others what the document is, such as when it is mailed out or brought into court. The file number is condensed to be usable in Word Perfect. Each paragraph has a number which contains all the information necessary to identify its location, so that each page stands by itself. The prefix indicates it is Through Highway; the first number is the Region; the second two digits are the county number (which is listed in Figure 1); the next three digits are the highway; and the decimal is the paragraph sequence number.

Following the paragraph it is recommended that the approval date and the installation date be shown. It has also been recommended but not shown at this time that the RP number can be added for future look-up convenience, such as with a GIS system. This would certainly be a Region option.

For sections which have concurrent highways, duplicate paragraphs will be necessary under each highway.

EXCEPTIONS

The exceptions appear in the list following each designated through highway. One descriptive paragraph is devoted to each intersection where an exception occurs and the paragraphs are sequentially numbered geographically for each route. If an intersection is not addressed in the exceptions, the fundamental principle of the Declarations applies: The state trunk highway does not STOP and all non-state trunk highways do.

The exception paragraphs for any through highway route are numbered consecutively in each Region beginning with .1. From time to time, it becomes necessary to add paragraphs within this structure. The following system is typically used:

To insert a new paragraph between paragraphs one (1) and two (2), the new paragraph becomes paragraph .1.1 as follows, or the Region *may* choose to correct the numbering each time.

WRITING EXCEPTIONS

Standard writing formats have been developed for the Declarations to ensure uniformity of application and consistency of interpretation.

The basic exception paragraph takes the following form:

TH-5-52-080.9 — North and southbound traffic on State Trunk Highway 80 **shall** stop before entering the intersection of State Trunk Highways 80 and 60.

Approved Date: xxx — Installed Date: yyy

1. The traffic is first identified:

   "North and southbound traffic"

2. Then the highway on which it is moving (or in the case of turn lanes or ramps, the highway which the traffic is leaving) is identified:

   "on State Trunk Highway 80"

3. Then the action this traffic must take is specified:

   *"**shall** stop"*

4. Then the location where this action is to be taken is identified:

   "before entering the intersection of State Trunk Highways 80 and 60"
   (The county does not have to be repeated in each paragraph if the format at the beginning of this procedure is used.)

Within city and village limits, in addition to the highway numbers, the names of streets *may* be included in parentheses to document the location of the State Trunk Highway or Connecting Highway at the time of the action.

TYPICAL EXCEPTION SITUATIONS

Many intersections present similar control situations and are merely variations of the basic exception paragraph discussed earlier. Some of these more common variations will now be addressed.

<u>Permitting Non-STH traffic to enter without stopping</u>

TH-2-51-020.14 — Southbound traffic on State Trunk Highway 20 **shall** stop before entering the intersection of State Trunk Highway 20 and County Trunk Highway "D", but eastbound traffic on county trunk Highway "D" **shall** not be required to stop.

Approved Date: xxx — Installed Date: yyy

<u>Permitting right turns without stopping</u>

TH-6-47-010.2 — Southbound traffic on U.S. Highway 10 (Cedar Street) **shall** stop before entering the intersection of U.S. Highway 10 (Cedar Street) and Cherry Street in the city of Prescott, but traffic making a right turn to go west on Cherry Street **shall** not be required to stop.

Approved Date: xxx — Installed Date: yyy

<u>Exceptions for signal flashing arrangement</u>

TH-2-51-011.3 — When the traffic control signal at the intersection of State Trunk Highway 11 (Durand Avenue), Ohio Street/Meachem Road in the city of Racine is not operating, east and westbound traffic on State Trunk Highway 11 (Durand Avenue) **shall** stop before entering the intersection.

Approved Date: xxx Installed Date: yyy

Exceptions for simple interchanges

For simple interchanges the interchange can be considered as single intersection for the purpose of writing the exception. This eliminates the need to prepare an exception for each ramp intersection in the interchange. Shown below are three examples of such interchanges.

TH-4-37-051.20 North and southbound traffic on the ramps in the southeast and northwest quadrants of the interchange of U.S. Highway 51 and State Trunk Highway 153, **shall** stop before entering the intersections of the ramps and State Trunk Highway 153.

Approved Date: xxx Installed Date: yyy

This exception paragraph was included under the Through Highway listing for U.S. Highway 51, as the traffic required to stop is identifiable as U.S. Highway 51 ramp traffic. No entry is included under the Through Highway listing for STH 153, as STH 153 traffic is not required to stop at these intersections.

TH-4-49-051.15 North and southbound traffic on the ramps in the southeast and northeast quadrants of the interchange of U.S. Highway 51 and County Trunk Highway "B", **shall** stop before entering the intersections of the ramps and County Trunk Highway "B".

Approved Date: xxx Installed Date: yyy

Note that this paragraph mentions nothing about arterial controls on CTH "B". This is because CTH "B" stops at those locations and the fundamental principle of the declarations is that all non-STH traffic will be required to stop unless specifically accepted in the declarations.

TH-3-36-043.10 North and southbound traffic on the ramps in the southeast and northwest quadrants of the interchange of Interstate Highway 43 and County Trunk Highway "JJ" **shall** stop before entering the intersections of the ramps and County Trunk Highway "JJ", but eastbound and westbound traffic on County Trunk Highway "JJ" **shall not** be required to stop.

Approved Date: xxx Installed Date: yyy

The through movement on "JJ" had to be covered.

Exceptions of interchanges with multiple controls

The following is an example of a descriptive paragraph dealing with an individual ramp terminal within an interchange.

TH-2-67-094.12 Eastbound traffic on the ramp in the southwest quadrant of the interchange of Interstate Highway 94 and Moorland Road, in the city of Brookfield, **shall** stop before entering the intersection of the ramp and the southbound roadway of Moorland Road, but eastbound traffic turning right to go south on Moorland Road **shall** yield before entering the southbound roadway of Moorland Road. Southbound traffic on Moorland Road **shall not** be required to stop.

Approved Date: xxx Installed Date: yyy

No turn on red

TH-1-13-051.18 North and southbound traffic on U.S. Highway 51 in the city of Madison controlled by the traffic control signal at its intersection with U.S. Highway 151 **shall not** turn right during steady red signal indications.

Approved Date: xxx Installed Date: yyy

CHANGES IN THE DECLARATIONS

For the files, the Region *may* prepare a formal action memo documenting changes. Changes in the Arterial Highway Declarations usually take one or a combination of the following forms:

1. Deletion of an existing exception;
2. Addition of a new exception;
3. Amendment of an existing exception;
4. Addition of a new highway to the list of through highways; and
5. Deletion of an existing highway from the list of through highways.

<u>Deletion of an existing exception</u>

State Trunk Highway 12:

Delete paragraph TH-8-57-002.3 approved on November 30, 1988.

<u>Addition of new exception</u>

U.S. Highway 12:

Add the following:

TH-5-27-012.38 Southeast bound traffic on U.S. Highway 12 **shall** stop before entering the west intersection of U.S. Highway 12, U.S. Highway 10, and State Trunk Highway 27.

Approved Date: xxx Installed Date: yyy

<u>Substitution of a new exception for an existing one</u>

U.S. Highway 151:

Delete paragraph TH-2-13-151.17 on July 16, 1988 and substitute the following:

TH-2-13-151.17 ____

____

<u>Amendment of an existing exception</u>

Use the substitution procedure above.

<u>Deletion of a through highway</u>

State Trunk Highway 152:

Delete in its entirety.

13-2-5 Temporary Long Truck Routes — April 1996

Circumstances *may* require that the Department establish a temporary long truck route on a highway which is not designated as a long truck route. In order to clearly and simply provide for the temporary situation it is recommended that the Region prepare a rule in the following form:

TEMPORARY DESIGNATED HIGHWAY FOR

LONG TRUCK ROUTE

The following highway **shall** be a designated highway for the duration of the improvement project 1234-56-78, according to ss.348.07(4) Wisconsin Statutes, and Trans 276.08 Wisconsin Administrative Code:

(Highway) from STH XX to STH YY.

Authorized by Regional Trans. Director Date

13-2-10 Oversize/Overweight Single Trip Permitting — July 2012

PURPOSE

The purpose of this document is to provide internal guidance for all primary and secondary region staff regarding the routing and permitting of any given oversize/overweight (OSOW) load the region may be asked to review. The guidelines contained herein may not perfectly apply to every instance, request, or situation encountered, but the guidelines will serve as a solid foundation. All issues or concerns which arise that are not covered or discussed herein are subject to the discretion of the Region.

DEFINITIONS

Freeway/Expressway - Four-lane divided highway facilities with full or partial control of access by means of grade separation.

Multi-Trip Permit - A permit that is valid for unlimited, non-specific route trips during a range of 3 to 12 months. For example construction companies frequently move large construction equipment to and from job sites.

Oversize/Overweight Load - A load that requires a permit due to exceeding certain dimensions and weights.

OSOW Freight Network -The OSOW FN is a map which depicts the preferred statewide travel routes for OSOW loads. The map is maintained by, and available from, the Regional Freight Operations Unit.

Local Law Enforcement - Local law enforcement consists of municipal (city, village, or town) police or county sheriff. Local law enforcement does not include State Patrol.

Pole Car - A pole car is an escort vehicle equipped with a height sensor. A pole car must precede the load and move sufficiently ahead of the oversize vehicle when approaching structures to ascertain clearance prior to the load arriving. The height sensor pole is made of a non-conductive, non-destructive, flexible material, and shall be set 6–inches above the true height of the load.

Single Trip Permit - A permit that is valid for 14 days and for one trip only. The carrier specifies the route, and the return trip is allowed at no charge if requested with the original permit application.

Urbanized Area - A populated area that normally experiences peak hour traffic volumes in the morning, afternoon and evening travel periods. (As defined and updated by DTIM traffic model analysis that is updated on two year intervals).

PERMITTING

1. Requests and Approvals - The submittal and approval permit process shall be handled electronically.

2. Review - The automated permit system is not designed to identify all geometric scenarios. For example, the routing system does not evaluate for length or turning capabilities. Region review shall be required when:
    a. Width exceeds 15'11" per Trans 250.05(a). Trans 254.12, Trans 260, and the business routes are coded into the oversize/overweight automated issuance system, Superload.
    b. The proposed route for loads with an overall length of 100' to 139'11", and less than 16' in overall width will be reused on the same route within a three month period.
    c. Construction staging and detours will impact loads with an overall length of less 140' and less than 16' in overall width. The automated permit system is not designed to identify any routes deficiencies for such loads.
3. Denial or Restrictions
    a. The following issues shall result in the denial of a permit:
        - Proposed moves resulting in interrupted power or other utility service to essential services, such as hospitals, fire stations, etc..
    b. The following issues may result in the denial of a permit or substantial restrictions by the Region:
        - Exceed roadway plus shoulder width;
        - Exceed bridge or structure width;
        - Require 'wrong way' vehicle movement when a suitable alternative route is available;
        - Occur at times of the year that may cause excessive roadway damage;
        - Interfere with high traffic volumes;
        - Substantially impair power service to customers on route as determined by affected utility company;
        - Require excessive removal or rearrangement of permanent or temporary traffic control devices;
        - Utilize a route that is unsuitable due to construction constraints, geometric limitations, and/or unsafe passing conditions. Applicant will be advised to submit another route;
        - Impact state maintained traffic signal equipment (e.g. temporary removal). Any removals shall be approved by the Region and shall be completed by or at the direction and in the presence of WisDOT electricians. Removal of monotube signal arms may require additional (contracted) forces. Any approved removals will be at the expense of the carrier.
        - Reject the proposed route for radioactive materials if another route other than Wisconsin is reasonably available
4. Special Circumstances
    a. Ramp-Off/Ramp-On (RORO). At the discretion of the Region, RORO may be permissible where conditions would result in an excessive route detour. The Region shall determine the appropriateness of RORO based upon load type and load frequency.
    b. Sign Removal. Sign removal may be permitted to alleviate geometric deficiencies due to load length or width. Removal must be previously authorized by the Region, and the carrier is responsible for the immediately replacement of all removed signs.

       Sign removal shall be coordinated through the regional traffic unit. The preferred method of sign removal/replacement is by the appropriate County Highway Department. If a specific project has a large number of loads and/or scheduling prohibits County Highway Department involvement, WisDOT Regional staff may consider authorizing hauler removal/replacement signs. OSOW load hauler may be required to complete an "Approved Traffic Sign/Post Removal and Replacement Log."

Figure 1. Approved Traffic Sign/Post Removal and Replacement Log

Instructions:

1. Attach photograph showing original sign installation for each intersection that requires removal/replacement (R/R) of traffic signs. Label intersection photo by naming the photo as the load approaches and leaves the intersection (ex. I43 SB/WIS 96 WB)
2. For multiple signs/posts requiring R/R at an individual intersection label each sign/post from left to right as viewed on the intersection photo.
3. Complete each field below on log
4. Within 24 hours of R/R, fax this log (including) photos to (xxx) xxx-xxxx. Send/email copies of original to WisDOT at: XXXXXXXX

A. WisDOT Permit Number: _______
B. Date of Pre-Approved Traffic sign/Post Removal and Replacement: _______
C. OSOW Permit Holder Contact Information (Company Name, POC, address, office phone, cell phone, fax, email): ________
D. Escort Company Contact Information (Company Name, POC, address, office phone, cell phone, fax, email): ________
E. Individual Conducting Pre-Approved traffic Sign/Post Removal and Replacement (Company Name, POC, address, office phone, cell phone, fax, email): ________

Include a table identifying the following information:

Intersection/sign number, date/time of R/R, printed name of individual(s) conducting R/R, signature certifying sign replaced properly and with same orientation as shown in original photos.

c. Counter-directional Movements. The Region shall review and approve counter-direction movements of loads at modern intersections including roundabouts.
d. Loads with Low Level Radiation. DMV will notify DTSD OSOW Unit that a load, consistent with a regional review requirement as prescribed in Trans Rules or this guidance (see Permitting Section 2 above), is radioactive. Upon notice OSOW Unit will work with regions reviewers who shall review the following:
    i. the location, number, and extent of slows,
    ii. expected conflict with other traffic due to volumes and congestion,
    iii. proximity of route to population centers,
    iv. general level of radiation,
    v. availability of other routes in Wisconsin other than those proposed,
    vi. outreach and notification 2 weeks before the move with local communities on route
    vii. other objective risks and issues associated with the load and route
e. Other. Other special circumstances not specifically listed here shall be subject to the review and approval of the Region.

5. Suspension
    a. Frequent Violators. Carriers which evidence frequent and/or serious infringement of permit, equipment or traffic regulations will face suspension of existing permits, ineligibility for multiple trip permits or outright denial of future WisDOT oversize/overweight permits, as deemed necessary by the DMV/BHM.
    b. Appeal. The right of the hauler to appeal is established under Wis. Stats. 348.25(9).
6. Conflict Resolution
    a. External. When carriers, county officials, local law enforcement, or external DOT staff raise issues, questions, or concerns regarding permits, the DMV should be contact at (608) 266-7320.
    b. Interregional field recommendation discrepancies. The Bureau of Highway Maintenance (BHM) will make the final recommendations based on coordination between the Regions when a vehicle is traveling through multiple Regions and when regional recommendations conflict.

Primary and secondary contacts are provided in the list below.

Regional Office	Contact
SW Region, Madison	Jeff Gustafson Jim Pavelski
SW Region, La Crosse	Joe Schneider Andrew Winga
SE Region, Waukesha	Eric Perea Allison Blackwood Stacey Pierce Dan Dedrick
NE Region, Green Bay	Rod Hamilton Jodi Marsh
NC Region, Wisconsin Rapids & Rhinelander	Laurie Miller Jack Keiffer
NW Region, Eau Claire	Gary Coequyt Greg Mattson Jeff Olson
NW Region, Superior	Greg Mattson Gary Coequyt Jeff Olson Joe Whirry
Bureau of Technical Services Pavement Section	Laura Fenley Bob Arndorfer
Bureau of Highway Maintenance Freight Section	Dan Mulder

ROUTE CONDITIONS

It is recognized that physical roadway conditions may change at the time of the move and the carrier must be aware that they are ultimately responsible for maintaining safe operating conditions and reviewing roadway and vehicle characteristics (i.e., horizontal and vertical clearances, intersection geometrics, load height, tire pressure, etc.).

HOURS OF OPERATIONAL LIMITATIONS

1. The Region shall review permits for hours or days of operation and any other special conditions of operation for escorted loads with an overall length over 160', regardless of overall width.
2. Per Trans 254.11(3), no oversize vehicle that exceeds 12' in width, 13'6" in height, or 100' in length is allowed to operate during the hours of darkness, unless specifically directed and authorized by WisDOT Regional Office.
3. No Region-reviewed oversize vehicle moves shall be made within urbanized areas as defined by DTIM traffic modeling analysis between the hours of 6:00am – 9:00am and 3:00pm – 6:00 pm, or if the area experiences a noon peak period, which will be listed in the Regional recommendations.
4. OSOW vehicles moving at speeds of 25 mph or less (notwithstanding bridge restrictions listed on the permit) should be required to move from 9:30pm – 5:30am to maintain consistent and safe operations for motorists in metro areas and on conventional highways of the State Highway System. Travel time shall be subject to Region discretion and approval.
5. Loads with a width in excess of 16' may be required to move at night, subject to the discretion of the Region.

ESCORT GUIDELINES

1. General. The following Table provides escort vehicle guidance based upon oversize/overweight load type. Final escort configurations shall be at the direction of the Region. For Wind see Escorts in TEOpS 13-2-11.

WEIGHT	LENGTH	WIDTH	HEIGHT	ESCORT
Up to 350K	Any	Any	<16'01"	Pole car requirement subject to Region review.
Up to 350K	Legal to 139'11"	15'01" -16'0"	>16'01"	Pole car is required. Must lead the load by a minimum of 0.5-miles.
Up to 350K	Legal to 139'11"	16'0" – 17'11"	Any	Two (2) private vehicles.
Up to 350K	Legal to 139'11"	18' – 20'	Any	One (1) law enforcement vehicle and one (1) private vehicle.
Up to 350K	Legal to 139'11"	>20'	Any	Two (2) law enforcement vehicles and one (1) private vehicle.
Up to 350K	>140'	<10'	Any	On freeways and expressways, private escort vehicles may be used in lieu of law enforcement escorts.
Up to 350K	140' – 159'11"	Up to 17'11	Any	One (1) law enforcement vehicle and one (1) private vehicle at the determination of the Region.

Up to 350K	>160' – 199'11"	>8'6" to 16'0"	Any	Two (2) private vehicles. Region may require law enforcement vehicle.
Up to 350K	200' to 250'	8.6 to 16'0"	Any	Two (2) private vehicles one (1) law enforcement vehicle.
Up to 350K	160'- 224'11"	< or = to 8.6	Any	Two private escort vehicles. Region may require one law enforcement vehicle depending on route complexity.
Up to 350K	>225'	Any	Any	Minimum of Two (2) State Patrol escort vehicles.
>350K	Any	Any	Any	At least one State Patrol Escort (see Heavy Slow Loads below)
Key:	< Less Than	> Greater Than		

Note: When multiple conditions for weight and dimension are met reviewer should use the requirement that provides the most coverage for the load in question.

2. Nighttime or Round-The-Clock Movement. Any company requesting nighttime or round-the-clock movement shall have a minimum of one (1) law enforcement officer and one (1) private escort, at the direction of the Region.
3. The WisDOT always retains the right to be more restrictive when it is deemed necessary.

CONVOYS

1. Review. Each Region shall review all convoy requests and efficiencies should also be considered.
2. Size. Convoys shall not exceed two oversize vehicles per convoy.
3. Conditions. Multiple convoys of a single carrier or project shall have a staged departure with a minimum of ½ hour travel time between convoys, and maintain said travel time separation for the full duration of the trip.

LAW ENFORCEMENT

1. Escort Type
   a. State Patrol escorts may be used when moving through multiple counties.
   b. State Patrol, county, or local law enforcement may be used when moving within a local area.
2. Responsibility - Law enforcement responsibility shall be limited to traffic control and load escort. Carriers shall not rely on the law enforcement officers for route navigation and guidance through turning movements.

HEAVY AND SLOW LOADS

1. All vehicles over 270,000 pounds shall be reviewed by the Bureau of Technical Services Pavements Section.
2. The Bureau of Structures reviews overweight loads for adequacy of any structure to safely accommodate such a load at certain speeds prior to BHM and Regional review. BTS review shall be included if applicable.
3. The Region(s) shall review gross vehicle weights exceeding 350,000 pounds and traveling at less than posted speeds for the facility on route.
4. The Region(s) shall review all loads operating at a maximum speed of 45 mph or less on a limited access facility.
5. Recommendations for building moves will be based on the discretion of the Region's evaluation of safety and best practices.
6. Loads in excess of 350,000 pounds escorts based on overall dimension, weight, anticipated speed, and complexity of route. Use the table above for a preliminary reference point. Loads with six or more slow to 5 miles per hour bridge crossing requirements shall have 1 State Patrol and One Private escort.

INSPECTIONS

1. See TEOpS 13-2-12

WORK ZONES

1. Travel through work zones otherwise limited by posted signs or other constraints (i.e. lane width restrictions) cannot proceed without prior authorization of DMV, BHM, and BTO on the permit. Permit vehicles without prior authorization should interdict and call DMV to either approve travel through the work zone or find an alternate route.

COORDINATION

1. Responsibility

   a. It is the responsibility of the carrier to contact local community and county public works departments or law enforcement agencies to apply for additional permits on connecting highways, and if required by the municipality, for travel on the local roadways.

   b. Carriers shall coordinate with railroad officials as to the times of move for railroad tracks with short storage distances and humped crossings.

Documentation - All carriers shall be required to carry a log documenting all local community, law enforcement, and agency coordination, during operation.

13-2-11 Oversize/Overweight Wind Industry Permits — January 2014

If not stated in this policy, follow TEOpS 13-2-10.

DEFINITIONS

Wind Tower Multi-trip Permit – specific permits relating to a process implemented to plan for multiple trips of oversize/overweight loads to wind projects.

Wind Multi-Trip Permit – A permit that is valid for unlimited, specified route trips during a range of 3 to 6 months. This is applied to each vehicle identification number (VIN) from a company seeking this permit type

Oversize/Overweight Load – A load that requires a permit due to exceeding certain dimensions and weights.

Pole Car – A pole car is an escort vehicle equipped with a height sensor. A pole car must precede the load and move sufficiently ahead of the oversize vehicle when approaching structures to ascertain clearance prior to the load arriving. The height sensor pole shall be made of a non-conductive, non-destructive, flexible material.

Single Trip Permit – A permit that is valid for 14 days and for one trip only. The carrier specifies the route, and the return trip is allowed at no charge if requested with the original permit application.

Urbanized Area – A populated area that normally experiences peak hour traffic volumes in the morning, afternoon and evening travel periods. It is at the discretion of the Region to determine if an area is considered urbanized and if an oversize/overweight vehicle will significantly impede on traffic during peak periods.

Freeway/Expressway – Four-lane divided highway facilities with no or minimal at grade intersections and sharp curves. Expressways are divided arterial highway facilities that have partial control of access, generally with grade separations at major intersections.

GUIDELINES

1. WisDOT permitted hours of operation for movement of wind tower components are:

   - 6PM Sunday through Noon on Friday, except during the peak traffic hours of 6AM-9AM and 3:30PM-6PM, Monday through Friday, in below specified urban areas
   - 12:01AM Saturday through 10AM Saturday
   - 12:01AM Sunday through 10AM Sunday

2. Oversize/overweight permits will restrict travel during peak traffic hours only in the counties of Brown, Outagamie, Winnebago, Dane, Milwaukee, Ozaukee, Washington, Waukesha, Racine, Kenosha, and LaCrosse. The maps for the wind tower restricted urban areas can be found in:

   \\Mad00fph\n4public\BHO\osow\Time Restrictions\ (internal DOT access only)

Wind Tower Allowable Times of Travel

Day\Hour	12:01 AM Midnight	1:00 AM	2:00 AM	3:00 AM	4:00 AM	5:00 AM	6:01 AM	7:00 AM	8:00 AM	9:01 AM	10:00 AM	11:00 AM
Monday	X	X	X	X	X	X	e/u	e/u	e/u	X	X	X
Tuesday	X	X	X	X	X	X	e/u	e/u	e/u	X	X	X
Wednesday	X	X	X	X	X	X	e/u	e/u	e/u	X	X	X
Thursday	X	X	X	X	X	X	e/u	e/u	e/u	X	X	X
Friday	X	X	X	X	X	X	e/u	e/u	e/u	X	X	X
Saturday	X	X	X	X	X	X	X	X	X	X	n/p	n/p
Sunday	X	X	X	X	X	X	X	X	X	X	n/p	n/p

Day\Hour	12:01 PM Noon	1:00 PM	2:00 PM	3:00 PM	**3:30 PM**	4:00 PM	5:00 PM	6:01 PM	7:00 PM	8:00 PM	9:00 PM	10:00 PM	11:00 PM
Monday	X	X	X	X	e/u	e/u	e/u	X	X	X	X	X	X
Tuesday	X	X	X	X	e/u	e/u	e/u	X	X	X	X	X	X
Wednesday	X	X	X	X	e/u	e/u	e/u	X	X	X	X	X	X
Thursday	X	X	X	X	e/u	e/u	e/u	X	X	X	X	X	X
Friday	n/p	n/p	n/p	n/p	n/p	n/p	n/p	n/p	n/p	n/p	n/p	n/p	n/p
Saturday	n/p	n/p	n/p	n/p	n/p	n/p	n/p	n/p	n/p	n/p	n/p	n/p	n/p
Sunday	n/p	n/p	n/p	n/p	n/p	n/p	n/p	X	X	X	X	X	X

X = Travel Permitted
e/u = Exception for Urban Areas noted below
n/p = Travel Not Permited

***Urban Areas**
Green Bay
Kenosha
La Crosse
Appleton including Neenah/Menasha and STH 15

***Counties**
Dane County
Milwaukee County
Ozaukee County
Racine County
Washington County
Winnebago County

*Urban Areas and or Counties may change due to further LOS Analysis   Page 1   5/6/2009

3. 30 minute "pulsing" will be allowed. This permit restriction will be replaced with this language: "It is the carrier's responsibility to plan for staging and managing of the departures of permitted loads to avoid congestion on the route due to massing of the permitted loads.

4. Permits *may* include a condition for convoying of two loads in order to more efficiently use escorts. This condition is available on a very limited case-by-case basis and the consecutive convoys cannot move less than 30 minutes apart.

5. Escorts (Wind Only)

WEIGHT	LENGTH	WIDTH	HEIGHT	ESCORT
< 170K	100' to 120'	< 13'	<14'6"	One private escort. Pole car requirement subject to Region review.
< 171K – 270K	121- 189'11"	13'01" -16'0"	14'7" – 15'11"	Two (2) private escort vehicles. Pole car requirement subject to Region review.
Up to 350K 1 to 5 slow to 5mphs	190'6"- 200'0"	16'0" to 20'	16' to 20'	One (1) private vehicle and one (1) state patrol escort vehicles. One (1) private shall be a properly equipped pole car and lead the load by 0.5 miles at all times.
Up to 350K 6 or more slow to 5mphs	200'1"	>20'	>20'	Two (2) state patrol escort vehicles and one (1) private vehicle to provide a properly equipped pole car and lead the load by 0.5 miles at all times.
Key:	< Less Than > Greater Than			

a. The WisDOT always retains the right to be more restrictive when it is deemed necessary.
b. Subject to inspection results or other concerns base loads regardless of weight and dimension maybe required to have one State Patrol Escort until such time as the concern triggering this requirement or concern is removed.

6. Work Zones

Travel through work zones otherwise limited by posted signs or other constraints (i.e. lane width restrictions) cannot proceed without prior authorization of DMV, BHM, and BTO on the permit. Permit vehicles without prior authorization should interdict and call DMV to either approve travel through the work zone or find an alternate route.

7. Ramp Off/Ramp On Method

   Ramp off/Ramp on movements for wind industry truck shipments may be utilized and approved by the regions in order to keep the load on the OSOW Freight Network. This method *should* only be used to avoid construction, low bridge clearance, or weight restricted facility. The interchange must be a diamond interchange with a clear path between the exit and entrance ramp. The presence of fixed barriers or medians eliminates this method as an option. Ramp off/Ramp on *should not* be used consecutively on a route or for the overall permit. This method *should* be limited to 1 or 2 exceptions on a route. Additional ramp off/ramp on exceptions are at the discretion of DMV permitting office and BHM staff and only when alternative routes cannot be reasonably identified.

GENERAL NOTES

It is recognized that physical roadway conditions *may* change at the time of the move and the carrier must be aware that they are ultimately responsible for maintaining safe operating conditions and reviewing roadway and vehicle characteristics (i.e., horizontal and vertical clearances, intersection geometrics, load height, tire pressure, etc.)

Contact DMV if there are any loads that do not conform to these load requirement guidelines.

13-2-12 OSOW Inspection Requests and Waiver Procedure — December 2011

PURPOSE

To provide a process for annual vehicle and driver inspections or waivers for specialized transport vehicles that require a permit to travel in Wisconsin and are reviewed under TEOpS 13-2-10 and TEOpS 13-2-11 of this chapter.

DEFINITIONS

OOS – Out of Service violations for the purposes of this section are violations that are significant including but not limited to Brakes, Frame, Suspension, Tires, couplings or any other signification physical feature necessary for safe mobility of the vehicle. OOS for lighting that can be fixed and signed off on would not be considered in the review of a carrier for the purposes of this guidance.

FMCSA – Federal Motor Carrier Safety Administration

PROCEDURE

Process	Carrier in Regulatory Compliance	Carrier not in Compliance
ISS	Below 65	Above 65
NAS 7 - Out of Service (OOS)	No OOS w/in 24 months	OOS in last 24 – Order Inspection
396 for Truck and Trailer*	Submit for file	Do not request

1. All house/building movers (other than mobile homes and modular home carriers) shall be ordered for inspection as part of every permit application.
2. BHM OSOW Freight Unit to check ISS on the first of every month for all carriers that have NAS 7 inspections that will be over 12 months old in OSOW Freight Unit Database within 30 days from the 1st of the month:
   a. If a carrier is new to Wisconsin, record is significantly out of date, or not in the OSOW Freight Unit Database than that carrier shall be ordered for inspection.
   b. All carriers who have an ISS score of 65 or greater BHM to request inspection at next permit request if load originates in Wisconsin.
   c. For loads originating outside Wisconsin and where inspections are required by any other states in route to Wisconsin DMV shall request a signed copy of that inspection. The out of state inspection shall have no Out of Service (OOS) violations and is only good for permit the carrier is applying for at the time of application. If subsequent permit requests originate outside Wisconsin carrier shall supply an inspection with no OOS violations from the other state. BHM will repeat the process at the time of the carrier's permit request for a load originating in Wisconsin and order an inspection if necessary.
   d. If a carrier is inspected and found to have OOS violations for lights or other items that can be fixed and signed off on by DSP carrier shall be able to proceed with their load at that time.
3. BHM to submit list of carriers identified under item 2 above and ask DSP to check these carriers for OOS violations in Wisconsin within the last 24 months from the date of the request.
   a. If no OOS violations are found for last 24 months - proceed to 3 b if there are OOS proceed to 3c.

   b. DMV to request STANDARD OPERATING PROCEDURE (SOP's) and 396 (carrier's annual self-inspection) submittal from carrier.
   c. If there are OOS violations found for the last 24 months from date of request BHM shall order inspection at next permit request (skip task 4 and 5 below). BHM to continue to repeat item 3c on an annual basis until carrier is free of OOS violations for a period of 24 consecutive months from the date of a permit request.
4. DMV to request most recent copy of FMCSA annual inspection (aka 396) performed by company or other authorized agency for the tractor and trailer units supplied as part of permit request. DMV to provide copy to BHM. This should be repeated annually even if the carrier is in compliance.
5. For item 4, Carrier has 30 calendar days from the date of request to comply.

NON-COMPLIANCE

1. If carrier is not waived for inspection in accordance with this procedure and fails to comply with a request for inspection twice – subsequent permits shall be held until compliant per DMV discretion. DMV to provide BHM OSOW Freight Unit with any waivers of inspection requirement and reason (i.e. not originating Wisconsin). BHM to provide list of non-compliant carriers who have not responded to inspection requests to DMV to monitor carrier applications in the event the carriers:
   - Next permit dimensions and or weight do not meet requirement for review by BHM – OSOW Freight Unit*
   - Next permit would be on a previously approved route that does not require BHM – OSOW Freight Unit review
2. If a carrier who is initially granted a waiver fails to provide to DMV a FMCSA 396 self-inspection form in accordance with items 4 & 5 above of this procedure the carrier shall be consider non-compliant and their annual inspection waiver is revoked until they either submit to and pass an inspection or provide the requested documentation.
3. BHM OSOW Freight Unit will provide DMV with a monthly list of carriers if any that fall subject to Non Compliance item 2 above.

*OSOW Inspections requested by OSOW Freight Unit are for loads in excess of 16 wide, 140 feet long, or 270,000 pounds, or any combination thereof or wind industry components.

13-2-15 Oversize/Overweight Permit Suspension — May 2009

BACKGROUND

State Patrol and other law enforcement officials currently have the authority to restrict or suspend travel on Wisconsin roadways when unsafe driving conditions occur. According to Trans 254.06 (4) Validity for Single Trip Permits for Oversize or Overweight Vehicles or Loads, and Trans 255.06(4) Validity for Multiple Trip Permits for Oversize or Overweight Vehicles or Loads, *"A permit is not valid during periods when adverse weather or road conditions, such as fog, smoke, heavy rain, snow or ice or wind velocity, impair the safety of a movement under the permit."*

GUIDELINES

The following conditions are considered when defining a travel restriction:

- Impassable or unsafe roadway conditions on the traveled way – extremely slippery, reduced visibility, significant snow cover, flooding over the road, high winds and blowing snow causing whiteout conditions or drifting, and severe wind chill.
- Recovery activities incomplete – vehicle & debris removal operations, transportation of recovery resources, snow removal

<u>Winter Weather, Flooding, and Other Events</u>

WISDOT will incorporate provisions within oversize-overweight (OSOW) shipment permits to reinforce the accountability of carriers to comply with Trans 255.06(4). The carrier's responsibility to remain aware of current roadway restriction, closure, and alternate route information **shall** also be emphasized.

DTSD will maintain web-based travel warning and information sources for travelers, such as

- 511 Traveler Information Services
- Lane and Ramp Closures (Lane Closure System)

- Work Zones & Detour Information

DTSD will not maintain web pages or otherwise support customized or specialized traffic and incident information services or resources specifically for truck routing or oversize-overweight permitted shipments.

DTSD will not be involved in motor carrier notifications or related further action, including internet posting of maps. DMV *may* notify the motor carriers of events or *may* alternately rely upon the provisions in the OSOW permit stating it is the motor carrier's responsibility to refrain from travel when unsafe driving conditions occur.

COMMUNICATION

Internal WISDOT communication with DTSD by other Divisions (including DMV and DSP) **shall** be directed through the State Traffic Engineer of Operations. This **shall** include deliberations involving emergency suspensions of OSOW permits. The State Traffic Engineer of Operations or their designee **shall** be responsible for timely coordination with DTSD Regional OSOW Coordinators and other DTSD representatives.

13-3-1 Policy

December 2011

A Low-Speed Vehicle (LSV) is defined in Wis. Stat. S.340.01(27h). Formerly known as “Neighborhood Electric Vehicles (NEVs),” LSVs are four-wheeled, motorized vehicles that comply with federal safety standards stated in 49 CFR ss. 571.3(b) and 571.500. LSVs are manufactured with a maximum speed of 25 MPH. Golf carts are not LSVs.

Wisconsin law (ss. 349.26) provides town, village and city governments’ broad discretion to permit LSVs to operate on highways within their territorial boundaries. Municipal ordinances take priority over county ordinances, as well as the default rules explained below. The default rules apply where there are no municipal or county ordinances.

Under new legislation effective October 2010, WisDOT no longer has authority to permit or prohibit LSV use on highways. The law, however, prohibits LSV use on any highway with a speed limit greater than 35MPH, which effectively prohibits LSV use on most of the state highway system.

DEFAULT RULES – NO LOCAL ORDINANCE

Per the Default Rules, LSVs may be used as follows:

- Connect Highways – A person may operate an LSV on a connecting highway only if the speed limit of the connecting highway is 25 MPH or less
- Local Roads – A person may operate an LSV on any highway, other than a connecting highway, that has a speed limit of 35 MPH or less and that is under the maintenance jurisdiction of a municipality or county. Exception apply at intersections:
  - At an intersection of a local (municipal or county) road with a state trunk highway or connecting highway, LSVs may be used only if:
    1) The state trunk highway or connecting highway has a speed limit at the intersection of 35 MPH or less; and
    2) Traffic at the intersection is controlled by traffic control signals.
  - At intersections of a local (municipal or county) road with expressways, freeways, or controlled-access highways, LSVs may not be used. This means that an expressway, freeway or controlled access highway effectively creates an impassable barrier to LSV travel in the absence of an ordinance. LSVs cannot cross these highways at grade or at grade-separated interchanges.

13-5-1 Statutory Authority and the Approval Process — November 2024

Speed limits are absolute limits that are established for a roadway under ideal conditions. They also help traffic enforcement by setting standards for what is an unsafe speed. Setting speed limits appropriately helps to reduce the significant risks drivers impose on others – especially vulnerable road users.

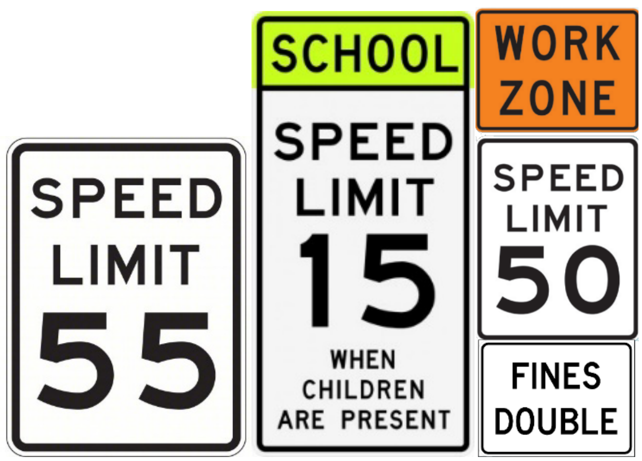
The concept of establishing speed limits is based upon the nationally accepted principle that the majority of drivers are cautious, prudent and drive at speeds that are reasonable, regardless of the posted speed limit. This “reasonable and prudent” theme is part of the Wisconsin State Statutes in ss. 346.57 (4) and ss. 349.11 (7).

The policy described within aligns with Wisconsin State Statutes and the Wisconsin Manual on Uniform Traffic Control Devices (WMUTCD) [1].

13-5-2 Types of Speed Limits — November 2024

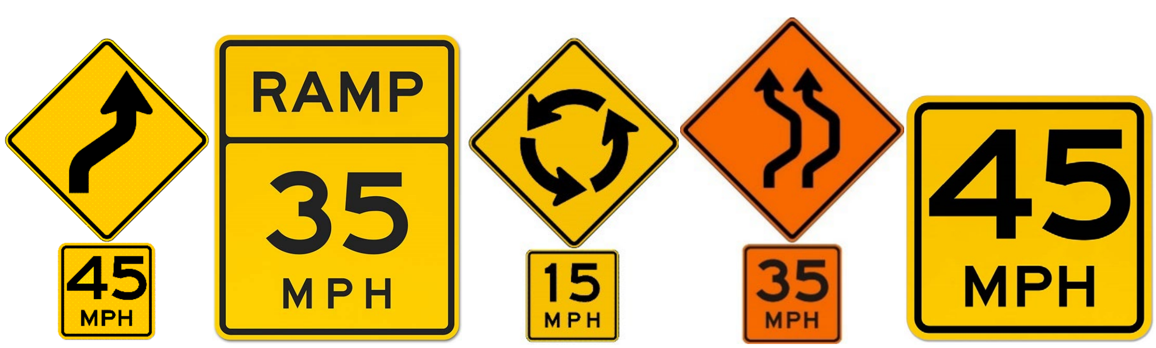
Regulatory

Speed limits posted with a white background and black legend sign are maximum speed limits that a road user must adhere to under average or ideal conditions. These are referred to as regulatory speed limits and examples are shown below. Regulatory speed limits are absolute speed limits, above which it is unlawful to drive regardless of roadway conditions, traffic volumes, pedestrian presence, school activity, highway construction or maintenance workers or other factors.



Advisory

Speed limits posted with a yellow or orange background with black legend sign are warning signs used to advise a road user of a recommended driving speed for an upcoming road condition or hazard. These are used in situations where there is a small section of road that *should* be traveled at a lower speed. These can be used at curves, intersections with reduced visibility, or within work zones. These signs are advisory and not enforceable in Wisconsin unless a driver is driving too fast for conditions. Below are examples of advisory speed limits.



13-5-3 Types of Regulatory Speed Limits November 2024

Statutory Speed Limits

Statutory speed limits are established by state law and are based on the classification (or type) of roadway (e.g., 70 mph on freeways, 45 mph on rustic roads). Statutory speed limits in Wisconsin are governed by ss. 346.57 which establish maximum/minimum speed limits for all roadways. These limits are established legislatively and are applied throughout Wisconsin on public roadways. Statutory speed limits ensure a limit is in place on all roads.

Modified Speed Limits (Modifications to Statutory Speed Limits)

Modified speed limits are typically established on roadways where the statutory speed limit or existing limit is no longer appropriate due to a change in land use, road design, access, traffic volumes, construction/maintenance activity, or number of crashes or crash potential along a roadway. Modified speed limits *should not* be used to address spot safety issues. Often, other engineering countermeasures are more appropriate to address safety issues.

Unless speed limits are set initially by state statutes (statutory speed limits), all speed limits in Wisconsin must be established through an engineering and traffic investigation.

Speed limits that are not used in Wisconsin are as follows:

- Nighttime speed limits – limits that are adjusted based on day or night conditions.
- Minimum speed limits – limits establishing the lowest allowable speed for a roadway.
- Specialty vehicle speed limits (e.g., trucks, golf carts, etc.) – limits applied to certain classes of vehicles.
    - Exceptions include: All-Terrain Vehicles (ATV) and Utility Terrain Vehicles (UTV)
- Seasonal speed limits – limits that are applied for a specified period(s) during the year, generally at locations with significantly different levels of roadside activity at different times (e.g., high traffic tourist area popular in summer).

13-5-4 Definitions November 2024

An engineering and traffic investigation is the analysis and evaluation of available pertinent information including, but not limited to, the safety and operational efficiency of all road users, and the application of appropriate principles, provisions, and practices as contained in the WMUTCD.

The following provides definitions of information typically included within an engineering and traffic investigation.

Roadway Context Terminology

<u>Roadway Geometry</u> is information on the roadway facility's features and dimensions such as lane widths, shoulder widths, curb and gutter presence, curves, sidewalk/pathways, presence of lighting, and available sight distance.

<u>Traffic Volume</u> is used to describe the number of vehicles at a given location on an average day of the year. This is often expressed as either an Average Daily Traffic (ADT) or Annual Average Daily Traffic (AADT) count.

<u>Area Type</u> is a designation for the setting of the environment where the roadway facility is located. There are three area types:

- Urban – locations that have a population of 5,000 or greater. In urban settings there is minimal undeveloped land and several buildings including schools, commerce centers and others.
- Rural – locations that have a population less than 5,000. In rural settings there are typically large areas of undeveloped land with minimal buildings or residences. These may include small towns and unincorporated communities.
- Suburban – transitional areas between rural and urban settings. These typically are locations that are built up areas on the outskirts of cities and villages.

<u>Functional Classification</u> is a transportation planning term that defines how a route *should* perform in serving the flow of traffic through a highway network. It is the grouping of highways, roads and streets by the character of

service they provide (e.g., principal arterial, minor arterial, collector (major/minor), local street).

Vulnerable Road User encompasses non-motorists including people walking, biking or rolling. These include pedestrians, bicyclists, other cyclists, and individuals utilizing other means of personal transportation.

Speed Terminology

Operating Speed (Free-Flow Speed) is defined as the speed at which a driver operates a typical vehicle, or a speed at which the overall traffic operates during free-flow conditions. Free-flowing speed is defined as conditions in which a driver has the ability to choose a speed of travel without undue influence from other traffic, traffic control devices (e.g., traffic signals, roundabouts), conspicuous police presence, or environmental factors. In other words, the driver of a free-flowing vehicle chooses a speed that they find comfortable on the basis of the appearance of the road [2] [3]. WisDOT measures free-flowing vehicle speeds when there is a gap of five seconds or more between vehicles per lane.

Design Speed is the speed selected during the roadway design process that determines the various geometric design features of the roadway such as horizontal alignment, vertical alignment, and cross-section design elements [4]. This includes lane widths, shoulder widths, curb and gutter presence, curves, and available sight distance.

The following are definitions for speed-related performance metrics:

- 85th Percentile Speed is the speed at or below which 85 percent of the sample of free-flowing vehicles travel.
- 50th Percentile Speed (also known as the median speed) is the speed at which 50 percent of the sample of free-flowing vehicles travel.
- Average speed is the typical speed of the sample of free-flowing vehicles. This is calculated by taking the sum of all observed speeds within the same sample and dividing by the total number of observations.
- Pace is the 10-mph range of travel speeds containing the largest number of observed vehicles. This is a metric used to assess the speed dispersion or spread of vehicle speeds. A normal speed dispersion *should* have approximately 70% of the vehicles within this 10-mph range.
- Speed variance is the difference in travel speeds of vehicles traveling on the same stretch of roadway simultaneously. Large speed variances increase the potential for crashes.

Roadway Classifications

State Trunk Highways (STH) are highways that include both Wisconsin State Highways and United States (US) Highways that are maintained by WisDOT. In Wisconsin, these are highways designated with numbers.

County Trunk Highways are highways maintained by County Highway Departments or other municipalities. In Wisconsin, these are highways designated with letters.

Local Streets are roadways that are maintained by incorporated municipalities (i.e., villages/cities) that serve primarily residential traffic and provide a connection between highway systems.

Town Roads are typically low-volume roadways that are maintained by townships.

Rustic Roads are roadways designated by the Rustic Roads Board which have characteristics that promote natural features or wildlife and low volume for the purposes of recreational enjoyment. For more information see the Rustics Road webpage.

Alleys are roadways that are narrow passages between or behind development.

Freeways are high-speed roadways that are access-controlled, and all crossroads are grade-separated (i.e., interchanges/overpasses).

Expressways are high-speed roadways that are partially access-controlled, and crossroads can be either at-grade intersections or grade-separated (i.e., interchanges/overpasses).

Other

Variable speed limits are limits that can dynamically change based on traffic, weather or other conditions.

Connecting Highways are local streets and roads that carry state highway travel and are marked as STHs through cities and villages.

Outlying district is an area contiguous to any highway within the corporate limits of a city or village where on each side of the highway within any 1,000 feet, buildings are spaced on average more than 200 feet apart.

Semiurban district is an area contiguous to any highway where on either or both sides of the highway within any 1,000 feet, buildings are spaced on average less than 200 feet apart.

13-5-5 Background November 2024

Modified speed limits are typically established on roadways where the statutory speed limit or an existing speed zone is no longer appropriate due to changes in land use, access, traffic volumes, number of crashes or crash potential along the highway. Speed zoning is a means of establishing uniform regulatory speed limits for similar driving conditions throughout the state. It is a means of informing motorists who may be unfamiliar with the road of the "reasonable" driving speeds under ideal operating conditions. Speed limits are established under ideal conditions and not based on temporary situations (e.g., construction, seasonal variations in traffic/pedestrian volumes, special events).

Unreasonably low speed limits, also called irrational speed limits, are not effective in changing driver behavior and have several negative effects. While irrational speed limits do not result in desired driver behavior, resulting negative effects include higher financial cost due to the need for increased enforcement, higher potential for crashes due to larger variability in vehicle speeds, and encouragement of motorist disregard of other, rational posted speed limits. Irrationally low speed limits also promote a false sense of security among residents and pedestrians who may expect that posting lower limits will change drivers' speed behavior.

Driving environment is the main influence on motorists' speeds. Drivers rely heavily on cues from the roadway environment to judge how fast they are traveling. The primary basis for how a motorist estimates their speed is the visual sensation they observe from the roadway geometrics (e.g., lane width, presence of curves, on-street parking, access along the roadway, bicycle and pedestrian activity, sidewalks/pathways, presence of lighting, etc.) and other information about objects in their immediate vicinity. Roadway design and driving environment *should* be balanced to achieve the following goals [2]:

- The driver's perceptual experience of the roadway *should* be consistent with the intended travel speed
- There *should* be some consistency between relevant roadway cues and the posted regulatory speed.

13-5-6 Authority November 2024

The statutory authority for establishment of regulatory speed limits is provided in ss. 346.57 and ss. 349.11. These statutes vest WisDOT with the authority to establish regulatory speed limits on the state trunk highway system. Furthermore, the statutes provide WisDOT with approval authority (refer to ss. 349.11(3)(c)) for some regulatory speed limits that local units of government establish.

Statutes define that all speed limit changes **shall** be based on an engineering and traffic investigation, including modifications allowed under Statute. An engineering and traffic investigation **shall** be performed by a registered professional engineer with appropriate traffic engineering expertise and/or experience in traffic engineering studies, or by an individual working under the supervision of such an engineer, through the application of procedures and criteria established by the engineer. An engineering and traffic investigation **shall** be documented in writing.

Connecting Highway

Connecting highways are local streets and roads that carry state highway traffic and are marked as State Trunk Highways. Wisconsin ss. 84.02(11) and ss. 86.32(1) define connecting highways and the funding provided to maintain these roadways. Connecting Highway funding aids are used to maintain these streets and roads at state trunk highway system standards and compensate local governments for the incremental costs of through-traffic routed over municipal streets. For more information see the Connecting Highway webpage.

Connecting Highway speed limits are maintained by the respective municipality. Wisconsin ss. 86.32 states such maintenance, operation and traffic control of the connecting highways and swing and lift bridges **shall** be subject to review and approval by WisDOT.

Municipalities that maintain connecting highways are responsible for the maintenance and traffic control of the roadway which includes establishing speed limits. Thus, local authorities responsible for these roadways **shall** follow information within Table 6.1 to establish speed limits. Proposed changes to speed limits on these facilities that impact the operation of connecting highways **shall** be subject to review and approval by WisDOT.

Approval Authority

Local Government

- Local units of government, under their respective maintenance jurisdictions, can approve speed limit modifications as allowed in Table 6.1.
- When speed limits are recommended outside of the approval authority defined by ss. 349.11, local units of government are required to coordinate with WisDOT. For information on how to request WisDOT to review a speed limit modification, see TEOpS 13-5-7.1.
- Local units of government *should* follow the guidance outlined within TEOpS 13-5 to satisfy the requirements of an engineering and traffic investigation.

Table 6.1 Speed Limits and Local Authority

Statutory (Fixed) Limits per ss. 346.57(4)	What Local Governments[a] can do per ss. 349.11(3) and (7)
70 mph – Freeway/Expressway	N/A
65 mph – Freeway/Expressway	N/A
55 mph – State Trunk Highway	N/A
55 mph – County Trunk Highway	Lower the speed limit to 50 or 45 mph
55 mph – Town Road	Lower the speed limit to 50 or 45 mph
45 mph – Rustic Road	Lower the speed limit to 40, 35 or 30 mph
35 mph – Town Road with average driveway spacing less than 150 feet	Lower the speed limit to 30 or 25 mph
25 mph – Inside corporate limits of a city or village	Raise the speed limit up to 55 mph Lower the speed limit to 20 or 15 mph
15 mph – Street or Town Road adjacent to a public park	Lower the speed limit to 10 or 5 mph
15 mph – Alley	Lower the speed limit to 10 or 5 mph
15 mph – Pedestrian Safety Zone (with a public transit stop)	No changes permitted
Construction or temporary maintenance zones	See TEOpS 13-5-16 and 13-5-17
School zone/School crossing	See TEOpS 13-5-12
Connecting Highway	Subject to WisDOT approval
(a) All speed limit changes shall be based on an engineering and traffic investigation, including modifications allowed under Statute. Local governments can implement speed limit changes on the local road system without WisDOT approval when proposals are within the constraints identified above.	

WisDOT Regional offices

- Regional offices are authorized to approve speed limit changes on local roads and streets, including county trunk highways, where those changes fall outside the authorized limits that the local authorities *may* exercise as specified in the statutes.
- Regional offices are authorized to establish reductions in speed limits in construction zones on a temporary basis while the need for the reduction exists.
- Regional offices are authorized to approve speed limits which fall within 5 mph of the measured 85th percentile speed and no more than 2 mph below the measured average speed, or where speed limits are established based on statutory requirements. In the absence of speed information, regional staff **shall** coordinate with WisDOT Bureau of Traffic Operations (BTO). Exceptions include:
    - Adjusting speed limits due to relocations from development, access modifications or adjusting due to signage requirements. Extensions *should not* exceed 300’ without BTO approval. Speed studies *may* be required for extensions due to these changes.
    - Construction of new roadway facilities or reconstruction of existing facilities in which speeds are posted in accordance with the design speed. If speeds are posted below the design speed, coordination with BTO is required.

WisDOT Bureau of Traffic Operations (BTO)

- The following **shall** be approved by the Traffic Analysis and Safety Unit (TASU) within BTO:
  - Speed limits not meeting the criteria defined above and within Table 6.1.
  - Speed studies that are not able to collect speed data (e.g., short roadways).
  - Modifications or proposed modifications on expressways/freeways with posted speeds greater than or equal to 65 mph.
  - Use of variable speed limits.

13-5-7 Engineering and Traffic Investigation Procedure — November 2024

Request Process

Requests to review a speed zone on the State Trunk Highway (STHs) **shall** be submitted in writing by a local unit of government or County Traffic Safety Commission and include the following:

- Current regulatory speed limit and begin/end points
- Proposed regulatory speed limit
- Proposed begin/end points of proposed zone(s)
- Reasoning for the request (e.g., change in land use, access, traffic volumes, crash trends)

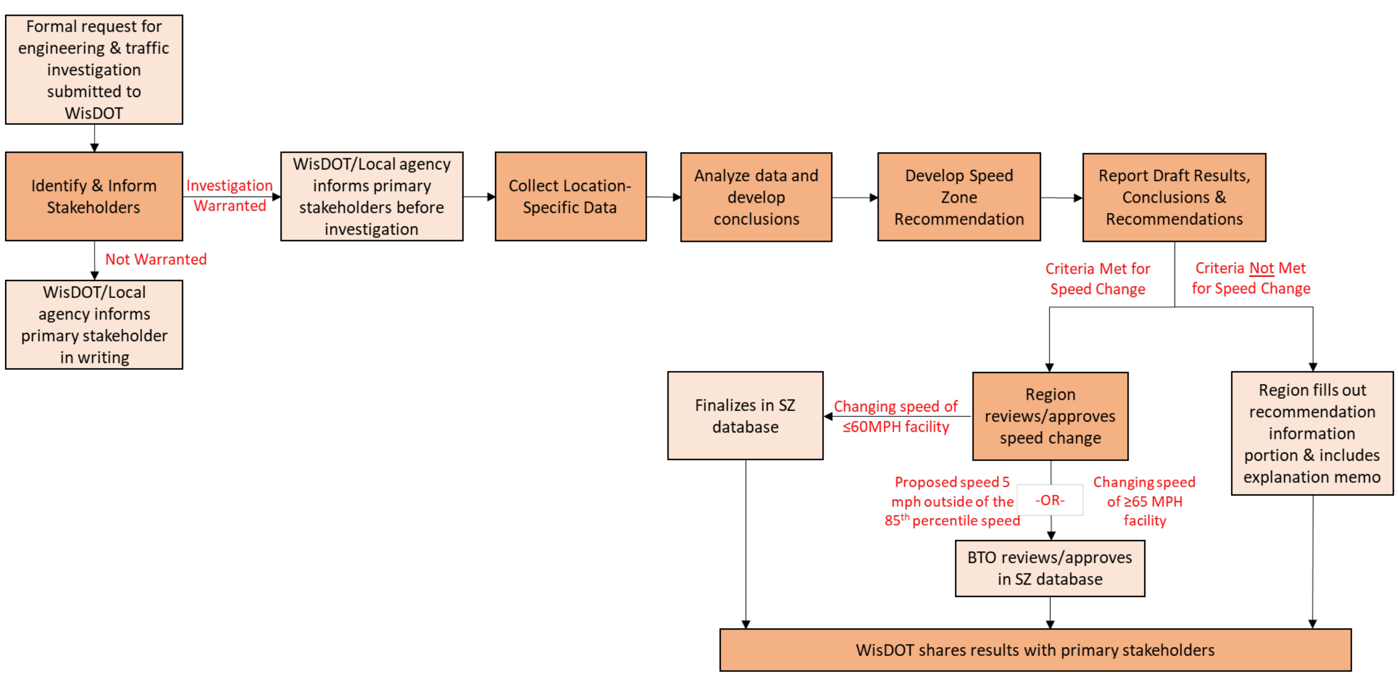
For contact information, please see the WisDOT Speed Limits webpage.

Upon receipt of request, WisDOT will then determine if a review of the speed limit is appropriate. WisDOT does not entertain requests to modify speed limits from individual citizens or advocacy groups. Considerations for speed limit adjustments **shall not** be based solely on the following:

- Noise complaints
- Accommodating specialty vehicles (e.g., ATV/UTV)
- Correcting spot safety concerns
- Future concerns that have not yet occurred (e.g., future development, future roadway improvements)

If an engineering and traffic investigation is warranted, WisDOT will then follow a process outlined in Figure 7.1.

Figure 7.1 Engineering and Traffic Investigation Process



Requirements

For a speed limit to be effective, it *should*:

- Reflect consistent application of traffic engineering principles
- Be a reasonable speed so the majority of drivers will comply voluntarily
- Be based on ideal or average conditions and not temporary situations (e.g., construction, seasonal variations in traffic/pedestrian volumes, special events)
- Local units of government *should* follow the guidance outlined within this manual to satisfy the requirements of an engineering and traffic investigation.
- For state-maintained highways, a traffic engineer with a Wisconsin Professional Engineer License is required to approve a speed limit modification.

An engineering and traffic investigation **shall** include the following section headings. Include information within each section as appropriate based on the study location.

1. Roadway Context Information
    - Primary function or purpose of roadway (e.g., residential street, thoroughfare, commuter route, freight route, recreational route, etc.)
    - Roadway environment (e.g., development adjacent to the road, average building setback, and types of land use)
    - Roadway characteristics (e.g., number of lanes, lane widths, shoulder type and width, roadway curvature, median type, sight distance, presence of curb and gutter, etc.)
    - Roadside features (e.g., presence of and distance to roadside hazards including trees, rock outcrops, street furniture, embankments, edge drop-off, side slopes, water bodies, etc.)
    - Area Type (e.g., urban, suburban, rural)
    - Access density (e.g., number and type of driveways and intersections, etc.)
    - Road users (e.g., pedestrians, bicyclists, ATV/UTV, horse and buggies, other vulnerable road users, etc.)
    - Traffic Volumes (e.g., AADT/ADT, truck volumes and proportions, pedestrian and bicycle volumes, etc.)
    - Public transit volume and location or frequency of stops
    - Other information relevant to the roadways purpose and function (e.g., parking practices, functional classification, design speed, etc.)
2. Safety Information
    - Years reviewed (minimum of 3 years of reported crash history)
    - Number and type of crashes
    - Number of injury and fatal injury crashes
    - Number of vulnerable road user crashes
3. Speed performance metrics
    - 85th percentile speed
    - 50th percentile speed
    - Average speed
    - Pace
4. Other relevant information
    - Review of past speed studies to identify any trends in operating speeds

- Recent significant changes (traffic control changes, speed limit adjustments, lane adjustments, new development, etc.)
- Current level of enforcement

For urban and suburban roadways, and on rural roadways that serve as main streets through developed areas of communities, speed performance metrics *should not* be used as the sole criterion to establish speed limits without consideration of roadway context factors described above. On a freeway, expressway, or rural highway (outside urbanized locations or conditions), the speed limit that is posted *should* be within 5 mph of the 85th percentile speed of free-flowing traffic as long as all the factors described within the roadway context section of this policy have been considered and determined to be non-mitigating.

After analyzing information collected above as part of an engineering and traffic investigation, the analyst **shall** use it to develop and support speed zone recommendations. The engineering and traffic investigation **shall** provide a recommendation indicating whether conditions warrant a need to modify the speed limit of the studied section of roadway or not. Decisions regarding the potential change in a speed limit *should* be based on the objective findings of the engineering and traffic investigation and on conditions that exist at the time of the evaluation.

There are expert system tools available to aid in the process of determining appropriate speed limits which can be used to supplement the requirements listed above:

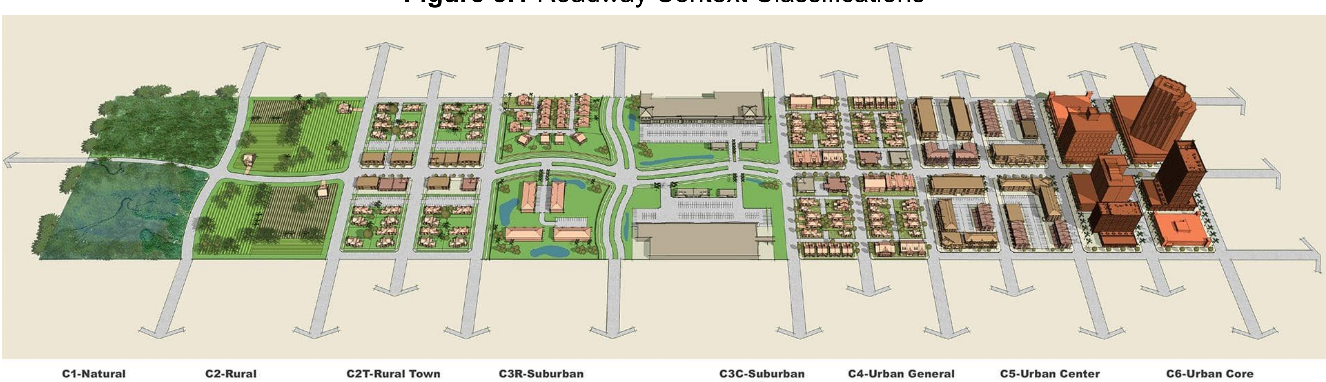
- USLIMITS2
- NCHRP 966: Posted Speed Limit Setting Procedure and Tool

13-5-8 Transitioning between Speed Limits — November 2024

Roadway context and environmental factors play a critical role in establishing appropriate speed limits. Drivers must perceive the need to transition from one speed to another. Development density adjacent to the roadway, building setback distance, the number of streets and driveways that access the roadway, sight distance, roadway features including the presence of curb and gutter, shoulders, medians, sidewalks, pedestrians, bicyclists, and other vulnerable road users provide cues to the driver based on their past experiences. Other aspects considered when setting appropriate speed limits are the number and type of crashes observed, traffic volumes, and observed speeds.

Figure 8.1 illustrates several different roadway context scenarios.

Figure 8.1 Roadway Context Classifications



Source: *Florida DOT's context classification, 2020* [5]

Table 8.1 provides planning-level speed limit recommendations based on the roadway context classifications.

Table 8.1 Design speeds based on context classifications

Context Category	Design Speeds (mph)
Natural	55
Rural	45, 50, 55
Rural Town	40, 45
Suburban Residential	35, 40, 45
Suburban Commercial	35, 40, 45
Urban General	25, 30
Urban Center	20, 25, 30
Urban Core	20, 25, 30

Minimum speed zone lengths *should* follow the guidance in Table 8.2. Engineering judgement *should* be used in determining the appropriate length given the roadway context. If conditions require lengths shorter than those described below, coordinate with BTO's Traffic Analysis and Safety Unit for approval.

Table 8.2 Minimum length of speed zones

Speed Limit (mph)	Minimum Length (miles)
≤40	0.3
45, 50, 55	0.6
60, 65, 70	1.0

Note: *Adjusted values from Methods and Practices for Setting Speed Limits* [6]

Speed Zone Termination Points

The begin and end points of a speed zone *should* be located in locations with adequate sight distance and in advance of where the roadway environment changes (e.g., driveway density, lane transitions, curb and gutter presence, etc.) such that a driver may expect a different speed.

When the roadway environment or roadway characteristics change (e.g., driveway density, lane transitions, curb and gutter presence), the regulatory speed limit sign **shall** be located at the changed condition. Examples include placing speed limit signage within straight sections of roadway or prior to entering a community where there is minimal development, but the roadway characteristics change (e.g., unpaved shoulders to curb and gutter). In advance of the of changed condition, the reduced speed limit sign **shall** be located based on TEOpS 2-3-30. The location of the reduced speed limit sign *should* be adjusted based on engineering judgement such that it is located where adequate sight distance is available or in advance of the changed condition based on site conditions.

Both travel directions of speed zones *should* begin and end at the same location to align with driver expectation. Roadway conditions, existing signage and other factors play a role in locating where speed limit signs can be placed in the field. When posted, the beginning and end points of a speed zone **shall** match the ordinance/declaration description as close as possible.

Roadway characteristics such as access points and intersections sometimes prevent speed zones from being aligned in both directions. In situations where a speed zone is written to change at an intersection, the signs **shall** be posted on either side of the intersection. When reviewed as part of a study or within an improvement project, efforts *should* be made to modify these speed zones to align on one side of the intersection.

- For situations in which the separation of the begin and end points is significant or different speeds are posted for each direction, engineering judgement *should* be used.
- If conditions require an offset speed zone coordinate with BTO's Traffic Analysis and Safety Unit for approval.

Gateway Treatments

Gateway treatments are used to capture the attention of a driver to provide awareness of changes in the roadway environment and encourage them to reduce their speed. Examples of this include enhanced signing (e.g., additional warning signage, beacons, dynamic speed display signs), median islands, curb extensions/bump-outs, roundabouts, chicanes, etc. Gateway treatments are important tools to consider in areas where there are large reductions in the posted speed due to an abrupt change in the roadway environment.

13-5-9 Data Collection Best Practices — November 2024

A speed investigation *should* be performed during non-peak traffic conditions, during daylight hours, and under ideal weather conditions on a typical weekday, when motorists are likely to be traveling at uninterrupted/free-flow speeds. Collecting speed data during peak commute times, unique events, weekends, or holidays may unintentionally capture more variable travel characteristics.

A template for summarizing and reporting speed performance metrics is available on the Speed Limit References and Resources webpage.

Below are best practices for collecting speed performance metrics:

- The observer or speed-measuring device *should* be inconspicuous to the observed traffic so unusual driver behavior does not skew data.
- Speed data *should* be collected away from factors that might influence vehicle speeds, such as railroad crossings, intersections, horizontal and vertical curves, and work zones.
- Vehicle headway (the time between successive vehicles per lane) of five or more seconds *should* be present for reliable speed observations. Measurements collected with smaller headways may not reflect free-flow conditions, as the lead vehicle may influence the speed of the vehicle(s) behind it.

Sample Size Requirements

Selecting a sample size (number of observations) is an important step in collecting speed performance metrics. Below are requirements to help set an appropriate sample size:

- A minimum sample size for speed data collection *should not* be less than 100 vehicles per lane per direction. For example:
    - 200 vehicles for a roadway with one through lane in each direction
    - 400 vehicles for a roadway with two through lanes in each direction
- For roadways classified as very-low volume local roads, the minimum sample size *should not* be less than 30 vehicles. If the analyst anticipates that a sample of 30 vehicles cannot be collected within a reasonable amount of time, coordinate with BTO's Traffic Analysis and Safety Unit to identify alternative data sources or collection methods.

Data Collection Methods

An analyst can use a variety of data collection devices. These devices can be grouped into three categories, which for these purposes, are based on the location that the speed data collection device is installed.

- Manually operated handheld devices that are portable and can be used in most places (e.g., radar gun and laser gun).
- In-road devices that are installed into or on top of the roadway surface (e.g., pneumatic road tube).
- Out-of-road devices that are installed overhead or to the side of the roadway surface (e.g., radar recorders).

Each device has distinct advantages and disadvantages for collecting and analyzing data that may factor in determining the appropriate device to use for a particular location. See WisDOT's Data Collection Methods document on the Traffic Operations Manual webpage for more information.

13-5-10 Documentation November 2024

Speed Zone Database

The approval process for speed limit modifications proposed by WisDOT on the State Trunk Highway system is conducted electronically within the Speed Zone Database. The following summarizes the different levels of review and approval.

1. If an engineering and traffic investigation is completed on an established speed zone, the investigation findings and other relevant documents **shall** be stored within the database.
2. If WisDOT Regional office authority is met (see TEOpS 13-5-6.2), the designated Regional approver **shall** electronically sign/approve the speed zone declaration.
3. If WisDOT Bureau of Traffic Operations (BTO) approval is needed, coordinate with BTO's Traffic Analysis and Safety Unit for approval of the speed zone declaration.

Format

Speed zone declarations **shall** reference recognizable and permanent landmarks (e.g., intersections or highways) and denote a distance to or from these landmarks. Landmarks that change (e.g., construction limits, city limits, building names, railroad crossings, etc.,) **shall not** be used.

13-5-11 Local Speed Limits November 2024

Request Process

Coordinate with the appropriate government agency to discuss concerns or proposed modifications on county highways, city or village roads, or town roads. Upon receipt of request, local authorities can initiate action to modify a speed limit and create a new speed zone on a local road through an engineering and traffic investigation. TEOpS 13-5 is provided to help guide local agencies in establishing appropriate speed limits. Wisconsin ss. 346.57 and ss. 349.11 are most applicable to modification of regulatory speed limits. These statutes, and local government authority are summarized in Table 6.1.

The following are common examples for local agencies:

- The roadway does not currently have a posted speed and is rural in nature (e.g., sparse development, no curb and gutter, gravel shoulders and grass ditches). In this scenario, by ss. 346.57, the speed limit is 55 mph.
- Lowering a 55-mph county trunk highway or rural roadway to 50 or 45 mph. In this scenario, the county or township *may* lower the speed limit to either 50 or 45 mph under the approval authority listed in ss. 346.57 and ss. 349.11 without WisDOT approval, but an engineering and traffic investigation is required to support the change.

Ordinances

It is recommended that the local approval process include legal adoption of the speed zone recommendation through passage of an ordinance. This establishes a legal record of the speed limit modification and allows the speed zone to be enforceable by law enforcement agencies. Proposed changes that lie outside the constraints presented in Table 6.1 **shall** be reviewed and approved by WisDOT before legal adoption by local authorities. It is recommended that the local process conclude with the local authority responding to the submitting party in writing, providing notification of approval or an explanation of the reasons for denial. The following is an example county ordinance.

Sample Ordinance

Establishment of Speed Zones

The Board of Supervisors of the County of Alpha do ordain as follows:

A traffic and engineering investigation having been made on the following described highways, the maximum permissible speed at which vehicles *may* be operated on said highways, which speed is herewith established as reasonable and safe pursuant to Section 349.11, Wisconsin Statutes, **shall** be as set forth herein subject to approval by the Wisconsin Department of Transportation, and upon the erection of standard signs giving notice thereof, all in Alpha County Wisconsin:

1. County Trunk Highway "A", Town of Soup, Alpha County.

   Forty-five miles per hour from its intersection with County Trunk Highway "B", northerly to its intersection with State Trunk Highway 201.

2. County Trunk Highway "B", Town of Blank, Alpha County.

   Thirty miles per hour from the intersection of Rabbit's Foot Ave, northerly to a point 0.35 miles north of said intersection.

Documentation

Typical documentation of an engineering and traffic investigation can include a cover letter, memo describing the background and roadway context, , map and/or photos of the area, safety information, speed performance metrics, findings, methodologies, and any other documentation to help support the recommendation. Contact the local WisDOT Regional office for an example of an engineering and traffic investigation or for any questions on the speed limit setting process. See WisDOT's Speed Limit webpage for contact information.

Speed Limits Within and Outside Incorporated Areas (Outlying District and Semiurban District)

Outlying District and Semiurban Districts are defined in ss. 346.57(1)(ar) and 346.57(1)(b) respectfully. These statutes are meant to establish speed limits based on access (building) density and *should not* be used as the sole criteria to establish a speed limit without consideration of other factors listed within TEOpS 13-5-7.2.

13-5-12 School Zones — November 2024

Wisconsin State Statutes require that school advance warning signs be installed and maintained on every highway where a school ground is contiguous to the highway. There is no requirement that a school speed limit be posted except where it differs from the 15-mph provision in ss. 346.57 (4)(a) and (b). These two provisions place the requirement on the motorist to reduce speed to 15 mph when children are present, even in the absence of speed limit signs.

Sign Requirements

School speed limits require the use of a regulatory school speed zone sign. For more information on school signage, see TEOpS 2-3-54. If used, they *should* be posted at 10 mph less than the posted regulatory speed limit of the roadway.

The physical arrangements of schools along state trunk highways vary greatly. The following are examples to help illustrate guidelines within this policy. Other locations not fitting these will have to be reviewed to determine the appropriate use of school zone signs.

Urban Areas

- In a built-up section of a city or village, where the roadway speed limit is low (i.e., ≤30 mph) and sidewalks are present, many or most of the children walk to school. However, some children may be transported by vehicles which can lead to congestion.
- In developed areas, sudden stoppages and slowdowns are common. If the roadway is a higher speed facility (e.g., 35 mph or greater) it would be desirable to study the location to determine the appropriate school speed limit for the roadway.

Rural Areas

- In a rural area, the school may be the only development along the roadway. In these areas, speed limits often are higher and there are few to no children who bike or walk to school. It is WisDOT's policy to refrain from posting school speed limits under these conditions.
- Since children are unlikely to be present in vicinity of the roadway, school speed limit signs are ineffective at changing a motorist's behavior. If there are no children present, do not post a school speed limit sign. See TEOpS 2-3-54 for information on school signage.

Conflicts with signs

Where school speed limits are posted, it is considered good practice to omit the full-time regulatory speed limit signs in the school zone to prevent confusion or avoid giving motorists grounds for disobeying the school speed limit.

13-5-13 Dynamic Speed Display Signs — November 2024

See TEOpS 2-1-7 regarding policy for dynamic speed display signs.

13-5-14 Posted versus Design Speeds — November 2024

Design speed is used to establish design parameters for the various features of the roadway. The selected design speed *should not* be based on speed measurements but *should* be established based on factors such as the anticipated adjacent land use, topography, crash risks, and operating speed of the roadway. The posted speed **shall not** exceed the statutory speed limit and *should* be equal to or 5 mph lower than the selected design speed. When conditions prevent a roadway feature or element from meeting design speed requirements, the posted speed **shall not** be based on the individual design speed of the feature.

Local agencies *should* coordinate with the WisDOT regional offices if they have any questions with respect to design speeds and approval authorities outlined in Table 6.1.

Policy

For construction of new roadway facilities or reconstruction of existing facilities, the posted speed limit *should* be posted in accordance with the design speed. Below are considerations for establishing appropriate speed limits on new or reconstructed facilities:

- For WisDOT improvement projects, the project team **shall** coordinate with the regional traffic and planning sections to mutually agree upon an appropriate speed limit. The regional traffic unit **shall** document the speed zone with a speed zone declaration. See TEOpS 13-5-10.
- Posted speeds *should* generally be equal to or within 5 mph of the selected design speed.
  - There are cases, however, where the posted speeds *may* be higher or lower than the design speed for a section of highway.
  - For speed limits posted below the design speed, coordination with the Traffic Analysis and Safety Unit (TASU) in the Bureau of Traffic Operations (BTO) is required.
- Isolated intersections with reduced speed limits **shall** be investigated for design modifications rather than maintaining a posted reduced speed. See TEOpS 13-5-15.
- Conversion of a two-lane roadway to a four-lane roadway **shall not** automatically constitute changing the speed limit from 55 mph to 45 mph.
- Where local roads are converted to state highways or built on relocation, such as bypasses, the speed limit *should* be based on the new geometrics of the roadway and the function and purpose of the highway as either an expressway or conventional highway.
  - The function of the highway includes adjacent land use, spacing of access points and proximity to the roadway.
  - The speed limit that existed prior to the conversion to a state highway *may not* necessarily be retained.

Design parameter considerations

Design parameters and features of the roadway are initially based on a design speed but careful consideration *should* be used to design a roadway to achieve an appropriate operating speed. Design speeds are used to design a roadway to operate safely and efficiently to serve its intended purpose. In some situations, there may be features that are unable to meet these design thresholds and may require a motorist to travel at a reduced speed. See FDM 11-10-1.5 for more information and documentation requirements.

Individual design features such as isolated horizontal and vertical curves **shall not** dictate posted speed limits unless safety issues are identified post-construction. Other examples include:

- **Free-flow ramps at system and service interchanges** - Ramps are signed with advisory speeds mounted under a horizontal alignment sign and ramp speed warning sign.
- **Curves and/or turns with a speed rating less than design speed on a section of highway** – Curves and/or turns are signed with horizontal alignment signs and an advisory speed that provides a motorist with the recommended safe operating speed of the curve or turn.
    - Example: A 55 mph rural section of highway often has turns and curves that necessitate the driver to lower their speed in order to safely negotiate the curve or turn. The regulatory speed limit is not changed for each one of these turns or curves.
- **At transition sections from 4 to 2 lanes** - The transition area where a divided highway becomes an undivided highway *should* use engineering judgement to determine the proper location of where these speed limit transitions occur.
- **Other design features -** such as the presence and offset of curb, curb type (e.g., vertical face, sloped face), wider or narrower shoulders, or other design features **shall not** be a determining factor in establishing an appropriate speed limit in isolation.

13-5-15 Speed Limits on Approach to Controlled Intersections — November 2024

Sections of the state highway system in the immediate vicinity of a controlled intersection *should not* be considered for a speed zone reduction due strictly to the presence (or planned presence) of an intersection control condition. Intersection control conditions include stop conditions (one-way, two-way or all-way), traffic signals, roundabouts, or access restrictions (controlled either by regulatory signs or channelizing islands).

If requests for a modified speed limit in advance of a controlled intersection stem from safety concerns, roadway improvements *should* be considered that pertain to the specific site (e.g., channelized or extended turn lanes, modification to signal phasing or timing, rumble strips, advance warning signs, warning beacons, signing/marking enhancements, etc.). Speed limit reductions in advance of the intersection will likely not influence safety and may even promote poor engineering decisions in the future (e.g., signal equipment placement, signal timing or sign placement).

Existing locations that do not comply **shall** be allowed to remain until such time as the intersection is resurfaced or reconstructed.

Rather than establishing a lower speed limit in advance of a controlled intersection, consider design features such as:

- Stop Conditions – Proper placement of advance warning signs (per WMUTCD).
- Traffic Signals – Intersection lighting (per TEOpS 11-4-2) and Dilemma zone detection on high-speed approaches (per Traffic Signal Design Manual (TSDM) 8-1-6).
- Roundabouts – Proper geometric design of splitter islands, roadway curvature (per FDM 11-26) and lighting (per TEOpS 11-4-3).
- Corridor Access Management – Proper geometric design principles (per FDM 7-35).

13-5-16 Temporary Traffic Control Zones (Construction Work Zone Speed Limits) — November 2024

Refer to Section 6B.01, Temporary Traffic Control Plans, of the WMUTCD for more information on reducing the speed in temporary traffic control zones (i.e., construction work zones). Reductions in speed limits for temporary traffic control zones *should* be evaluated according to the criteria in this policy. Table 16.1 provides an illustration of different temporary traffic control zone scenarios.

There is often less need for reduced speed limits in temporary traffic control zones on rural conventional highways. On rural conventional highways, drivers do not have the same expectation for free-flowing traffic as they do on rural freeways. With driveway access and crossing movements on conventional highways, drivers tend to be alert to such movements and other similar conflicts even without reduced speed limits.

Temporary traffic control zones which require lower operating speeds due to changes in alignment (e.g., crossovers and transitions) or other work activities that occupy a short work area, *should* use warning signs with advisory speed plaques in lieu of regulatory speed limit signs.

Authority

The WisDOT work zone operations engineer within BTO has approval authority for temporary traffic control zone speed limits on all interstates and facilities with a posted speed of 65 mph or greater. The WisDOT regional work zone engineer has the authority to approve and establish temporary traffic control zone speed limits on all other roadways.

Policy

Engineering judgment **shall** be used when determining appropriate speed zones. This policy is intended to assist with the development of an appropriate work zone speed limit. Contact the regional work zone engineer or BTO for assistance with applying this policy.

Speed zones provide drivers an indication of what is considered a reasonable speed for that section of roadway. Proximity to construction activities, drop offs, lane closures, narrow lanes/shoulders and pavement condition all influence the driver's determination of a reasonable speed. The type of construction work, project length, area type (i.e., urban vs. rural), facility type, occurrence of night work and traffic mix (e.g., commuter, recreational, truck percentages) all impact driver expectations and the determination of what is a reasonable speed. The policy criteria described below *should* only be used for facilities during intermediate-term and long-term work activities as defined in Part 6 of the WMUTCD.

Speed reductions in segments without active work can lead to disregard of the posted speed. Work with your project manager to incorporate standard special provisions for removing temporary speed zones when active work is not taking place.

Policy criteria 1 through 6 *should* be evaluated, along with engineering judgment, to develop an appropriate work zone speed limit. The most restrictive work zone impact *should* be used as the determining condition.

All reduced work zone speed limits **shall** be approved prior to approval of the 90% Transportation Management Plan (TMP).

Temporary Traffic Control Zone Policy Criteria

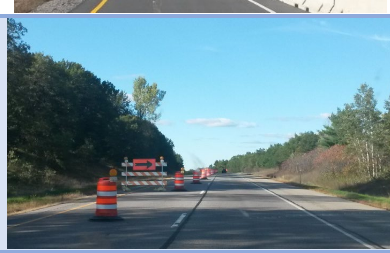
1. Interstates and Expressways with 70 or 65 mph speed limit:
   - If bi-directional traffic separated by concrete barrier temporary precast, then speed limit *may* be lowered to 60 mph if warranted.
   - If bi-directional traffic separated by tubular markers, then reduce to 55 mph.
   - If workers are present within 12 feet of live traffic without positive protection* for any length or work area, then reduce to 55 mph.
   - If work area is less than or equal to 0.5 miles in length with lane shifts or narrowed travel lanes and has positive protection*, then post warning signs with an advisory speed plaque.
   - If work area is less than or equal to 0.5 miles in length with no lane shifts or narrowed travel lanes and has positive protection*, then do not lower the speed limit.
   - If work is taking place outside the clear zone, then do not lower the speed limit.
   - During periods of no work activity, restore speed limit to posted speed. Such speed limit reduction **shall** be subject to documented approval by the BTO work zone operations engineer. When a reduced work zone speed limit is recommended in the TMP, a temporary speed zone declaration **shall** be completed and sent to BTO for approval.
2. Expressways and other multi-lane highways with 55 or 50 mph speed limit:
   - Reduce to 45 mph only in situations that have a combination of extreme lane shifts, narrowed lanes, bi-directional traffic, or milled surfaces.

- Restore speed limit to normal posted speed when reduction criteria are not present.

3. Multi-lane highways with 45 mph speed limit:
   - Reduce speed limit to 35 mph only in situations that have a combination of extreme lane shifts, narrowed lanes, bi-directional traffic, or milled surfaces.
4. Two-lane rural highways with 55 mph speed limit:
   - Reduce to 45 mph only in situations that have a combination of extreme lane shifts, narrowed lanes or milled surfaces.
   - A flagging operation in and of itself would typically not warrant a reduced speed limit since motorists are controlled by the flagging devices.
5. Two-lane rural roadways with speed limit of 45 mph or less:
   - Typically, no reduction in speed limit.
   - *May* consider a speed reduction up to 10 mph in increments of 5 mph in situations that have a combination of extreme lane shifts, narrowed lanes or milled/gravel surfaces.
6. Two-lane urban roadways with speed limit of 40 mph or less
   - No change in speed limit except reduction to 35 mph *may* be considered in situations that have a combination of extreme lane shifts, narrowed lanes or milled/gravel surface.

*Positive protection is defined by FHWA as a temporary precast concrete barrier that contains or redirects vehicles and separates workers from the active travel lanes.

Table 16.1 Example Temporary Traffic Control Zone Scenarios

	Bi-directional traffic separated by flexible tubular markers
	Active work areas within 12-ft. of live traffic without positive protection
	Lane shift to shoulder or temporary pavement
	Lane closure without positive protection

Work Zone Temporary Speed Zone Declarations

Reduced speed limits in temporary traffic control zones are subject to approval by the BTO work zone operations engineer. A Temporary Speed Zone Declaration (TSZD) **shall** be submitted through the Department's online Wisconsin Transportation Management Plan (WisTMP) system.

- Complete the Temporary Speed Zone Declaration Form and attach it to Section 4 of the TMP.
- The TSZD will be approved by BTO and/or the regional work zone engineer by signing the 90% TMP.

13-5-17 Maintenance Work Zones — November 2024

Wisconsin ss. 349.11(10) provides that a county *may* establish a speed limit through a maintenance work zone on a state trunk highway less than the authorized speed limit. This includes all freeways and interstate highways. The State Patrol will enforce the speed limit but need to be informed of its inauguration and the ordinance, resolution, or action enacting it.

Follow TEOpS 13-5-16, policy criteria 1-6 when establishing a temporary speed zone reduction for maintenance activities.

Document the reduced regulatory speed in the Wisconsin Lane Closure system (WisLCS).

13-5-18 References — November 2024

[1] **Federal Highway Administration**. *Manual on Uniform Traffic Control Devices for Streets and Highways, 11th Edition*, FHWA, December 2023.

[2] **National Cooperative Highway Research Program.** *Human Factors Guidelines for Road Systems*, Washington D.C., NCHRP, 2012.

[3] **Federal Highway Administration**. *Safe System Approach for Speed Management*, FHWA, May 2023.

[4] **American Association of State Highway and Transportation Officials**. *A Policy on Geometric Design of Highways and Streets, 7th Edition*, AASHTO, 2018.

[5] **Florida Department of Transportation**. *FDOT Context Classification Guide*, FDOT, July 2020.

[6] **Federal Highay Administration**. *Methods and Practices for Setting Speed Limits*, FHWA, 2012.

13-10-1 Authority and Policy July 2012

PURPOSE

This policy covers the process that a municipality **shall** follow when requesting permission to close a state highway and provide a temporary detour route. The municipality may need to close a state highway for maintenance work or the moving of large objects or machinery. **Closing and detouring a state highway route for special events is covered under TEOpS 2-10-1.**

AUTHORITY

Section 84.07(4) establishes the conditions under which a city or village *may* detour State Trunk Highway traffic:

> "Except in the case of emergency, no city, village or town **shall** obstruct any street over which any State Trunk Highway is marked, unless it first makes arrangements with the Department for marking a detour."

This provides the statutory basis for the issuance of detour permits. The arrangements with the Department must be documented in a detour permit.

APPROVAL

The Region Traffic Engineer or designee has the authority to make decisions with regard to requests for permits to temporarily close or obstruct a street carrying the marked route of a state highway, or to detour the marked route of a state highway. Those decisions are subject to the conditions established in this policy. Permits may be issued only to a municipality upon formal request from its governing body and **shall not** be issued to individuals or non-governmental organizations. All closures and restrictions on Corridors 2030 roadways require approval by the Regional Traffic Engineer (RTE) via the Lane Closure Planning System.

GENERAL PROVISIONS

Applications for permits and the approval thereof **shall** be made in writing on the standard form provided for the purpose (DT1479, copy appended), with such attachments as are necessary, such as a map. When a permit application is denied, the denial *should* be in writing with a letter of explanation to the applicant.

Circumstances that *may* be result in a decision to grant a permit include:

1. Construction, maintenance and repair of streets, structures and utilities.
2. The movement of large single objects such as buildings and machinery.

In all instances, the Region must be satisfied that traffic on the state highway route will not be unduly inconvenienced and that an adequate detour will be provided.

The municipality **shall** agree to accept the terms and conditions of the permit as specified by the Department. Refer to Figure 1 for the Permit Application by Municipality for Permission to Detour State Trunk Highway Traffic (DT1479 form).

The Region should consider the following requirements for the approval process of the roadway closure and detour permit. The Region *may* modify or impose additional reasonable requirements or restrictions to the permit as are necessary for the particular circumstances of that permit.

1. A plan for traffic control and detour, and documentation of the means to implement it, *should* be submitted to the WisDOT Region Traffic Engineer for review at least 90 calendar days in advance of the event.
2. A detour **shall** be required. Motorists **shall** be guided through the detour by signs and/or law enforcement personnel.
3. A detour permit application (Form DT1479) **shall** be completed.
4. All traffic control and detour signs **shall** be in conformance with the standards established in the MUTCD.

5. The municipality **shall** notify appropriate media, emergency services and affected schools five (5) days prior to the detour.
6. All road closures and detours **shall** be coordinated with the State Patrol and/or the local law enforcement agency. The coordination **shall** be documented by the municipality.
7. The WisDOT Region Traffic Engineer *should* notify the Region Communications Manager of the Special Event once the DT1479 form has been completed and signed.
8. The municipality **shall** be responsible for providing adequate traffic control for the duration of the closure and effective coordination with law enforcement.
9. The municipality **shall** be responsible for all costs associated with providing the traffic control, law enforcement, and coordination of other services to accomplish the closure consistent with the permit requirements.

Figure 1. Forum DT1479

APPLICATION BY MUNICIPALITY FOR PERMISSION TO DETOUR STATE TRUNK HIGHWAY TRAFFIC

Wisconsin Department of Transportation

DT1479 6/2007 (Replaces ET604) s.84.07(4) Wis. Stats.

TO: REGIONAL TRAFFIC SECTION

Municipality	County
Area Code – Telephone Number	E-Mail Address
Name of Street(s) to be Closed ☐ STH ☐ USH	Streets Closed Between (Street Name) FROM: TO:
PROPOSED TEMPORARY ROUTE	
☐ MAP ATTACHED	Date and Duration of Detour Date: Time: a.m. to a.m.
Reason	
Name and Address to Whom Permit will be Returned	

The above municipality requests permission to close the marked route as described, during which time the municipality will provide temporary route as designated.

The municipality agrees to accept the following terms and conditions:

1. The municipality shall provide a detour having structural, geometric and traffic control characteristics, which are acceptable to the Region. A detour map which provides street names shall be submitted.
2. The municipality shall furnish, erect and remove signs and markers at the sole expense of the municipality, unless provided for in (3), or unless directed by officers for short routes and short timeframe (less than 3 days).
3. A Detour and Traffic Control Plan shall be submitted to the Region for approval. An example is Standard Detail Drawing 15C2-4C.
4. The municipality shall agree to minimize, as much as practicable, the duration of closure, including providing for assembly and dispersal of parades in areas removed from the state highway route.
5. The municipality shall accept full responsibility for any damage to local roads and streets resulting from closure and detour.
6. The requester shall arrange for adequate traffic control from either WisDOT or the appropriate county, and provide documentation of enforcement coordination.
7. The requester shall notify all media, emergency services and schools, five (5) days prior to the detour.
8. Additional conditions: . Attachments: ☐ Yes ☐ No

(Authorized Official Signature) (Title) (Date)

Permission is granted to temporarily close the designated segment of state trunk highway and to provide a detour, subject to the stated conditions.

(Permit Number) (Approved By) (Date)

13-10-2 Use of Highway Right-of-Way for Special Events — December 2008

PURPOSE

The Department receives frequent requests to use the highway right-of-way for various activities. These activities are typically short-term, readily definable activities that fall in two categories:

- roadway or roadside modifications, repairs, or maintenance operations by a local unit of government, or permitted railroad or utility work,
- and certain types of special events, such as parades, marathons, bicycle races, charity walks/runs, filming, etc.

Roadway or roadside operations, including utility work, are regulated under Chapters 90 and 96 of the Maintenance Manual and DOT Permit Form DT1812. The purpose of this policy is to establish criteria on the use of the highway right-of-way for the special events that can be conducted with the road open to traffic under certain restrictions.

Road closures and detours for special events shall be governed by the guidance in TEOpS 13-10-1 and DOT Permit Form DT1479. Signing for Special Events off of the State Highway system shall be governed by the guidance in TEOpS 2-15-25.

The basis for allowing the use of the highway for these special events is Wisconsin State Statute 349.185, which allows governments in charge of maintaining the highway the authority to regulate community events or celebrations, processions or assemblages on the highways. The word "assemblage" is interpreted to mean that the Department *may* consider activities such as street fairs, bike racing and marathons as legitimate reasons for traffic restrictions, up to and including closing the street and arranging for a detour if the municipality so chooses.

In general, use of the state highway right-of-way for special events will not be allowed unless a legitimate public interest (supported by the Local Government) is served and the activity does not cause safety or capacity problems. Requests for closing and detouring the highway **shall** come from the municipal government. Special event requests that only require temporary traffic restrictions *may* come from the municipality, individuals, private enterprises or a neighborhood community. Authorization for usage of the highway right-of-way for special events *may* be granted by the WisDOT Region office in the form of a permit, provided all pertinent criteria covered in these guidelines are satisfied. All closures and restrictions on Corridors 2030 roadways require approval by the Regional Traffic Engineer (RTE) via the Lane Closure Planning System.

DEFINITIONS

<u>Freeways</u> are defined as divided arterial highway facilities that have <u>fully</u> controlled access at interchanges only. Interstate Highways are freeways with the interstate route designation.

<u>Expressways</u> are defined as divided arterial highway facilities with partially controlled access by a combination of interchanges, at-grade intersections, and driveways.

<u>Conventional Highways</u> are defined as streets or roads other than freeways, expressways, or low-volume roads. They may be divided or undivided, two-lane or multi-lane, and access is available at intersections and driveways.

GENERAL POLICY CRITERIA

1. Special events on the highway right-of-way **shall not** be allowed on freeways, expressways or any roadway with a posted speed above 55 mph.
2. The permit **shall** identify that the special event sponsor agrees to assume the entire responsibility and liability for all damages or injury to all persons, whether employees or otherwise and to all property, arising out of, resulting from or in any manner connected with the operation of the special event. The sponsor **shall** provide proof of General Liability Insurance Coverage and **shall** agree to defend and indemnify WisDOT, it's agents and employees from all such claims including, without limiting the generality of the foregoing, claims for which WisDOT may be paid or incurred to enforce the provisions of this paragraph, and the sponsor shall further agree and pay for such general liability coverage which protects the state as an additional named insured.
3. The requestor **shall** submit the permit application to the WisDOT Region Traffic Section at least 90 calendar days in advance of the event.

4. The sponsor **shall** be responsible for any damage done to the highway property as a result of the special event.
5. The special event minimum attendance is typically 100 participants. This attendance number does not include spectators.
6. A special event **shall not** occur more than once annually by the same sponsor in the same location. Special events **shall not** occur more than twice a year in the same location.
7. WisDOT is responsible for determining whether the event qualifies for special event signs, providing guidance on acceptable signs and placement, reviewing the permit application, and assuring compliance with the permit.
8. The Region Traffic Section will evaluate the safety of any nighttime special event requests.

DETAILED POLICY CRITERIA

1. Special Events **shall** not be allowed during peak traffic periods, as determined by the WisDOT Region Traffic Engineer.
2. The time duration of the Special Event should not exceed four hours or when the last event participant has cleared the roadway.
3. The use of the right-of-way **shall not** interfere with motorists' safe operation of their vehicles.
4. The use of the right-of-way shall not obstruct sight distance and shall not detract from motorists' view of traffic control devices.
5. A plan for traffic control and documentation of the means to implement it **shall** be submitted to the WisDOT Region Traffic Engineer for review and approval at least 90 calendar days in advance of the event.
6. All traffic control signs shall be in conformance with the MUTCD.
7. Advance notices to the media **shall** be coordinated by the Requestor.
8. All special events **shall** be coordinated with the State Patrol and/or the local law enforcement agency as appropriate, by the requestor. Documentation of this coordination is required.
9. Parking shall not be allowed on the state highway right-of-way, which includes the shoulders.
10. If the event will take place on highways maintained by other agencies, the Requestor **shall** coordinate the event and provide proof by letter to the WisDOT Region Traffic Engineer.
11. The usage of police powers for special events **shall not** substitute for appropriate signing.

SIGNING LIMITATIONS

1. No commercial advertising is allowed on the signs. The inclusion of a brand name within the name of an event, such as "Brand X Racing Event" is permissible. The sign message *may* include the word "Event" or "Parking". Event names on signs should be as clear and concise as possible. Pictographs **shall not** be allowed on the signs, per interpretation of the MUTCD and guidance from FHWA.
2. The signing layout detail and installation locations **shall** be approved by the Regional Traffic Section and Bureau of Traffic Operations.
3. Guidance signs with red, orange, yellow, or fluorescent yellow-green background **shall** not be used. Temporary work zone warning signs **shall** be fluorescent orange. Sign base material **shall** consist of plywood or sheet aluminum. If banners are used, they must meet the requirements of the policy on banners (TEOpS 13-12-1). Posts **shall** be of an approved type for highway signs per WISDOT standards. Signs **shall** be manufactured by a fabricator who has been in the traffic signing business for a minimum of three years.
4. Letter size, font, and spacing **shall** meet MUTCD guidelines. Minimum of 6" upper case letters and 4 ½" lower case letters **shall** be used.
5. If the event takes place at night, the signs **shall** be high intensity, retroreflective.
6. Changeable message signs *may* be used, subject to WisDOT policy requirements for use of changeable message signs. The Regional Traffic Section **shall** approve the message content, letter height, and sign location by completing the PCMS Usage Request Form for special events in TEOpS 17-2-1. Larger letter

heights are needed on changeable message signs for readability. Refer to the TEOpS 17-2-1 for additional provisions regarding PCMS usage.

7. Pre-event signing *may* be required up to 10 days in advance of the special event. The signing layout and installation details for pre-event signing **shall** be approved by the Regional Traffic Section and the Bureau of Traffic Operations.

IMPLEMENTATION/COST

1. The event organization or requesting group **shall** pay for all costs associated with the special event signing including costs to obtain the permit, which *may* include WisDOT review costs, any costs to acquire, install, and remove the special event signs, including changeable message signs, and any additional costs incurred by the Department. The event organizer will be responsible for obtaining signs that conform to Department standards and arranging to have those signs placed, operated, and removed consistent with the terms of the permit. All work on the highway right of way must be performed by a contractor or local government agency approved by WisDOT.
2. Installation by county forces *may* be an option in some situations. When that occurs, all costs are charged back to the requesting organization.

APPLICATION BY MUNICIPALITY FOR PERMISSION TO DETOUR STATE TRUNK HIGHWAY TRAFFIC
DT1479 7/2011 (Replaces ET604) s.84.07(4) Wis. Stats.

Wisconsin Department of Transportation

TO: REGIONAL TRAFFIC SECTION

Municipality		County
(Area Code) Telephone Number		Email Address
Name of Street(s) to be Closed ☐ STH ☐ USH		Streets Closed Between (Street Name) FROM: TO:
Proposed Temporary Route		
☐ MAP ATTACHED	Date and Duration of Detour Date:	Time: a.m. to a.m.
Reason		
Name and Address to Whom Permit will be Returned		

The above municipality requests permission to close the marked route as described, during which time the municipality will provide temporary route as designated.

The municipality agrees to accept the following terms and conditions:

1. The municipality shall provide a detour having structural, geometric and traffic control characteristics, which are acceptable to the Region. A detour map which provides street names shall be submitted.
2. The municipality shall furnish, erect and remove signs and markers at the sole expense of the municipality, unless provided for in (3), or unless directed by officers for short routes and short timeframe (less than 3 days).
3. A Detour and Traffic Control Plan shall be submitted to the Region for approval. An example is Standard Detail Drawing 15C2-4C.
4. The municipality shall agree to minimize, as much as practicable, the duration of closure, including providing for assembly and dispersal of parades in areas removed from the state highway route.
5. The municipality shall accept full responsibility for any damage to local roads and streets resulting from closure and detour.
6. The requester shall arrange for adequate traffic control from either WisDOT, traffic control contractor, or the appropriate county, and provide documentation of enforcement coordination.
7. The requester shall notify all media, emergency services and schools, five (5) days prior to the detour.
8. Additional conditions: . Attachments: ☐ Yes ☐ No

(Authorized Official Signature) (Title) (Date)

Permission is granted to temporarily close the designated segment of state trunk highway and to provide a detour, subject to the stated conditions.

(Permit Number) (Approved By) (Date)

13-11-1 Policy May 1990

(The following was contained in a memorandum of April 4, 1974, instituting the issuance of permits for surveying and related activities.)

From time to time private land surveyors, utility company surveyors, and others doing similar work are an highway right-of-ways for the purpose -of making land surveys, locating landmarks or monuments, surveying for utility lines, etc. The work way take place wholly on or above the highway surface as is the case in measuring distances and courses or establishing elevations, or it *may* include excavation, for example to locate monuments. For the safety of both highway traffic and persons making these surveys, it appears desirable to re-emphasize the requirements for such operations.

It is recognized that such private survey work on or along a highway is accomplished in a short time and does not involve any significant interference with traffic or hazard to either traffic or the survey crew. In such cases, the survey personnel have the same status as any pedestrian upon the highway, although unlike persons engaged in highway construction or maintenance they are not exempt from the provisions of the Rules of the Road. Such survey personnel *should* be strongly encouraged to wear high-visibility clothing. Whether or not they *should* place advance warning signing will depend somewhat upon whether the work is near or across the roadway, or if it is done well away from traffic.

A permit is required whenever the survey activity will necessitate actual closure of a portion of the roadway for more than a very brief period such as when an isolated measurement is made across the road. The attached permit format *should* be used. The Region *should* add special conditions necessitated by the specific situation. When the highway is heavily traveled it way be desirable to require that a uniformed police officer be provided to direct traffic.

Permits for surveys and other similar operations not requiring an excavation on highway right-of-ways will normally be issued by the Regional Traffic Section and a copy **shall** be sent to the Central Office Traffic Section.

Whenever it is necessary to cut into the roadway surface, to use mechanized equipment or to make any substantial excavation elsewhere in the highway right-of-way to locate a monument or for any reason, a permit is required from the Maintenance Section.

E-T-613-74

State of Wisconsin / Department of Transportati

APPLICATION FOR PERMIT TO CONDUCT PRIVATE LAND SURVEY ON STATE HIGHWAY RIGHT OF WAY

To the District Engineer – Wisconsin Dept. of Transportation - Division of Highways

Address

City State Zip Code

The undersigned hereby requests permission to temporarily close a portion of the roadway of the state trunk highwa indicated below for the purpose of making a land survey which cannot be safely and expeditiously conducted withou such closure. The undersigned applicant certifies that he has read and will comply with the conditions of this applica tion including any conditions which may be imposed by the Division of Highways prior to issuance of a permit.

Date of Application	APPLICANT	By
Address	Date of Closure	Hours
Highway to be closed USH _____ STH _____	County	Location Description
Description of closure (lane, width, etc.)		

CONDITIONS FOR A PERMIT

1. The permittee shall minimize as much as practicable the duration of work on the highway right of way.
2. Adequate standard warning signs (SURVEY CREW AHEAD; FLAGMAN AHEAD; ONE LANE ROAD; RIGHT or LEFT LANE CLOSED AHEAD; etc. as appropriate) shall be used at and in advance of the work. Traffic cones or barricades s be provided and used as needed or as required by the district engineer.
3. Survey crew members, including flagmen, shall wear high visibility vests.
4. Flagmen, when required by this permit (see below), shall use either a red flag at least 18" x 18" in size in good condition on a 3' staff or alternatively a sign paddle with the words STOP, SLOW or GO as appropriate.
5. This permit does not authorize disturbance of highway surfacing or excavation elsewhere in the highway right of way.
6. Survey crew vehicles shall be parked in a safe location where they will not interfere with visibility or operations for traffic on the highway.
7. In applying for and accepting this permit, the permittee agrees to hold the Division of Highways and its employees harmless from any claim which may arise as a result of operations under the permit.
8. No trees, brush or shrubs shall be cut in the course of work under this permit.
9. Additional conditions:

PERMIT

Permission is hereby granted to the above applicant and his employees to temporarily close the indicated part of the state trunk highway roadway for the requested period of time as set forth in the application, subject to the conditions stated above.

PERMIT NO.	DATE ISSUED	EXPIRATION DATE	APPROVED BY

13-12-1 Policy January 2014

GENERAL

Communities *may* request permits to install banners and/or civic displays to promote special events or to display civic pride. These banners/displays can provide a very effective and efficient means to convey a message to the motorist, and when used correctly can provide a positive effect for the flow of traffic, and ultimately traffic safety.

The MUTCD, Section 1A.01 and Wisconsin State Statute 86.19 clearly state that advertising messages **shall not** appear on traffic control devices. Even though banners and civic displays are not considered traffic control devices and are not used to control traffic, they can compete with essential traffic control signs. Therefore, careful consideration must be taken to provide signs and messages which do not conflict with these rules or have a negative impact on traffic safety.

Regional Transportation directors, or their designees, *may* approve or deny applications for permission to install temporary banners or civic displays. Applicants *may* be municipalities, or private entities who must receive endorsement from the respective municipality. Approval **shall** be by means of the standard form. Denial *should* be by letter, giving reasons for rejection.

DEFINITIONS

Banners are defined as flexible, horizontal signs that are either overhead or ground mounted displays that *may* promote public activities such as parades, celebrations, speeches, concerts, plays, musicals, contests, athletic events and charitable events. Banners are considered short-term and are removed once the event has completed.

Civic Displays are considered a permanent decorative feature installed by the community to promote civic pride and are not associated with a special event. Examples of civic displays include:

- Decorations on light poles, including wrapping
- Community achievements
- Holiday decorations
- Civic mottos or emblems
- Seasonal messages
- Extra enforcement locations, such as EZ Wrap

Freeways are defined as divided highways with fully controlled access at interchanges only. Interstate Highways are freeways with the interstate route designation.

Expressways are defined as divided highways with partially controlled access by a combination of interchanges, at-grade intersections, and driveways.

Conventional Highways are defined as streets or roads other than freeways or expressways. They *may* be divided or undivided, two-lane or multi-lane, and access is available at intersections and driveways.

POLICY

1. Banners and civic displays **shall not** display commercial advertising or advertise specific commercial products, services or businesses. The inclusion of a brand name within the name of an event, such as "Brand X Bike Race" is permissible.
2. Lettering on banners **shall** be a minimum of 4” in height and overhead banners **shall** have a minimum clearance of 17 feet (bottom of banner to top of roadway).
3. All banners **shall** be made out of a flexible material, and have no horizontal stiffeners, except banners supported on overpasses. Civic displays *may* be made out of a rigid material.
4. Banners and civic displays **shall not** be permitted on freeways or expressways.
5. Banners and civic displays **shall** be removed or replaced when legibility is impaired due to wear or fading.
6. Any new posts installed for banners or civic displays **shall** be NCHRP 350 crash compliant.

7. Maximum length of time for banners promoting community events is 30 days and 90 days for community promotion. Civic displays *may* be installed indefinitely, provided they remain in good shape.
8. Banners and civic displays **shall not** be installed on existing traffic control devices or supports.
9. The applicant **shall** accept full responsibility for any damage claims from any permitted banner or civic display.
10. Banners located in the highway right-of-way *should* be located as close to the right-of-way line as possible.

TEMPORARY BANNER / CIVIC DISPLAY INSTALLATION APPLICATION / PERMIT
Wisconsin Department of Transportation
DT1876 1/2014 (Replaces ET717) s.86.19(2) Wis. Stats.

Submit application in duplicate to the Division of Transportation System Development Regional Office, Wisconsin Department of Transportation (WisDOT). A single application may be made for each associated pair of temporary banners or group of civic displays.

Applicant – *If applicant is not a municipality, indicate endorsement below by responsible municipal official.*		
Contact Person Name		(Area Code) Telephone Number
Mailing Address, City, State and ZIP Code		Email Address
Wording on Banner		
Location(s) Highway Number	At	
	And At	
Date To Be Erected	Date To Be Removed	

The undersigned applicant requests permission to install temporary banner(s) and/or civic displays at the above location(s). It is understood and agreed that the applicant shall comply with the general and specific conditions stated below and/or attached. The undersigned certifies that he/she is authorized to sign this application on behalf of the named applicant.

X	X
(Applicant or Authorized Representative Signature) (Date – m/d/yyyy)	(Municipal Endorsement Signature)
Representative Title	Municipal Title

CONDITIONS

1. A banner is defined as a flexible, horizontal sign extending with its rope or cable supports across an entire roadway.
2. The lettering on banners shall be at least 4 inches in height and the minimum clearance to ground on overhead banners shall be 17 feet.
3. The banner shall not be made of rigid material, and shall have no horizontal stiffeners, except that it may be supported on an overpass. Civic displays may be made of ridged material.
4. Banners and civic displays shall not be permitted over Interstate highways, freeways or expressways.
5. Banners and civic displays shall be removed or replaced when legibility is impaired due to wear or fading.
6. Permitted maximum length of time for banner displays is 30 days for events, and 90 days for community promotion.
7. No banner or civic displays shall be installed using state-owned supports.
8. If new supports are installed to support an overhead banner or any civic display, the applicant shall review the proposed installation with the Regional Traffic Engineer.
9. The applicant shall accept full responsibility for any damage claims resulting from any permitted banner or civic displays.
10. Owners of banners or civic displays which do not conform to the stated conditions are subject to penalty as provided in s.86.19(3) Wis. Stats.
11. Notwithstanding the preceding, no banner or civic display shall display commercial advertising or advertise specific commercial products, services or businesses. The inclusion of a brand name within the name of an event, such as "Brand X Bike Race" is permissible on banners.
12. The applicant shall provide certification, by a Professional Engineer, that any banners or civic displays installed on lighting supports shall meet wind loading requirements.
13. Other conditions: ☐ No ☐ Yes ☐ On Reverse ☐ Attached

PERMIT Approved for the Wisconsin Department of Transportation

Permit Number	X
	(WisDOT Representative Signature) (Date – m/d/yyyy)
	Print Name and Title

13-13-1 Authority and Policy — January 1993

POLICY

Regional Transportation Directors *may* approve or disapprove crossings for snowmobiles over or under freeways which are on the State Trunk Highway system. The crossings *may* be via State Trunk Highways, other public highways, and non-highway crossings.

CROSS-REFERENCE

Operation of snowmobiles on or in the vicinity of highways, s. 350.02, Wis. Stats., (1) freeways, and (2) highways.

REQUEST AND APPLICATIONS

Requests for approval for snowmobiles to cross freeways *should* be made in writing, and approvals or disapprovals will be transmitted in writing. Requests will be accepted only from governmental authorities who are responsible for the designation and maintenance of snowmobile trails within their jurisdiction. A copy of each request, together with the approval or denial **shall** be sent to the State Traffic Engineer for Highways and to the State Maintenance Engineer for Highways.

GENERAL PROVISIONS

An official snowmobile trail or an approved snowmobile route (defined in s. 350.01, Wis. Stats.) must be designated on both sides of the freeway at the point of the proposed crossing.

The Regional Transportation Director **shall** be satisfied that snowmobiles *may* cross the freeway ramps with reasonable safety if using the proposed crossing, assuming that the snowmobile operator uses ordinary safety precautions and obeys the law relating to snowmobile operation.

AT CROSSROADS WITH INTERCHANGES

Snowmobiles *may* cross freeways at crossroads with interchanges, whether the crossroad is over or under the freeway provided that the ramp crossings are visible to the motorist did not obscured by snow piles, curvature or other features, and provided that, if the crossroad is under the freeway' the crossing can be made without violating ss. 350.02(2)(b)1, 2 and 4, Wis. Stats. (In some cases, the design of the bridge *may* prevent this).

OTHER CROSSINGS

Snowmobiles *may* cross freeways at bridges other than at crossroads providing that it *may* be done without violating the access control and there is adequate horizontal and vertical clearance.

CONDITIONS OF APPROVAL TO BE ACCEPTED BY MUNICIPALITY

1. The county or municipality **shall** sign the trail with approved snowmobile signs in compliance with the standards of the DNR.
2. The Regional Transportation Director *may* impose such additional reasonable requirements as a prerequisite to approval as are necessitated by the particular circumstances of the request.

13-13-2 Model Ordinance — April 1996

POLICY

Wisconsin Act 61 of 1995 provided for the operation of snowmobiles on roadways of streets and highways in municipalities for trips from residences or lodges to the nearest trail out of town. This includes permission to travel on state and county highways. The law requires that the municipality pass an ordinance to this effect. The ordinance *may* specify all roadways, all roadways with certain omissions, or specific roadways and segments.

The ordinance and guidelines were prepared by the DNR and the Snowmobile Council. They were reviewed by the State Traffic Engineer. The municipalities who are interested in this are likely to obtain these documents from the other agencies, but a copy is included herein for the Regions' information and for making copies if asked.

SNOWMOBILE ACCESS
MODEL ORDINANCE

AN ORDINANCE TO ALLOW SNOWMOBILE ACCESS FROM A RESIDENCE OR RESIDENCE AND LODGING ESTABLISHMENT TO A SNOWMOBILE ROUTE OR TRAIL, IN THE (TOWN/CITY/VILLAGE) OF ________________________________, _______________________ COUNTY, WISCONSIN AND PRESCRIBING PENALTIES FOR VIOLATION THEREOF.

The (Town/City/Village) Board of the (Town/City/Village) of ______________________, ______________________ County, Wisconsin do ordain as follows:

Section I. Intent

1a. The intent of this ordinance is to provide a means for persons to travel from a residence within the limits of (Town/City/Village) _____________________________, ___________________ County, Wisconsin for the shorten distance that is necessary for a person to operate a snowmobile to the snowmobile route or trail that is closed to that residence.

OR

1b. The intent of this ordinance is to provide a means for persons to travel from a residence and lodging establishment within die limits of (Town/City/Village) ___________________________, ______________________ County, Wisconsin for the shortest distance that is necessary for a person to operate a snowmobile to the snowmobile route or trail that is closest to that residence and lodging establishment

Section II. Statutory Authority

This ordinance is adopted as authorized under s.350. 18 (3) (a).

Section III. Designated Roadways and/or Highways

No person **shall** operate a snowmobile on a roadway or shoulder of a highway not designated as a snowmobile route other than the following:
(a) all roadways or shoulders or,
(b) the following listed roadways or shoulders

____
____
____

Section IV. Conditions

This ordinance designates the roadways and/or shoulders of specific highways for snowmobile travel by persons residing in or staying at a lodging establishment within the limits of (Town/City/Village) _________________________________, _______________________ County, Wisconsin to travel for the shortest distance that is necessary to reach the snowmobile trail or route that is closest to that residence or lodging establishment subject to the following conditions:

Section V. Speed

A snowmobile operated on a portion of the roadway or shoulder of a highway pursuant to this ordinance **shall** observe roadway speed limits.

Section VI. Enforcement

This ordinance **shall** be enforced by any law enforcement officer of the (Town/City/Village) of ________________________________, _________________________ County, Wisconsin.

Section VII. Penalties

Wisconsin state snowmobile penalties as found in s. 350.11(1)(a), Wis. Stats., are adopted by reference.

Section VIII. Severability

The provisions of this ordinance **shall** be deemed severable and it is expressly declared that the (Town/City/Village) Board would have Wised the other provisions of this ordinance irrespective of whether or not one or more provisions *may* be declared invalid. If any provision of this ordinance or the application to any person or circumstances is held invalid, the remainder of the ordinance and the application of such provisions to other persons or circumstances **shall** not be affected.

Section VIII. Effective Date

This ordinance will become effective upon passage and publication.

Passed this ___________ day of ___________________, ________ (year).

(Town/City/Village) Chairman

____

GUIDELINES FOR WRITING LOCAL SNOWMOBILE ACCESS ORDINANCES

This guideline and attached model ordinance is provided to assist you in developing your local ordinance. You *may* be more restrictive, you do not have to include lodging establishments and additional snowmobile regulations such as snowmobile routes can be included. Please feel free to utilize all or portions of this model.

State law allows Towns, Cities and Villages to enact local regulations allowing snowmobilers to travel between a residence or a lodging to travel along roadways and/or shoulders of highways to die closest snowmobile route or trail. The authority to enact local snowmobile residential access regulations is found in Chapter 350. 1 1(1)(a) of the Wisconsin Statutes.

Section I. Intent

State the specific name of the (Town/City/Village) covered by the ordinance. The law gives you the option to allow residential access and lodging access (only if residential access is also allowed) within your jurisdiction to operate their snowmobiles on a roadway or shoulder of a highway. Specify which activities you are allowing.

Section II. Statutory Authority

Your authorizing statute is s.350.18 (3)(a).

Section III. Designating Roadways and/or Highways

You have authority to open all the roadways and shoulders of highways within your jurisdiction for residential/lodging establishment access. This includes state and county trunk highways within your jurisdiction. Even though this authority exists, you also have the right to omit these major roadways from your ordinance. You are encouraged to open up only those roadways that will suit the needs of the snowmobilers in your community. Once determined, list the specific roadways to be open to snowmobilers.

The authorizing law gives you two options on where snowmobiles *may* be operated. One is the roadway which is the traveled portion of a highway or on the shoulder. Specify in this section where you are authorizing snowmobile operation.

Section IV. Conditions

Except for speed limits, the authorizing law does not grant additional authority to regulate snowmobile operation. (Municipal snowmobile ordinances are subject to the limitations of s.350.18, Wis. Stats.) However, you have the right to establish conditions on the right to use the roadways. The following is a list of conditions for your consideration:

1. Snowmobiles **shall** be operated on the extreme right side of the roadway and travel with the flow of traffic.
2. Snowmobiles are to be operated in single file.
3. Headlights *should* be on at all times.
4. Snowmobile operators **shall** yield the right-of-way to other vehicular traffic and pedestrians.

Snowmobiles violating any of the above conditions would be subject to the underlying violation of operating on the roadway.

Section V. Speed

Section 350. 18 Wis. Stats., allows municipalities to adopt certain ordinances in strict conformity with state law. This language mirrors that found in founding s. 350.02(2)(a) 6, Wis. Stats.

Section VI. Enforcement

The law enforcement officer/s within your jurisdiction *should* be listed as the enforcement authority. State Conservation Wardens do not have authority to enforce local ordinances,

Section VII. Penalties

The appropriate penalty section to be adopted would be s.350.1 1(1)(a), Wis. Stats.

Consideration *should* be given to include in your ordinance a seasonal effective date to eliminate problems that might occur because of early/late snowfalls. This would also eliminate any prospects of snowmobile use during non-winter seasons.

Snowmobile activity is constantly growing and local regulation can be responsive to the public need. Through regulation, a safe, enjoyable snowmobiling environment can be provided while at the same time controlling undesirable conflict. Understanding is needed by everyone involved in the process.

Once, your ordinance is adopted, you are required to submit a copy to the Department of Natural Resources, Attn. Snowmobile Section, P.O. Box 7921, Madison, Wisconsin 53707 and to the office of the law enforcement agency of the municipality and county having jurisdiction over such street or highway.

13-25-1 No Turn on Red — May 1990

Guidelines for prohibiting turning movements on red indication at specific intersections are as follows:

A. Turning on red *should* be prohibited where:

1. Sight distance of vehicles approaching is less than the following minimums:

Cross Street Speed Limit (MPH)	Minimum Sight Distance (Feet)
20	120
25	150
30	190
35	220
40	270
45	320
50	360

2. The intersection has more than four approaches or has unusual geometrics which cause unexpected conflicts. The restriction *should* apply to only those approaches affected.

3. The intersection is within 200 feet of a railroad grade crossing, and the sequence is pre-empted during train crossings. The restriction *should* apply to the right turn toward the crossing.

B. Turning on red *may* be prohibited where:

1. Large volumes of pedestrians exist such as on downtown streets.
2. There has been more than one accident directly resulting from turning on red signal per year.
3. There are two lanes turning right, or two opposing lanes turning left.

C. Turns on red *may* be prohibited at school crossings, but allowed at other times. Refer to 2B-37 of MUTCD.

D. All restrictions must be authorized by an approved declaration before posting.

13-26-1 Passing on Right at Intersection — February 2017

BACKGROUND

Passing on the right at intersections can present enforcement problems if the marking and signing are not clear as to whether a motorist can pass on the right where there is a standing left turner at an intersection. The intersection *may* have a paved shoulder, a paved right turn lane or a gravel shoulder.

The State Statutes "Rules of Road" indicate the following:

ss 346.08 When overtaking and passing on the right permitted. The operator of a vehicle *may* overtake and pass another vehicle upon the right only under conditions permitting such the movement in safety and only if the operator can do so while remaining on either the roadway or a paved shoulder, and then only under the following conditions:

1. When the vehicle overtaken is making or about to make a left turn or U-turn; or
2. Upon a street or highway with unobstructed pavement of sufficient width to enable 2 or more lines of vehicles lawfully to proceed, at the same time, in the direction in which the passing vehicle is proceeding; or
3. Upon a one-way street or divided highway with unobstructed pavement of sufficient width to enable 2 or more lines of vehicles lawfully to proceed in the same direction at the same time.

This language can be misunderstood. Therefore, it is important to provide the proper signing and pavement marking for intersection lane control. Refer to TEOpS 2-2-20 for additional lane control signage.

POLICY

1. Provide pavement marking in accordance with Figure 1 if the intersection is to operate with a bypass option lane where the right lane functions as a right turn lane or bypass lane. If the intersection is to operate with a bypass option lane where the right lane functions as a bypass lane, provide pavement marking in accordance with Standard Detail Drawing 15C8-10b (Intersections).
2. Provide signing and pavement marking in accordance with Figure 2 if the intersection is to operate with an exclusive right turn lane.
3. Provide signing as optional in accordance with Figure 3 or Figure 4 if you desire to restrict drivers from making the maneuver to bypass a standing left turner. Typically this sign is used only if you have a history of crash issues. The sign is intended for use at intersections.

Note: Figure 1 is used except in unusual cases, Figure 2 is used for higher crash locations. Evaluate the number of right turns versus left turns to determine the proper marking and signing for right turn only lane versus allowing the right hand lane as a bypass lane.

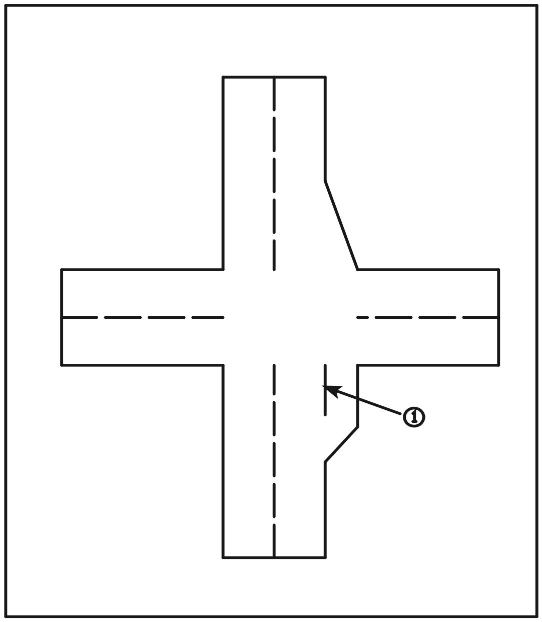


FIG. 1 PAVED BYPASS/RIGHT TURN LANE

1 8" CHANNELIZING PAVEMENT MARKING

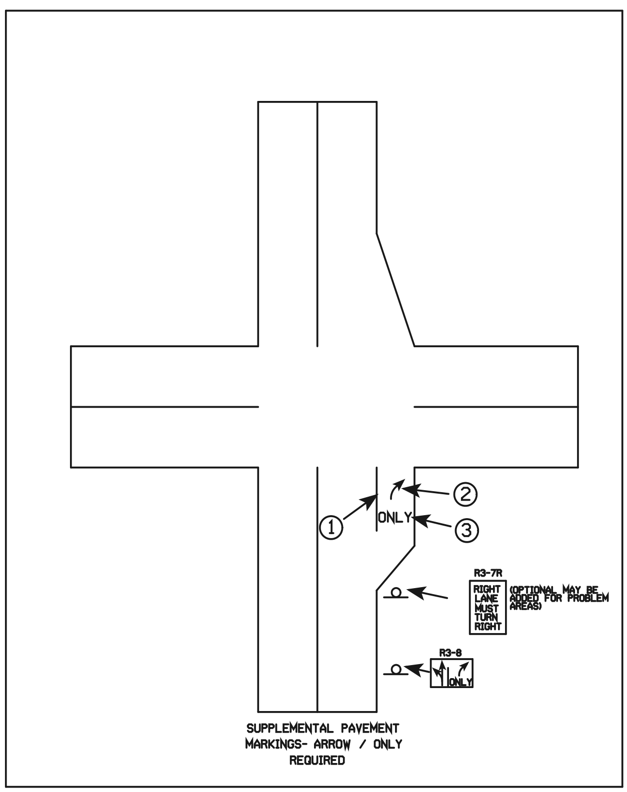


FIG. 2 EXCLUSIVE PAVED RIGHT TURN LANE

1 8" CHANNELIZING PAVEMENT MARKING

2 TYPE 2 ARROW PAVEMENT MARKING

3 WORD PAVEMENT MARKING

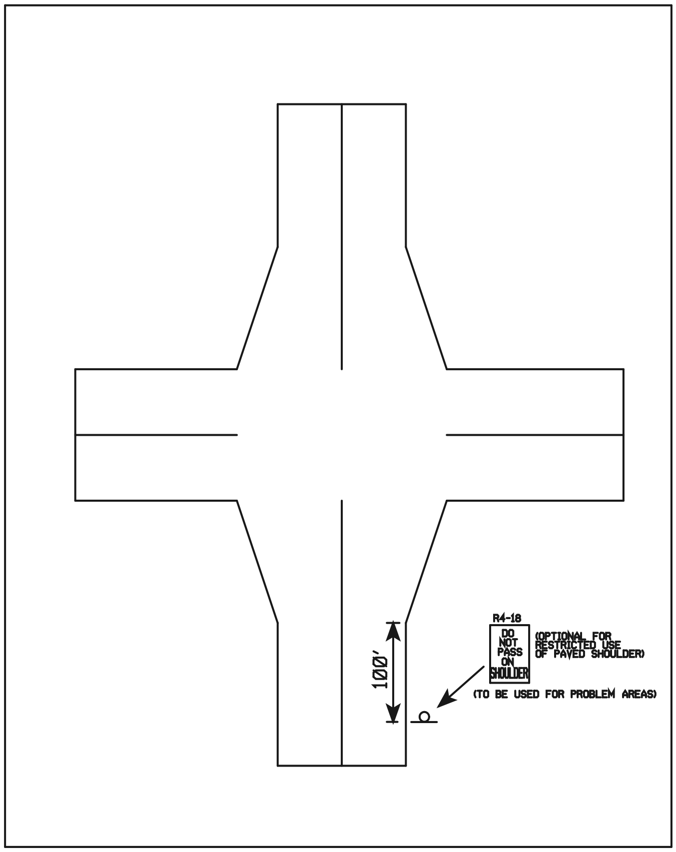


FIG. 3 PAVED RIGHT TURN LANE

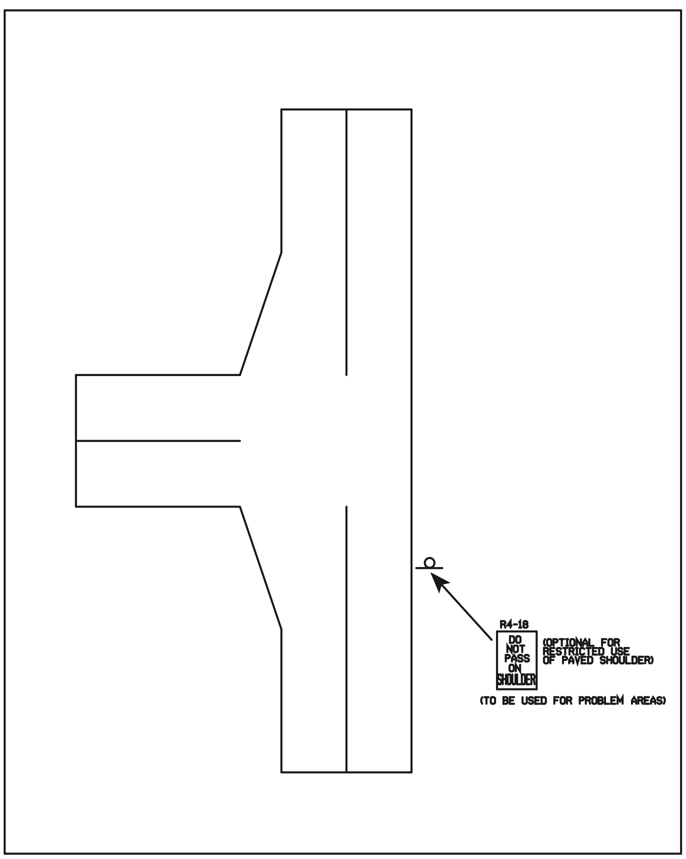


FIG. 4 T-INTERSECTION

13-26-5 All-Way Stop May 2009

PURPOSE

This policy describes WisDOT's philosophy regarding the use of all-way stop control (AWSC) as a permanent method of traffic control at State Trunk Highway (STH) intersections that are under WisDOT jurisdiction or State Trunk Highway intersections under local jurisdiction as a Connecting STH. (WisDOT maintains statutory approval authority for any stop controls implemented on Connecting STHs).

GUIDANCE

Refer to MUTCD 2B.07, Multiway Stop Applications, for further detail.

WisDOT has maintained a philosophy that emphasizes minimal use All Way Stop Control (AWSC) as a permanent traffic control method. This philosophy is based on the concept of maintaining mobility by allowing traffic to "free-flow" as much as possible. Also, all STHs in Wisconsin are statutorily designated as "through" highways, and typically *should not* be stopped without strong justification. AWSC *should* be considered only after other less restrictive options have been evaluated and determined not to be feasible.

EVALUATION CRITERIA

MUTCD 2B.07 describes several criteria that *should* be considered in an engineering study for a multi-way stop sign installation. These guidance criteria include the need for interim traffic control, crash history, and traffic volume. MUTCD 2B.07 also describes additional criteria that *may* be considered in an engineering study. These optional criteria include the need to control left turn conflicts, pedestrian conflicts, sight restriction, and the intersection of two residential neighborhood collector streets.

An AWSC Warrant Criteria worksheet *may* be found at the following link:
http://wisconsindot.gov/dtsdManuals/traffic-ops/manuals-and-standards/teops/awsc-warrant.xlsx

All the criteria in MUTCD 2B.07, both guidance and optional, **shall** be considered when evaluating whether AWSC is an appropriate method control for intersections on the STH system. In addition, the following supplemental criteria **shall** also be considered:

1. Functional Highway Classification - There are five levels of functional highway classes used by WisDOT: principal arterial, minor arterial, major collector, minor collector, and local roads. For desirable AWSC, the intersecting roadways *should* have the same or similar functional class on at least three approaches. Similar functional class would be only one level of difference between intersecting highways. For example, a minor arterial and major collector would be considered similar functional class, but a principal arterial and major collector would not be considered similar.
2. Average Daily Traffic (ADT) - For AWSC, it is highly desirable for the intersecting roadways to have closely balanced ADTs on at least 3 approaches. Closely balanced ADTs would be considered as the volume of at least one of the minor roadway approaches (stop controlled on a 2-way stop) being not less than 70% of the higher volume of the two approaches on the major roadway (through STH).
3. Crash History - AWSC *should* be considered if it is expected to correct a significant number of intersection crashes that have occurred in the last 5 years (that are susceptible to correction by a multi-way stop installation), and/or expected to significantly reduce the overall severity of future crashes from what previously occurred. AWSC, while typically reducing severe right angle crashes, *may* increase less severe rear-end crashes.
4. Alternatives - Improvement alternatives that are less restrictive than AWSC **shall** be considered and evaluated. See section D below.
5. Mobility Impact - Evaluate the ramifications of stopping the existing "through" STH, including the average vehicle delay and queue length. Perform an AWSC capacity analysis and compare it to the existing two-way stop control capacity analysis. Will the high-volume of existing "through" STH traffic experience significant delays for the benefit of reducing delays for a low-volume side street?
6. Right turn inclusion - Similar to signal warrant evaluation, the inclusion of right turns from the minor approach(es) in the AWSC warrant analysis *should* be evaluated. See the WisDOT Traffic Signal Design Manual (TSDM) 2-3-2.

ALTERNATIVES TO AWSC

Similar to MUTCD Section 4B.04, Alternatives to Traffic Control Signals, consideration **shall** be given to providing less restrictive alternatives to AWSC even if one or more of the warranting factors in the MUTCD is satisfied.

These alternatives *may* include, but are not limited to, the following:

1. Adding a dedicated right turn lane (with optional “pork-chop” channelizing island) on the stop-controlled minor roadway approach(es) to separate the minor roadway right turns from minor roadway left turn / through movements and reduce the delay for a high-volume right turn.
2. Remove or relocate vision corner obstructions such as utilities, vegetation, parking, or other sight restrictions that are impeding the side street traffic from finding reasonable gaps in the “through” highway. Utilize local government setback ordinances as enforcement when these impediments are located outside the highway right-of-way.
3. Restrict, relocate, or consolidate driveway access that *may* be interfering with intersection operation.
4. Installing a roundabout intersection.
5. Relocating the stop line on the minor approach to improve the sight distance.
6. Installing warning signs and / or supplemental flashing beacons advance of the intersection. (See TEOpS 4-5-1 Beacons Policy).
7. Improve pedestrian crossing ability by providing a mid-crossing refuge island or decreasing the crossing distance by using curb bumpouts.
8. Improve sight distance for the minor roadway to see vehicles approaching on the through roadway by modifying a vertical crest in the through profile or modification of the horizontal curve.
9. Restricting turning movements if alternate access points are nearby.

16-1-1 Overview April 2025

1.1 Originator

The Traffic Analysis and Safety Unit (TASU) within the Bureau of Traffic Operations (BTO) is the originator of this chapter. Submit all questions and comments concerning this chapter to the DOT Traffic Analysis & Modeling (DOTTrafficAnalysisModeling@dot.wi.gov) mailbox.

1.2 General

This chapter addresses the methodologies and tools for conducting traffic operations analyses for the evaluation and design of WisDOT facilities. Traffic operations analyses provide an assessment of how traffic demands for all modes of travel and the capacity of the facility affect the overall performance of the transportation system. The results of traffic operations analyses assist WisDOT in determining the best way to meet the department's goal of providing a safe, reliable, and efficient multimodal transportation system.

There are multiple tools and methodologies for completing traffic operations analysis, each having their own set of capabilities and limitations. Selecting the appropriate analysis procedure and tool is not always intuitive and can prove challenging. The primary goal of this chapter is to address this challenge by providing guidance on the uniform and consistent application of the various traffic operations analysis tools, methodologies, and procedures. The policy within this chapter does not cover the travel demand models (TDMs) used to generate traffic forecasts. Refer to the Transportation Planning Manual (TPM) for additional details regarding traffic forecasting protocols.

1.3 Content

Attachment 1.1 outlines the process for the development and review of traffic models. For cost-effective traffic analyses, project managers *should* refer to Attachment 1.1 as they develop the project schedules, budgets, and management plans.

This chapter defines WisDOT's policy pertaining to traffic analysis tools and methodologies. Use the policy within this chapter in conjunction with WisDOT's Facilities Development Manual (FDM).In the event the two documents provide conflicting information, contact BTO-TASU (DOTTrafficAnalysisModeling@dot.wi.gov) to confirm the controlling methodology.

1.4 Acronyms/Terminology

The key terms and acronyms used within this chapter include:

AADT – Annual Average Daily Traffic

BPED – Bureau of Planning and Economic Development

BSHP – Bureau of State Highway Programs

BTO – Bureau of Traffic Operations

CDR – Concept Definition Report

Department – Wisconsin Department of Transportation

DOT – Department of Transportation

DHV – Design Hour Volume

DTA – Dynamic Traffic Assignment

DTIM – Division of Transportation Investment Management

DTSD – Division of Transportation System Development

FDM – Facilities Development Manual

FHWA – Federal Highway Administration

GoF – Goodness of Fit

HCM – Highway Capacity Manual

HCM7 – Highway Capacity Manual, 7th Edition: A Guide for Multimodal Mobility Analysis

LOS – Level of Service

Macroscopic simulation – Macroscopic traffic simulation models (a.k.a. travel demand models)

Mesoscopic simulation – Mesoscopic traffic simulation models (a.k.a. DTA)

Microsimulation – Microscopic traffic simulation models

MOEs – Measures of Effectiveness

O-D Matrix – Origin-Destination Matrix

PDAS – Program Development and Analysis Section (part of BSHP)

PMP – Project Management Plan

RFP – Request for Proposal

RTOR – Right-Turn on Red

TASU – Traffic Analysis and Safety Unit (part of BTO)

TAT III –Traffic Analysis Tool Box Volume III, published by FHWA

TAT IV - Traffic Analysis Tool Box Volume IV, published by FHWA

TDM – Travel demand models used to generate traffic forecasts

TEOpS – Traffic Engineering, Operations and Safety Manual

TFS – Traffic Forecasting Section (part of BPED)

TOPS Lab – University of Wisconsin, Madison Traffic Operations and Safety Laboratory

TSDM – Traffic Signal Design Manual

V-SPOC – WisTransPortal Volume, Speed, and Occupancy Application Suite

WisDOT – Wisconsin Department of Transportation

1.5 Terminology

The key terms used within this chapter include:

DTA – Dynamic Traffic Assignment. DTA is a modeling approach that captures the relationship between dynamic route choice behaviors (path and start time) and transportation network characteristics (travel speeds, signal timings, level of congestion, etc.) It is possible to incorporate DTA into any level of simulation models (macroscopic, mesoscopic, microscopic); however, the most common application of DTA is for mesoscopic simulation models. Therefore; this policy assumes all DTA models are mesoscopic models.

Macroscopic simulation – Tools using this methodology assess the operation/capacity of a facility or network utilizing the deterministic relationships of the flow, speed, and density of the traffic stream. The simulation analyzes the movement of vehicles on a section-by-section basis. Travel demand models (TDMs) are an example of a macroscopic model. This policy does not cover the use of macroscopic simulation models.

Mesoscopic simulation – Tools using this methodology analyze the movement of individual vehicles or vehicle cells as they travel through a simulated network using predefined capacity and speed-density relationships. Mesoscopic models incorporate a level of network and operational detail comparable to microsimulation models with the route choice flexibility of macroscopic simulation models (TDMs). Most mesoscopic simulation models incorporate DTA, thus, this policy utilizes the term DTA model throughout to represent mesoscopic simulation models.

Microsimulation – Microscopic traffic simulation. Tools using this methodology analyze the movement of individual vehicles as they travel through a simulated network. As the simulation progresses, it updates factors such as the vehicle's position and its need to increase/decrease speed or change lanes several times a second.

Traffic Models – the computer models used to carry out traffic operations analysis. These include both the HCM-based traffic analyses and microsimulation analyses. This does not include TDMs.

LIST OF ATTACHMENTS

Attachment 1.1 Traffic Model Development & Review Process

16-1-2 Basic Principles September 2019

2.1 Establish Project Purpose, Needs, and Goals

The traffic analysis requirements for a project are highly dependent on the project goals. If the project goal is to provide a preliminary or planning level assessment of the traffic operations, then a higher-level analysis may suffice. If the goal of the project is to define project-specific design requirements, then a detailed analysis is often necessary.

Every project is unique, with its own set of assumptions and applicable methodologies. A clear understanding of the purpose, needs, and goals of the project is critical in determining the necessary level of traffic analysis. When developing the project schedule and budget, consider the traffic analysis and modeling needs, including the associated peer review requirements. Ideally, the traffic analysis and modeling needs *should* dictate the schedule as opposed to having the project schedule dictate the level of traffic analysis. This ensures the appropriate level of traffic analysis is conducted at the most appropriate stage of the project life cycle, reducing the need for any rework. Defining the project schedule without consideration of the traffic analysis needs may compromise the integrity of the traffic models, which in turn may affect the selection of the project alternative.

2.2 Defining the Traffic Analysis Scope/Level of Effort

To provide clear guidance for the project and to ensure that the project goals and objectives are satisfied, the project team *should* address the following questions during the initial project kick-off meeting:

- What agencies/divisions/bureaus need to be involved in the project as it pertains to the traffic analysis (i.e., who are the intended stakeholders)? What will be their intended level of involvement (project resource, project review, traffic analysis, etc.)?
- In general, what is the purpose of the project, specifically as it pertains to the traffic analysis (i.e., what questions does the traffic analysis need to answer)?
- What type of process will the project address (planning, design, construction, etc.)?
- What type of study area will the project consider (corridor, intersection/interchange, highway segment, etc.)?
- What transportation components will the project address (travel modes, traffic control, facility type, etc.)?
- What types of outputs are important for the decision-making process? What are the intended deliverables? Is the purpose of the evaluation detailed technical assessment, visual animation, or both?
- What transportation alternatives does the project need to consider? What evaluation criteria will the project apply?
- Are there any known/key issues about the study area? If so, how will the project address them?
- What are the schedule and budget constraints (including agency review needs) associated with this effort?
- What is the critical path for the project? Does the traffic analysis fall within the critical path? When will changes in the project scope/purpose significantly affect the project schedule?

The facilitator of the kick-off meeting *should* use DT2290 to guide the discussion of the key aspects of the project, specifically as they pertain to the traffic analysis needs. Circulate the completed DT2290 form to the internal stakeholders immediately after the completion of the kick-off meeting and update the form as necessary as the project progresses. Although the DT2290 form *should* remain a fluid document, be cautious of unnecessary changes to the scope of the project or traffic model (i.e., watch out for scope creep).

2.3 Identify Need for Consultant Team

After defining the project goals, objectives, and traffic analysis needs, the internal WisDOT project team *should* coordinate closely with the regional traffic operations staff to assess whether the regional office has the knowledge, time, and resources available to conduct the anticipated level of traffic analysis required for the project. Oftentimes, the regional traffic operations staff can perform the simpler traffic analyses (such as the deterministic-HCM analyses) in-house while the more complex and demanding traffic analyses (such as the microscopic traffic simulation analyses) typically require outsourcing the work to one or more consultant firms.

If in need of consultant services, the internal WisDOT project team *should* follow the process in FDM 8-5 to select and procure the consultant team(s) to perform the necessary traffic analyses for the project. Historically, BTO has maintained master contracts for general traffic engineering services (BTO01) and traffic modeling and analysis services (BTO03). Coordinate with BTO regarding the potential use of either of these master contracts.

After procuring the consultant team(s), the internal WisDOT stakeholders *should* meet with the selected consultant firm(s) to define/clarify their roles, tasks, and tentative schedule. WisDOT *should* procure the consultant team(s) and host the traffic analysis kick-off meeting early on during the project process to allow the consultant(s) to provide input on the traffic analysis methodologies, including the identification of the appropriate traffic analysis tool(s). Refer to TEOpS 16-10 for details on defining the most appropriate traffic analysis tool(s).

2.4 Initiate Traffic Analyses

Follow the process illustrated in Attachment 1.1 to conduct the necessary traffic analyses. Refer to TEOpS 16-10 for details on defining the most appropriate traffic analysis tool(s) and analysis methodologies, TEOpS 16-20 for guidance on conducting microsimulation analyses, and TEOpS 16-25 for details on conducting peer reviews.

Coordinate with WisDOT regional traffic staff as necessary to address any questions/concerns regarding the traffic analyses tool(s), methodologies, or results. If desired, the WisDOT regional traffic engineer may request additional support or guidance from BTO-TASU.

Attachment 1.1 Traffic Model Development & Review Process

Last Updated: January 2018

List of Abbreviations

FHWA = Federal Highway Administration
BTO = Bureau of Traffic Operations – Traffic Analysis & Safety Unit
BSHP = Bureau of State Highway Programs (Program Development & Analysis
Forecasting = WisDOT Traffic Forecasting Section
DTSD PT = DTSD Project Team
RTO = Region Traffic Operations
RTM = Region Traffic Modeler
PRT = Peer Review Team
CT = Consultant Team
Indep. Consult. = Independent Consultant
CDR = Concept Definition Report
PMP = Project Management Plan
Sim. = Microscopic Simulation

NOTE

The timeline for each task will vary from one project to another depending on the project scope, project limits, & number of alternatives being analyzed. The Project Manager should establish project specific timelines for each task during the project definition/scoping stage.

LEGEND

- DTSD Project Team &/or DTSD Region Leads Task
- Bureau of Traffic Operations (BTO) – Leads Task
- WisDOT Traffic Forecasting Leads Task

1. DEFINE PROJECT

SECTION	ROLE
DTSD PT	Lead Role
DTSD Region	Coordinate with DTSD PT as Needed
FHWA (if applicable)	Review CDR &/or PMP

TASK(S)/GOAL(S)
i. Establish Project Need, Goals & Scope
ii. Identify Project Type & Need for FHWA Involvement
  a) Standard/Routine
  b) High Profile
  c) Mega
iii. Prepare CDR &/or PMP

DELIVERABLE: Project Scope, Project Goals, CDR &/or PMP
TIME LINE: Up to 2 Weeks

Is it a Mega or High Profile Project and/or will it involve FHWA?
Yes → TRACKS A&B: Statewide Level Review (Requires Early Involvement of Statewide Bureaus)
No → TRACK C: Region Level Review (Obtain Input from Statewide Bureaus as Needed)

TRACKS A&B

2A-B. SELECT/PROCURE CONSULTANT TEAM (CT)

SECTION	ROLE
DTSD PT	Lead Role
DTSD Region	Coordinate with DTSD PT as Needed
BTO	Assist DTSD PT as Needed

TASK(S)/GOAL(S)
i. Identify Need for CT to Assist in Analysis of Project
ii. Define Roles/Tasks/Tentative Schedule for CT as applicable
  a) Operational Analysis
  b) Simulation Model Development &/or Review
  c) Other Analysis, Travel Demand Model/Forecast Work, etc.
iii. Select/Procure CT as applicable

DELIVERABLE: Consultant Work Order - Contract
TIME LINE: Up to 6 Weeks

3A-B. DEVELOP DATA COLLECTION PLAN

SECTION	ROLE
DTSD PT	Lead Role
CT From Task 2A (if applicable)	Develop Data Collection Plan/Collect Data
DTSD Region/BTO	Coordinate/Assist DTSD PT as Needed

TASK(S)/GOAL(S)
i. Establish Data Sources & Needs & Define Data Collection Plan
ii. Initiate Data Collection (Data Collection To be Completed By Task 9A/9B)

DELIVERABLE: Data Collection Plan
TIME LINE: Up to 4 Weeks

4A-B. SELECT TRAFFIC ANALYSIS TOOL(S)

SECTION	ROLE
DTSD PT	Lead Role – Coordinate w/RTO & BTO
RTO	Provide Input to DTSD PT
BTO	Provide Input on Analysis Tool(s)
CT From Task 2A (if applicable)	Assist DTSD PT

TASK(S)/GOAL(S)
i. Assess Applicability of Various Analysis Tools
ii. Select Analysis Tool(s) Most Appropriate for Project
iii. DTSD PT/RTO to Prepare Memo on Analysis Tool Selection (To Be Submitted to BTO for Concurrence)

DELIVERABLE: Summary of Analysis Tool Selection Process
TIME LINE: Up to 2 Weeks

Is a Microscopic Simulation Model Proposed for Use?
Yes → TRACK A
No → TRACK B

TRACK A

5A. OUTLINE PROJECT PROCESS

SECTION	ROLE
DTSD PT/Region	Lead Role - w/Input from Statewide Bureaus
CT From Task 2A	Assist DTSD PT with Defining Timeline for Traffic Analysis Tool(s)/Model Development
BTO & RTO	Provide Input on Analysis Methodology
BSHP	Provide Input on Design Values
Forecasting	Provide Input on Forecasting Method
SEWRPC (if applicable)	Provide Input on Forecast Schedule/Method
MPOs (if applicable)	Provide Info on Local Concerns
FHWA (if applicable)	Provide Input on Federal Policy/Issues

TASK(S)/GOAL(S)
i. Discuss Timeline, Goals, Analysis Years, Design Hours, Alternatives
ii. Develop Summary/Outline of Proposed Process, Complete DT2290

DELIVERABLE: Defined Project Process & DT2290
TIME LINE: Up to 2 Weeks

6A. ESTABLISH PEER REVIEW TEAM (PRT)

SECTION	ROLE
DTSD PT/Region	Lead Role – Coordinate w/BTO
BTO	Assist With Indep. Consult. Contract, Member of PRT
RTM or Indep. Consult.	Lead PRT
Region Traffic Ops, BSHP, & Forecasting	Member of PRT
MPOs (if applicable)	Provide Input on Local Concerns

TASK(S)/GOAL(S)
i. Identify PRT Members
ii. Select/Procure Independent Consultant (If Needed)
iii. Define Roles/Schedule for Peer Review

DELIVERABLE: Peer Review Members & Process
TIME LINE: Up to 2 Weeks

7A. INITIATE TRAFFIC FORECAST REQUEST

SECTION	ROLE
DTSD PT/Region	Lead Role
Forecasting & SEWRPC (if applicable)	Provide Input on Data Needs & Schedule for Forecast Development

TASK(S)/GOAL(S)
i. Identify Types of Forecasts, Alternatives, Forecast Years, & Design Hours
ii. Request Forecast Results & Trip Tables (Complete/Submit DT1601)

DELIVERABLE: DT1601
TIME LINE: Up to 2 Weeks

8A. DEVELOP WISDOT TRAFFIC FORECAST

SECTION	ROLE
Forecasting – Central Office	Lead Role
Forecasting – SE Region	Lead Role in SE Region
SEWRPC (if applicable)	Develop Forecast - SE Region

TASK(S)/GOAL(S)
i. Develop Forecast per DT1601 or Review/Approve Forecast per DT1594
ii. Provide Trip Tables as Requested/Needed

DELIVERABLE: Completed/Approved Forecast
TIME LINE: Varies, See DT1601

9A. RUN OPERATIONAL/ALTERNATIVE ANALYSES

SECTION	ROLE
CT From Task 2A	Lead Role
DTSD PT/Region	Oversee CT's Work
RTO	Review CT's Work
BTO & Statewide Bureaus	Provide Assistance as Needed

TASK(S)/GOAL(S)
i. Run Operational Analysis Utilizing Analysis Tool Selected in Task 4A (Paramics, HCS, Synchro, etc.) for Base & Future/Alternative Scenarios
ii. Prepare Report/Memo Summarizing Analysis Results

DELIVERABLE: Summary of Operational Analyses
TIME LINE: Up to 3 Weeks per Alternative

10A. DEVELOP/CALIBRATE SIMULATION MODEL

SECTION	ROLE
CT Selected in Task 2A	Lead Role
RTM or RTO	Review CT's Work
DTSD PT/Region	Provide Project Oversight

TASK(S)/GOAL(S)
i. Run Base Case Using Sim. Model Selected in Task 4A
ii. Calibrate Base Case to Actual Volumes/Validate
iii. Revise Base Case as Needed per Task 11A
iv. Run Future/Alternative Case(s) & Revise as Needed per Task 10A

DELIVERABLE: Calibrated/Validated Simulation Model(s)
TIME LINE: Up to 6 Weeks per Alternative

Additional Runs

11A. INDEPENDENT PEER REVIEW (TEOpS 16-25)

SECTION	ROLE
RTM or Indep. Consult. From 6A	Lead Review of Simulation Model, Report to PRT
DTSD PT/Region	Oversee Peer Review Process
WisDOT PRT From 5A	Assist in Peer Review as Needed

TASK(S)/GOAL(S)
i. Conduct Independent Peer Review of Analysis Conducted in Task 9A & Task 10A for Base Scenario
ii. After Approval of Base, Review Future/Alt. Scenario Analysis & Model
iii. Complete DT2291 & DT1887 as applicable

DELIVERABLE: DT2291 & DT1887 as applicable
TIME LINE: Up to 8 Weeks per Alternative

12A. DELIVER FINAL ANALYSIS/REPORT

SECTION	ROLE
CT Selected in Task 2A	Lead Role
DTSD PT	Provide Input as Needed

TASK(S)/GOAL(S)
i. Prepare Summary of Analysis/Calibration Method, Assumptions & Results
ii. Save Final Report & Analysis in WisDOT Project File

DELIVERABLE: Final Calibration/Analysis Report
TIME LINE: Up to 3 Weeks

TRACK B

5B. OUTLINE PROJECT PROCESS

SECTION	ROLE
DTSD PT/Region	Lead Role
CT From Task 2B (if applicable) &/or RTO	Define Timeline for Traffic Analysis Tool(s)/Model Develop., Provide Input on Analysis Methodology
Statewide Bureaus	Provide Input As Needed
SEWRPC (if applicable)	Provide Input on Forecast Schedule/Method
MPOs (if applicable)	Provide Info on Local Concerns
FHWA (if applicable)	Provide Input on Federal Policy/Issues

TASK(S)/GOAL(S)
i. Discuss Timeline, Goals, Analysis Years, Design Hours, Alternatives
ii. Develop Summary/Outline of Proposed Process, Complete DT2290

DELIVERABLE: Defined Project Process & DT2290
TIME LINE: Up to 2 Weeks

6B. ESTABLISH PEER REVIEW TEAM (PRT)

SECTION	ROLE
DTSD PT/Region	Lead Role
BTO	Assist With Indep. Consult. Contract and PRT As Needed
RTM or Indep. Consult.	Lead PRT
RTO	Member of PRT
BSHP & Forecasting	Assist PRT As Needed
MPOs (if applicable)	Provide Input on Local Concerns

TASK(S)/GOAL(S)
i. Identify PRT Members
ii. Select/Procure Independent Consultant (If Needed)
iii. Define Roles/Schedule for Peer Review

DELIVERABLE: Peer Review Members & Process
TIME LINE: Up to 2 Weeks

7B. INITIATE TRAFFIC FORECAST REQUEST

SECTION	ROLE
DTSD PT/Region	Lead Role
Forecasting & SEWRPC (if applicable)	Provide Input on Data Needs & Schedule for Forecast Development

TASK(S)/GOAL(S)
i. Identify Types of Forecasts, Alternatives, Forecast Years, & Design Hours
ii. Request Forecast Results & Trip Tables (Complete/Submit DT1601)

DELIVERABLE: DT1601
TIME LINE: Up to 2 Weeks

8B. DEVELOP WISDOT TRAFFIC FORECAST

SECTION	ROLE
Forecasting – Central Office	Lead Role
Forecasting – SE Region	Lead Role in SE Region
SEWRPC (if applicable)	Develop Forecast - SE Region

TASK(S)/GOAL(S)
i. Develop Forecast per DT1601 or Review/Approve Forecast per DT1594
ii. Provide Trip Tables as Requested/Needed

DELIVERABLE: Completed/Approved Forecast
TIME LINE: Varies, See DT1601

9B. RUN OPERATIONAL/ALTERNATIVE ANALYSES

SECTION	ROLE
CT From Task 2B	Lead Role
DTSD PT/Region	Oversee CT's Work
RTO	Provide Input on Analysis Methodology
BTO & Statewide Bureaus	Provide Assistance as Needed

TASK(S)/GOAL(S)
i. Run Operational Analysis Utilizing Analysis Tool Selected in Task 4B (HCS, Synchro, Sidra, etc.) for Base & Future/Alternative Scenarios
ii. Prepare Report/Memo Summarizing Analysis Results

DELIVERABLE: Summary of Operational Analyses
TIME LINE: Up to 3 Weeks per Alternative

11B. DTSD PROJECT TEAM/PEER REVIEW (TEOpS 16-25)

SECTION	ROLE
RTM or Indep. Consult. From 6B	Lead Review of Analysis, Report to PRT
DTSD PT/Region	Oversee Peer Review Process
RTO	Assist in Peer Review as Needed
WisDOT PRT From 5B	Provide Input as Needed

TASK(S)/GOAL(S)
i. Conduct Independent Peer Review of Operational Analysis Conducted in Task 9B for Base Scenario
ii. After Approval of Base, Review Future/Alternative Scenario Analysis
iii. Complete DT1887

DELIVERABLE: DT1887
TIME LINE: Up to 4 Weeks per Alternative

12B. DELIVER FINAL ANALYSIS/REPORT

SECTION	ROLE
DTSD PT &/or CT Selected in Task 2B	Lead Role

TASK(S)/GOAL(S)
i. Prepare Summary of Analysis Method, Assumptions & Results
ii. Save Final Report & Analysis in WisDOT Project File

DELIVERABLE: Final Analysis Report
TIME LINE: Up to 3 Weeks

TRACK C

2C (Optional). SELECT/PROCURE CONSULTANT TEAM (CT) - AS NEEDED

SECTION	ROLE
DTSD PT	Lead Role
DTSD Region	Coordinate with DTSD PT as Needed
RTO	Assist DTSD PT as Needed

TASK(S)/GOAL(S)
i. Identify Need for CT to Assist in Analysis of Project
ii. Define Roles/Tasks/Tentative Schedule for CT as applicable
  a) Operational Analysis
  b) Simulation Model Development &/or Review
iii. Select/Procure CT as applicable

DELIVERABLE: Consultant Work Order - Contract
TIME LINE: Up to 6 Weeks

3C. DEVELOP DATA COLLECTION PLAN

SECTION	ROLE
DTSD PT	Lead Role
CT From Task 2C (if applicable)	Develop Data Collection Plan/Collect Data
DTSD Region/BTO	Coordinate/Assist DTSD PT as Needed

TASK(S)/GOAL(S)
i. Establish Data Sources & Needs & Define Data Collection Plan
ii. Initiate Data Collection (Data Collection To be Completed By Task 9C)

DELIVERABLE: Data Collection Plan
TIME LINE: Up to 4 Weeks

4C. SELECT TRAFFIC ANALYSIS TOOL(S)

SECTION	ROLE
DTSD PT	Lead Role – Coordinate w/RTO
RTO	Provide Input to DTSD PT
BTO	If Requested, Provide Input on Analysis Tool(s)
CT From 2C (if applicable)	Assist DTSD PT

TASK(S)/GOAL(S)
i. Assess Applicability of Various Analysis Tools
ii. Select Analysis Tool(s) Most Appropriate for Project
iii. DTSD PT/RTO to Prepare Memo on Analysis Tool Selection (To Be Submitted to BTO for Concurrence)

DELIVERABLE: Summary of Analysis Tool Selection Process
TIME LINE: Up to 2 Weeks

5C. OUTLINE PROJECT PROCESS

SECTION	ROLE
DTSD PT/Region	Lead Role
CT From Task 2C (if applicable) &/or RTO	Define Timeline for Traffic Analysis Tool(s)/Model Develop., Provide Input on Analysis Methodology
Statewide Bureaus	Provide Input As Needed
SEWRPC (if applicable)	Provide Input on Forecast Schedule/Method
MPOs (if applicable)	Provide Info on Local Concerns
FHWA (if applicable)	Provide Input on Federal Policy/Issues

TASK(S)/GOAL(S)
i. Discuss Timeline, Goals, Analysis Years, Design Hours, Alternatives
ii. Develop Summary/Outline of Proposed Process, Complete DT2290

DELIVERABLE: Defined Project Process & DT2290
TIME LINE: Up to 2 Weeks

7C. INITIATE TRAFFIC FORECAST REQUEST

SECTION	ROLE
DTSD PT/Region	Lead Role
Forecasting & SEWRPC (if applicable)	Provide Input on Data Needs & Schedule for Forecast Development

TASK(S)/GOAL(S)
i. Identify Types of Forecasts, Alternatives, Forecast Years, & Design Hours
ii. Request Forecast Results & Trip Tables (Complete/Submit DT1601)

DELIVERABLE: DT1601
TIME LINE: Up to 2 Weeks

8C. DEVELOP WISDOT TRAFFIC FORECAST

SECTION	ROLE
Forecasting – Central Office	Lead Role
Forecasting – SE Region	Lead Role in SE Region
SEWRPC (if applicable)	Develop Forecast - SE Region

TASK(S)/GOAL(S)
i. Develop Forecast per DT1601 or Review/Approve Forecast per DT1594
ii. Provide Trip Tables as Requested/Needed

DELIVERABLE: Completed/Approved Forecast
TIME LINE: Varies, See DT1601

9C. RUN OPERATIONAL/ALTERNATIVE ANALYSES

SECTION	ROLE
RTO &/or CT From Task 2C	Lead Role
DTSD PT/Region	Oversee Analysis
Statewide Bureaus	Provide Assistance as Needed

TASK(S)/GOAL(S)
i. Run Operational Analysis Utilizing Analysis Tool Selected in Task 4C (HCS, Synchro, Sidra, etc.) for Base & Future/Alternative Scenarios
ii. Prepare Report/Memo Summarizing Analysis Results

DELIVERABLE: Summary of Operational Analyses
TIME LINE: Up to 3 Weeks per Alternative

Is a Microscopic Simulation Model Proposed for Use?
Yes → 10C
No → 11C

10C. DEVELOP/CALIBRATE SIMULATION MODEL

SECTION	ROLE
CT Selected in Task 2C	Lead Role
RTM &/or RTO	Oversee CT's Work
DTSD PT/Region	Provide Project Oversight

TASK(S)/GOAL(S)
i. Run Base Case Using Sim. Model Selected in Task 4C
ii. Calibrate Base Case to Actual Volumes/Validate
iii. Revise Base Case as Needed per Task 11C
iv. Run Future/Alternative Case(s) & Revise as Needed per Task 11C

DELIVERABLE: Calibrated/Validated Simulation Model(s)
TIME LINE: Up to 6 Weeks per Alternative

Additional Runs

11C. DTSD PROJECT TEAM/REGION REVIEW (See TEOpS 16-25)

SECTION	ROLE
RTO	Lead Review of Analysis, Reports to DTSD PT
DTSD PT/Region	Oversees Review
Statewide Bureaus	Assists in Review as Needed

TASK(S)/GOAL(S)
i. Conduct Review of Operational Analysis Developed in Task 9C & if applicable Task 10C for Base Scenario
ii. After Approval of Base, Review Future/Alternative Scenario Analysis & Model (if applicable)
iii. Complete DT2291 & DT1887 as applicable

DELIVERABLE: DT2291 & DT1887 as applicable
TIME LINE: Up to 4 Weeks per Alternative

12C. DELIVER FINAL ANALYSIS/REPORT

SECTION	ROLE
DTSD Project Team &/or CT Selected in Task 2C	Lead Role

TASK(S)/GOAL(S)
i. Prepare Summary of Analysis/Calibration Method, Assumptions & Results
ii. Save Final Report & Analysis in WisDOT Project File

DELIVERABLE: Final Calibration/Analysis Report
TIME LINE: Up to 3 Weeks

16-5-1 Data Assembly and Collection April 2025

1.1 Introduction

Transportation planning and engineering requires real-world data to understand system performance, identify emerging trends, and find solutions to issues. This section discusses data assembly, collection, and preparation for use in the development of traffic models and other general capacity analyses. Other specialized studies, such as safety, transit, parking, noise, or freight, would need data beyond the scope of this section. Data requirements are highly dependent on the individual project needs and goals and may necessitate additional data beyond that discussed within this policy. Prior to gathering any data, coordinate with the regional traffic engineer to discuss the data needs for the project, identify potential data sources, and develop a data assembly/collection plan.

1.2 Data Assembly/Collection Plan

This section describes the typical components of a data assembly/collection plan ("data plan"). The actual data plan will vary depending on the specific needs of the project. Regardless of the precise content, the data plan *should* provide clear guidance as to how, when, and where to obtain the required data. The data plan should also include details on the schedule and budget needs necessary to compile the data elements. Preparing the data plan should occur during project scoping to avoid project delays and to allow time for acquiring existing and any new time-sensitive data.

The following provides an example outline of a data assembly/collection plan.

1. **Introduction/Background**

   Provide a brief background on the project, including a description of the project's needs and purpose. Include a discussion on the traffic analysis tools, traffic models, and other analyses that require data for the project.

2. **Data Needs**

   Identify the data requirements necessary to develop, calibrate, and validate the traffic models and other analyses tools. See TEOpS 16-5-1.4 for guidance on selecting the appropriate data for analysis. When defining the data needs, consider not only the project objectives but also other potential uses and users of the data to optimize resources. Coordinate with WisDOT regional traffic staff to determine if there are current or upcoming projects that could also benefit from the required data.

3. **Data Locations**

   Illustrate the data needs on a list or map. Label what type of data to assemble at each location. As the data plan progresses, identify where existing data is available and its source, as well as where new data collection is necessary.

4. **Data Sources**

   List potential sources for obtaining the necessary data and identify the owner or responsible party for each data source. Data sources could include existing databases, previous studies, and new data collection efforts. The Bureau of Traffic Operations (BTO) - Traffic Analysis and Safety Unit (TASU) Data Hub provides a list of potential data sources. Coordinate with WisDOT regional traffic staff to verify other potential sources of data. Additional resources for identifying data sources include WisDOT Bureau of State Highway Programs (BSHP) and WisDOT Traffic Forecasting Section (TFS).

5. **Justification for New Data Collection**

   Identify any gaps, errors, obsolete, or other issues/concerns with existing data sources. Establish an approach for resolving the identified issues. Document and justify the need for new/additional field data collection. Follow the Transportation Planning Manual (TPM) and other available WisDOT guidelines for data collection as applicable.

6. **Methodology for Acquiring Data**

   For new data collection efforts, identify the approach for gathering the data. Include information on how to collect the data, when to collect the data (e.g., months of the year, days of the week, time periods, or time of day), who is responsible for the data collection, the duration of the counts (e.g., peak-hour, peak-period, one week, one month, etc.) and the time interval (e.g., 5 minutes, 15 minutes, 1 hour, etc.). Where appropriate, define how to determine the appropriate sample size. Refer to TEOpS 16-5-1.3 for additional guidance on the techniques for acquiring data.

7. **Data Preparation and Management Strategies**

   Establish procedures for conducting data quality assurance and control. Define protocols for archiving and storing the data files, noting that WisDOT will maintain ownership of all data collected for WisDOT projects. Refer to TEOpS 16-5-1.5 for additional information on data preparation.

8. **Schedule and Budget**

   Prepare a schedule and an itemized budget for the data assembly/collection efforts.

Submit the data plan to the WisDOT regional traffic engineer for review and approval prior to gathering any data. Involve WisDOT TFS and BTO-TASU in the review of the data plan as appropriate. Save the data plan with the project files.

1.3 Techniques for Acquiring Data

There are several resources available on data acquisition techniques, three of which include:

- *Manual of Transportation Engineering Studies, 2nd Edition* (1)
- *Highway Capacity Manual, 7th Edition* (HCM7) (2)
- *Traffic Monitoring Guide* (3)

As noted in the above documents, it is possible to acquire transportation data through office reviews, existing databases, and field data. Oftentimes, it is necessary to utilize a combination of all three approaches. See below for additional details on each of these data acquisition techniques.

1.3.1 Office Reviews

Office reviews include any means of gathering data from existing sources to determine physical system characteristics and asset locations. Example office reviews include inspecting aerial maps, as-built plans, and Photolog. Office reviews are appropriate for high-level data acquisition to become familiar with a project location, land use, and existing infrastructure. The age of existing sources can vary and may not reflect current conditions. Verify office reviews with field reviews as appropriate, especially when using the data for detailed study or design projects.

1.3.2 Existing Databases

WisDOT has access to or maintains existing databases of traffic count, speed, and other transportation data. Examples include: MetaManager, WisTransPortal, and WisDOT TCMap (Traffic Count Map), among others. Existing databases often contain data aggregated at a statewide level for facilities managed by WisDOT. Data for local municipalities or counties may or may not be available. Coordinate with WisDOT regional traffic staff to identify existing database sources.

Evaluate the spatial and temporal resolution of existing databases against project needs. Validate existing databases with field reviews as appropriate, especially for older or unmaintained databases.

1.3.3 Field Data

Field data collection refers to any manual or automatic method of obtaining data directly from the field. This may include taking video or pictures, jotting down field notes, or using portable microwave/radar or other equipment. Field data collection may require specialized equipment that entails mounting hardware to poles or locating equipment on private property. Contact WisDOT regional staff to approve data collection techniques with these requirements. It is advisable to contact property owners and local law enforcement to inform them of the data collection activities. Contact the WisDOT Traffic Data Unit (traffic.counts@dot.wi.gov) for specifications and guidance relating to the statewide count program traffic count data. Guidance for conducting turning movement counts is available on the BTO Traffic Analysis, Modeling and Data Management Program area webpage.

Complete office reviews and consult existing databases first before collecting field data. The age of existing data and effort to reconcile old and new data, however, can create challenges. For example, balancing old and new traffic volumes (see TEOpS 16-5-15 for additional details on volume balancing), or utilizing speed and count data from different days, can increase the traffic model calibration effort.

Prior to collecting new counts, coordinate with WisDOT regional traffic staff to verify there are no other sources of data available. Additional resources for identifying data sources include WisDOT BSHP and WisDOT TFS. Document and justify the need for any new traffic counts and save as part of the project files.

1.4 Selecting Appropriate Data for Analysis

Data needs (type, amount, etc.) vary by the facility type and study purpose. As the complexity and detail of the analyses increase, so does the need for more meticulous data. Table 1.1 shows potential data requirements for use in traffic modeling of typical weekday AM and PM peak period scenarios. Table 1.1 also identifies if the data type is a required capacity analysis input, or if the data, although not necessarily required, may have value for calibration or general deficiency analyses.

Analyses beyond the scope of Table 1.1 may require additional data. Such analyses include, but are not limited to:

- Analysis of special peak periods (e.g., weekends or special events)
- Travel time reliability analysis (See *HCM7* (2), Chapters 11 and 17 for freeways and arterials, respectively)
- Project-specific needs
- Other specialized analyses (e.g., safety, transit, parking, noise, freight, etc.)

Table 1.1 Selecting Data for Traffic Analysis

Facility Type	Data Type	Notes and Potential Data Needs/Sources	Required for Capacity Analysis	Useful for Calibration or Deficiency Analysis	Additional Resources
Signalized Intersection	Intersection Geometry and Configuration	• Number of lanes on each approach, lane markings, and turn lane lengths • Aerial maps/photography • Photolog/Google Streetview • Confirm with field reviews as appropriate	X		
	Turning Movement Counts	• 15-minute interval counts, for all turning movements, vehicle classes, and pedestrians/bikes • Weekday AM and PM peak period counts (typically 3 hours each) • Other peaks and times as necessary • Ensure counts reflect traffic demand and not discharge in oversaturation conditions. Supplement turning movement counts with additional counts upstream of queuing.	X		ITE (1)
	Saturation Flow	• Obtain if existing conditions operate at or over capacity • Use TEOpS 16-15-5.2.2.3 as estimates when field data is unavailable		X	TEOpS 16-15 ITE (1) HCM (2)
	Right-Turn on Red (RTOR)	• If applicable, observe RTOR operation in the field • Use TEOpS 16-15-5.2.1.3 as estimates when field data is unavailable		X	TEOpS 16-15
	Signal Timing	• Contact WisDOT regional staff for signal plans and timing	X		WisDOT regional staff

Facility Type	Data Type	Notes and Potential Data Needs/Sources	Required for Capacity Analysis	Useful for Calibration or Deficiency Analysis	Additional Resources
	Queue Length	• Record queue lengths on all approaches. Queue length is extremely sensitive to prevailing conditions and traffic volumes. Record queues and volumes simultaneously when possible.		X	ITE (1)
	Delay	• Perform travel time runs through the intersection during peak periods to determine actual versus free-flow travel time		X	ITE (1)
Unsignalized Intersection	Intersection Geometry and Configuration	• Number of lanes on each approach, lane markings, turn lane lengths, and control sign types (stop, yield) and locations • Aerial maps/photography • Photolog/Google Streetview • Confirm with field reviews as appropriate	X		
	Turning Movement Counts	• 15-minute interval counts, for all turning movements, vehicle classes, and pedestrians/bikes • Weekday AM and PM peak period counts (typically 3 hours each) • 12 to 14 hour counts if analyzing traffic signal warrants • Ensure counts reflect traffic demand and not discharge in oversaturation conditions. May need to supplement turning movement counts with additional counts upstream of queuing.	X		ITE (1)
	Crash History	• Required if analyzing traffic signal warrants		X	WisTransPortal WisDOT regional staff
	Queue Length	• Record queue length for stop or yield controlled movements. Queue length is extremely sensitive to prevailing conditions and traffic volumes. Record queues and volumes simultaneously when possible.		X	ITE (1)
	Gap Acceptance	• Use Wisconsin calibrated gap parameters for roundabout analysis (FDM 11-26-20.4). • Can require intensive labor effort; only conduct gap studies if traffic modelling and engineering judgement fail to produce reasonable results		X	FDM 11-26-20.4 ITE (1)
	Sight Distance	• Verify sight distance in the field if considering geometric improvements		X	ITE (1)
Freeway	Highway Geometry and Configuration	• Speed limit, number of lanes, auxiliary lane lengths, and merge/diverge/weave locations • Aerial maps/photography • Photolog/Google Streetview • Confirm with field reviews as appropriate	X		
	Statewide Count Program Data	• Use Automatic Traffic Recorder (ATR) counts where possible to obtain current and historical trends. • WisDOT short-term counts • Ensure counts are of sufficient duration to capture all congestion • 15-minute interval counts are preferable	X		WisDOT regional staff WisDOT Traffic Data Unit

Facility Type	Data Type	Notes and Potential Data Needs/Sources	Required for Capacity Analysis	Useful for Calibration or Deficiency Analysis	Additional Resources
	Ramp Counts	• WisDOT short-term counts • Volume, Speed and Occupancy (V-SPOC) data • Obtain new counts when WisDOT short-term counts are unavailable or no longer reflect existing conditions • 15-minute interval counts are preferable	X		WisDOT regional staff V-SPOC WisTransPortal
	Ramp Terminal Intersection Data	• Assemble signalized and unsignalized intersection data shown above at all interchanges • Data at the ramp terminals within the same interchange *should* reflect the same date/time	X		ITE (1)
	Capacity	• If existing conditions are over capacity, use 15-minute volume and speed data to estimate capacity		X	HCM (2)
	Spot Speeds	• V-SPOC, microwave, or radar data collection useful for determining free-flow and congested speeds		X	ITE (1) V-SPOC
	Travel Time	• FHWA NPMRDS or other 3rd party data providers • Use travel time runs to verify 3rd party data • Use GPS tracking to continuously record time/speed		X	ITE (1)
	Origin-Destination	• Bluetooth or other OD study method • 3rd party data provider • WisDOT Travel Demand Model (TDM)		X	TEOpS 16-5-20 Transportation Planning Manual (TPM)
Rural Corridor	Highway Geometry and Configuration	• Speed limit, number of lanes • Aerial maps/photography • Photolog/Google Streetview • Confirm with field reviews as appropriate	X		
	Count Data	• Counts, covering a minimum of a 24-hour period, along the corridor wherever major changes in traffic occur (before and after major intersections, corridor termini). • 15-minute interval counts are preferable	X		ITE (1)
	Intersection Data	• Assemble signalized and unsignalized intersection data shown above at all intersections. • Aerial maps/photography • Photolog/Google Streetview • Confirm with field reviews as appropriate	X		ITE (1)
	Driveway Locations	• Required for calculating access point density for two-lane highway HCM analysis • Aerial maps/photography • Photolog/Google Streetview • Confirm with field reviews as appropriate	X		WisDOT regional staff
	Passing Lanes and No Passing Zones	• Required for two-lane highway HCM analysis • Aerial maps/photography • Photolog/Google Streetview • Confirm with field reviews as appropriate	X		WisDOT regional staff
	Spot Speeds	• Requires microwave or radar data collection. Useful for speed limit analysis.		X	ITE (1)

Facility Type	Data Type	Notes and Potential Data Needs/Sources	Required for Capacity Analysis	Useful for Calibration or Deficiency Analysis	Additional Resources
	Travel Time	• Travel time runs for end-to-end through the corridor • Use GPS tracking to continuously record time/speed		X	ITE (1)
Urban Corridor	Highway Geometry and Configuration	• Speed limit, number of lanes • Aerial maps/photography • Photolog/Google Streetview • Confirm with field reviews as appropriate	X		
	Intersection Data	• Assemble signalized and unsignalized intersection data shown above at all intersections. • Aerial maps/photography • Photolog/Google Streetview • Confirm with field reviews as appropriate	X		ITE (1)
	Count Data	• Supplement intersection counts with directional counts covering a minimum of a 24-hour period to determine daily traffic volumes.	X		ITE (1)
	Transit Routes, Stops, & Parking	• Note bus routes, bus stop frequency, and parking maneuvers for use in intersection traffic analysis	X		WisDOT regional staff
	Spot Speeds	• Requires microwave or radar data collection. Useful for speed limit analysis.		X	ITE (1)
	Travel Time	• Travel time runs for end-to-end through the corridor • Use GPS tracking to continuously record time/speed		X	ITE (1)
	Origin Destination	• Useful for complex corridors where traffic patterns affect operations such as closely spaced intersections			TEOpS 16-5-20
Additional Resources (1) Manual of Transportation Engineering Studies, 2nd Edition (2) Highway Capacity Manual, 7th Edition					

1.5 Data Preparation

After assembling data from existing or field sources, additional data preparation steps typically include data storage, cleaning, reduction, and presentation. The following sections discuss each of these steps in more detail.

1.5.1 Data Storage

Store data with file and folder names consistent with conventions established for the project. If integrating the project data into existing databases, check with WisDOT regional staff and BTO-TASU to ensure the project data is in a compatible format. Regardless of file and folder convention, ensure there is a traceable record of the data to facilitate ease of use and file transfers. Include a “readme” file, map, emails, or other documentation to accompany the data.

Before processing the data, save a backup of the original unmodified/raw data in case of computer failure. Unmodified data is also useful to keep because it allows comparisons between raw and processed data when investigating data quality issues discovered during later analyses.

1.5.2 Cleaning the Data

Inspect the data for missing values, outliers, duplicate records, misplaced locations, or counter-intuitive trends. Document and justify the need to collect additional data to address issues.

Use descriptive statistics (average, mean, standard deviation, etc.), graphs, and maps to help visualize and spot issues with the data. Avoid filling in, or imputing, missing data unless necessary for the specific analysis. When it is necessary to impute missing data, the documentation should note where and why it was necessary. The documentation should also provide a summary of the techniques used to fill in the data gaps.

1.5.3 Data Reduction

Data reduction, or analysis, aims to answer questions that vary in complexity and vary from project to project. Analysis involves translating raw data into meaningful information using summaries, graphs, maps, and tables. Regardless of the data type or complexity, the analysis should be reproduceable and understandable by others to facilitate decision making and to allow for error checking.

Most data reduction processes start by converting the raw data into a format suitable for analysis. Keep the converted data separate from the raw/unmodified data to prevent data loss. Data conversion could include combining multiple files into one file, reshaping the organization of tables, or projecting spatial data to a common coordinate system. Data conversion may also be part of the cleaning process (TEOpS 16-5-1.5.2). It may be necessary to filter the dataset to extract specific records or time periods of interest for further exploration and more detailed analysis.

Documenting the data reduction should scale with the complexity of the analysis. For example, collecting and analyzing intersection turning movement counts for import into a traffic model may be a linear process of documenting the field data, inputs, and outputs of the analysis in a traffic report. More complex data analyses may be iterative and require additional documentation of methodology and assumptions. The analyst may need to try multiple statistical tests (hypothesis testing, ANOVA, etc.), or create diverse types of tables and graphs before formulating conclusions. Creating documentation throughout complex analyses can help the analyst keep track of and support resulting conclusions in addition to keeping the project organized.

1.5.4 Presentation of Data

Mass amounts of data can be overwhelming. Thus, it is important to present the data in such a way as to accurately communicate what the data means in an easy to understand format. Take into consideration the target audience; public documents may require simplified explanations of the technical details. Data visualization techniques like tables, graphs, maps, infographics, pictures, and videos can enhance communication by providing a clear and concise message without overwhelming the audience. Highlight key information to focus the audience's attention on conclusions. Check with WisDOT regional staff for preferences and examples of data presentation methods, especially regarding public involvement.

16-5-15 Volume Balancing — September 2019

15.1 Introduction

Traffic volume balancing is the act of reconciling discrepancies in traffic volumes between adjacent locations. Discrepancies or imbalances are often the result of having to utilize counts from various times, days, or years. Longer time differences between adjacent counts typically results in larger imbalances. Although utilizing counts from the same period may minimize these differences, limited data collection resources may preclude this as an option. Differences in data collection methods may also lead to an imbalance of traffic volumes. Depending on the calibration of the device and skill of the manual counter, manual traffic counts may be more error-prone than automatic data collection devices.

The purpose of balancing is to create a logical set of volumes that is representative of the current or forecasted year traffic demand. Balancing the traffic volumes is necessary when evaluating a "closed-system" corridor with no driveways or other access points between intersections/ramps. In a closed-system corridor, the amount of traffic leaving one location must equal the amount of traffic arriving at the next downstream junction. A balanced volume data set is typically more critical for intersection-focused analyses versus analyses that focus on the mainline, although project specific needs *may* necessitate volume balancing along a freeway-only corridor. Additionally, since microsimulation models track individual vehicle movements, most microsimulation software require a balanced volume data set. For those microsimulation models that do not require a balanced volume data set to function (e.g., SimTraffic), use of unbalanced volumes will result in vehicles randomly appearing/disappearing from the roadway network, potentially skewing the results of the analysis.

There is no single unique solution when balancing volumes. Balancing using traffic counts taken on one day would yield a different answer than counts taken on a different day. Likewise, one analyst's results from the volume balancing process will not necessarily match the results from another analyst. This policy addresses how to reconcile imbalanced traffic volumes to foster consistency in traffic analysis conducted within Wisconsin. The Bureau of Traffic Operations, Traffic Analysis and Safety Unit (BTO-TASU) has developed Excel spreadsheet tools to help perform volume balancing in a consistent manner. The volume balancing Excel tools, one-page user guides, and step-by-step job aids are available on the BTO Traffic Analysis, Modeling and Data Management Program area webpage. TEOpS 16-5-15.4.3 provides additional details on the BTO-TASU volume balancing tools.

Although an analyst *may* choose to develop their own templates for balancing volumes, BTO encourages the use of the BTO-TASU volume balancing tools. Obtain approval from the WisDOT regional traffic engineer on the volume balancing methodology prior to developing or utilizing a tool other than that provided by BTO-TASU.

15.2 Benefits of Volume Balancing

When implemented judiciously, volume balancing helps "clean" the traffic data. The balancing process can moderate the effects of the daily, monthly, and seasonal factors, lessen the impact of counting errors (such as counts affected by equipment problems), and temper the influence of outliers (such as counts collected on non-representative days). To a limited degree, volume balancing may also allow the analyst to fill in gaps of data with a preliminary count estimate (e.g., using last year's data as an approximation of the volume at a site where a detector has recently failed).

Volume balancing may also be beneficial for the development of origin-destination (O-D) matrices, the mechanism for providing traffic volume demand data for most microsimulation software. By avoiding oscillation between conflicting numerical targets that slows or prevents convergence, volume balancing reduces the matrix estimation effort. Refer to TEOpS 16-5-20 for additional details on the O-D matrix development process.

Volume balancing ensures that traffic demands reflect what the analyst intends to simulate (e.g., microsimulation). Balancing also helps the simulation to meet the microsimulation traffic volume validation requirements of TEOpS 16-20-8.3.1 and TEOpS 16-20-8.4.1.

15.3 When to Conduct Volume Balancing

Unless mitigating circumstances dictate otherwise, the analyst **shall** perform volume balancing for:

- Closed-system corridor analyses (i.e., there are no mid-block driveways or other access points for traffic to enter or exit the network) along arterials and freeways where a balanced volume data set is critical for the operational analyses (e.g., HCM freeway facility analyses) and
- Apart from SimTraffic analyses as defined below, all microsimulation analyses.

The analyst could choose to, but does not have to, perform volume balancing for:

- Analyses of an urban corridor with driveways, or
- SimTraffic analyses to evaluate signal timings and progression.

Scenarios that typically do not warrant volume balancing include:

- Analysis of a single isolated intersection or interchange, provided that the adjacent interchanges, intersections, or driveways will not impact traffic operations.
- HCM/deterministic or planning-level analysis of a long freeway corridor with isolated interchanges (e.g., K30 analysis on I-39/90).

Depending on the purpose and need of the project; the analyst *may* not include all driveways or intersections along the study corridor within the traffic model. In these instances, the analyst *should* confirm that the excluded driveway/intersection can appropriately account for any imbalance in the traffic volumes. If not, the analyst *should* consider including a "dummy" access to act as a sink/source to capture the representative imbalance and then balance the remaining volumes along the corridor.

Coordinate with the WisDOT Traffic Forecasting Section (TFS) (DOTTrafficForecasting@dot.wi.gov) to confirm whether to conduct volume balancing before or after completion of the traffic forecasts. If requesting WisDOT TFS to balance the traffic volumes, note this on the DT1601 – Project Level Traffic Forecast Request form.

If unsure about the need for volume balancing on a specific project, check with the WisDOT regional traffic engineer. If desired, the WisDOT regional traffic engineer *may* request additional support or guidance from BTO-TASU (DOTTrafficAnalysisModeling@dot.wi.gov).

15.4 Volume Balancing Process

The typical volume balancing process includes the following primary steps:

1. **Assemble** traffic volume data (traffic counts and forecasts). See TEOpS 16-5-15.4.1.
2. **Select** the volume data to use as a starting point for balancing (referred to as the "raw" or initial volumes). See TEOpS 16-5-15.4.2.
3. **Balance** volumes by adjusting the raw/initial volumes up or down as needed to account for imbalances and driveways. Where and how the analyst makes these adjustments typically depends on the type of facility included in the traffic model (freeway-only, intersection-only, or mixed freeway-arterial corridors). See TEOpS 16-5-15.4.3.
4. **Review** the balanced volumes for reasonableness; adjust balanced volumes as necessary. See TEOpS 16-5-15.4.4.
5. **Document** the data sources and volume balancing methodology. See TEOpS 16-5-15.4.5.

The following sections detail each step of the volume balancing process. The BTO-TASU volume balancing tools provide a mechanism to help organize, document, and perform volume balancing. Refer to TEOpS 16-5-15.4.3 for additional details on the BTO-TASU volume balancing tools.

15.4.1 Assemble Traffic Volumes

Obtain existing or base year (if other than current year) and forecasted traffic count data for each intersection, ramp, mainline, and major driveway within the analysis limits. If available, the analyst *should* also gather historical count information which may be helpful in assessing data quality and identifying outliers.

There are several data sources for traffic volumes with varying levels of availability and data quality. Some of these resources include manual counts and various detection methods (e.g., loop, microwave, radar, video, etc.). Sources available in Wisconsin include: WisDOT, Wisconsin Traffic Operations and Safety (TOPS) Lab (WisTransPortal), and local municipalities. The BTO-TASU Data Hub provides a list of additional data sources with a brief description of types of data available through each source, a hyperlink to the primary data source, and notes to consider when selecting a particular data source. Contact WisDOT regional traffic staff to determine whether there are other data sources available for the project study area. Additional resources for identifying data sources include WisDOT Bureau of State Highway Programs (BSHP) and WisDOT TFS.

If the required data, such as turning movement counts, is not available from existing sources, project specific data-collection efforts *may* be necessary. Document and justify the need for new/additional field data collection. Follow the Transportation Planning Manual (TPM) and other available WisDOT guidelines for data collection as applicable.

Review, verify, and document the validity of the count data prior to balancing the volumes. Coordinate with WisDOT regional traffic staff as appropriate.

15.4.1.1 Forecasted Traffic Volumes

Refer to the TPM for guidance on when and how to obtain forecasts from WisDOT TFS. If there is a need to convert daily traffic forecasts into hourly volumes through use of K-factors or other means, document the conversion process and obtain approval of the hourly volumes from TFS and WisDOT regional traffic staff. If desired, the WisDOT regional traffic engineer *may* request additional support or guidance from BTO-TASU. Refer to the Traffic Forecasting webpage and Section 40.3 of the TPM for more information regarding the use of design-hourly volumes and K-factors.

15.4.1.2 Data Quality

Traffic count quality may vary by location, data collection device, and data collection method. The analyst must apply judgement based on historical data, adjacent counts, and location-specific knowledge to assess traffic count quality. Permanent automatic traffic recorder (ATR) stations typically produce high quality traffic counts and often have extensive historical data that can help in assessing data quality if located within the analysis limits.

The analyst **shall** document the rationale for any suspected errors and any manual error corrections in the BTO-TASU or other equivalent volume balancing worksheet. Report any suspected errors in counts, especially those from WisDOT data sources, back to the appropriate WisDOT contact.

If there are potential errors in the data, depending on the project-specific needs, obtaining new counts may be more effective compared to adjusting questionable counts before or during balancing. Prior to collecting new counts, coordinate with WisDOT regional traffic staff to verify there are no other sources of data available. Additional resources for identifying data sources include WisDOT BSHP and WisDOT TFS. Follow the TPM and other available WisDOT guidelines for data collection as applicable.

15.4.1.3 Volume Balancing Between Multiple Projects

Occasionally, the study limits of one project will intersect or overlap with the limits of another project. Theoretically, the same location in multiple projects *should* have the same volume for the same analysis period. However, differing study limits, facility types, and study-specific priorities (e.g., if one project prioritizes the freeway facility while the other project prioritizes the arterial corridor) may result in variations in volumes at the same location. The project study teams *should* seek to minimize differing volumes for the same location and analysis period. Document and identify reasons for and potential consequences of any volume differences. Obtain approval from WisDOT regional traffic staff prior to utilizing the resulting traffic volumes in any analysis.

Throughout the volume balancing process, the overlapping project teams *should* coordinate and share volume and forecast information with each other and the WisDOT regional traffic staff. This will ensure consistency and avoid duplicating efforts. Involve BTO-TASU and WisDOT TFS in these coordination efforts as appropriate.

15.4.2 Select Raw/Initial Volumes

To start the volume balancing process, the analyst must select a single traffic volume for each study location. If multiple existing or historical counts are available for the same location, choose the count that is representative of the scenario under investigation. Selected counts may or may not be the most recent count depending on data quality factors as described in TEOpS 16-5-15.4.1.2. Document, in the BTO-TASU or other equivalent volume balancing worksheet, the data source and count date and identify whether the raw/initial volume accounts for seasonal, daily, and axle factor adjustments (typically incorporated into mainline counts but not raw turning movement counts). If balancing forecasted volumes, use the forecasted hourly volumes as described in TEOpS 16-5-15.4.1.1 as a starting point for the balancing process. Record the details of any additional adjustments made to the raw/initial or forecasted volumes before starting the balancing process. Note any other unique information regarding the traffic volumes within the BTO-TASU or other equivalent volume balancing worksheet and save as part of the project files.

15.4.3 Balance Volumes

Traffic volume balancing can be a highly iterative, time consuming, and judgement-oriented process because there are an infinite number of solutions to achieve balanced volumes. The BTO-TASU volume balancing tools provide a mechanism to help organize, document, and perform volume balancing. There is one tool for balancing along freeway-only corridors and one tool available for balancing intersection volumes along an arterial corridor. These tools provide a template for manual balancing and provide automatic balancing methods to help the iterative process. The analyst **shall** review and, if necessary, adjust the results from the automated balancing methods to ensure the balanced volumes are logical.

Projects *may* need to develop their own templates for balancing volumes beyond the tools provided by BTO-TASU. Any volume balancing templates **shall** provide an organized means for reviewing:

- Raw/initial input volumes (existing, base-year or forecast volumes)
- Comparisons between raw/initial and balanced volumes
- Methodology for balancing volumes
- Notes regarding count errors, manual adjustments, and large discrepancies between raw/initial and balanced volumes.

Obtain approval from the WisDOT regional traffic engineer on the volume balancing methodology prior to developing or utilizing a tool other than that provided by BTO-TASU. Consult with WisDOT TFS as appropriate. If unsure about whether the tools available for volume balancing will work for a particular project, the WisDOT regional traffic engineer *may* contact BTO-TASU (DOTTrafficAnalysisModeling@dot.wi.gov) for additional support or guidance.

15.4.3.1 Volume Balancing Calculation Methods

Volume balancing *should* seek to minimize the difference between raw/initial and balanced volumes. Proportioning (pro-rata) methodologies and goal-seeking optimization routines are common calculation methodologies to obtain balanced volumes[1,2,3]. To account for any data quality concerns and to capture location-specific knowledge, the volume balancing process will also typically involve manual adjustments. The BTO-TASU volume balancing tools provide templates to help implement these methodologies.

The goals of the project and the type of facility in the traffic model (freeway-only, intersection-only, or mixed freeway-arterial corridors) *may* require the prioritization of critical locations over others during the volume balancing process. Prioritized locations *should* have minimal difference between the raw/initial and balanced volumes and *may* result in larger differences at lower priority locations. The following sections (TEOpS 16-5-15.4.3.2.2 – 4.3.2.5) discuss balancing priorities for different facility types.

15.4.3.2 Balancing Freeway-Only Corridors

Freeway analysis typically focuses on the freeway mainline, merge, diverge, and weaving traffic operations. Volume balancing for freeway-only corridors *should* prioritize mainline and ramp locations before any ramp-terminal intersection or arterials in the study limits.

Analysts will often use ATR locations on the freeway mainline as “anchor” points, meaning they consider the raw/initial volumes as fixed values. To eliminate any imbalance along the corridor, the analyst will adjust the ramp volumes between the anchor points and will hold the volumes at the anchors constant. The analyst *should* ensure that any location used as an anchor has high-quality volume data representative of the scenario under investigation. Even if anchor points are high quality, the analyst *may* consider allowing some flexibility (e.g., allow ± 20 vehicles/hour/lane difference between the raw/initial and balanced volumes) at the anchor location if it helps minimize differences between raw/initial and balanced volumes at other critical locations. Confirm the allowable flexibility at anchor points with WisDOT regional traffic staff. Involve WisDOT TFS as appropriate. If desired, the WisDOT regional traffic engineer *may* request additional support or guidance from BTO-TASU.

If the analyst suspects that the differences between the raw/initial and balanced volumes at ramp-terminal intersections may trigger operational issues affecting the mainline freeway, they *should*:

- If possible, manually adjust the balanced volumes at the ramp-terminal to reduce the differences between the raw/initial and balanced volume; or
- Conduct separate sensitivity analysis with higher demand intersection volumes to investigate operational concerns.

Coordinate the need for manual adjustments or sensitivity analysis with WisDOT regional traffic staff. Involve WisDOT TFS as appropriate. If desired, the WisDOT regional traffic engineer *may* request additional support or guidance from BTO-TASU. Document any manual adjustments or sensitivity analysis within the BTO-TASU or other equivalent volume balancing worksheet and save as part of the project files.

15.4.3.3 Balancing Intersection-Only Corridors

Intersection-focused analyses *should* prioritize high-volume capacity-critical intersections and allow more flexibility at lower-volume locations with reserve capacity. The purpose of the analysis may provide additional priorities for balancing. For example, a study focused on signal timing and coordination *may* allow more flexibility in changing mainline volumes that have fixed phase lengths to avoid overestimating side road timing needs.

The volume balancing process will typically resolve any imbalances between intersections by proportioning adjustments amongst all contributing turning movements, and not necessarily take into consideration any prioritization of which locations or turning movements are most important. Thus, if utilizing the BTO-TASU volume balancing tools or other automated balancing tool, the analyst *may* need to manually refine outputs to reflect any project-specific prioritization. Note any project-specific prioritization needs or other unique considerations within the BTO-TASU or other equivalent volume balancing worksheet and save as part of the project files.

The analyst *should* also consider driveways when balancing intersection corridors. Refer to TEOpS 16-5-15.4.3.2.5 for additional details on volume balancing at driveways.

[1] Federal Highway Administration, *Traffic Monitoring Guide*. 2016 (3)
[2] Shaw, J. Automated Optimal Balancing of Traffic Volume Data for Large Access-Controlled Highway Networks and Freeway-to-Freeway Interchanges. Proceedings from the TRB 2014 Annual Meeting. (5)
[3] Ren, J. & Rahman, A, Automatically Balancing Intersection Volumes in a Highway Network. 12th TRB Transportation Planning Applications Conference. 2009. (6)

15.4.3.4 Balancing Mixed Freeway-Arterial Corridors

Traffic models that contain both freeway and arterial intersections are the most complex case for volume balancing, and require simultaneous consideration of freeway-only and intersection-only priorities (see TEOpS 16-5-15.4.3.2 and TEOpS 16-5-15.4.3.3, respectively). The analyst *should* prioritize capacity-critical freeway, mainline, and intersection locations first and allow more flexibility at lower-volume locations with reserve capacity. The analyst can accomplish this by utilizing the weighting factors to influence the automated balancing in the BTO-TASU freeway volume balancing tool or by manually adjusting outputs. Note any project-specific prioritization needs or other unique considerations within the BTO-TASU or other equivalent volume balancing worksheet and save as part of the project files.

Balancing the freeway and arterials simultaneously *may* or *may not* be feasible from a calculation standpoint. If not, balancing *may* require iterating between balancing the freeway and arterial separately and using the results of one iteration to inform the next.

15.4.3.5 Volume Balancing at Driveways

Driveways are any mid-block locations where traffic can enter or exit the network and are typically access points to businesses or intersections excluded from the traffic model. The analyst **shall** review any volume imbalance between intersections to ensure that the driveways could realistically capture the magnitude of the imbalance. Land use, development type, and directionality of the imbalance *may* help determine if the imbalance is reasonable.

- If a driveway imbalance appears unreasonably high, volume balancing *should* minimize the imbalance to a reasonable percentage. For example, the analyst *may* adjust the imbalance to be within 10% of the adjacent intersection volumes.
- If a driveway imbalance appears unreasonably low, the analyst *should* use caution when adjusting the imbalance, as it *may* be possible for the incoming and outgoing traffic at the driveway to yield no net change in volume. The analyst *should* also consider the directionality of the traffic (i.e., origin and destination) when assessing reasonableness.

Microsimulation *may* require special treatment of driveways depending on if the simulation is closed-system (such as Vissim) or open-system (such as SimTraffic).

Vissim uses a closed-system of roadway links where traffic can only enter or exit at the network edges, which assumes balanced input volumes. The analyst must account for driveways in the network by the following methods:

- Explicitly model all high-volume driveways which affect operations of adjacent junctures as separate intersections.
- Combine multiple low-volume driveways into one or more “dummy” intersections.
- Omit driveways with negligible effects on traffic operations from the traffic volume and eliminate all volume imbalances. This method is acceptable only if the balanced volumes and traffic operations at intersections near the omitted driveways are representative of field or benchmark conditions.

SimTraffic uses an open-system network where simulated vehicles instantly appear or disappear mid-block when there are imbalanced input volumes. Depending on the project-specific needs, this *may* or *may not* be acceptable. With an open-system network, it *may* be necessary to include major driveways as explicit intersections to replicate field or benchmark conditions.

The analyst *should* direct any questions regarding how to accommodate driveways to the WisDOT regional traffic engineer. If desired, the WisDOT regional traffic engineer *may* contact BTO-TASU (DOTTrafficAnalysisModeling@dot.wi.gov) for additional support or guidance. Note any project-specific needs or other unique considerations within the BTO-TASU or other equivalent volume balancing worksheet and save as part of the project files.

15.4.4 Review

To ensure that the results are logical and representative of the analysis scenario, it is critical to carefully review the results of the volume balancing process, especially if using automated balancing tools. Diagnostic checks to help the review *should* include:

- Comparison between raw/initial and balanced counts using the WisDOT root normalized squared error (RNSE)[4] metric (See TEOpS 16-20-8.4.1).
    - RNSE less than 3.0 are typically acceptable,
    - RNSE 3.0 to 4.9 *may* be acceptable,
    - RNSE 5.0 or greater require further investigation. Avoid RNSE values equal to or greater than 5.0, unless lowering the difference negatively affects higher priority locations. Document and explain the reason for high RNSE values.
- Review of any remaining imbalances in the balanced volumes to ensure they appropriately reflect driveways.

Diagnostic checks of balanced volumes sometimes reveal errors in the raw/initial traffic count data. If this occurs, the balancing process *may* restart using corrected raw/initial values as inputs or remain as-is if the balanced volumes are reasonable. In either case, document the error in the raw/initial count.

Final review of balanced volumes typically occurs during the modeling peer review process described in TEOpS 16-25 and Section 10 of the TPM. WisDOT regional traffic staff will typically lead the volume balancing review process, with assistance from WisDOT TFS, WisDOT BTO-TASU and an independent consultant as deemed appropriate. Refer to the Volume Balancing Checklist available on the BTO Traffic Analysis, Modeling and Data Management Program area webpage for criteria to consider while reviewing the balanced volumes. Document and save the results of the volume balancing review with the project files. Direct questions regarding review of volume balancing to BTO-TASU (DOTTrafficAnalysisModeling@dot.wi.gov).

15.4.5 Document

Document the volume balancing methodology including a summary of the raw/initial and balanced traffic volumes, data sources, and count dates. Note any count errors and manual adjustments. Explain any large discrepancies between raw/initial and balanced volumes. Describe any sensitivity analysis and potential impacts to the operational analyses. Provide a summary of the volume balancing peer review. If utilizing the BTO-TASU volume balancing tools, it *may* be sufficient to provide this documentation within the Excel template. Use of alternate volume balancing methodologies or tools, or complex volume balancing scenarios *may* require a technical memorandum to properly document the process. Consult with the WisDOT regional traffic engineer to confirm the required level of documentation (i.e., confirm the need for a technical memorandum). Save the completed volume balancing tools and associated documentation with the project files.

Obtain approval from the WisDOT regional traffic engineer on the volume balancing methodology and documentation prior to proceeding with the traffic analysis. Involve WisDOT TFS and BTO-TASU in the review of the volume balancing documentation as appropriate, noting that volume balancing of forecasted traffic volumes for use in microsimulation models will require WisDOT TFS approval. Refer to TEOpS 16-25 and Section 10 of the TPM for additional details on when to involve WisDOT TFS and BTO-TASU in the review process.

16-5-20 Origin-Destination Matrix Development — September 2019

20.1 Basic Principles

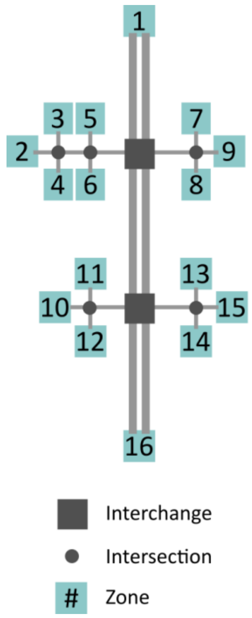
This policy focuses on the use of origin-destination (O-D) matrices in microsimulation models. Refer to the TPM for additional details on working with O-D matrices in travel demand models (TDMs).

An O-D matrix is a table that displays the number of trips (i.e., traffic demand) traveling from each origin (row) to each destination (column) in the study area. The O-D matrix provides a mechanism to illustrate the travel demand patterns across small and large transportation networks in a single table. An analyst will often use O-D matrices to load traffic demand data into a microsimulation model. Figure 20.1 provides an example of an O-D matrix.

[4] $RNSE = \sqrt{\frac{(Vb-Vr)^2}{Vr}}$ Where Vb = Balanced Volume and Vr = Raw Volume

O-D matrices can be challenging to develop in terms of time and amount of data. The following provides information to help the analyst choose appropriate O-D estimation or data collection methods and data requirements when working with microsimulation models. Document the O-D development methodologies and assumptions, typically within the Traffic Forecasting Methodology Report, and submit to WisDOT regional traffic staff and WisDOT TFS for review and approval. WisDOT TFS will summarize their comments on the development of the O-D matrices within DT2340. Involve BTO-TASU in the review as appropriate (see TEOpS 16-25).

Figure 20.1 Example Zone Map and O-D Matrix



O-D Matrix

Destinations

Origins	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	0	1	18	12	39	27	25	13	40	33	40	2	33	27	49	32
2	10	0	23	8	43	23	19	2	39	16	42	1	0	45	35	5
3	2	1	0	21	17	37	5	32	37	18	35	35	30	5	34	6
4	26	14	1	0	17	13	25	3	42	36	31	28	50	42	46	35
5	45	38	22	16	0	0	49	49	22	8	2	9	12	5	7	17
6	8	32	18	26	15	0	17	20	37	26	41	11	3	26	41	45
7	22	34	4	49	41	31	0	20	28	48	36	37	10	8	3	38
8	47	32	8	37	16	28	27	0	9	33	28	5	2	12	28	7
9	40	49	33	15	29	47	37	28	0	12	32	2	46	12	37	26
10	41	31	49	48	22	0	47	9	11	0	34	21	41	30	33	12
11	15	45	42	25	14	49	2	1	12	18	0	10	31	19	35	11
12	39	47	4	12	26	12	29	33	47	6	34	0	40	46	40	15
13	10	13	19	22	46	21	13	15	39	42	13	42	0	7	3	34
14	37	27	49	8	44	40	42	12	15	8	39	2	27	0	24	49
15	40	7	24	36	33	33	34	46	31	46	22	43	13	28	0	18
16	5	8	33	5	38	39	13	47	36	8	20	21	29	23	47	0

20.2 Defining Zones

One of the first steps in building an O-D based microsimulation model is to establish a set of zones which represent the locations where traffic enters and exits the model. Zones can be origins or destinations of traffic. The schematic in Figure 20.1 illustrates an example zone map where the numbers represent the zones at the edges of the network.

Figure 20.1 also shows an example O-D matrix which corresponds to the zone map in the schematic. The values in each cell of the matrix represent the number of one-way trips between each O-D pair for a given time period. If a model is comprised entirely of two-way links, each zone will function as both an origin and a destination. In the O-D matrix, zeros reflect intrazonal trips (the shaded diagonal line in Figure 20.1), impossible trip pairs, or just the absence of trips between the zones. Depending on the zone structure, it *may* be possible for a trip to start and end at the same zone, specifically for U-turns or alternative intersection designs[5]. For the traffic model to properly capture these trips, it *may* be necessary to modify the zone structure by splitting zones into separate origin and destination zones or by adding "dummy" zones.

Consistent zone numbering helps organize O-D matrices. For example, an analyst might start with Zone 1 at one end of the model and continue numbering to the other end as shown in Figure 20.1. If the modeling objectives include analyzing the impacts of future development, it *may* be appropriate to reserve one or more "dummy" zone numbers to facilitate adding the development traffic to the design year model.

Prior to developing the O-D matrices, the analyst *should* meet with WisDOT regional traffic staff to confirm the proposed zone structure. It *may* be advantageous to involve WisDOT TFS and BTO-TASU in these meetings, especially if they will be involved in the review of the traffic model (see TEOpS 16-25).

[5] Alternative intersections reroute one or more turning movements (typically left-turns) away from the center of the primary intersection to a secondary junction and then back through the primary intersection. Examples of alternative intersections include, but are not limited to, restricted crossing U-Turn (RCUT), median U-Turn (MUT) and displaced left turn (DLT).

20.3 Sources of O-D Data

There are multiple techniques, within two main classifications (field measurement or synthesis), available for collecting or estimating O-D data. The basis of the O-D data for the simulation modeling (not including the TDM) typically comes from three main sources:

- TDM data
- Field measured O-D data
- O-D synthesis using traffic count data

Depending on the level of detail and confidence required to accomplish the goal of the simulation analysis, the analyst *may* utilize one or more sources to develop the O-D matrix. Refer to TEOpS 16-5-20.4 for additional details on what O-D sources *may* be appropriate for modeling.

20.3.1 TDM O-D Data

In Wisconsin, the Metropolitan Planning Organizations (MPOs) and most Regional Planning Commissions (RPCs) coordinate with WisDOT TFS to develop and maintain TDMs which aid in the development of long-range transportation plans. WisDOT TFS also maintains a statewide TDM. Contact WisDOT TFS to determine the latest version of TDMs for project data. Complete the DT1599 (Agreement for and Restrictions on use of WisDOT Travel Demand Models) form and submit to WisDOT TFS (DOTTrafficForecasting@dot.wi.gov) to request a copy of the TDM or subarea model extraction and the associated O-D trip tables. Refer to the TPM for additional details on the TDMs in Wisconsin.

If there is an existing TDM that covers the area of interest, the associated O-D information from a subarea model extraction can be a good starting point for the O-D matrix for the microsimulation models. However, since the microsimulation models typically have more detail than TDMs, in terms of the transportation network and zones, and often require more discrete analysis periods, the conversion from the TDM is not without effort. The additional effort *may* be attributable to the following:

- To utilize the TDM subarea O-D data in the more detailed simulation models, the analyst must first make sure that they align the origin and destination data between the two models. This *may* require the analyst to group the zones within the more detailed model to reflect the TDM zone structure.
- Although peak hour or peak period data *may* be available from the TDM, in some of the TDMs, the output is only representative of 24-hour traffic flows. Further, the TDM output *may* only represent traffic patterns from the nearest decennial census year. Thus, to develop accurate peak hour or peak period O-D matrices from regional TDM data, the analyst *may* need to apply factors to the O-D data to represent the desired conditions (e.g., AM and PM peak hours of the existing conditions).
- TDM O-D data typically reflect regional travel patterns and *may not* be able to accurately capture turning movements at the intersection level. If the project goals require detailed intersection level analysis, prior to utilizing the TDM O-D data, it *may* be necessary to gather field counts to validate and modify the volume targets. Before collecting new field counts, coordinate with WisDOT regional traffic staff to verify there are no other sources of the necessary data available. Additional resources for identifying data sources include WisDOT BSHP and WisDOT TFS. Follow the TPM and other available WisDOT guidelines for data collection as applicable.

20.3.2 Field Measured O-D Data

O-D data collection methods have historically been labor and time intensive, but modern technologies and data sources have reduced the effort involved. The benefits of having additional data from the field (e.g., better understanding of travel patterns in the study area, a more legally defensible and accurate model), often out-weigh the additional time and effort spent collecting the O-D information necessary for development of microsimulation models. With that said, before conducting any new O-D field surveys, coordinate with WisDOT regional staff and WisDOT TFS to verify there are no existing sources of relevant O-D data available. Refer to Section 60 of the TPM for additional information on O-D travel surveys as they pertain to TDMs.

Historical techniques for collecting O-D data have included: roadside interviews, mail-back (postcard) surveys, telephone surveys, and license plate matching. These techniques often have limited sample sizes and can be invasive or disruptive to traffic. License plate matching using video data collection can still be a useful technique, but requires extensive data collection equipment, data reduction, and has privacy concerns because it *may* be possible to trace the license plates to a database of vehicle owners.

Modern techniques for collecting O-D data include:

- **Wireless Data Readers:** Analyst can utilize Bluetooth devices to determine vehicle O-D patterns. Bluetooth is a short-range wireless communication protocol for connecting consumer electronics such as headsets, mobile phones, laptop computers, global positioning systems (GPS), and car communication systems. Every device equipped with Bluetooth has a number called the Media Access Control (MAC) address. Bluetooth devices exchange MAC addresses to initiate communication with each other. Unless the user has manually disabled "discovery mode", the Bluetooth device transmits its MAC address periodically to search for new connections. For traffic monitoring purposes, it is not necessary to establish communication with the Bluetooth device—it is sufficient to monitor the signals from passing vehicles, record the MAC addresses they transmit, and re-identify the devices when they cross another zone boundary. In principle, this is like the license plate matching technique, but it avoids some of the privacy concerns since there is no master database of MAC addresses. The number of discoverable vehicles by Bluetooth, sometimes referred to as the "penetration rate," can vary depending on location and time of day, so it is necessary to scale up (i.e., post-process) the raw Bluetooth O-D matrix to reflect actual traffic volumes. With Bluetooth surveys, it is important to note that most, if not all, commercial trucks have GPS devices in discovery mode, while it is unknown if passenger vehicles have GPS, potentially leading to an overrepresentation of heavy vehicles. Additionally, the Bluetooth penetration rate is relatively low (typically less than 10%). The sample size *should* consider the penetration rate and potential overrepresentation of heavy vehicles to ensure that the Bluetooth O-D data sufficiently captures the travel patterns of those utilizing the roadway system.
- **Aerial Observation:** Airplanes, helicopters, drones, or even hot air balloons can observe and photograph traffic to collect O-D data. The images can be post-processed, via manual methods or computer algorithms, to track vehicle paths through the study area to measure O-D data. License plates are typically not visible in the photos, avoiding privacy concerns.
- **Third Party Probe Data Providers:** Third party companies like Streetlight, Teralytics, and others use "probe" data from GPS and cell phones to develop O-D matrices. The companies process, anonymize, and report the data in project-specific O-D zones. Purchased O-D data *may* have higher penetration rates than Bluetooth O-D data because of the multiple sources of probe data collected by third parties. Like, Bluetooth O-D data, third party probe data *may* provide an overrepresentation of heavy vehicles. The analyst *should* consider this potential overrepresentation when determining the sample size.

Forward the results of any O-D data collection efforts to WisDOT TFS (DOTTrafficForecasting@dot.wi.gov) for their reference and potential use within the TDM.

20.3.3 O-D Synthesis Using Traffic Count Data

Although there is a link between traffic volumes and O-D traffic demand, measuring traffic volumes in the field is often easier than measuring O-D demand data. Potential reasons for this include, but are not limited to, the following:

- Observations and data collection at spot/isolated locations (e.g., turning movement volumes at a single intersection or traffic flows on a basic freeway segment) can provide traffic volume data. However, congestion upstream or downstream of the count site *may* be metering traffic such that the spot location volume *may not* reflect the "true" demand. To capture "true" demand, it *may* be necessary to collect additional field data at the upstream or downstream locations, which *may* or *may not* be within the project study area.
- Multiple combinations of travel patterns can yield the same traffic volume at a spot location. Thus, to measure O-D data in the field, it is often necessary to track a vehicle from the point it first enters the roadway network to the point it exits the network.

Document, typically within the Traffic Forecasting Methodology Report, and save the results of any O-D synthesis efforts with the project files.

20.3.3.1 Manual Estimation Techniques

It *may* be possible to utilize manual estimation techniques to develop an O-D matrix from traffic counts. Analysts will typically use manual techniques for small O-D matrices or when TDM data is not available but *may* also choose to utilize manual techniques when obtaining O-D field data is time or cost prohibitive or when they wish to refine a previously developed O-D matrix. Typical manual techniques include gravity model estimation, by-hand estimation (such as using turning movement percentages or local traffic knowledge), or software designed for O-D estimation.

The gravity model is an algorithm used in transportation planning to measure the amount of traffic between activity centers. The model assumes the number of trips between two zones is directly proportional to the number of trip attractions in the destination zone and inversely proportional to a function of travel time between the two zones. In other words, the number of trips destined for a particular zone is dependent on the zones relative attractiveness and the length or difficulty of making the trip. The amount and type of land use in each zone determines this relative attractiveness based on the amount of travel people are willing to make for different trip purposes. Drivers usually take the shortest, fastest route and, as congestion makes one route less desirable, drivers will use other routes.

Employing the gravity model to create an O-D table will rarely lead to row and column totals that sum correctly so it is necessary to factor the cells within a matrix using biproportional matrix balancing (also known as the Fratar or Furness procedure). The Furness procedure factors the rows and columns by multiplying a row or column by the ratio of the desired to actual values. Figure 20.2 illustrates an example of the Furness procedure. After several iterations, the matrix *may* converge as the ratio of desired to actual values approaches one. If it does not converge, the analyst *should* perform enough iterations to result in a tolerable error. Additionally, the analyst could average the last row and column iterations to help improve the O-D estimation.

Figure 20.2 Example Biproportional Matrix Balancing (Fratar or Furness Procedure)

1. Sample OD Matrix

(Could be the output from a gravity model estimation)

	1	2	3	4	Sum	Desired	Row Factor
1	0	19	81	40	140	140	1.0
2	45	0	68	12	125	125	1.0
3	92	46	0	82	220	220	1.0
4	64	71	15	0	150	150	1.0
Sum	201	136	164	134			
Desired	190	145	200	150			
Column Factor	0.95	1.07	1.22	1.12			

Column totals do not match desired values.

2. Multiply Step 1 matrix cells by column factors

	1	2	3	4	Sum	Desired	Row Factor
1	0	20	99	45	164	140	0.85
2	43	0	83	13	139	125	0.90
3	87	49	0	92	228	220	0.97
4	60	76	18	0	154	150	0.97
Sum	190	145	200	150			
Desired	190	145	200	150			
Column Factor	1.0	1.0	1.0	1.0			

Row totals do not match desired values.

3. Multiply Step 2 matrix by row factors

	1	2	3	4	Sum	Desired	Row Factor
1	0	17	84	38	140	140	1.00
2	38	0	75	12	125	125	1.00
3	84	47	0	89	220	220	1.00
4	59	73	18	0	150	150	1.00
Sum	181	138	177	139			
Desired	190	145	200	150			
Column Factor	1.05	1.05	1.13	1.08			

Column totals do not match desired values.

4. Multiply Step 3 matrix by column factors…

5. Multiply Step 4 matrix by row factors…

6. Iterate until row and column sums converge to desired values

20.3.3.2 O-D Estimation Software

Another way for an analyst to synthesize an O-D matrix from traffic counts is through utilization of specialized O-D estimation software. Often the estimation software is part of a larger software suite, such as Cube Analyst (part of the Cube TDM software) or VISUM (part of PTV's suite of tools). O-D estimation software often requires several iterations and fine-tuning of algorithm parameters to produce an O-D matrix. The analyst *should* read and understand the parameters used by each software method. As true for any estimation methodology, it is critical to carefully check the resulting O-D matrix for reasonableness.

20.4 O-D Data Requirements

Model size and complexity are the primary factors in determining the O-D data requirements. The number of zones in the network determines the model size. Model complexity is more subjective. Factors that tend to influence the complexity of the model include weaving areas, closely-spaced intersections, and other locations where O-D patterns affect traffic operations. The number of zones in the model also increases complexity by requiring exponentially more data. For example, a model with 5 zones has 5x5=25 O-D pairs, while a model with 50 zones has 50x50=2500 O-D pairs. As the model increases in size and complexity, so does the need for more accurate sources of O-D data. Additionally, the larger and more complex the model, the more time and resources are necessary to develop the O-D matrix.

To allow for the discussion of O-D estimation data requirements, this policy divides model size and complexity into three categories:

- **Small** – Models with fewer than 20 zones
- **Medium** – Models with 20 to 50 zones
- **Large** – Models with more than 50 zones

Small models typically have less than 20 zones. O-D matrices for models of this size typically require limited or no field-measured O-D data. The analyst *should* gather traffic counts for the project area. Additionally, with some knowledge of local traffic patterns, the analyst often can develop the O-D by hand. If existing data sources cannot provide the information, at critical locations affected by O-D patterns, consider collecting field O-D data or performing sensitivity analysis.

Medium sized models have about 20 to 50 zones. Although the number of zone pairs increases substantially for models of this size, knowledge of regional trip patterns and basic trip distribution methods can result in acceptable O-D matrices without the need to use a special O-D estimation tool. Consider using the gravity model, or estimation software, to estimate the number of trips between known attractions. A TDM subarea extraction *may* also help in developing O-D matrices. It *may* be necessary to collect field data at critical locations affected by O-D patterns.

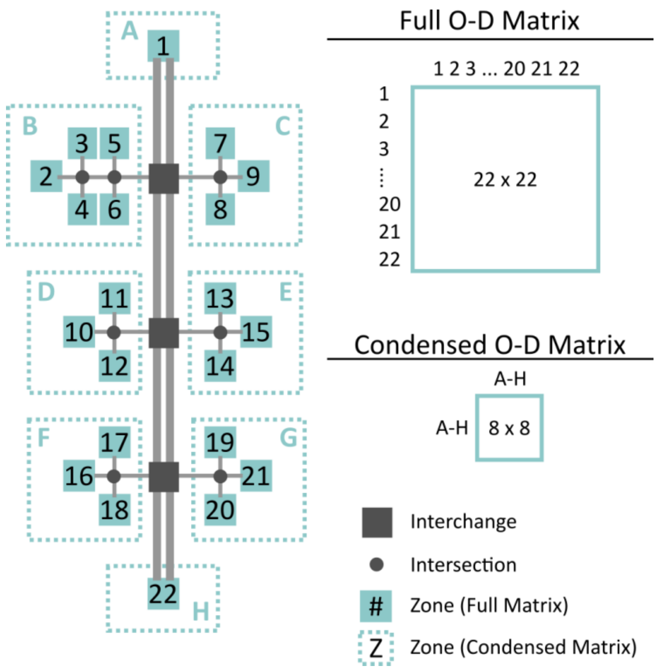
Large models tend to have more than 50 zones. Because of the number of O-D pairs, the analyst will need to employ multiple O-D estimation methods, and it will require considerable time and effort to deal with the amount of data. Use of a TDM subarea extraction will most likely be necessary for development of an O-D matrix. It *may* require the use of field data and hand-estimation to refine the matrix.

Regardless of the model size, before conducting any new O-D field surveys, coordinate with WisDOT regional staff and WisDOT TFS to verify there are no existing sources of relevant O-D data available.

Grouping zones to develop a condensed O-D matrix can be an effective technique for reducing data requirements, especially for large models or when working with TDM data. For example, a freeway focused model that includes arterial intersections could have its zones condensed to have one zone to represent each ramp terminal as shown in Figure 20.3. Figure 20.3 condenses the full 22x22 O-D matrix into an 8x8 O-D matrix. The condensed O-D matrix would require less detailed information, similar to what is available from most TDMs, and could reduce the level of effort for field data collection. Once the analyst has the condensed O-D matrix, they can expand it to the full zone structure using turning movement counts or local knowledge. Condensing and expanding O-D matrices allows broader patterns to be well-represented with less data requirements.

Prior to finalizing the details of the model and O-D matrices, the analyst *should* meet with WisDOT regional traffic staff to verify the O-D data requirements and needs. It *may* be advantageous to involve WisDOT TFS and BTO-TASU in these meetings, especially if they will be involved in the review of the traffic model (see TEOpS 16-25). Document any decisions pertaining to the O-D data requirements, typically within the Traffic Forecasting Methodology Report, and save with the project files.

Figure 20.3 Example Zone Grouping



20.5 Future Year O-D Estimation

Analysis of future year scenarios in microsimulation models require a future year O-D matrix. Typical techniques for developing future year O-D matrices include:

- Global scale factor
- Local scale factors
- Travel Demand Model

Of these methods, the TDM method is the most comprehensive method for integrating with traffic forecasts. Document the selected O-D estimation technique, typically within the Traffic Forecasting Methodology Report, and save with the project files.

The global scale factor method assumes all zones within the O-D matrix change by the same uniform amount. Typically, an analyst will limit the use of a global scale factor for future scenarios to sensitivity analysis testing, or for a simplified approximation to more rigorous forecasting. A global scale factor can be useful for interpolating or extrapolating a forecast to a different analysis year or helping to estimate how much spare capacity a facility *may* have.

The local scale factor method has the analyst apply changes to select O-D pairs to investigate the effects of a specific change in demand. For example, in a Traffic Impact Analysis (TIA), the analyst could change specific O-D pairs to reflect the expected development. An analyst can also use local scale factors to refine results from either the global scale factor or TDM methods for creating a future year O-D matrix.

Developing a future year microsimulation O-D matrix using TDM subarea extraction O-D matrices involves many steps as shown in Attachment 20.1 – O-D Process Flow Chart, and often requires many iterations to produce an acceptable future year O-D matrix for more detailed simulation analyses. The process starts with calculating the change in traffic between the TDM base and future year O-D matrices. As discussed in the *National Cooperative Highway Research Program (NCHRP) Report 255: Highway Traffic Data for Urbanized Area Project Planning and Design* (4), there are two methods available for computing the change in traffic from the TDM:

- **Absolute change** – Takes the difference between the future year and base year TDM O-D matrices. For example: if one O-D pair has 100 trips in the base year and 200 trips in the future year, the change is +100 trips. The change in traffic would be negative if the future year trips were lower than base year trips.
- **Relative change** – Takes the ratio of the future year to base year TDM O-D matrices. Using the same example above, the relative change would be 200 trips future / 100 trips base = 2.0.

The process continues by applying the results from both methods to the base microsimulation O-D matrix. Consider an example where the same O-D pair in the example above has 80 trips in a microscopic simulation O-D matrix. The future year could have 180 trips (80 trips + 100 trips) using the absolute change method. The future year could also have 160 trips (80 trips * 2.0) using the relative change method. Since both the absolute change and relative change methods often yield reasonable results, the analyst will typically average the results of the two methods (170 trips) as a starting point.

In some cases, the absolute or relative change methods *may* yield extreme results, typically for TDM O-D pairs that have a very small number of trips. For example: consider an O-D pair that changes from 1 trip in the base year to 10 trips in the future year. This is a 10-times increase using the relative method, but only a 9-trip increase using the absolute method. Even after averaging, the future simulation O-D matrix *may* yield unreasonably high traffic volumes because of the large multiplicative increase from the relative change method. The analyst *may* consider using only the absolute method for this O-D pair instead.

20.6 Review

The analyst **shall** review the O-D matrices, specifically any future O-D matrices, for reasonableness. Performing validation tests on the microsimulation model (see TEOpS 16-20-8) and reviewing traffic growth or land use can help in determining reasonableness. This could include verifying that the change in traffic at the origin and destination zones reflect that shown in the traffic forecasts or TDM. Additionally, the relative change between the existing and future O-D matrices *should* mirror the trends from the traffic forecasts.

Another check *may* include looking for O-D pairs that show fewer trips in the future year than the base year. A no-build scenario (assuming the status quo for population, land use, and transportation trends), would typically assume zero O-D growth at a minimum (no negative growth) to demonstrate that demand in the future would at least be equal to what exists today. Future decreases in O-D *may* be appropriate if there is a definitive cause, typically in an alternative scenario analysis such as a route closure, new transportation mode, or alternative land use or population scenario. Reviewing minimum and maximum growth in the future O-D matrix within the context of the scenario assumptions can help in determining reasonableness.

The WisDOT regional staff and WisDOT TFS **shall** conduct a peer review of the O-D matrices developed for microsimulation models in accordance with the procedures outlined in TEOpS 16-25. The region will involve BTO-TASU in the peer review process as appropriate. The DT2291 and DT2340 forms provide a means to document the peer review. Save the DT2291, DT2340, and all other notes on the peer review of the O-D matrices with the project files.

20.7 Document

Document the O-D development methodologies and assumptions, typically within the Traffic Forecasting Methodology Report. Explain the rationale for the zone structure, including the numbering scheme and use of any “dummy” zones. Provide graphics and tables to illustrate the zone map schematic. Describe what the O-D data represents (e.g., day, month, year, analysis period, etc.) making sure to note the source(s) of the O-D data. Provide justification for the use of any new O-D data collection efforts.

Outline the techniques used to develop the O-D matrices (field-measured, synthesis, manual estimation, O-D estimation software, etc.) and describe any project-specific needs and other unique considerations taken into consideration.

Submit a copy of the Traffic Forecasting Methodology Report and any other documentation associated with the O-D development to WisDOT regional traffic staff and WisDOT TFS for review and approval. The region will involve BTO-TASU in the review as appropriate.

Save all the final O-D matrices and any associated documentation with the project files.

LIST OF ATTACHMENTS

Attachment 20.1 O-D Process Flow Chart

16-5-70 References April 2025

1. **Institute of Transportation Engineerings.** *Manual of Transportation Engineering Studies, 2nd Edition.* ITE, 2010. ISBN-13: 978-1-933452-53-1; ISBN-10: 1-933452-53-6.

2. **Transportation Research Board.** *Highway Capacity Manual, 7th Edition: A Guide For Multimodal Mobility Analysis.* Washington, D.C. : National Academy of Sciences, 2022. ISBN 978-0-309-08766-7.

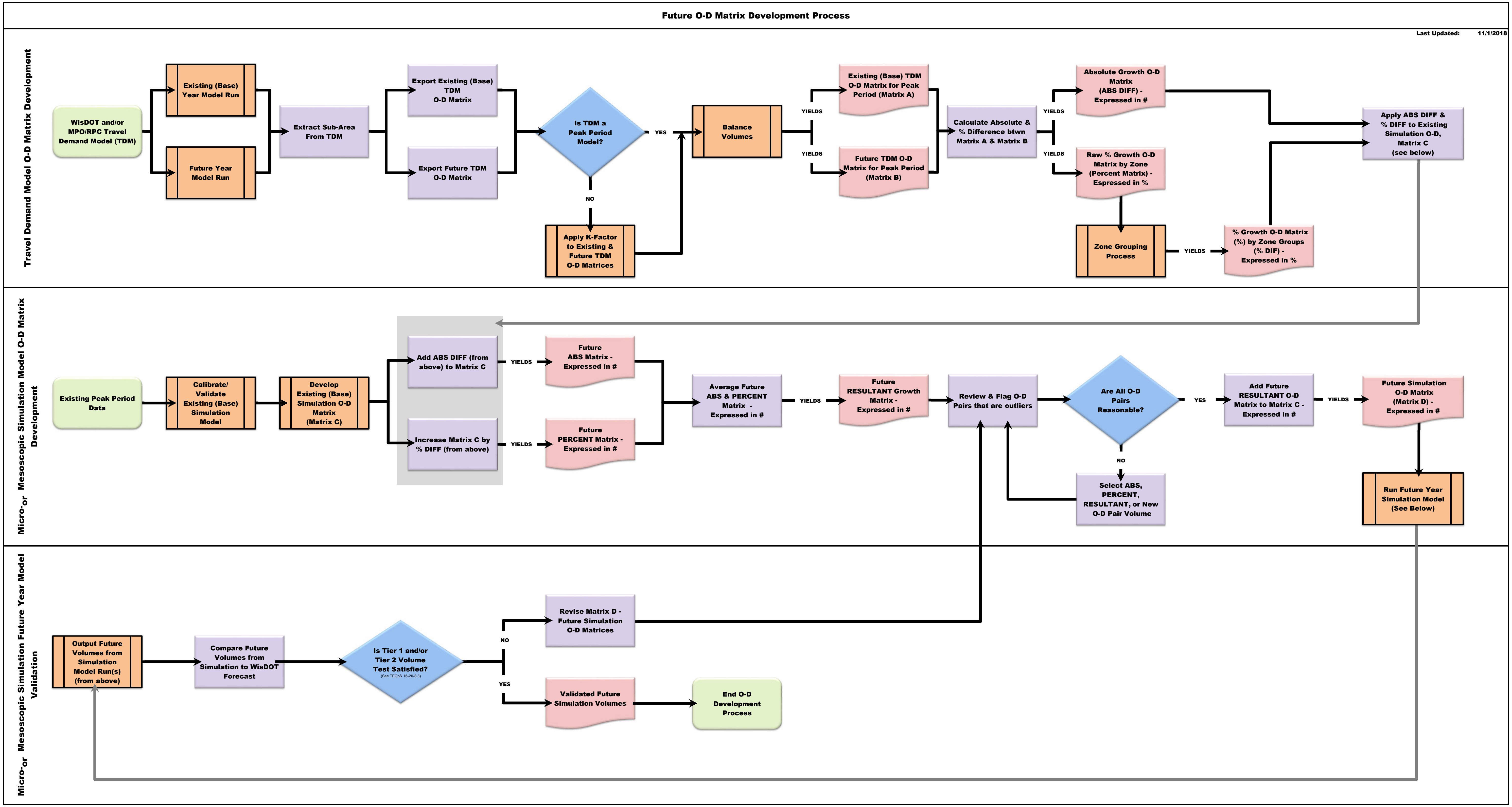
3. **Federal Highway Administration.** *Traffic Monitoring Guide.* Washington, D.C: U.S. Department of Transportation, 2016. FHWA-PL-17-003.

4. **Transportation Research Board.** *NCHRP Report 255: Highway Traffic Data for Urbanized Area Project Planning and Design.* Washington, D.C. : National Cooperative Highway Research Program (NCHRP), 1982. ISBN 0-309-03450-7/ISSN 0077-5614.

5. **Shaw, J.** Automated Optimal Balancing of Traffic Volume Data for Large Access-Controlled Highway Networks and Freeway-to-Freeway Interchanges. *Proceedings from the TRB 2014 Annual Meeting.*

6. **Ren, J. & Rahman, A.** Automatically Balancing Intersection Volumes in a Highway Network. 12th TRB Transportation Planning Applications Conference, 2009.

Attachment 20.1 O-D Process Flow Chart



16-10-1 Overview of Available Traffic Analysis Tools April 2025

The Federal Highway Administration (FHWA) Office of Operations - Traffic Analysis Tools Program provides substantial background and guidance on the available types of tools and careful selection of the right tool for the task. FHWA's *Traffic Analysis Toolbox Volume II (TAT II)* (1) was prepared to assist traffic engineers and planners in selecting the most appropriate traffic analysis tool. For more information on the FHWA guidance, visit the Traffic Analysis Tools homepage and refer to the set of documents in the Traffic Analysis Toolbox series.

1.1 Categories of Traffic Analysis Tools

The primary categories of traffic analysis tools utilized at WisDOT include:

- HCM-based deterministic tools
- Signal optimization tools
- Work zone analysis tools
- Traffic simulation tools
- Dynamic traffic assignment (DTA) tools
- Travel-time reliability analysis tools

The following provides guidance on selecting the appropriate tool category before selecting from the WisDOT-supported software packages.

1.2 HCM-Based Deterministic Tools

The Highway Capacity Manual (HCM) provides several analytical or deterministic methodologies that can estimate roadway or intersection capacity, delay, density, and other performance measures for various elements of the street and highway system.

The HCM methodologies are based on the standard relationship between flow, speed, and density of the traffic stream. Since the HCM methodologies are deterministic, a fixed set of inputs will yield a single set of outputs. As such, tools that implement the HCM methodologies are typically simplistic and easy to utilize and *should* be the first choice for most traffic analyses.

Although the HCM procedures are good for analyzing the performance of isolated and non-congested facilities they do have limitations. For example, the HCM models do not have the ability to account for interactions between network elements (e.g., they cannot reflect a queue backup at a ramp terminal within the adjacent freeway operations) and they may under predict the extent of congestion in oversaturated conditions. Consider the strengths and limitations of the HCM methods when deciding if an HCM-based tool is appropriate for a specific analysis or study.

The *Highway Capacity Manual, 7th Edition: A Guide for Multimodal Mobility Analysis (HCM7)* (2) is the most current version of the HCM. Unless the WisDOT regional engineer provides prior authorization, the traffic analysis shall follow the HCM7 methodologies. For project analysis initiated prior to January 1, 2023, it may be acceptable to continue to follow the *HCM6* (3) methodologies. Coordinate with the regional traffic engineer or Bureau of Traffic Operations, Traffic Analysis and Safety Unit (BTO-TASU) to verify whether to continue using the HCM6 methodologies or whether to update to the HCM7 methodologies.

The WisDOT-supported tools that implement the HCM methodology for capacity analysis are:

- Highway Capacity Software (HCS), McTrans
- Synchro, Trafficware
- SIDRA, Akcelik and Associates (supported only for roundabout analyses)
- Vistro, PTV Group (requires prior approval from the WisDOT regional traffic engineer)

Refer to the BTO Traffic Analysis, Modeling and Data Management Program area webpage for the version and build of the above software that WisDOT currently supports.

Although WisDOT does support the use of Vistro for the analysis of signalized and stop-controlled intersections, acceptance of Vistro is up to the discretion of the WisDOT regional office. See TEOpS 16-10-5 for additional guidance on how to select the most appropriate traffic analysis tool for a specific project and refer to TEOpS 16-15 for additional details on conducting HCM-based deterministic analyses.

1.3 Signal Optimization Tools

Signal optimization tools help identify the optimal signal cycle lengths, phase times, splits, and offsets for signal systems ranging from isolated signals to coordinated signal systems. Typically, the process begins with the analyst setting up a network representing the geometric layout and traffic demand in the intersection or corridor of interest. The software then tries thousands of different combinations of cycle length, split, and offset to determine the "optimal" signal timing.

In this context, the word "optimal" has a strict mathematical definition called the objective function, which typically tries to minimize the total delay per vehicle. The analyst can impose policy- or experience-based constraints on the signal phasing, such as the minimum green time provided to minor movements, to influence the optimization.

Use professional judgment to fine-tune the results from signal optimization efforts when deciding on new or updated traffic signal timing and phasing; this is particularly important when a corridor includes unsignalized intersections or major driveways that affect operations.

The WisDOT-supported tools that perform signal optimization are:

- Synchro, Trafficware
- Vistro, PTV Group (requires prior approval from WisDOT regional traffic engineer)

Refer to the BTO Traffic Analysis, Modeling and Data Management Program area webpage for the version and build of the above software that WisDOT currently supports.

Although WisDOT does support the use of Vistro for signal optimization, acceptance of Vistro is up to the discretion of the WisDOT regional office. See TEOpS 16-10-5 for additional guidance on how to select the most appropriate traffic analysis tool for a specific project.

WisDOT previously supported HCS for signal optimization, however, recent studies found that the optimization features in HCS tended to underestimate the phase and cycle length requirements, especially for coordinated signal systems. As such, the analyst *should not* utilize HCS when optimizing signal timing plans for field implementation. Analysts may continue to utilize the optimization features of HCS for the evaluation, assessment, and comparison of the capacity/operation of alternative scenarios.

1.4 Work Zone Analysis Tools

Specialty tools are available for analyzing traffic in highway construction zones. These analysis tools typically provide a way to compare travel times with and without construction and compute the resulting work zone queue length, delay, and road user cost. Other frequently occurring issues that the analyst may need to assess for construction on rural and urban highways and freeways include, but are not limited to, the following:

- Selecting appropriate hours for lane closures
- Assessing the use of two-way, one-lane operation
- Identifying construction staging needs
- Quantifying the amount of traffic that could divert to alternate routes
- Evaluating potential mitigation measures (e.g. providing a temporary bridge to maintain traffic during construction), including cost-benefit analyses

The work zone traffic analysis tool (WZTAT) should be used for all freeway and expressway construction projects to determine queuing, delay and road user costs based on the capacity. Refer to FDM 11-50-30 and coordinate with the WisDOT regional work zone engineer or BTO Work Zone Engineers for assistance in determining work-zone related delay, queue, and road-user costs for freeways and highways as appropriate.

1.5 Traffic Simulation Tools

There are three primary categories of traffic simulation tools: macroscopic, mesoscopic, and microscopic simulation. Simulation tools usually provide visual animation of the traffic flow; however, it is possible to have a simulation tool without the visual component. The following describes each of these simulation tools in more detail.

1.5.1 Macroscopic Traffic Simulation

Macroscopic traffic simulation tools assess the operation/capacity of a facility or network utilizing the deterministic relationships of flow, speed, and density of the traffic stream. The simulation analyzes the movement of vehicles on a section-by-section basis. Travel demand models (TDMs) are an example of a macroscopic tool. The policy within this chapter does not cover macroscopic simulation tools or TDMs. Refer to the Transportation Planning Manual (TPM) for additional details regarding TDMs.

1.5.2 Mesoscopic Traffic Simulation

Mesoscopic traffic simulation tools analyze the movement of individual vehicles or vehicle cells as they travel through a simulated network using predefined capacity and speed-density relationships. Mesoscopic models incorporate a level of network and operational detail comparable to microsimulation models with the route choice flexibility of macroscopic simulation models (TDMs). Most mesoscopic simulation models incorporate dynamic traffic assignment (DTA), thus, this policy utilizes the term DTA model throughout to represent mesoscopic simulation models. Refer to TEOpS 16-10-1.6 for additional discussion on DTA tools.

1.5.3 Microscopic Traffic Simulation

Microscopic traffic simulation or microsimulation, refers to tools that analyze the movement of individual vehicles as they travel through a network. As the simulation progresses, it updates factors such as each vehicle's position and its need to increase/decrease speed or change lanes several times a second. As a result, these tools are suitable for evaluating the interaction of different components of the transportation network, such as queues from an intersection that cause lane blockage upstream or complex weaving and merging behaviors. Additionally, the visual animation of traffic flows can make microsimulation traffic models useful for public outreach and stakeholder presentations.

Microscopic modeling work typically requires significantly more time, data, and effort than other tools. In addition, improperly calibrated microsimulation models can provide misleading outputs, such as showing congestion where none exists, or free-flowing traffic where there is congestion. When using the model outputs to make critical decisions, the project manager should insist on crosschecking with simpler tools to assure that microsimulation outputs are reasonable. WisDOT supports the use of microscopic simulation models, but prior to utilizing microsimulation, the WisDOT project team should first assess whether an HCM-based deterministic tool could sufficiently accommodate the traffic analysis needs of the project.

The WisDOT-supported programs that perform microscopic simulation are:

- Vissim, PTV Group
- SimTraffic, Trafficware

Refer to the BTO Traffic Analysis, Modeling and Data Management Program area webpage for the version and build of the above software that WisDOT currently supports.

SimTraffic is only applicable for arterial analysis and is best suited for signalized corridors. WisDOT does not currently support the use of SimTraffic for roundabout analysis; however, contingent on approval from the WisDOT regional traffic staff, it may be acceptable to use SimTraffic to gauge how a roundabout might interact with an adjacent traffic signal. The analyst will often use SimTraffic to observe driver behavior and conduct a "reality check" on the Synchro outputs. SimTraffic may also be beneficial for reporting the vehicle queues, especially when vehicles spill out of the turn lane and block through traffic. If the primary purpose of the SimTraffic model is to conduct "reality checks", calibration and validation of the traffic model may not be necessary. However, prior to using the model outputs from SimTraffic for critical design decisions, the analyst shall calibrate and validate the SimTraffic model (TEOpS 16-20).

Prior to January 1, 2018, WisDOT supported the use of Paramics. As such, projects that initiated the microsimulation traffic analysis using Paramics prior to January 1, 2018 may continue to use Paramics for the duration of the project. However, if there is a need to make major revisions to the traffic models (e.g., use of different base year conditions), the analyst should consider switching the traffic models over to Vissim. Consult with the WisDOT regional traffic contact or BTO-TASU to determine whether it is appropriate to switch software programs.

See TEOpS 16-10-5 for additional guidance on how to select the most appropriate traffic analysis tool for a specific project and refer to TEOpS 16-20 for additional details on conducting microsimulation analyses.

1.6 Dynamic Traffic Assignment (DTA)

DTA is a modeling approach that captures the relationship between dynamic route choice behaviors (path and start time) and transportation network characteristics (travel speeds, signal timings, level of congestion, etc.) It is possible to incorporate DTA into any level of simulation models (macroscopic, mesoscopic, microscopic); however, the most common application of DTA is for mesoscopic simulation models. Therefore; this policy assumes all DTA models are mesoscopic models.

DTA tools are useful for analyzing roadway networks with parallel routes, especially when there is a need to evaluate potential diversion traffic. Other scenarios where a DTA model may be beneficial include those that involve shifts in the temporal distribution of traffic (i.e., peak spreading or contraction).

WisDOT does not currently support any DTA tools. However, BTO-TASU is willing to consider the use of DTA if the project needs support/justify its use. Coordinate with WisDOT regional traffic staff and BTO-TASU and obtain prior approval before utilizing DTA.

1.7 Travel-Time Reliability Analysis Tools

Travel-time reliability analysis tools allow the analyst to assess how travel times along a corridor fluctuate over time in response to various traffic, roadway, and weather conditions. The analysis considers both recurring and nonrecurring delays where nonrecurring delays are associated with crashes, work zone activities, and event activities, among other unexpected or atypical conditions.

Travel-time reliability analysis is data intensive in that it requires details on weather conditions, work zone activity, incident/crash data, and variation in traffic demands for a period of several days or more (ideally, the reliability analysis would cover one-year worth of data). As such, prior to conducting travel-time reliability analysis, the WisDOT project team *should* assess whether reliability is critical to meeting the goals and needs of the project. Review of the National Performance Management Research Data Set (NPMRDS) can provide insight into the variability of travel times along the corridor. If the roadway network is congested but has reliable travel times (i.e., the travel time along the corridor is always the same), there would be little benefit to performing reliability analysis. However, if the travel time along the corridor is highly unreliable (i.e., there is considerable variation in travel time along the corridor from one day to the next), then it may be necessary to evaluate travel-time reliability performance measures. Coordinate with WisDOT regional traffic staff to determine whether to conduct travel-time reliability analysis for a specific project.

The WisDOT-supported tool that performs reliability analysis is:

- HCS, McTrans

Refer to the BTO Traffic Analysis, Modeling and Data Management Program area webpage for the version and build of the above software that WisDOT currently supports.

16-10-5 Traffic Analysis Tool Selection — September 2019

There is no "one size fits all" traffic analysis tool. The tools used for each analysis vary in their data requirements, capabilities, methodology, and output. Tools that are more powerful require greater time and effort, so it is important to match the analysis methods with the scale, complexity, and technical requirements of the project. HCM-based deterministic tools *should* typically be the first choice for most traffic analyses. However, when the analysis requirements do not fit within the confines of the HCM-methodology or when there is a need to provide supplemental information, it may be necessary to utilize an alternative analysis tool such as microsimulation. Oftentimes, it is necessary to use a combination of multiple traffic analysis tools to meet the project goals and needs (e.g., the analyst may utilize Vissim as the primary analysis tool but may utilize HCS or Synchro at spot locations or to provide another reference point to aid in calibration of the Vissim model).

Attachment 5.1 provides a flowchart to help navigate and select the most appropriate WisDOT-supported traffic analysis tool(s) based on the type of traffic flow (uninterrupted or interrupted). If the project consists of both uninterrupted and interrupted flow facilities, follow the path for each type of flow independently. Utilize the tool that will best address both flow regimes and will result in the most efficient use of resources. This may require the use of the most comprehensive tool (Vissim) or it may require the use of multiple traffic analysis tools.

If the project does not justify the use of microsimulation analyses, but there is a need or desire for visualization or simulation of the traffic operations, the analyst may utilize the SimTraffic component of Synchro or the built-in Vissim module of Vistro. The resulting visualization can allow the analyst to observe driver behavior to conduct "reality checks" of the Synchro and Vistro outputs. Note that SimTraffic and the built-in Vissim module of Vistro are uncalibrated microsimulation models, so use caution when presenting the results.

Use the flowchart in Attachment 5.1 as a guide only. The final determination of the most appropriate traffic analysis tool depends on the specific details, needs, and goals of the project. Professional judgment and coordination with WisDOT regional traffic staff need to factor into the selection of the most cost effective and efficient traffic analysis tool. If unsure of which traffic analysis tool to utilize, contact BTO-TASU (DOTTrafficAnalysisModeling@dot.wi.gov).

Document the rationale for choosing the selected traffic analysis tool(s) in the Traffic Analysis Tool Selection memoranda and submit to the WisDOT regional traffic staff for approval.

LIST OF ATTACHMENTS

Attachment 5.1 Traffic Analysis Tool Selection

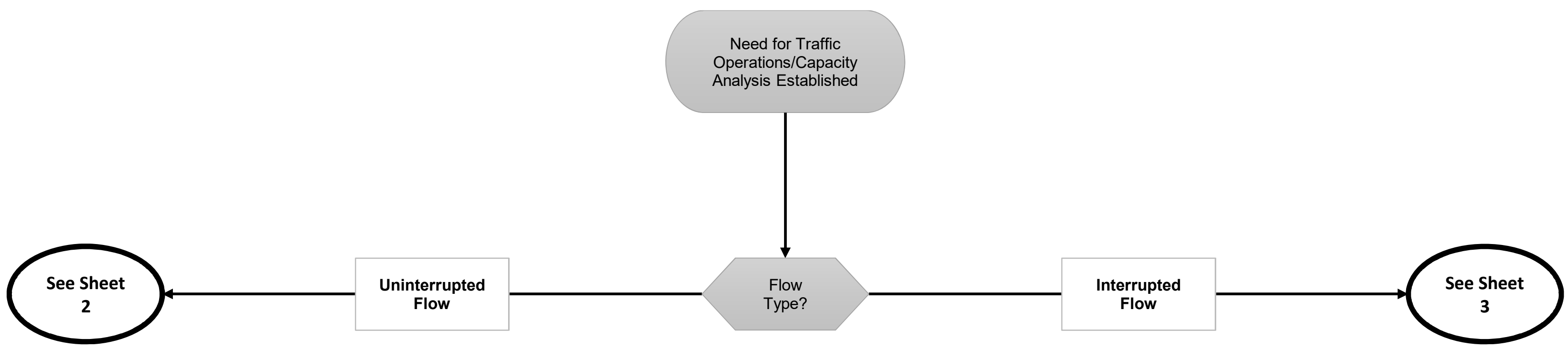
16-10-20 References April 2025

1. **Federal Highway Administration.** *Traffic Analysis Toolbox Volume II: Decision Support Methodology for Selecting Traffic Analysis Tools*. 2004. FHWA-HRT-04-039.

2. **Transportation Research Board.** *Highway Capacity Manual, 7th Edition: A Guide For Multimodal Mobility Analysis.* Washington, D.C. National Academy of Sciences, 2022. ISBN 978-0-309-08766-7.

3. **Transportation Research Board.** *Highway Capacity Manual, 6th Edition*. Washington D.C. National Academy of Sciences, 2016. ISBN 978-0-309-36997-8.

Attachment 5.1   Traffic Analysis Tool Selection

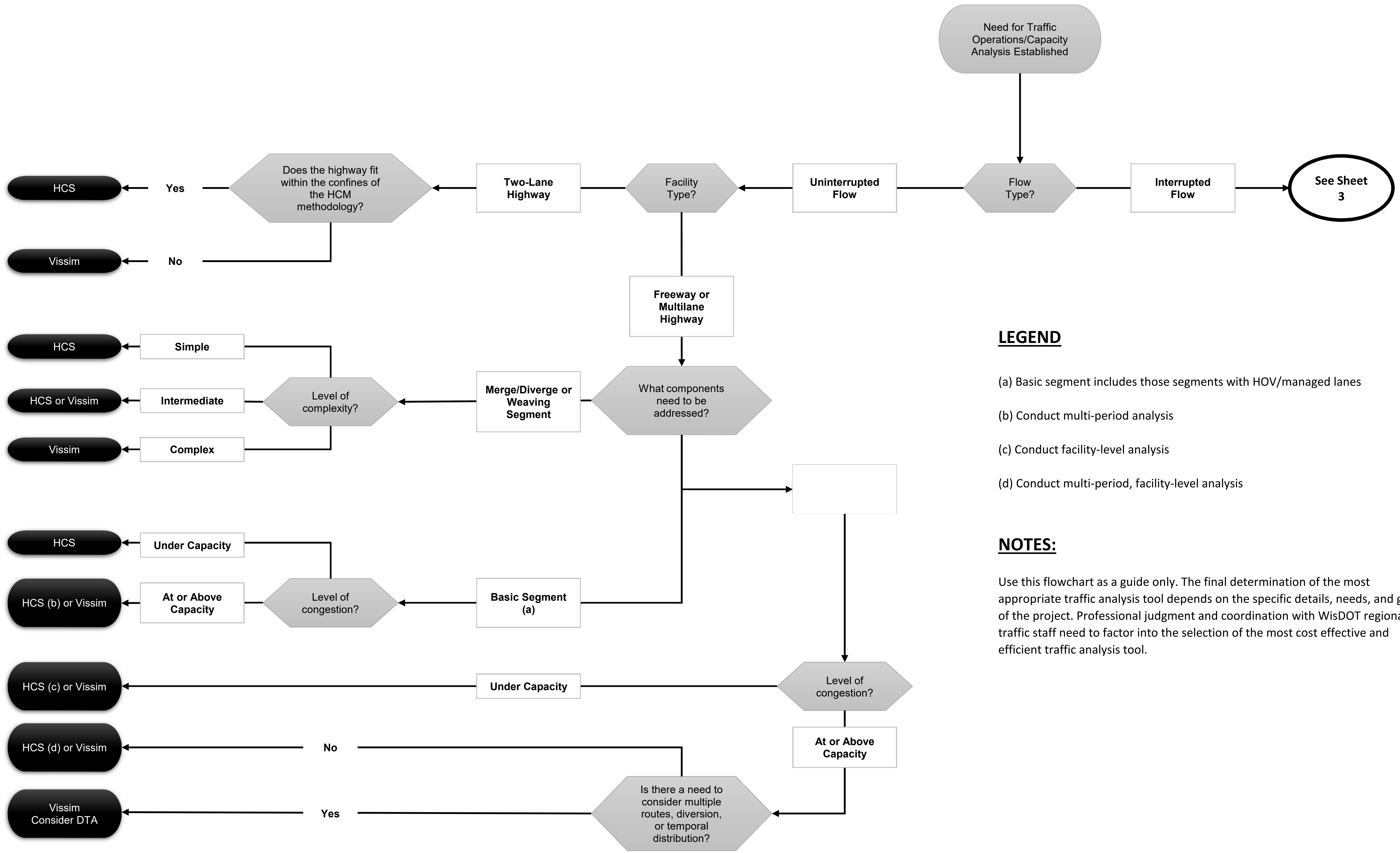


NOTES:

1. If the project consists of both uninterrupted and interrupted flow facilities, follow the path for each type of flow independently. Utilize the tool that will best address both flow regimes and will result in the most efficient use of resources. This may require the use of the most comprehensive tool (Vissim) or it may require the use of multiple traffic analysis tools.

2. Use this flowchart as a guide only. The final determination of the most appropriate traffic analysis tool depends on the specific details, needs, and goals of the project. Professional judgment and coordination with WisDOT regional traffic staff need to factor into the selection of the most cost effective and efficient traffic analysis tool.

Attachment 5.1 Traffic Analysis Tool Selection



LEGEND

(a) Basic segment includes those segments with HOV/managed lanes

(b) Conduct multi-period analysis

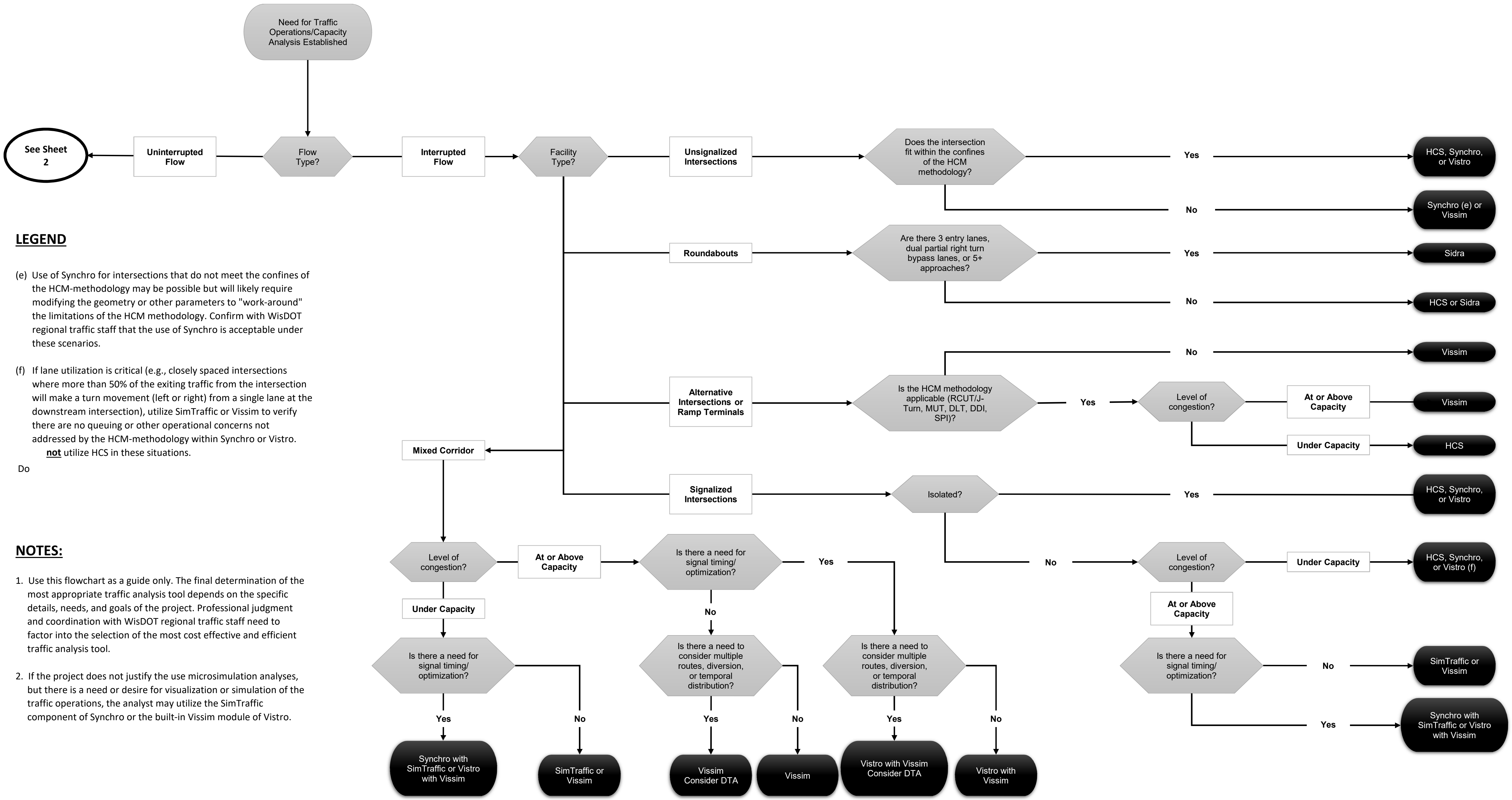
(c) Conduct facility-level analysis

(d) Conduct multi-period, facility-level analysis

NOTES:

Use this flowchart as a guide only. The final determination of the most appropriate traffic analysis tool depends on the specific details, needs, and goals of the project. Professional judgment and coordination with WisDOT regional traffic staff need to factor into the selection of the most cost effective and efficient traffic analysis tool.

Attachment 5.1 Traffic Analysis Tool Selection



LEGEND

(e) Use of Synchro for intersections that do not meet the confines of the HCM-methodology may be possible but will likely require modifying the geometry or other parameters to "work-around" the limitations of the HCM methodology. Confirm with WisDOT regional traffic staff that the use of Synchro is acceptable under these scenarios.

(f) If lane utilization is critical (e.g., closely spaced intersections where more than 50% of the exiting traffic from the intersection will make a turn movement (left or right) from a single lane at the downstream intersection), utilize SimTraffic or Vissim to verify there are no queuing or other operational concerns not addressed by the HCM-methodology within Synchro or Vistro. Do <u>not</u> utilize HCS in these situations.

NOTES:

1. Use this flowchart as a guide only. The final determination of the most appropriate traffic analysis tool depends on the specific details, needs, and goals of the project. Professional judgment and coordination with WisDOT regional traffic staff need to factor into the selection of the most cost effective and efficient traffic analysis tool.

2. If the project does not justify the use microsimulation analyses, but there is a need or desire for visualization or simulation of the traffic operations, the analyst may utilize the SimTraffic component of Synchro or the built-in Vissim module of Vistro.

16-15-1 Basic Principles February 2025

1.1 Introduction

The Highway Capacity Manual (HCM) provides several analytical or deterministic tools that can estimate roadway or intersection capacity, delay, density, and other performance measures for various elements of the street and highway system. The HCM also includes procedures for evaluating bicycle, pedestrian, and transit facilities. In most cases, the HCM is the standard for traffic analysis in the US; its methods are generally reliable and have been well-tested through significant validation efforts. The Highway Capacity Manual, 7th Edition: A Guide for Multimodal Mobility Analysis (HCM7) (1) is the most current version of the HCM. A list of the updates included with the release of HCM7 is noted in the "Forward" section of HCM7. The most significant changes include:

- A new two-lane highway methodology which incorporates new performance measures
- A new network analysis method for the evaluation of spillback between freeways and urban streets
- Addition of guidance on the application of HCM methods for determining impacts of connected and automated vehicles (CAVs)
- Enhancements to existing pedestrian analysis methods at signalized intersections and uncontrolled pedestrian crossings

All projects initiated on or after January 1, 2023 **shall** follow the HCM7 methodologies unless otherwise authorized by WisDOT regional traffic staff.

The HCM consists of the following four volumes:

- Volume 1: Concepts
- Volume 2: Uninterrupted Flow
- Volume 3: Interrupted Flow
- Volume 4: Applications Guide (a web-based document, requires a free user account)

Each chapter within Volume 2 and Volume 3 of the HCM has six or more sections covering the following topics: introduction, concepts, methodology, extensions to the methodology, applications, and references. The methodology section (typically Section 3) highlights the scope, strengths, and limitations of the applicable HCM methodology, and as such, serves as a good reference when determining whether use of the HCM methodology is appropriate. HCM, Volume 1, Chapter 7 provides additional guidance as to when an alternative (non-HCM based) analysis methodology *may* be appropriate.

The HCM procedures are good for analyzing the performance of isolated and non-congested facilities but do have limitations. For example, the HCM models *may* under-predict the extent of congestion in oversaturated conditions. Consider the strengths and limitations of the HCM methods when selecting the methodology to apply. Document the rationale for choosing the selected traffic analysis methodology (HCM-based, microsimulation, etc.) in the Traffic Analysis Tool Selection memoranda and submit to the WisDOT regional traffic staff for approval.

TEOpS 16-10 provides a brief description of when and how to apply the HCM methodologies and identifies the WisDOT-supported programs that implement the HCM methodology.

1.2 Traffic Data

Traffic data such as existing and forecasted traffic volumes (e.g., turning movement counts, directional design hour volumes, etc.) including pedestrian and bicycle volumes, heavy vehicle truck percentages, and peak-hour factor values are key inputs into the HCM-based operational analysis. In near, or over-capacity, conditions it is critical that the existing traffic counts reflect the traffic demand and not just the volume throughput.

When gathering the existing traffic data, note any special lane utilizations or imbalances, especially at roundabouts, intersections with dual or triple turn lanes, or interchange ramps with more than one lane. Intermediate design year forecasts may be beneficial for conducting sensitivity analysis to determine when capacity expansion may be necessary (i.e., when it might be necessary to expand a roundabout from a one-lane to a two-lane entry).

See TEOpS 16-5 for additional details on assembling and preparing the traffic data. FDM 11-5-2 provides additional information on gathering traffic forecasts.

16-15-5 Signalized Intersections February 2025

5.1 Introduction

WisDOT accepts the use of the HCM, Chapter 19 methods for estimating the performance of a signalized intersection from the perspective of the motor vehicle, pedestrian, and bicycle modes. These procedures are applicable for three-leg and four-leg intersections that operate in isolation from nearby signals with a pre-timed, semi-actuated or fully-actuated controller. Signalized intersections that are not isolated, that operate in an actuated-coordinated manner, or are part of a system or corridor require the use of a combination of both the signalized intersection methods of Chapter 19 and the urban street segment procedures outlined in Chapter 18. For closely spaced signals, such as those found at freeway ramp terminals, the analyst *should* follow the methodology presented in Chapter 23 for interchange ramp terminals. If the project spans multiple contiguous urban street segments, consider applying the Chapter 16 urban street facilities methodologies.

The analyst *should* recognize and account for the methodological limitations of the signalized intersection methods. There are cases that *may not* fit within the analytical framework of the HCM, including but not limited to intersections with five or more approaches, those with more than two exclusive turn lanes on any approach or those with complex geometry or controller operations. When these, or similar limitations exists, the project manager *should* specify the use of an alternative tool such as microsimulation. See TEOpS 16-20 for additional details on performing microsimulation analysis.

The WisDOT-supported tools that implement the HCM methodology for signalized intersection analysis are:

- Highway Capacity Software (HCS), McTrans
- Synchro, Cubic|Trafficware
- Vistro, PTV Group (requires prior approval from WisDOT regional traffic engineer)

Refer to the *WisDOT Supported Traffic Analysis Tools* document for the version and build of the above software that WisDOT currently supports. See TEOpS 16-10-5 for additional guidance on how to select the most appropriate traffic analysis tool for a specific project.

When conducting capacity analysis for signalized intersections, apply the basic signal parameters as outlined in the following section in conjunction with the HCM-based analysis methodologies.

5.2 Basic Parameters for Capacity Analysis

The Traffic Signal Design Manual, Section 3, Chapter 2-2 (TSDM 3-2-2) provides recommended parameters to use for the general analysis of state-owned signals; including minimum and maximum green times, pedestrian phase times and cycle lengths. TEOpS 4-2-5 provides guidance on yellow and all-red clearance intervals. The following provides updated direction for the use of right-turn on red (RTOR) and saturation flow rate. Unless noted otherwise, the policy within this section supersedes the guidance provided in TSDM 3-2-2. If it is unclear which guidance to follow, contact BTO-TASU (DOTTrafficAnalysisModeling@dot.wi.gov) for clarification.

5.2.1 Right-Turn on Red (RTOR)

5.2.1.1 Background

Right-turns made while facing a red traffic signal indication, permitted under Wisconsin statute 346.37(1)(c)3, can have a beneficial effect on traffic flow and intersection capacity as they reduce the number of vehicles serviced during the green phase. The following section describes how to apply RTOR when conducting capacity analysis for signalized intersections.

5.2.1.2 Dedicated Right-Turn Lanes

Since vehicles making other movements (through or left-turns) *may* block right-turn access at shared left-through-right (LTR) or shared through-right (TR) lanes, WisDOT has only investigated RTOR volumes at locations with dedicated right-turn lanes. For the purposes of RTOR inclusion in capacity analyses, a dedicated right-turn lane is any lane that satisfies at least one of the following criteria:

- Pavement markings or signage clearly dedicate the lane for a right-turn only movement
- Field observations indicate that the lane functions as a de-facto right-turn only lane (requires approval from WisDOT regional traffic staff)
- Subject approach flares out at the intersection such that a right-turning vehicle can safely fit beside a through vehicle within the same lane and field observations show vehicles using the approach flare to make right turns (requires approval from WisDOT regional traffic staff)

Additionally, for RTOR inclusion to be applicable for capacity analysis, the following must exist:

- Right-turns on red are permissible (i.e., field signage does not prohibit this maneuver during the analysis period)
- Vehicle queuing from the adjacent lane does not prevent vehicles wishing to make a right-turn from accessing the dedicated (or de-facto) right-turn lane

For additional clarification, as to what constitutes a right-turn lane for purposes of capacity analysis at signalized intersections, contact the WisDOT regional traffic engineer or BTO-TASU.

5.2.1.3 RTOR Estimation

An estimate of the proportion of vehicles making RTOR from a dedicated right-turn lane is most accurate when derived from field counts taken at the intersection in question. As it is not always practical to gather this information, WisDOT conducted field studies throughout Wisconsin in 2009 (3), 2015 (4), and 2021 (5) to develop recommendations for estimating RTOR volumes (V_{RTOR}) in relation to total right-turn demand (V_{RT}) for both planning-level and design-level analyses.

WisDOT has not studied RTOR at any intersection configuration other than those shown in Equations 5.2 – 5.12, such as shared lanes or triple right-turn lanes, thus unless intersection-specific field data is available to indicate otherwise, the analyst *should* assume that vehicles do not make RTOR movements at these locations. Obtain approval from WisDOT regional traffic staff prior to including RTOR volumes for triple right-turn lanes or shared lanes within the capacity analysis.

The analyst **shall not** use RTOR volumes in the analysis when field signage prohibits this maneuver during the analysis period.

5.2.1.3.1 Planning-Level Assessment

For planning-level analyses, when signal timing or phasing is still in flux, analysts *should* use the following equations to calculate the RTOR volumes.

- Single Right-Turn Lanes at Intersections: $V_{RTOR} = 0.38V_{RT}$ [Equation 5.1]
- Single Right-Turn Lanes at Interchange Off Ramps: $V_{RTOR} = 0.74V_{RT}$ [Equation 5.2]
- Single Right-Turn Lanes at Interchange On Ramps: $V_{RTOR} = 0.25V_{RT}$ [Equation 5.3]
- Dual Right-Turn Lanes at Intersections: $V_{RTOR} = 0.30V_{RT}$ [Equation 5.4]
- Dual Right-Turn Lanes at Interchange Off Ramps: $V_{RTOR} = 0.53V_{RT}$ [Equation 5.5]
- Dual Right-Turn Lanes at Interchange On Ramps: $V_{RTOR} = 0.12V_{RT}$ [Equation 5.6]

Where:

$V_{RTOR} =$ Right-turn on red volumes
$V_{RT} =$ Total right-turn demand

5.2.1.3.2 Design-Level Assessment

For design-level analyses, specifically when refining the storage requirements for right turn lanes, it *may* be appropriate to consider signal timings when calculating the RTOR volumes. In such instances, the analyst *may* apply the following equations:

- Single Right-Turn Lanes at Intersections: $V_{RTOR} = 0.18V_{RT} \times e^{1.26 \times R_{\%}}$ [Equation 5.7]
- Single Right-Turn Lanes at Interchange Off Ramps: $V_{RTOR} = 0.24V_{RT} \times e^{1.35 \times R_{\%}}$ [Equation 5.8]
- Single Right-Turn Lanes at Interchange On Ramps: $V_{RTOR} = 0.07V_{RT} \times e^{2.90 \times R_{\%}}$ [Equation 5.9]
- Dual Right-Turn Lanes at Intersections: $V_{RTOR} = 0.04V_{RT} \times e^{3.34 \times R_{\%}}$ [Equation 5.10]
- Dual Right-Turn Lanes at Interchange Off Ramps: $V_{RTOR} = 0.08V_{RT} \times e^{2.59 \times R_{\%}}$ [Equation 5.11]
- Dual Right-Turn Lanes at Interchange On Ramps: $V_{RTOR} = 0.07V_{RT} \times e^{1.53 \times R_{\%}}$ [Equation 5.12]

Where:

V_{RTOR} = Right-turn on red volumes
V_{RT} = Total right-turn demand
$R_{\%} = (C - g_{RT})/C$ = Percentage of the cycle showing red for the right-turn movement (e.g., 0.25 for 25%)
C = Cycle Length
g_{RT} = Right-turn green time

Use the WisDOT *Right Turn on Red Analysis Tool* to calculate the RTOR using the above design-level assessment equations.

5.2.1.4 RTOR Application

WisDOT supports the use of HCS for traffic signal analysis and supports the use of Vistro and Synchro for both traffic signal analysis and signal optimization (see TEOpS 16-10). Use and acceptance of Vistro for signal analysis and optimization, however, is up to the discretion of the WisDOT regional office. Due to limitations of the HCS optimization methodologies, WisDOT does not support the use of HCS for signal optimization.

Vistro uses the same module for both HCM-compliant analysis and signal optimization. Synchro, however, uses two distinct modules – one which provides HCM-compliant analysis and another which provides signal optimization as well as non-HCM-compliant analysis. The later module uses a proprietary methodology to calculate intersection delay and other values. Changes made in one module do not necessarily transfer to the other module. Therefore, there are nuances in how to conduct HCM-compliant analysis and signal optimization in Synchro which are not present in Vistro.

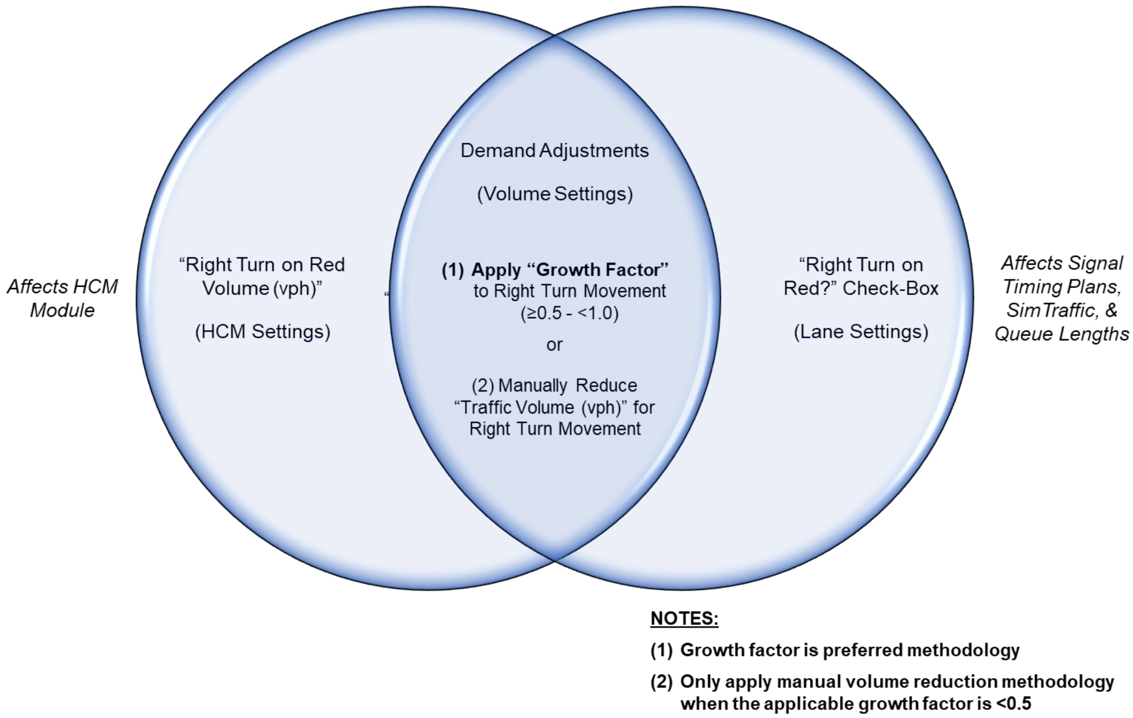
Figure 5.1 provides an overview of the various methodologies available for affecting RTOR in the two modules of Synchro. A subset of the methodologies, those which adjust demand, affect both Synchro modules. As noted in the figure, the “growth factor” method is the preferred methodology when the analyst is using Synchro to conduct HCM-compliant analysis and signal optimization. This methodology involves applying a growth factor of less than one to the right turn movements. For planning-level analyses, apply the following growth factors, derived from Equations 5.1, 5.3, 5.4 and 5.6 unless field data is available and supports otherwise:

- 0.62 for Single Right-Turn Lanes at Intersections
- 0.75 for Single Right-Turn Lanes at Interchange On Ramps
- 0.70 for Dual Right-Turn Lanes at Intersections
- 0.88 for Dual Right-Turn Lanes at Interchange On Ramps

Note that the above rates do not include a growth rate for Single or Dual Right-Turn Lanes at Interchange Off Ramps. Applying Equations 5.2 and 5.5 would yield a growth factor of 0.26 and 0.47, respectively for these scenarios; however, Synchro currently sets a floor of 0.5 for growth rates preventing the use of the 0.26 or 0.47. When dealing with Single and Dual Right-Turn Lanes at Interchanges, or when calculating the RTOR volumes using Equations 5.7 – 5.12 for design-level analysis, use the manual reduction method detailed below.

The manual reduction methodology also affects both modules in Synchro and involves manually reducing the right-turn volumes by the V_{RTOR}. This is less transparent when conducting a peer review and is more prone to typographical error. Therefore, WisDOT prefers the use of the growth factor method where possible.

Figure 5.1 Synchro RTOR Adjustments Venn Diagram



5.2.1.4.1 HCM-Compliant Analysis

WisDOT provides the following guidance on incorporating RTOR volumes when conducting HCM-compliant analysis. The RTOR volumes used *may* be based on field-collected values or the equations above (see Equations 5.1 – 5.12).

- HCS: Enter the V_{RTOR}, rounded to the nearest whole vehicle per hour (veh/h), into the "RTOR, veh/h" field for the relevant approaches. This field is at the bottom of the "Primary Input Data" within the HCS "Streets" module, which includes traffic signal analysis.
- Vistro: Go to the "Volumes" tab. Check the "Right Turn on Red" boxes for the relevant approaches and select the "Right Turn on Red Method" from the drop-down list (either Percentage or Absolute Value). If using the percentage methodology (recommended), enter the percentage of the total right turn demand (V_{RT}) that turn on the red indication (see equations 5.1 – 5.6) into the "Right Turn on Red Percentage [%]" field. The percentage methodology will calculate the V_{RTOR} which will automatically update with changes to the V_{RT}. If using the absolute value methodology, enter the V_{RTOR}, rounded to the nearest whole vehicle per hour (veh/h), into the "Right-Turn on Red Volume [veh/h]" field. Using the absolute value methodology will require a manual update to the V_{RTOR} every time there are modifications to the V_{RT}.
- Synchro: Use the growth factor method or manual volume reduction method (when the applicable growth factor is <0.5) outlined above. Uncheck the "Right Turn on Red" box in the "Lane Settings" for all approaches of a signalized intersection. Checking the "Right Turn on Red" box in the "Lane Settings" area **does not** affect the HCM-compliant analysis but **will** affect the queues in the "Timing Settings" window.

The analyst **shall not** enter a volume other than the default of 0 into the "Right Turn on Red Volume" field in combination with the growth factor method, as it will lead to incorrect results.

5.2.1.4.2 Signal Optimization

In Synchro, changes to the "Right Turn on Red Volume" field in the HCM module do not affect the signal timings or optimization calculations. If the analyst checks a box to allow RTOR within the "Lane Settings" module (automatically checked by default), Synchro uses an algorithm to determine a "Saturated Flow Rate (RTOR)". Synchro uses the "Saturated Flow Rate (RTOR)" value within the signal optimization function. The RTOR checkbox **does not** affect the HCM results. Synchro's proprietary RTOR methodology, enabled via the RTOR checkbox, is not straightforward and is thus not a preferred methodology for developing signal timing plans. When optimizing signals, the analyst *should* uncheck the RTOR checkbox for all approaches.

WisDOT prefers the use of the growth factor method for conducting signal optimization in Synchro. The analyst *should* only apply the manual volume reduction method when the applicable growth factor is <0.5.

5.2.1.4.3 Microsimulation Analysis

WisDOT also currently supports two microsimulation software programs for traffic signal analysis: SimTraffic (associated with Synchro, affected by demand reductions but not by changes within the HCM module) and Vissim. The analyst *should not* dictate RTOR volumes within microsimulation programs, as the models *should* determine when these turns happen based on how the right-turning vehicles interact with other vehicles in the system. Where right-turns at signals are critical movements, a good check for reasonableness could be comparing modeled RTOR volumes to field-collected ones. The analyst *should* direct any questions regarding how to model RTOR within a specific microsimulation software program to BTO-TASU (DOTTrafficAnalysisModeling@dot.wi.gov).

5.2.2 Saturation Flow Rate

5.2.2.1 Background

One of the many variables that influence the performance of traffic signals is saturation flow (sat. flow) rate. The base saturation flow rate for a lane is the theoretical number of vehicles that could travel through the intersection during one hour of green time under ideal conditions. The saturation headway, or the average time between the front bumper of one vehicle and the front bumper of the vehicle behind it under ideal conditions, determines the saturation flow rate. The HCM default values for base saturation flow rate are:

- 1900 passenger cars per hour per lane (pc/h/ln) in metropolitan areas with population ≥250,000
- 1750 pc/h/ln otherwise

The HCM provides several factors to adjust these base saturation flow rates to account for prevailing conditions at the approach, including heavy vehicle percentages, grade, lane width, etc. More information on flow rate concepts is available in HCM, Chapters 4 and Chapters 19.

This policy focuses on the saturation flow rate for left-turn lanes and through lanes.

5.2.2.2 Saturation Flow Rate Methodology

A field saturation flow study at an intersection will provide the most accurate measure of experienced flow rates on its approaches. Given the expense, it *may not* be practical to conduct these studies, especially at locations that are operating significantly under capacity.

Since it is impractical to conduct field studies for every intersection and in an effort to gain a better understanding of the range of saturation flow rates, WisDOT conducted field studies in 2015 (4) and 2021 (5) to evaluate saturation flow rates at various signalized intersections across the state. The study aimed to identify the variables, beyond those already accounted for by the HCM, which influenced the field saturation flow rates. The study followed the methodology laid out in the HCM and only collected data on the saturation flow rate for left-turn lanes (5) and through lanes (4).

The 2015 WisDOT sat. flow study (4) found that the following three factors affect the base saturation flow rate of a through lane at a signalized intersection: the urbanized area or cluster population, the total number of approach lanes (left, through and right), and the posted speed limit of the approach. Accordingly, the base saturation flow rate *may* differ from one approach to the next at a given signalized intersection. The field conditions or traffic signal design dictate the total number of approach lanes and the posted speed limit of the approach. The urbanized area or cluster population information is available from either the table or map provided by the 2010 Census Bureau.

WisDOT used the results of the 2015 (4) study to develop a methodology to estimate the base saturation flow rate for exclusive through lanes and shared through-right lanes at signalized intersections in Wisconsin. The 2021 WisDOT sat. flow study (5) found that the observed left-turn movement saturation flow rate is approximately 95.26% of the estimated through movement saturation flow rate, which is consistent with the 95.24% that the HCM suggests. Since the percentages are nearly identical, to calculate the left-turn saturation flow rate, WisDOT recommends first calculating the base saturation flow rate for through lanes using the WisDOT methodology described in section 5.2.2.3 below, and then applying the HCM default left-turn adjustment factor.

Since the methodology accounts for more variables and reflects Wisconsin-specific data, analysts *should* use the WisDOT sat. flow methodology as described below to estimate the base saturation flow rate for exclusive through lanes and shared through-right lanes at signalized intersections. If the WisDOT estimation methodology results in a sat. flow rate less than the relevant HCM default value, specifically if it is less than 1750 pc/h/ln, the analyst *should* consider completing a field study or using the HCM default values.

Coordinate with WisDOT regional traffic staff to determine the most appropriate methodology for calculating the base saturation flow rate for exclusive left, exclusive through, and shared through-right lanes. At ramp terminals, since there is typically a negligible number of through vehicles on the exit ramp, treat the shared left-through lane as an exclusive left-turn lane. WisDOT did not study the shared left-through-right lane configuration, however, if the through movement is the dominant movement, the analyst *may*, with caution, treat this lane configuration the same as an exclusive through lane. Use the HCM default base saturation flow rates for all other lane groups (i.e., shared left-through, shared left-right, and exclusive right turn lanes) unless there is field data or other documentation supporting an alternative value or WisDOT instructs otherwise.

5.2.2.3 Saturation Flow Rate Estimation

Use the WisDOT sat. flow spreadsheet (a Microsoft Excel based spreadsheet) or the adjustment factors shown in Table 5.1 to implement the WisDOT sat. flow methodology. The WisDOT sat. flow spreadsheet implements equations to apply the various site-specific adjustments in the same general form as the HCM and calculates the base sat. flow rate for each lane group

In lieu of the WisDOT sat. flow spreadsheet, the analyst *may* use the adjustment factors shown in Table 5.1 in conjunction with a starting saturation flow rate value of 1980 pc/h/ln (derived from the 2015 WisDOT sat. flow study (4)) and the following equation:

- $s_0 = 1980 \times f_{Pop} \times f_N \times f_{SL}$ [Equation 5.13]

Where:

$s_0 = Base\ saturation\ flow\ rate\ for\ exclusive\ left, exclusive\ through, and\ shared\ through-right\ lanes$

$f_{Pop} = Adjustment\ factor\ for\ population$

$f_N = Adjustment\ factor\ for\ number\ of\ approach\ lanes$

$f_{SL} = Adjustment\ factor\ for\ speed\ limit\ of\ approach$

As with the WisDOT sat. flow spreadsheet, apply the adjustment factors by approach to determine the base sat. flow rate for each lane group. The lane adjustment factor (f_N) is dependent on the total number of lanes on the approach (i.e., includes all left, through, right, and shared lanes)[1] and the speed adjustment factor (f_{SL}) is based on the speed limit of the approach. Accordingly, the base saturation flow rate *may* differ from one approach to the next at a given signalized intersection (e.g., the base saturation flow rate for the eastbound through movement *may* be 1950 pc/h/ln while the base saturation flow rate for the northbound through lane *may* be 1825 pc/h/ln).

Due to rounding, use of the adjustment factors from Table 5.1 *may* result in a slightly different sat. flow rate than that calculated using the WisDOT sat. flow spreadsheet. The WisDOT sat. flow spreadsheet uses formulas to calculate the adjustment factors and does not round until after it computes the sat. flow rate, where the adjustment factor methodology utilizes rounded values from Table 5.1 to compute the sat. flow rate.

An example of how to apply the adjustment factors for saturation flow rate follows:

Example 1: *A signalized intersection is within an urbanized area that has a population of 29,000 (f_{Pop} = 0.95). Looking at an approach with a left-turn lane, two through lanes, and two right-turn lanes (five total approach lanes, f_N = 0.97) and a posted speed limit of 40 MPH (f_{SL} = 1.00), the resulting base saturation flow rate would be:*

$s_0 = 1980 \times 0.95 \times 0.97 \times 1.00$ $s_0 = 1825$ *pc/h/ln*

Use the resulting base saturation flow rate ($s_o = 1825$ pc/h/ln) for operational analysis of the left-turn lane and two through lanes on this approach. Use the HCM default values for the two right turn

[1] Free-flow-right turn lanes do not count toward the number of lanes at an approach

lanes unless there is field data or other documentation supporting an alternative value or WisDOT instructs otherwise. Calculate the base saturation flow rate for the left-turn and through lane groups on all other approaches in a similar manner.

Table 5.1 WisDOT Saturation Flow Adjustment Factors

Population Adjustment Factor		Lane Adjustment Factor		Speed Adjustment Factor	
Urbanized Area/ Cluster Population	Adjustment Factor	Total # Approach Lanes	Adjustment Factor	Posted Speed Limit of Approach (mph)	Adjustment Factor
< 2,000	0.91	1	0.88	25	0.94
2,000 - 4,499	0.92	2	0.94	30	0.96
4,500 - 8,999	0.93	3	0.96	35	0.98
9,000 - 18,999	0.94	4	0.97	40	1.00
19,000 - 39,999	0.95	5	0.97	45	1.02
40,000 - 82,999	0.96	6	0.98	50	1.04
83,000 - 170,499	0.97	≥7	0.98	55	1.07
170,500 - 347,499	0.98				
347,500 - 704,499	0.99				
≥ 704,500	1.00				

Since the WisDOT sat. flow methodology calculates a Wisconsin, site-specific base saturation flow rate, the analyst should apply all other HCM adjustment factors (e.g., heavy vehicles, grade, lane width, Central Business District (CBD), left or right-turn vehicle presence, etc.) as appropriate to calculate the final adjusted sat. flow rate. These adjustments are typically applied within the individual software program (HCS, Synchro, Vistro).

It is important to note that the WisDOT sat. flow estimation methodology applies only to exclusive left, exclusive through, and shared through-right lanes. At ramp terminals, since there is typically a negligible number of through vehicles on the exit ramp, treat the shared left-through lane as an exclusive left-turn lane. WisDOT did not study the shared left-through-right lane configuration, however, if the through movement is the dominant movement, the analyst may, with caution, treat this lane configuration the same as an exclusive through lane.

5.2.2.4 Saturation Flow Rate Application

5.2.2.4.1 HCM-Compliant Analysis and Signal Timing Plan Development

As detailed in TEOpS 16-10, WisDOT currently supports three HCM-based software programs for traffic signal analysis, HCS, Vistro, and Synchro, although use of Vistro requires prior approval from the WisDOT regional traffic engineer. WisDOT provides the following guidance on entering base saturation flow rates generated from the WisDOT sat. flow methodology.

- HCS: Enter the base saturation flow rate, rounded to the nearest 5 pc/h/ln, into the “Base Saturation, pc/h/ln” field for the relevant movements. This field is in the “Traffic and Geometry” section within the HCS “Streets” module, which includes traffic signal analysis.
- Vistro: Check the “Override Base Saturation Flow Rate per Lane” box for the relevant lane groups in the “Saturation Flow” area of the “Traffic Control” tab. Enter the base saturation flow rate, rounded to the nearest 5 pc/h/ln, into the “User Defined Base Saturation Flow Rate per Lane (pc/h/ln)” field.
- Synchro: In the HCM module, used to generate fully HCM-compliant results, enter the base saturation flow rate, rounded to the nearest 5 pc/h/ln into the “Ideal Satd. Flow (vphpl)” field for the relevant movements. Alternately, edit this field through the “Lane Settings” module – changes made there carry through to the HCM module.

Note that the resulting base saturation flow rate calculated for a lane group containing a shared through-right lane would also be applied to the right turn movement unless there is an exclusive right turn lane on the approach.

Although the terminology within Synchro indicates that the base saturation flow rate is in vehicles per hour per lane (vphpl), further investigations found that this value is actually representative of passenger cars per hour per lane (pc/h/ln). Therefore, the analyst *should* enter the base saturation flow rate as calculated above in pc/h/ln without further adjustment.

As noted above (TEOpS 16-15-5.2.2.2), the field data used to develop the WisDOT sat. flow methodology purposely minimized the impact from heavy vehicles to lessen the impact of using pc/h/ln versus using veh/h/ln. Further, any of the adjustment factors beyond those included in the 2015 WisDOT sat. flow study (4) that are incorporated into the HCM base saturation flow rate calculations (heavy vehicles, grade, lane width, CBD, left or right-turn vehicle presence, etc.) will be applied on top of the WisDOT sat. flow rates within the software package used to calculate the final adjusted sat. flow rate in pc/h/ln.

5.2.2.4.2 Microsimulation Analysis

Capacity is not typically an explicit input within microsimulation programs, as it will vary based on vehicle interactions and various parameters. Since headway dictates saturation flow rate and because each microsimulation program has one or more adjustable parameters characterizing the concept of headway, adjustments to these settings will increase or decrease potential and realized capacities. The analyst *should* calibrate each signalized intersection, ensuring that the model meets the applicable validation thresholds and adequately replicates field behavior. Direct any questions regarding how to apply saturation flow rate within a specific microsimulation software program to BTO-TASU (DOTTrafficAnalysisModeling@dot.wi.gov).

16-15-10 Two-Way Stop-Controlled (TWSC) Intersections — February 2025

WisDOT accepts the use of the HCM, Chapter 20 methods for analyzing the performance of a two-way stop-controlled (TWSC) intersection from the perspective of the motor vehicle mode and the pedestrian modes. Currently, no specific methodology exists to assess the performance of bicycles at TWSC intersections. These methods are applicable to three-leg and four-leg intersections with stop-control only on the side street(s).

Analysts *should* recognize and account for the limitations of the TWSC methodology in Chapter 20. Some of the limitations of the TWSC methodology include, but are not limited to, the following:

- Only applicable for TWSC intersections with up to three through lanes (either shared or exclusive) on each major-street approach and up to three lanes on each minor-street approach (max of one exclusive lane per movement)
- Limited to no more than four approaches
- Limited to one stop-controlled approach on each side of the major street

Additionally, apart from a TWSC intersection located between two signalized intersections, the HCM methodology typically does not account for the effects from other intersections. For TWSC intersections located on an urban street segment between two coordinated signalized intersections, to account for the interaction of the adjacent signalized intersections, the analyst *should* follow the methodologies presented in Chapter 18 for urban street segments. When these, or similar limitations exists, the project manager *should* specify the use of an alternative tool such as microsimulation. See TEOpS 16-20 for additional details on performing microsimulation analysis.

The WisDOT-supported traffic engineering software programs for HCM-based TWSC intersection analysis are:

- *HCS, McTrans*
- *Synchro, Cubic|Trafficware (version 12 or newer)*
- Vistro, PTV Group (requires prior approval from WisDOT regional traffic engineer)

Refer to the *WisDOT Supported Traffic Analysis Tools* document for the version and build of the above software that WisDOT currently supports. See TEOpS 16-10-5 for additional guidance on how to select the most appropriate traffic analysis tool for a specific project.

16-15-15 All-Way Stop-Controlled (AWSC) Intersections — February 2025

WisDOT accepts the use of the HCM, Chapter 21 methods for analyzing the performance of unsignalized intersections with stop control at all approaches (i.e., requires every vehicle to stop before entering the intersection). HCM, Chapter 21 methodologies focus on the motor vehicle mode but do offer some guidance for how to assess the performance of pedestrian and bicycles. The procedure is applicable for typical AWSC configurations of three-leg and four-leg intersections with no more than four approaches and no more than three lanes on any given approach.

Analysts *should* recognize and account for the limitations of the AWSC methodology in Chapter 21. There are cases that *may* not fit within the analytical framework of the HCM, including but not limited to queue interactions from adjacent intersections, or the impact of pedestrians. When these, or similar limitations exists, the project manager *should* specify the use of an alternative tool such as microsimulation. See TEOpS 16-20 for additional details on performing microsimulation analysis.

The WisDOT-supported traffic engineering software programs for HCM-based AWSC intersection analysis are:

- *HCS, McTrans*
- *Synchro, Cubic|Trafficware*
- Vistro, PTV Group (requires prior approval from WisDOT regional traffic engineer)

Refer to the *WisDOT Supported Traffic Analysis Tools* document for the version and build of the above software that WisDOT currently supports. See TEOpS 16-10-5 for additional guidance on how to select the most appropriate traffic analysis tool for a specific project.

16-15-20 Roundabouts — February 2025

20.1 Roundabout Operations

20.1.1 Introduction

WisDOT accepts the use of the HCM, Chapter 22 methods for the analysis of isolated roundabouts with one-lane and two-lane entries, up to one yielding or non-yielding bypass lane per approach, and up to two circulating lanes. HCM, Chapter 22 methodologies focus on the motor vehicle mode but do offer some guidance for how to assess the performance of pedestrian and bicycles.

Section 3 of HCM, Chapter 22 provides detailed descriptions and equations for each step of the roundabout analysis, while Chapter 33, Roundabouts Supplemental of the HCM (Section 3) goes through each of the computational steps for two example problems: one for a single-lane roundabout with bypass lanes and one for a multi-lane roundabout. These steps describe how to calculate the capacity, LOS, and queue for a roundabout by hand. The use of software makes analyzing the operations of a roundabout more efficient.

Analysts *should* recognize and account for the limitations of the roundabout methodology in Chapter 22. For roundabouts that are not isolated, are part of a system or corridor of roundabouts, or are located within the influence area of an adjacent signal, the analyst *should* use a combination of the roundabout methods of Chapter 22 and the urban street segment procedures outlined in Chapter 18. For closely spaced roundabouts (roundabouts spaced less than 1,000 feet from center-to-center), specifically those found at freeway ramp terminals, the analyst *should* follow the methodology presented in Chapter 23 for interchange ramp terminals.

See TEOpS 16-15-20.5 for additional information on the use of supplemental tools for operational analyses and design.

20.1.2 Roundabout Capacity

The capacity of each entry to a roundabout is the maximum rate at which vehicles can reasonably enter the roundabout during a given time period under prevailing traffic and geometric conditions. An operational analysis considers entering and circulating traffic flow rates defined for the morning and evening peak periods for each lane at a roundabout. Analysis of the peak hour period is critical to assess the level of performance at each approach and the roundabout as a whole.

The maximum flow rate that a roundabout entry can accommodate depends on two factors: (1) the circulating flow in the roundabout that conflicts with the entry flow, and (2) the number of entering lanes on the approach to the circulatory roadway. When the circulating flow is low, drivers at the entry can enter the roundabout without significant delay. The larger gaps associated with low circulating flows make it easier for drivers to enter the roundabout and provide the opportunity for more than one vehicle to enter each gap. As the circulating flow increases, the size of the gaps in the circulating flow decreases, thus the rate at which vehicles can enter also decreases.

Evaluate the conflicting flow rates at each approach leg of the roundabout individually to determine the number of entering lanes required. Base the number of lanes within the circulatory roadway on the number of lanes needed to provide lane continuity. More detailed lane assignments and refinements to the lane configurations must be determined through a more formal operational analysis as described in TEOpS 16-15-20.2.

On multi-lane roundabouts, it is important to balance the traffic use of each lane to avoid overloading one or more lanes while underutilizing other lanes. In addition, poorly designed exits may influence driver behavior and cause lane imbalance and congestion on the opposite leg.

20.1.3 Pedestrian Effects on Entry and Exit Capacity

Pedestrians crossing at a marked crosswalk have priority over entering motor vehicles. As such, pedestrian traffic can have a significant effect on the capacity of a roundabout entry, especially if there are high pedestrian volumes.

To approximate the effect of pedestrian traffic, multiply the vehicular capacity by the entry capacity adjustment factor for pedestrians (fped) according to the relationship shown in Exhibit 22-18 and 22-20 of HCM7, Chapter 22 for single-lane and two-lane entry roundabouts, respectively.

Note that the effects of conflicting pedestrians on the approach capacity decrease as conflicting vehicular volumes increase, as entering vehicles become more likely to have to stop regardless of whether pedestrians are present. Consult the HCM for additional guidance on the capacity of pedestrian crossings if the capacity of the crosswalk itself is an issue. A similar effect in capacity may occur at the pedestrian crossing on the roundabout exit.

20.2 Wisconsin-Calibrated Models

20.2.1 Driver Behavior

Critical headway (also referred to as 'critical gap') and follow-up headway are the driver behavior parameters that influence the capacity of a roundabout approach and intersection. Critical headway is the smallest gap in circulating traffic that an entering driver would accept to enter the roundabout. Follow-up headway is the time between two successive entering vehicles accepting the same gap in circulating traffic. Figure 20.1 diagrams the concept of critical headway and Figure 20.2 diagrams the concept of follow-up headway.

Figure 20.1 Critical Headway

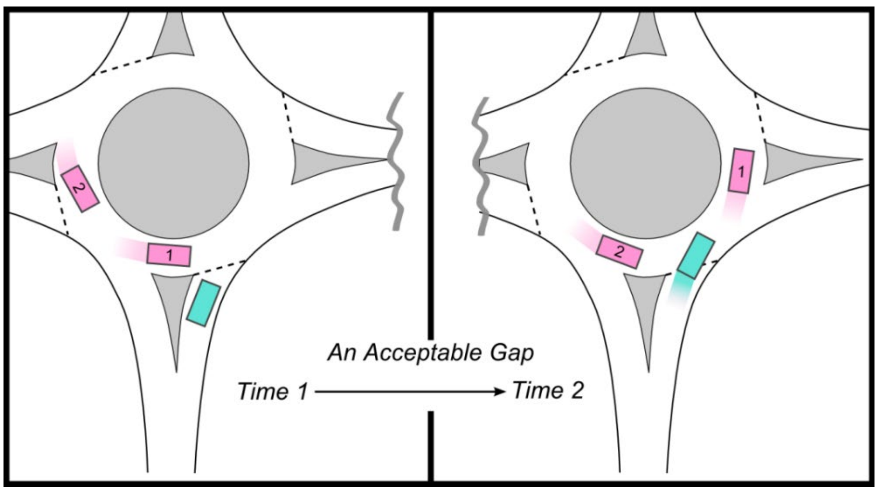
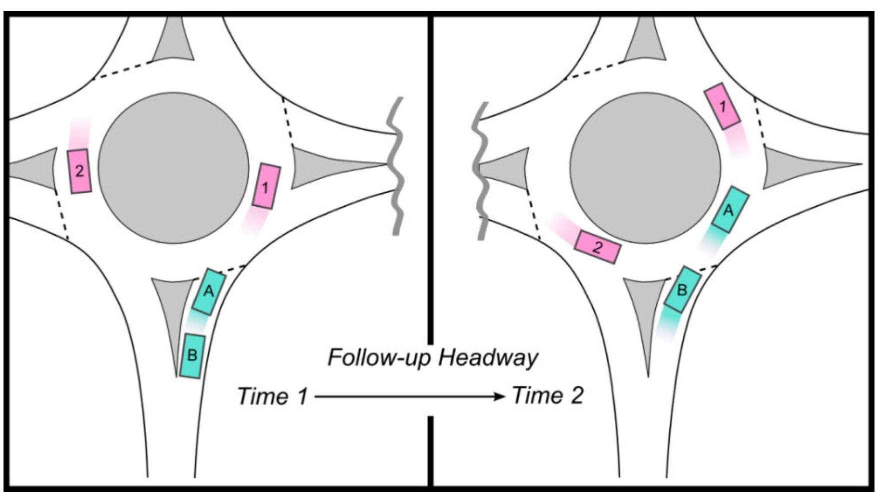


Figure 20.2 Follow-up Headway



The HCM (Chapters 22 and 33) provides an empirical capacity equation for estimating the operations of a U.S. roundabout which is based on an exponential gap-acceptance theory combined with field determined headway values. This method of analyzing roundabouts is the basis for Wisconsin's driver behavior-based approach to analyzing roundabout operations.

The general form of the capacity equation for a roundabout follows below in Equation 20.1 - Equation 20.3:

$$c_{pce} = Ae^{(-Bv_c)} \qquad \text{[Equation 20.1]}$$

$$A = \frac{3{,}600}{t_f} \qquad \text{[Equation 20.2]}$$

$$B = \frac{t_c - (t_f/2)}{3{,}600} \qquad \text{[Equation 20.3]}$$

where:

c_{pce} $= entry\ lane\ capacity, adjusted\ for\ heavy\ vehicles\ (pc/hr/ln)$

v_c $= lane\ capacity, adjusted\ for\ heavy\ vehicles\ (pc/hr)$

t_c $= critical\ headway\ (s), and$

t_f $= follow - up\ headway\ (s)$

Adjusting the critical and follow-up headways allow the capacity equation in Equation 20.1 to be calibrated to reflect local site conditions. The HCM provides default capacity equations based on observations of critical and follow-up headways made at US roundabouts in 2012 (7)

In an effort to calibrate the HCM capacity equations to reflect conditions in Wisconsin, in 2020, WisDOT completed a research project to observe headways at Wisconsin roundabouts (8). Table 20.1 lists the recommended headway values and the corresponding parameters A and B that were developed based on the findings of the study. The analyst **shall** use the values listed in Table 20.1 for roundabout capacity analyses statewide. Refer to Attachment 20.1 for an illustration of the roundabout lane configurations associated with the headway values in Table 20.1.

Table 20.1 Recommended Headway Values[1]

	Critical Headway, t_c	Follow-up Headway, t_f	Parameter A	Parameter B
Single Circulating (Conflicting) Lane				
Single Lane Entry (1 - 1)	4.7	2.6	1385	0.000944
Two Lane Entry				
Left Lane (L2 - 1)	4.7	2.5	1440	0.000958
Right Lane (R2 - 1)	4.4	2.5	1440	0.000875
Three Lane Entry				
Left Lane (L3 - 1)	4.6	2.3	1565	0.000958
Center Lane (C3 - 1)	4.4	2.6	1385	0.000861
Right Lane (R3 - 1)	4.4	2.4	1500	0.000889
Yielding Slip/Bypass Lane (R-bypass - 1)	4.0	2.3	1565	0.000792
Multi-Circulating (Conflicting) Lanes[2]				
Single Lane Entry (1 - 2)	4.8	2.6	1385	0.000972
Two Lane Entry				
Left Lane (L2 - 2)	4.6	2.6	1385	0.000917
Right Lane (R2 - 2)	4.3	2.6	1385	0.000833
Three Lane Entry				
Left Lane (L3 - 2)	4.6	2.5	1440	0.000931
Center Lane (C3 - 2)	4.4	2.4	1500	0.000889
Right Lane (R3 - 2)	4.6	2.5	1440	0.000931
Yielding Slip/Bypass Lane (R-bypass - 2)[3]	4.8	2.8	1286	0.000944

[1] Refer to the TADI 2020 research study for details on how the recommended headway values were calculated (8).
[2] Values are based on observations of roundabouts with two circulating (conflicting) lanes but are assumed to be similar for roundabouts with three circulating (conflicting) lanes. For roundabouts with more than two circulating (conflicting) lanes, consider conducting field investigations to verify values.
[3] The TADI 2020 research study (8) did not evaluate bypass lanes for multi-circulating lane roundabouts with more than one entry lane.

20.2.2 HCM Analysis

The WisDOT-supported traffic engineering software programs for HCM-based roundabout analysis are:

- HCS, McTrans
- SIDRA (HCM mode only), Akcelik & Associates

Refer to the *WisDOT Supported Traffic Analysis Tools* document for the version and build of the above software that WisDOT currently supports. Use of the WisDOT-supported software requires calibration with the recommended Wisconsin headway values listed in Table 20.1.

20.2.2.1 HCS

Consistent with the confines of the HCM methodology, HCS restricts analysis to no more than four approaches, a maximum of two entry lanes, and up to one yielding or nonyielding bypass lane per approach. For other roundabout lane configurations, use of SIDRA or a supplemental tool (see TEOpS 16-15-20.5) is required.

20.2.2.2 SIDRA

SIDRA can analyze roundabouts with multiple models, including SIDRA Standard and HCM6 capacity models. ; SIDRA does not yet reference HCM7; however, the roundabout capacity models are the same for HCM6 and HCM7, so the US HCM 6 model is reflective of both HCM6 and HCM7 methodologies. When analyzing Wisconsin roundabouts, the analyst **shall** use the US HCM 6 (HCM7) capacity and delay models and **shall** treat the level of service the same as sign control (located under the Roundabouts window, Options tab). Check the “Apply Extended Model” under the US HCM 6 roundabout capacity model to expand the available roundabout capacity model parameters to reflect the roundabout lane configurations illustrated in Table 20.1.

SIDRA (U.S. mode) expands upon the lane configuration limitations of the HCM methodology such that SIDRA (U.S. mode) is applicable for all roundabouts but is specifically required for the evaluation of roundabouts with three entry lanes, two right-turn bypass lanes, or five or more approaches. SIDRA applies the basic HCM procedures and provides essentially the same results as HCS. Verify the SIDRA results for three-lane entries and dual bypass lanes with one of the supplemental design-aid tools discussed in TEOpS 16-15-20.5.

Within SIDRA, there is the option to apply an HCM Roundabout Capacity Model Extension to address unbalanced flow conditions. Additionally, SIDRA has an Extra Bunching parameter (located under the Intersection window, Intersection tab, Approach Data field*)*, that when applied, adjusts the proportion of platooned vehicles in the traffic stream according to the proximity of and level of queuing at an upstream signalized intersection. Prior to utilizing either the unbalanced flow model extension or the extra bunching parameter for operational analysis, the analyst *should* verify the appropriateness of their use with the WisDOT regional traffic engineer or BTO-TASU.

In addition to the HCM mode, SIDRA has its own roundabout capacity model (i.e., SIDRA Standard) which is based on Australian and international research. The analyst *may* use the SIDRA Standard model as a design-checking tool, but this mode is not acceptable for demonstrating that the roundabout provides sufficient capacity. See TEOpS 16-15-20.5 for additional information on the use of supplemental design-aid tools.

20.2.2.3 Selecting the Appropriate Analysis Tool

Use Table 20.2 as guidance in choosing the most appropriate WisDOT supported analysis tool for the specific roundabout lane configuration under consideration. See TEOpS 16-10-5 for additional guidance on how to select the most appropriate traffic analysis tool for a specific project.

Table 20.2 Choosing the Appropriate Analysis Tool

Analysis Tool	Appropriate Situations
HCS	One or two-lane entries, single-lane right-turn bypass lanes, no more than four approach legs
SIDRA Intersection	One, two or three-lane entries, one or two-lane right-turn bypass lanes, up to 8 approach legs
Refer to the *WisDOT Supported Traffic Analysis Tools* document for the version of HCS and SIDRA Intersection that WisDOT currently supports.	

20.2.3 Calibrating the HCM Model

20.2.3.1 HCS

In order to calibrate the HCM model within HCS, the analyst will need to enter the headway values (both critical and follow-up) for each travel lane under the Roundabout "Traffic" tab. Critical and follow-up headway values **shall** match the accepted Wisconsin headways listed in Table 20.1. The headway values entered depend on the number of entry lanes and the number of lanes circulating (conflicting) past a given entry, see Attachment 20.1. Refer to the HCS Users Guide for additional details on how to modify the critical and follow-up headway values.

20.2.3.2 SIDRA

After entering the intersection geometry, the analyst has two options to calibrate the model within SIDRA to reflect the Wisconsin-specific values shown in Table 20.1.

With the first option, the analyst will need to revise the default Parameter A and Parameter B values (located under the Roundabouts window, HCM 6 Extended Data tab). In order to view the parameters for all combinations of entering and circulating lanes as shown in Table 20.1, the analyst will need to check "Apply Extended Model" under the US HCM 6 roundabout capacity model options (see Figure 20.3). In most cases, on dual or triple-lane entry roundabouts, the right lane acts as the dominant lane while the left and middle lane act as the subdominant lane(s).

Alternatively, the analyst can enter the headway values (both critical and follow-up) for each travel lane (located under the Gap Acceptance window, Data tab, Vehicle Movements Opposing field) making sure to specify the use of "Input" values rather than the default "Program" values (see Figure 20.4).

See the SIDRA User Guide for additional details on how to modify the Parameter A and Parameter B values and Gap Acceptance Data.

Figure 20.3 SIDRA HCM 6 Extended Data Roundabout Capacity Model Parameters

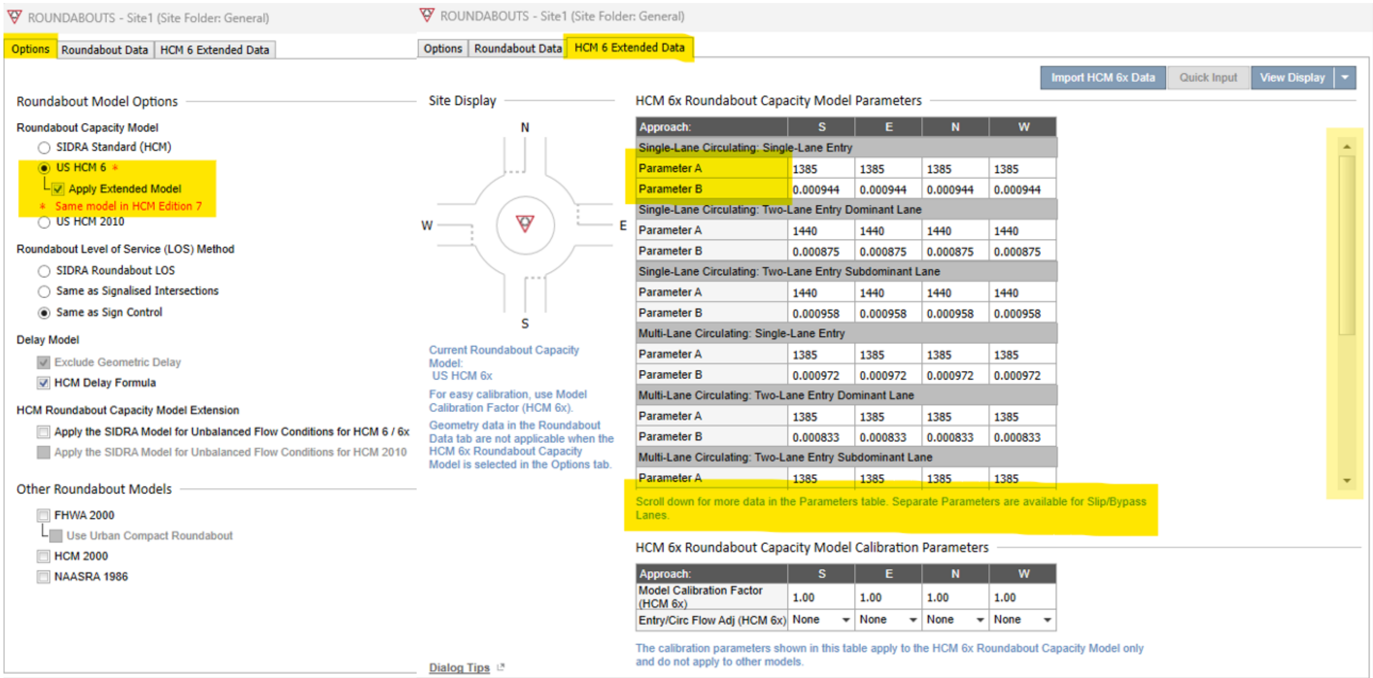
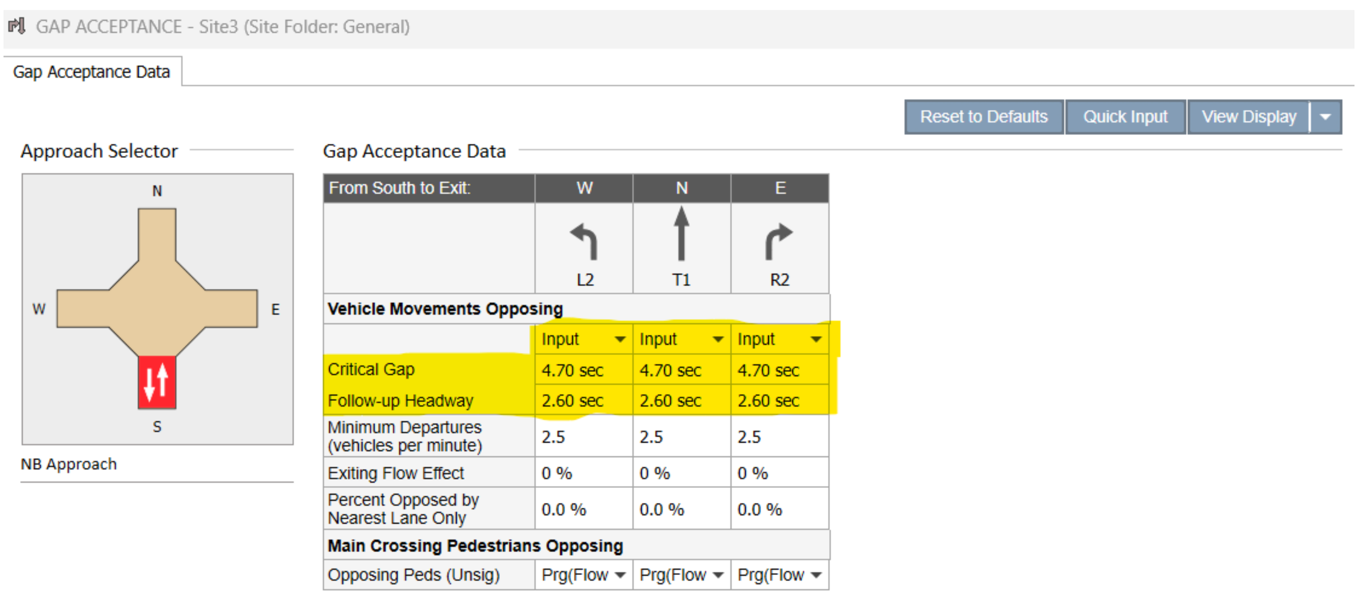


Figure 20.4 SIDRA Gap Acceptance Data



20.3 Compact Roundabout Analysis

The HCM methodology does not account for geometric parameters, such as the inscribed circle diameter (ICD), as factors in determining the operations of a roundabout. As international research has shown, changing the size of the ICD has an impact on overall operations. Therefore, without additional calibration, the current HCM single-lane roundabout methodologies will not correctly estimate the operations of a compact roundabout, generally overestimating the capacity.

Currently, both the presence of compact roundabouts and subsequently the research on compact roundabouts is minimal in the US. As such, as an interim approach until more research becomes available on in-service compact roundabouts operating at or near capacity, WisDOT studied the effects of known volume-based operational parameters of larger sized roundabouts (ICDs greater than 120 ft) on the varying ICDs and volume flow rates of compact roundabouts.

The analyses, completed with WisDOT-supported software (HCS and SIDRA), resulted in the development of volume calibration factors (VCFs) for two size ranges of compact roundabouts, those between 80-99 feet and those between 100-119 feet.

20.3.1 Volume Calibration Factor (VCF) Selection

Select a scaling factor based on the entering AADT and the proposed ICD size, as shown in Table 20.3.

Table 20.3 Volume Calibration Factor

Entering AADT	ICD	
	80 – 99 ft	**100-119 ft**
< 15,000	30%	20%
15,000 – 15,999	29%	19%
16,000 – 16,999	28%	18%
17,000 – 17,999	27%	17%
18,000 – 18,999	26%	16%
≥19,000	25%	15%

20.3.2 Application of VCFs using HCS

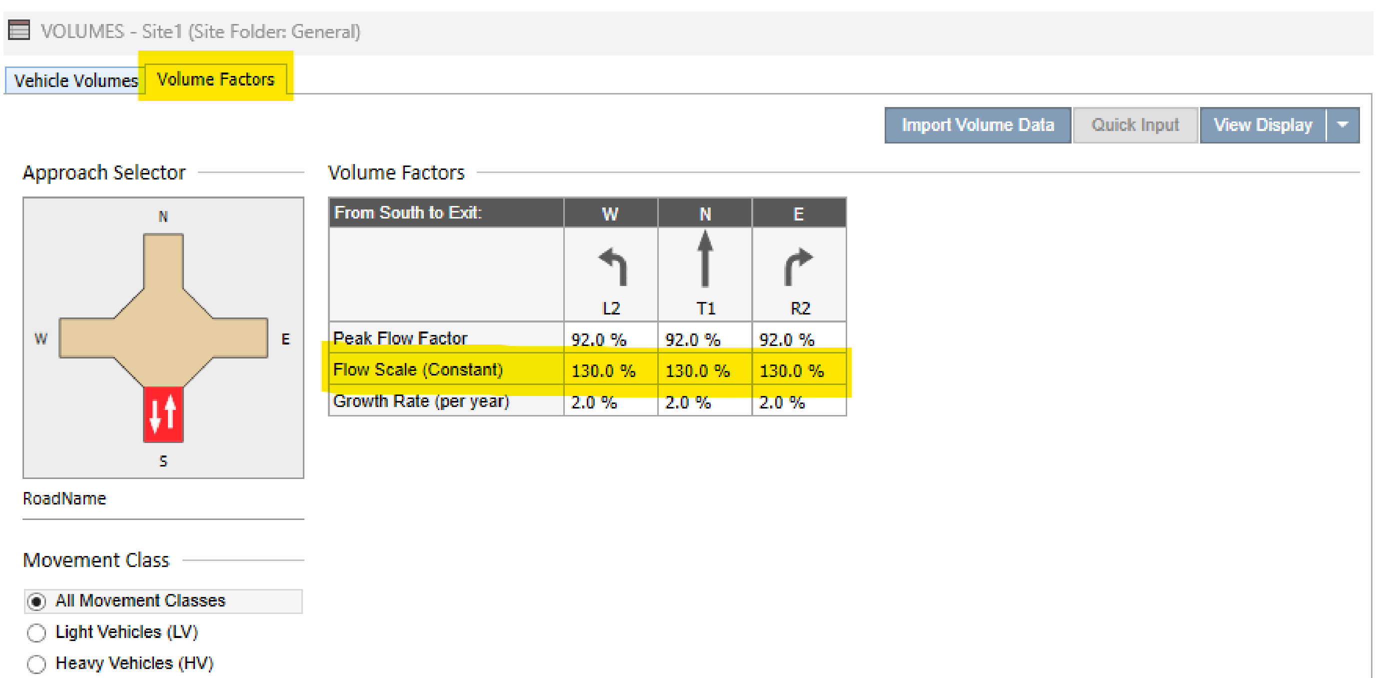
Manually increase the design year turn movement volumes by the appropriate VCF and enter the resulting volume into the Traffic tab. The new volume will be the (VCF + 100) * the field turning movement count. Enter the PHF and Percent Heavy Vehicles as determined by the field count data and use the appropriate Wisconsin calibrated headway values as shown in Table 20.1.

20.3.3 Application of VCFs using SIDRA

The following outlines the four-step process for applying the VCFs within SIDRA.

1. Start by setting up a site in SIDRA based on the instructions in TEOpS 16-15-20.2.2.2 and TEOpS 16-15-20.2.3.2. Enter the volumes, PHF, and Percent Heavy Vehicles as determined by the field count data and use the appropriate Wisconsin calibrated headway values as shown in Table 20.1.
2. Set the Roundabouts Site Input to use the US HCM 6 Roundabout Capacity Model.
3. To apply the VCF, open the Volumes window and activate the Volume Factors tab. Enter the VCF into the Flow Scale (Constant) cells under each movement, for every leg of the site. The new Flow Scale will be the VCF + 100, as shown in Figure 20.5.
4. Process the site as normal.

Figure 20.5 VCF Input as the Flow Scale



20.4 Operational Analysis and Design

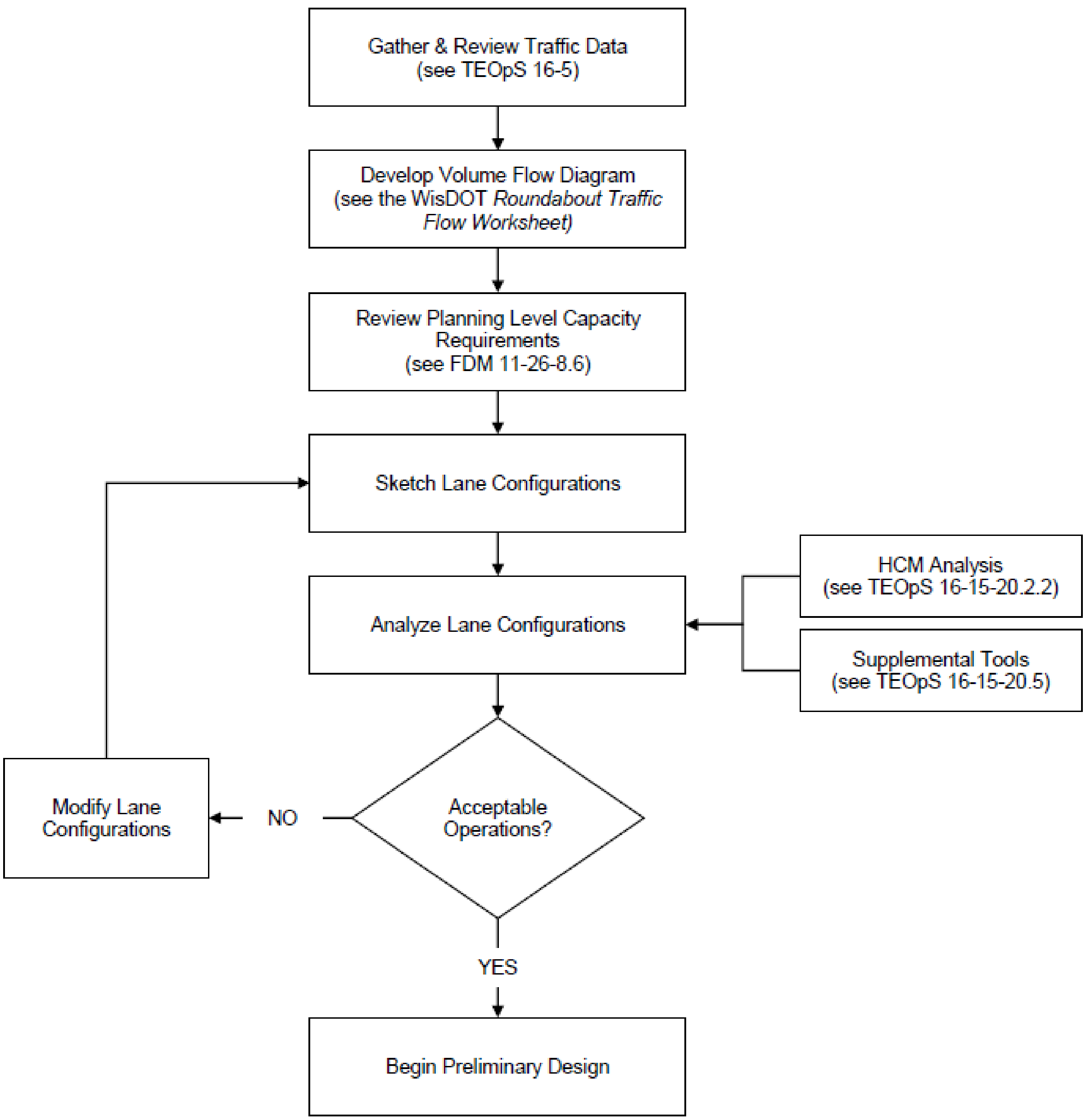
The lane configuration selected for typical operations with design year traffic conditions should be the basis of the roundabout design. Typically, a lane configuration for typical operations means that all or most movements operate at LOS D or better with a volume -to-capacity ratio less than one. See FDM 11-5-3.2 for further discussion on intersection LOS and see FDM 11-5-3.5 for further discussion on the typical level of service evaluation.

Figure 20.6 provides a diagram illustrating WisDOT's approved method for analyzing roundabouts using HCM guidance. As shown in Figure 20.6, only once the analysis is complete and the preferred lane configuration has been determined, *should* the preliminary design of the roundabout begin.

20.4.1 Develop Volume Flow Diagram

After gathering and reviewing the existing and forecasted traffic volumes for reasonableness (see TEOpS 16-5), develop a volume flow diagram that illustrates the entering and circulating volumes for each roundabout approach. Forecasts developed by the WisDOT Traffic Forecasting section include a volume flow diagram. Alternatively, the WisDOT Roundabout Traffic Flow Worksheet provides a format for summarizing the AM and PM peak hour traffic volumes and truck percentages for a 3-leg or 4-leg roundabout.

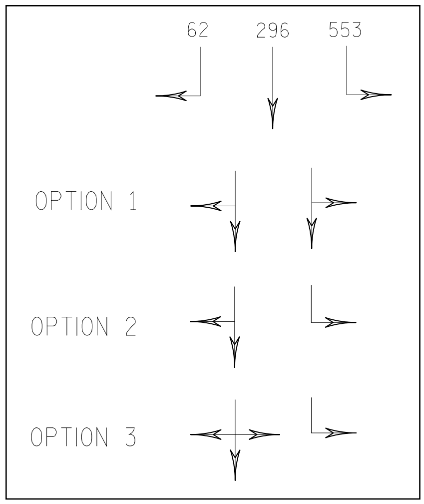
Figure 20.6 WisDOT Approved Method for Analyzing Roundabouts



20.4.2 Review Planning Level Capacity Requirements

Refer to FDM 11-26-8.6, Figure 8.2 to establish a planning-level estimate of the number of entry lanes a roundabout would require to serve the traffic demands illustrated in the volume flow diagram. Using the planning-level lane requirement estimates, determine the entry volumes for each lane of the roundabout approach. Adjust the lane volumes based on observed or estimated lane utilization patterns or imbalances. If no lane utilization patterns are observed, the HCM default values are 47% of entry flow in the left lane and 53% of entry flow in the right lane for left-through plus through-right (Option 1 in Figure 20.7) and left-through-right plus right lane configurations, and 53% in the left lane and 47% in the right lane for left plus left-through-right (Option 3 in Figure 20.7) lane configurations.

Figure 20.7 Roundabout Lane Configuration Options



20.4.3 Sketch Lane Configurations

A lane configuration sketch of the roundabout *should* accompany the traffic volumes to facilitate the selection of the number of lanes and the lane assignments. The layout process is critical because it affects the geometry. This step precedes the detailed roundabout capacity analysis. In Figure 20.7, the assessment of lane assignments for the example traffic flows could include three different options. Unless traffic demand for a given approach is indicative of the potential need for an exclusive left turn lane, the preferred configuration is Option 1 for its simplicity of design and because the configuration should accommodate both peak and off-peak traffic demand. In the example, Options 2 and 3 would require spiral geometry and marking treatment for the upstream entry left turn. Additionally, Options 2 and 3 imply a single-lane exit for lane continuity of the through movement. These alternatives complicate the design and may influence driver behavior by causing confusion when navigating the circulatory roadway. Figure 20.8 is an example of the roundabout lane configuration sketch employing Option 1.

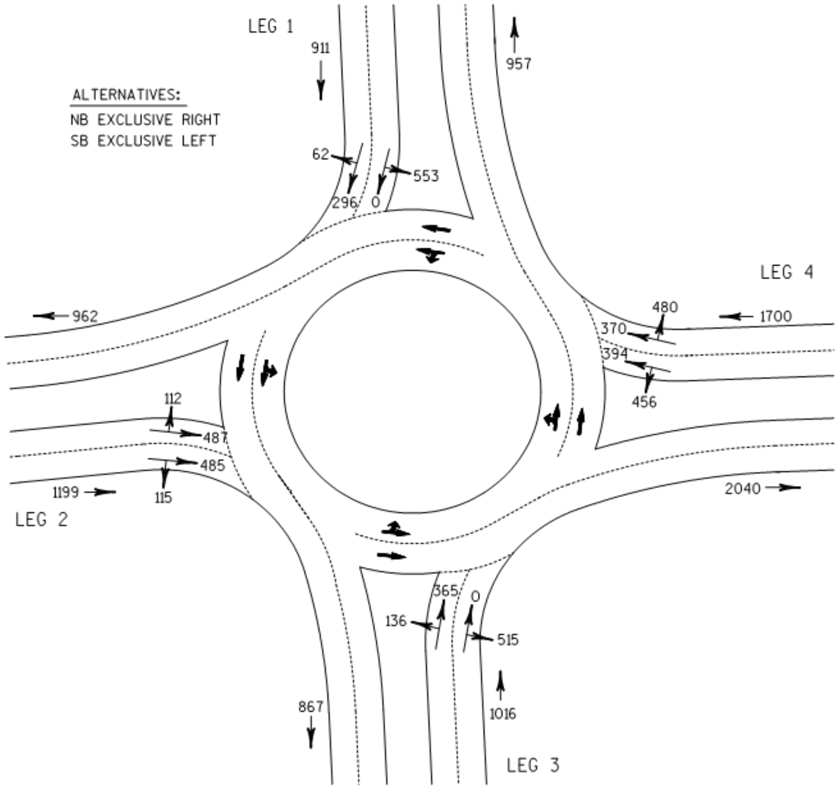
20.4.4 Analyze Lane Configurations

Evaluate the preliminary lane configurations following the HCM analysis methodology outlined in TEOpS 16-15-20.2. Start by using one of the two WisDOT supported HCM-based analysis tools (HCS or SIDRA) and conduct sensitivity testing with supplemental design-aid tools as appropriate (see TEOpS 16-15-20.5).

Following FDM guidance and HCM methodologies, check for acceptable levels of operation. If levels of operation are not acceptable, modify the preliminary lane configurations and reevaluate until a lane configuration for acceptable operations is determined, after which the detailed design can be completed.

Existing roundabouts may need to be field adjusted to improve capacity; use of supplemental tools may be appropriate to help determine potential improvements for an existing roundabout.

Figure 20.8 Lane Configuration Sketch



20.4.5 Special Considerations

Lane designation or lane assignments are critical to the success of the roundabout lane configuration and design. Conditions can be very complex with subtle problems that can reduce capacity and cause severe lane imbalance. Great care and sensitivity are required to achieve lane utilization balance. Supplementary software is especially suited to these situations.

- Unbalanced Conflicting Flows:

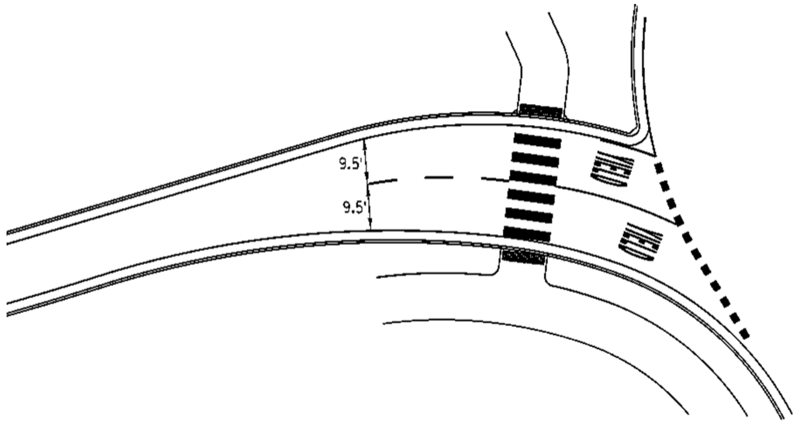
  At a roundabout with unbalanced conflicting flow patterns, a traffic stream with a low flow rate enters the roundabout having to yield to a circulating stream with a high flow or visa-versa.

  Unbalanced circulating flows highlight an operational condition that traffic engineers and designers *should* understand and interpret by taking into consideration all aspects including but not limited to the results of the analysis, the existing and future field conditions, and the traffic patterns to better inform the findings on the analysis. The SIDRA Standard capacity model is sensitive to the ratio of entering to circulating flow, and therefore may be able to reflect expectations of capacity when unbalanced flow conditions are expected. A microsimulation model can also supplement the analysis, but the level of data and effort to calibrate this model can be significant and may not be appropriate for an isolated roundabout analysis.

- Capacity Considerations of Flared Entries:

  In some situations, the use of appropriate lane arrows can encourage balanced lane use, thus improving capacity. Traffic often has a bias towards the right-most lane. Lane arrows either can encourage this bias or can encourage lane balance. Figure 20.9 shows the preferred pavement marking scheme to encourage balanced lane demand. It is important for the analyst not to assume that flared entries at roundabouts will always provide for balanced lane use and therefore add capacity to that entry as HCS and SIDRA will predict. This scenario *may* occur on the approach to a roundabout that has little to no conflicting circulating traffic (e.g., a roundabout at an interchange ramp or any roundabout with a one-way street). The suitable marking for an approach will depend on the turning volume proportions. A methodology similar to that described in TEOpS 16-15-20.4.2 is used to assess lane designation alternatives.

Figure 20.9 Capacity Considerations of Flared Entries



In addition, assessment of the potential for one lane to fill and block the flared lane is necessary to achieve the predicted levels of service (i.e., the geometry must be effective to match the capacity prediction). Lane starvation is a primary failure mechanism for flared entries. Microsimulation models have various forms of lane-by-lane simulation features, which allow the analyst to test alternative lane configurations with visualization of the simulated flows accumulating and filling the flared lanes.

20.5 Supplemental Tools for Operational Analysis and Design

When performing roundabout operational evaluations, analysts *should* recognize and account for the methodological limitations of the HCM. There are cases that *may not* fit within the analytical framework of the HCM, including, but not limited to: volume-to-capacity ratio exceeding 0.80, high-level of pedestrian or bicycle activity, priority reversal under extremely high flows, and flared entry lanes. When the volume-to-capacity ratio exceeds 0.80, the analyst *should* carefully consider predicted queues and delays and perform additional sensitivity analysis. Further analysis with microsimulation or design-aid tools such as SIDRA Standard, Rodel, or ARCADY can supplement the study if the effort is justifiable based on the site conditions.

Use of supplemental software tools may also be appropriate for evaluating operations for in-service roundabouts whereby collection of data under at or over capacity conditions are available to calibrate the roundabout capacity equations. FDM 11-26-8.10 provides additional details on the assessment of existing roundabouts.

Microsimulation is capable of system level analysis and allows the analyst to adjust roundabout designs indirectly. Additionally, microsimulation that provides for animation and visualization of operating predictions is useful for assessing lane utilization and capacity, especially when considering closely spaced roundabouts (roundabouts spaced less than 1,000 feet from center-to-center). Analysis with microsimulation may help identify lane imbalances or lane use problems within a series of intersections allowing for a more robust design of any single roundabout. Microsimulation may also prove beneficial for public outreach. Since microsimulation requires significantly more time, resources, and effort than HCM-based analysis, it is not appropriate to use for all roundabout analysis or design. Refer to TEOpS 16-10 for additional guidance on determining whether the use of a microsimulation tool would be appropriate. See TEOpS 16-20 for additional details on performing microsimulation analysis.

SIDRA Standard, Rodel, ARCADY and any other tool that designers have available to assist them in the design process can prove beneficial for the final geometric design of the roundabout. These programs provide for geometric sensitivity testing, allowing the user to test the effects of size and key geometric parameters (e.g., inscribed circle diameter, entry radius, phi angle, lane width, and flared entry) along with varied flows on an existing or proposed roundabout design. Prior to using supplemental design-aid tools, the analyst *should* first determine the basic lane configuration using the HCM-based operational analysis and any other pertinent considerations. When the results of the HCM analysis show that a multi-lane roundabout is necessary on an existing single-lane roadway, the designer *should* confirm the HCM results using supplemental design-aid tools.

Rodel and ARCADY apply UK research producing a model that relates geometry to capacity, for roundabout capacity calculations. SIDRA Intersection, when used in Standard mode, implements a capacity estimation method that assumes a dependence of gap acceptance parameters on multiple factors. Roundabout geometry, circulating flows, entry lane flows, and model designation of dominant or subdominant lanes all influence gap acceptance parameters to account for lane-by-lane capacity variation. SIDRA Standard utilizes what they call the Environment Factor as one of the main parameters to calibrate the capacity model. The recommended Environment Factor for U.S. roundabouts is 1.05 for one-lane roundabouts (approach road or circulating road has one lane) and 1.2 for multi-lane roundabouts (both approach road and circulating road have two or more lanes). See the SIDRA Intersection User Guide Calibration Parameters for Roundabout Capacity Models for details on how to apply the Environment Factor in the SIDRA capacity model.

LIST OF ATTACHMENTS

Attachment 20.1	Roundabout Lane Configurations

16-15-25 Alternative Intersections — February 2025

Alternative intersections separate out one or more of the turning movement conflicts (typically left-turns) by rerouting them away from the center of the intersection to a secondary junction. Alternative intersections *may* be signalized or stop-controlled on the minor street movements. Examples of alternative intersections include, but are not limited to, the following:

- Restricted Crossing U-Turn (RCUT), also known as the J-Turn or superstreet (a signalized RCUT),
- Median U-Turn (MUT), also known as the Michigan left turn or modified RCUT, and
- Displaced Left Turn (DLT), also known as the continuous-flow intersection

Refer to FDM 11-25 Attachment 3.3 for a brief description, summary of the key elements to consider, and some of the potential benefits/concerns associated with these alternative intersections. For additional information on RCUTs, see the WisDOT *Restricted Crossing U-Turn* webpage.

By rerouting one or more of the turn movements away for the center of the primary intersection, alternative intersections result in two or more closely spaced intersections that are operationally dependent on one another. Thus, the analyst *should* treat these intersections as a single unit.

WisDOT accepts the use of the HCM, Chapter 23 to assess the performance of the RCUT, MUT, and DLT from the perspective of the motor vehicle, pedestrian, and bicycle modes. Note that the Chapter 19 signalized methodology for pedestrians and bicycles is typically applicable for the minor street crossings at a signalized RCUT (superstreet) and for all crossings at the signalized MUT. The HCM, Chapter 23 methodology provides a means to measure experienced travel time and considers the control delay experienced at each intersection plus the additional travel time needed to travel from the primary/center intersection to the secondary junction and back to the primary/center intersection.

Analysts *should* recognize and account for the limitations of the HCM methodology. Specifically, the analyst *should* bear in mind that the HCM Chapter 23 methodology is only applicable to the RCUT, MUT, and DLT. Consider using microsimulation analysis tools for those alternative intersections that do not fit within the methodological limitations of the HCM. See TEOpS 16-20 for additional details on performing microsimulation analysis.

The WisDOT-supported traffic engineering software for HCM-based analysis of alternative intersections is:

- HCS, McTrans

Refer to the *WisDOT Supported Traffic Analysis Tools* document for the version and build of the above software that WisDOT currently supports. See TEOpS 16-10-5 for additional guidance on how to select the most appropriate traffic analysis tool for a specific project.

Trafficware has not yet implemented the HCM methodology for alternative intersections within Synchro; however, the analyst *may* be able to manipulate the coding within Synchro to analyze these intersections in accordance with the HCM methods. Confirm with the WisDOT regional traffic engineer whether it is appropriate to utilize Synchro for the analysis of alternative intersections.

16-15-30 Interchange Ramp Terminals — February 2025

The close spacing and interdependency of most ramp terminals requires that the operational analysis consider all ramp terminals within the interchange as a single unit. WisDOT accepts the use of the HCM, Chapter 23 for the analysis of interchange ramp terminals. As no specific methodologies for pedestrian and bicycle operations at interchange ramp terminals currently exist, the HCM, Chapter 23 methodologies for interchange ramps focus on the motor vehicle mode. Chapter 23, however, does provide some guidance for addressing bicycles and pedestrians at interchanges.

The HCM, Chapter 23 methodology addresses the following conventional interchange designs:

- Diamond interchanges,
- Partial cloverleaf (parclo) interchanges, and
- Interchanges with roundabouts.

Additionally, the HCM, Chapter 23 methodology addresses the following alternative interchange designs:

- Diverging diamond interchanges (DDIs) and
- Single-point interchanges (SPI).

Refer to FDM 11-25 Attachment 3.3 for a brief description, summary of the key elements to consider, and some of the potential benefits/concerns associated with each of these interchange designs. For additional information on DDIs and SPIs, see the WisDOT *Innovative interchange design* webpage.

The HCM, Chapter 23 methodology calculates the control delay experienced at each ramp terminal plus any additional travel time associated with driving between ramp terminals within the interchange. This allows for an equal comparison of the various interchange designs.

The analysts *should* recognize and account for the methodological limitations of the HCM, Chapter 23 methods. Specifically, the analyst *should* bear in mind that the analysis methodology is not applicable for freeway-to-freeway or system interchanges. Additionally, the methodology does not cover interchanges with TWSC intersections or interchanges consisting of both a signalized and roundabout intersection. Consider using microsimulation analysis tools for those interchanges that do not fit within the methodological limitations of the HCM. See TEOpS 16-20 for additional details on performing microsimulation analysis.

The WisDOT-supported traffic engineering software programs for HCM-based analysis of interchange ramp terminals are:

- HCS, McTrans
- Synchro, Cubic|Trafficware (conventional ramp terminals only)

Refer to the *WisDOT Supported Traffic Analysis Tools* document for the version and build of the above software that WisDOT currently supports. See TEOpS 16-10-5 for additional guidance on how to select the most appropriate traffic analysis tool for a specific project.

Trafficware has not yet implemented the HCM methodology for the alternative interchange ramp terminals (e.g., DDI, SPI) within Synchro; however, the analyst *may* be able to modify the coding within Synchro to analyze these types of interchange ramp terminals in accordance with the HCM methods. Confirm with the WisDOT regional traffic engineer whether it is appropriate to utilize Synchro for the analysis of the alternative interchange ramp terminals. In most cases, the analyst *should* only utilize Synchro for planning-level applications. For design considerations, the analyst should utilize a WisDOT-supported microsimulation tool. Refer to the *Best Practice – Vissim Analysis of Diverging Diamond Interchanges* for the recommended approach for analyzing DDIs, especially for design considerations.

16-15-35 Urban Street Facilities February 2025

WisDOT accepts the use of the HCM, Chapters 16 and 18 for an integrated multimodal analysis of an urban street facility, including the intersections and segments that make up the facility. The methodology provides the analytical framework to assess the automobile, pedestrian, bicycle, and transit modes by calculating delay and other performance measures by mode for each direction of travel along each segment of the given urban street facility, in addition to mid-block access points and other study intersections. The analyst *should* also consider the methods for TWSC, AWSC, roundabouts, and signalized intersections to the extent that those facilities exist along the subject roadway.

For intersections along an urban arterial or collector street that do not operate in isolation (i.e., the operation of one intersection influences the operation of the adjacent intersection), follow the Chapter 18 Urban Street Segment methodology. If the project spans multiple contiguous urban street segments, consider applying the Chapter 16 Urban Street Facilities methodologies. The Chapter 16 Urban Street Facilities methods allow the analysis of corridors of coordinated signalized intersections to capture average-phase-duration and other analytical components related to progression and vehicular platooning. If travel time reliability performance measures are of interest, consider using the urban street reliability methodologies in HCM, Chapter 17. For additional information on incorporating travel-time reliability into the analysis, contact BTO-TASU (DOTTrafficAnalysisModeling@dot.wi.gov).

Analysts *should* recognize and account for the limitations of the HCM urban streets methodology. Accordingly, limitations of the individual intersection methods are also limitations of the urban street methods. For urban street facilities that do not fit within the analytical framework of the HCM, including but not limited to cases involving turn-lane spillover, mid-block parking maneuvers, or capacity constraints between intersections, the project manager *should* specify the use of an alternative tool such as microsimulation. See TEOpS 16-20 for additional details on performing microsimulation analysis.

The WisDOT-supported traffic engineering software programs for HCM-based urban streets analysis are:

- HCS, McTrans
- Synchro, Cubic|Trafficware

Refer to the *WisDOT Supported Traffic Analysis Tools* document for the version and build of the above software that WisDOT currently supports. See TEOpS 16-10-5 for additional guidance on how to select the most appropriate traffic analysis tool for a specific project.

16-15-40 Freeway Facilities — February 2025

WisDOT accepts the use of the HCM analysis methods in Chapter 10 for a combined freeway facility, Chapter 11 for freeway reliability analysis, Chapter 12 for basic freeway segments, Chapter 13 for freeway weaving segments and Chapter 14 for freeway merge and diverge segments. Analysts *should* use these methods to assess uninterrupted flow facilities that typically have restricted access and consist of higher-speed roadways through rural, suburban, and urban areas. Since there is no pedestrian/bicycle traffic on freeways, the HCM methodology focuses on the vehicular mode of travel. For additional information on incorporating travel-time reliability into the analysis, contact BTO-TASU (DOTTrafficAnalysisModeling@dot.wi.gov).

Analysts *should* recognize and account for the limitations of the HCM methodology for freeway analysis. For freeway facilities that do not fit within the analytical framework of the HCM, the project manager *should* specify the use of an alternative tool such as microsimulation. See TEOpS 16-20 for additional details on performing microsimulation analysis.

The WisDOT-supported traffic engineering software for HCM-based freeway analysis is:

- HCS, McTrans

Refer to the *WisDOT Supported Traffic Analysis Tools* document for the version and build of the above software that WisDOT currently supports. See TEOpS 16-10-5 for additional guidance on how to select the most appropriate traffic analysis tool for a specific project.

16-15-45 Multilane Highways — February 2025

WisDOT accepts the use of the HCM, Chapter 12 methods for the analysis of an expressway or multilane highway. The methodology provides the analytical framework to assess the automobile and bicycle modes of travel. The analyst *should* use these methods to assess uninterrupted flow on multilane highway facilities with free-flow speeds between 45 and 70 mph, and two miles or more between traffic signals. These facilities *may* be divided, undivided, or have a two-way left-turn lane (TWLTL).

Many multilane highways will have periodic signalized intersections that are more than two miles apart. In these cases, the analyst *should* evaluate the highway segment portion using the Chapter 12 method and evaluate the isolated intersection using the signalized intersection analysis tools outlined in TEOpS 16-10-5.

Analysts *should* recognize and account for the methodological limitations of the multilane highway methods. For multilane highway conditions that do not fit within the analytical framework of the HCM, including but not limited to; effect of lane drops and lane additions at the beginning or end of the multilane highway segment, queuing impacts at transition areas (e.g., transitions from a multilane to two-lane highway), significant presence of on-street parking, or significant pedestrian activity, the analyst *should* use an alternative tool such as microsimulation. See TEOpS 16-20 for additional details on performing microsimulation analysis.

The WisDOT-supported traffic engineering software for HCM-based multilane highway analysis is:

- HCS, McTrans

Refer to the *WisDOT Supported Traffic Analysis Tools* document for the version and build of the above software that WisDOT currently supports. See TEOpS 16-10-5 for additional guidance on how to select the most appropriate traffic analysis tool for a specific project.

16-15-50 Two-Lane Highways February 2025

WisDOT accepts the use of the HCM, Chapter 15 methods for the analysis of a two-lane highway. The methodology provides the analytical framework to assess the automobile and bicycle modes of travel. Use these methods to assess uninterrupted flow (i.e., there are no traffic control devices that interrupt traffic) on two-lane highways that have one lane in each direction. Passing takes place on these facilities in the opposing lane of traffic when there is adequate sight distance and safe gaps in the opposing traffic. The two-lane highway methodology also includes a procedure for predicting the effect of passing and truck climbing lanes on two-lane highways.

In general, this analysis includes any segments that have signalized intersections spaced two or more miles apart. Classify two-lane highways with signalized intersections spaced closer than two miles apart as an urban street or arterial and apply the methodologies of HCM, Chapter 16 as appropriate. Further, analyze any major signalized or unsignalized intersections within the two-lane highway corridor using the appropriate tools as outlined in TEOpS 16-10-5.

HCM7 (1) introduced a new methodological framework to analyze two-lane highways that is vastly different from the methodology in previous versions of the HCM. HCM7 uses follower density as the performance measure, with thresholds for LOS based on posted speed limit. The HCM7 methodology uses three different segment types (passing zone, passing constrained, and passing/climing lane), which can be combined into a faciity-level analysis, and incorporates impacts from horizontal and vertical curves. Previous versions of the HCM broke out two-lane corridors into three classifications (Class I, Class II, and Class III) and used percent-time-spent-following (PTSF), average travel speed (ATS), or a combination of the two as the performance measures for determining LOS. The previous HCM methodology handled the impact of counter-directional passing on two-lane segment LOS through a “Percent no-passing zone (%)” rather than explicity requiring the identification of passing zones and passing constrained segments.

All projects **shall** follow the HCM7 methodologies unless otherwise authorized by WisDOT regional traffic staff.

Analysts *should* recognize and account for the methodological limitations of the two-lane highway methods. For two-lane highways that do not fit within the analytical framework of the HCM, the project manager *should* specify the use of an alternative tool such as microsimulation. See TEOpS 16-20 for additional details on performing microsimulation analysis.

The WisDOT-supported traffic engineering software for HCM-based two-lane highway analysis is:

- HCS, McTrans

Refer to the *WisDOT Supported Traffic Analysis Tools* document for the version and build of the above software that WisDOT currently supports. See TEOpS 16-10-5 for additional guidance on how to select the most appropriate traffic analysis tool for a specific project.

16-15-55 Network Analysis February 2025

HCM7, Chapter 38 introduces a new methodology for evaluating the interactions between freeways and urban streets. The methodology expands upon the analysis methods of individual intersections and segments to consider the spillback effects from the downstream facility. Since spillback affects each lane differently, the analysis is conducted on a lane-by-lane basis and provides performance measures at both the network and origin-destination level. The analysis methodology applies capacity adjustment factors dependent on the queue flow regime. There are five different flow regimes, regimes 0 – regime 4, where Regime 0 has no queues and Regime 4 has queues which block the adjacent lane.

WisDOT has not currently identified a specific HCM-based analysis tool for analyzing the interactions between freeways and urban streets. Direct any specific questions regarding the network analysis and spillback effects from the downstream facility to the WisDOT regional traffic engineer or BTO-TASU.

16-15-60 Pedestrian and Bicycle Facilities February 2025

60.1 Mid-Block Pedestrian Crossings

WisDOT accepts the use of the methods outlined by the HCM, Chapter 20-5 for one-stage and two-stage unsignalized mid-block pedestrian crossings, with or without a median refuge area, which are not located at an intersection. Assess the operations of mid-block pedestrian crossings by calculating seconds of delay per pedestrian or pedestrian-group.

Wisconsin-state law requires motorists to yield to pedestrians at designated mid-block pedestrian crossings. Motorist compliance, however, can vary. Implementation of pedestrian crossing treatments that are proven safety countermeasures (e.g., high visibility crosswalk markings, median refuges, and rectangular rapid flashing beacons [RRFBs] or pedestrian hybrid signals) have shown to increase motorist compliance rates and reduce pedestrian crashes. In the absence of local data, and subject to professional judgment, use the default motorist-yield-rates as recommended in the HCM7, Chapter 20 (Exhibit 20-28) for the analysis of mid-block pedestrian crossings.

Analysts *should* recognize and account for the limitations of the mid-block pedestrian crossing methodology (i.e., TWSC pedestrian mode method). For mid-block pedestrian crossings that do not fit within the analytical framework of the HCM, including but not limited to, signalized mid-block crossings or cases where the impact on the major street vehicular traffic is relevant, the project manager *should* specify the use of an alternative tool such as microsimulation. See TEOpS 16-20 for additional details on performing microsimulation analysis.

The WisDOT-supported traffic engineering software for HCM based mid-block pedestrian crossing analysis are:

- HCS, McTrans
- Synchro, Cubic|Trafficware

Refer to the *WisDOT Supported Traffic Analysis Tools* document for the version and build of the above software that WisDOT currently supports. See TEOpS 16-10-5 for additional guidance on how to select the most appropriate traffic analysis tool for a specific project.

60.2 Off-Street Pedestrian and Bicycle Facilities

WisDOT accepts the use of the HCM, Chapter 24 methods for the analysis of off-street pedestrian and bicycle facilities (i.e., non-motorized vehicle usage only). The methodology provides the analytical framework to assess the capacity and LOS for the following types of facilities:

- Walkways: pedestrian-only paved facilities (paths, ramps, and plazas) typically located more than 35 feet from an urban street
- Shared-use paths: paths, separated by a physical barrier from highway traffic, dedicated for the shared-use of all forms of non-motorized (pedestrian, bicyclists, runners, inline skaters, etc.)
- Exclusive off-street bicycle paths: separated by a physical barrier from highway traffic, dedicated for bicycle-only traffic

Analysts *should* recognize and account for the methodological limitations of the HCM. For off-street pedestrian and bicycle facilities that do not fit within the analytical framework of the HCM, the project manager *should* specify the use of an alternative tool.

WisDOT has not currently identified a specific analysis tool for analyzing off-street pedestrian and bicycle facilities. Direct any specific questions regarding the analysis of off-street pedestrian and bicycle facilities to the WisDOT regional and statewide bicycle and pedestrian coordinators.

16-15-70 References February 2025

1. **Transportation Research Board.** *Highway Capacity Manual 7th Edition: A Guide For Multimodal Mobility Analysis.* Washington, D.C. : National Academy of Sciences, 2022. ISBN 978-0-309-08766-7.

2. **Transportation Research Board**. *Highway Capacity Manual, 6th Edition: A Guide For Multimodal Mobility Analysis.* Washington, D.C. : National Academy of Sciences, 2016. ISBN 978-0-309-36997-8.

3. **R.A. Smith National.** *Right Turn on Red Methodology Evaluation.* 2009.

4. **TranSmart Technologies, Inc.** *Signalized Intersection Capacity Data Collection: A Statewide Evaluation of Saturation Flow Rate and Right Turn on Red.* November 2015.

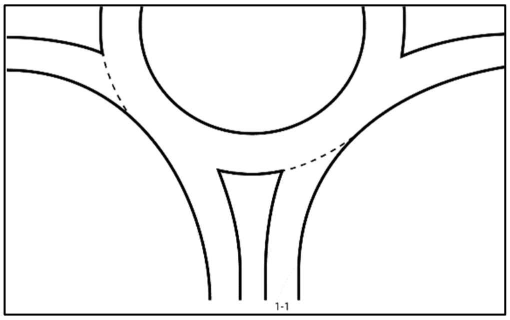
5. **Traffic Analysis and Design, Inc. (TADI).** *Signalized Intersection Data Collection - Phase III.* October 2021.

6. ***NCHRP 572.*** *Roundabouts in the United States.* 2007.

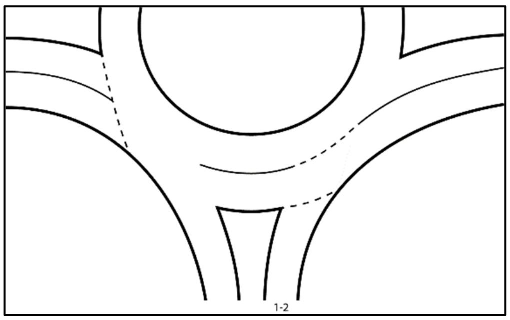
7. **Rodegerdts, L.A., A. Malinge, P.S., Marnell, S.G. Beaird, M.J. Kittelson, and Y.S. Mereszcak.** *Assessment of Roundabout Capacity Models for the Highway Capacity Manual: Volume 2 of Accelerating Roundabout Implementation in the Unites States.* Washington, D.C. : Federal Highway Administration, Sept. 2015. Report FHWA-SA-15-070.

8. **Traffic Analysis and Design, Inc. (TADI).** *Statewide Roundabout Traffic Operations Analysis.* March 2020.

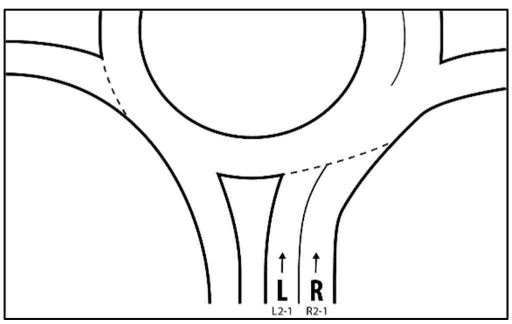
One-Lane Entry Conflicted by One Circulating Lane (1-1)



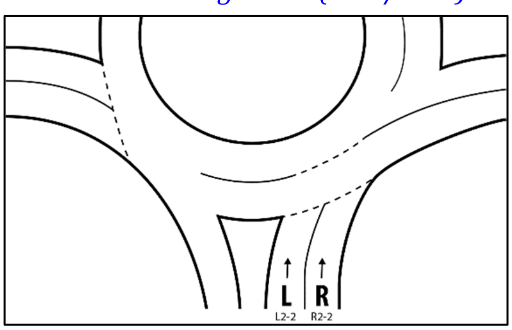
One-Lane Entry Conflicted by Two Circulating Lanes (1-2).



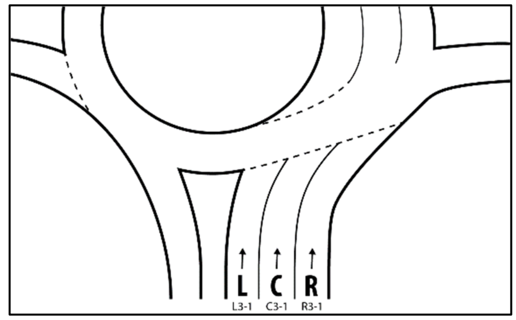
Two-Lane Entry Conflicted by One Circulating Lane (L2-1/R2-1)



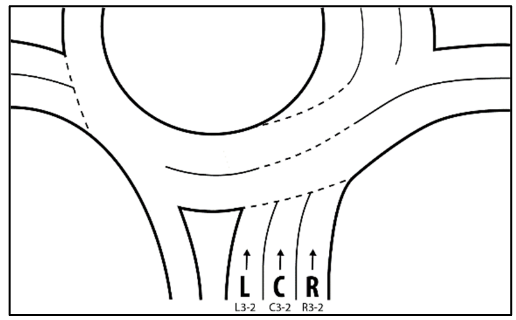
Two-Lane Entry Conflicted by Two Circulating Lanes (L2-2/R2-2).



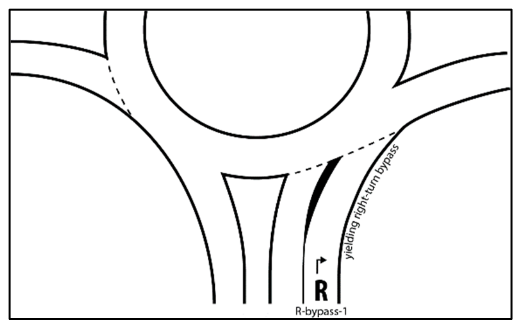
Three-Lane Entry Conflicted by One Circulating Lane (L3-1/C3-1/R3-1)



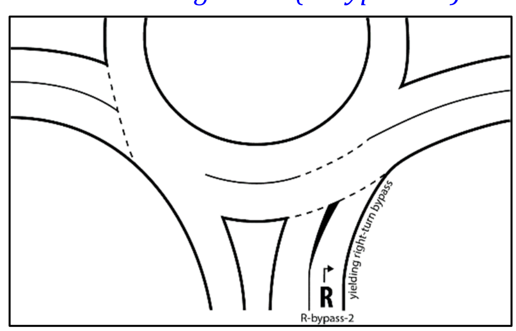
Three-Lane Entry Conflicted by Two Circulating Lanes (L3-2/C3-2/R3-2)



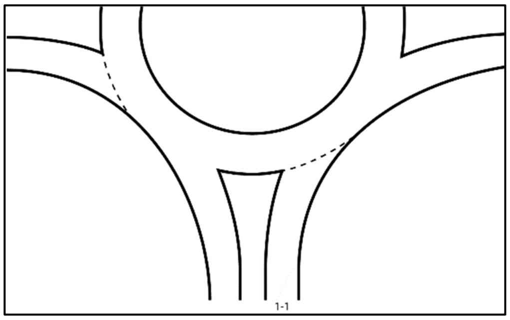
Right Yielding Bypass Lane Conflicted by One Exiting Lane (R-bypass - 1)



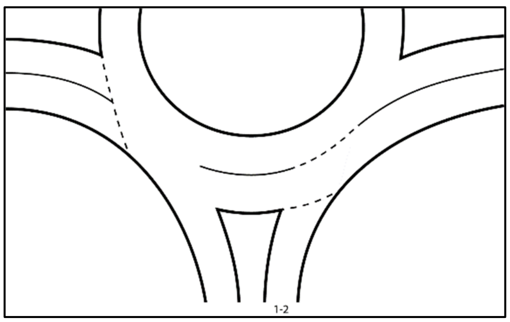
Right Yielding Bypass Lane Conflicted by Two Exiting Lanes (R-bypass - 2)



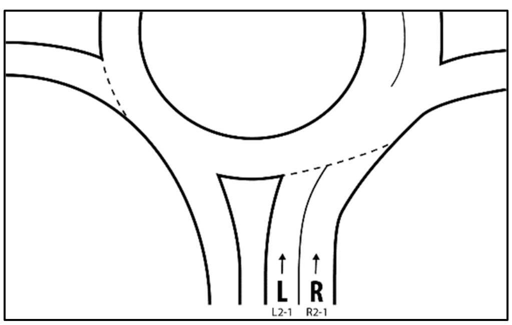
One-Lane Entry Conflicted by One Circulating Lane (1-1)



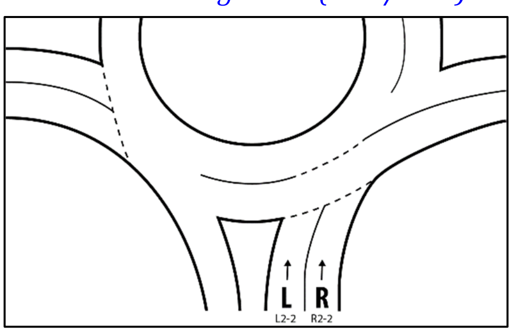
One-Lane Entry Conflicted by Two Circulating Lanes (1-2).



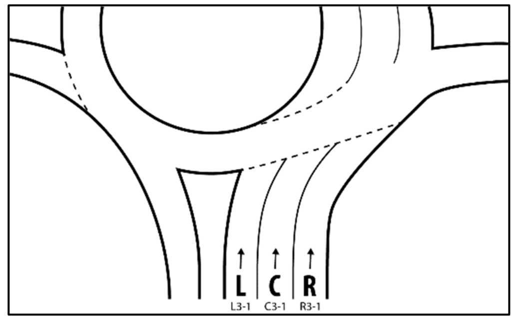
Two-Lane Entry Conflicted by One Circulating Lane (L2-1/R2-1)



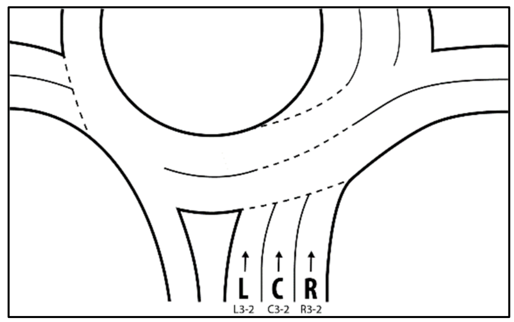
Two-Lane Entry Conflicted by Two Circulating Lanes (L2-2/R2-2).



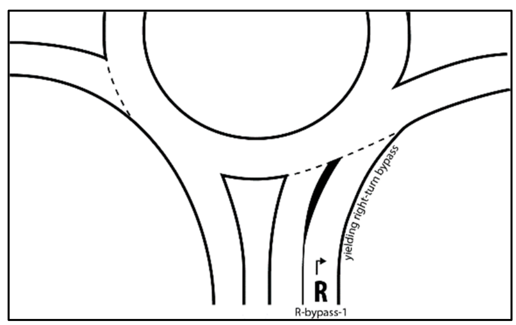
Three-Lane Entry Conflicted by One Circulating Lane (L3-1/C3-1/R3-1)



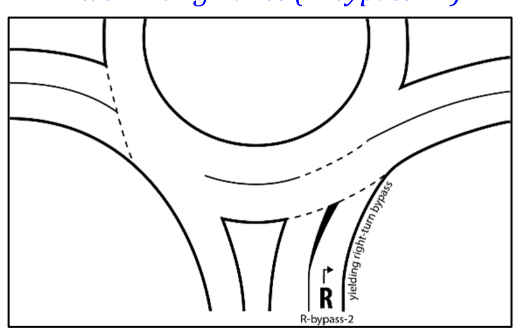
Three-Lane Entry Conflicted by Two Circulating Lanes (L3-2/C3-2/R3-2)



Right Yielding Bypass Lane Conflicted by One Exiting Lane (R-bypass - 1)



Right Yielding Bypass Lane Conflicted by Two Exiting Lanes (R-bypass - 2)



16-20-1 Basic Principles September 2019

1.1 Introduction

Microscopic traffic simulation, or microsimulation, refers to traffic analysis tools that analyze the movement of individual vehicles as they travel through a network. As the simulation progresses, it updates factors such as the vehicle's position and its need to increase/decrease speed or change lanes several times a second. Accordingly, these tools are suitable for evaluating the interaction of different components of the transportation network, such as queues from an intersection that cause lane blockages upstream or complex weaving and merging behaviors. Additionally, the visual animation of traffic flows can make microsimulation traffic models useful for public outreach and stakeholder presentations. Typical situations where microsimulation traffic analysis may be appropriate include scenarios that macroscopic tools cannot or do not address well, such as:

- Complex weaving along freeways and arterials
- Arterial and freeway interaction (e.g., spill-back from an arterial onto the freeway at an exit ramp)
- Non-traditional or alternative interchange/intersection analysis (e.g., diverging diamond interchanges and continuous flow intersections)
- Turn-lane spillover
- Oversaturated conditions
- Signal and roundabout interaction
- Vehicle/transit/pedestrian interaction

The primary purpose of traffic modeling is to simulate the transportation system under various volume and geometric conditions to assess what (if any) improvements are necessary. Most often, the models represent projected (or future) traffic conditions. Although analysts typically use traffic models to assess the impact of potential capacity/expansion improvements, they can also use microsimulation models to assess non-expansion improvements such as managed lanes, channelization optimizations (e.g., removing shared lane movements), and additional transit service.

WisDOT supports the use of microsimulation traffic models; however, it is important to match the analysis methods with the scale, complexity, and technical requirements of the project. Microsimulation modeling work typically requires significantly more time, data, and effort than other traffic analysis tools. Thus, prior to selecting microsimulation as the analysis tool, the project team *should* assess whether less resource-intensive traffic analysis tools can sufficiently meet the needs of the project. The project team *should* also consider the project schedule and budget to ensure that they can adequately accommodate the development and review of the microsimulation traffic models. TEOpS 16-10-5 provides additional information and guidance on selecting the most appropriate traffic analysis tool(s).

1.2 Calibration vs. Validation

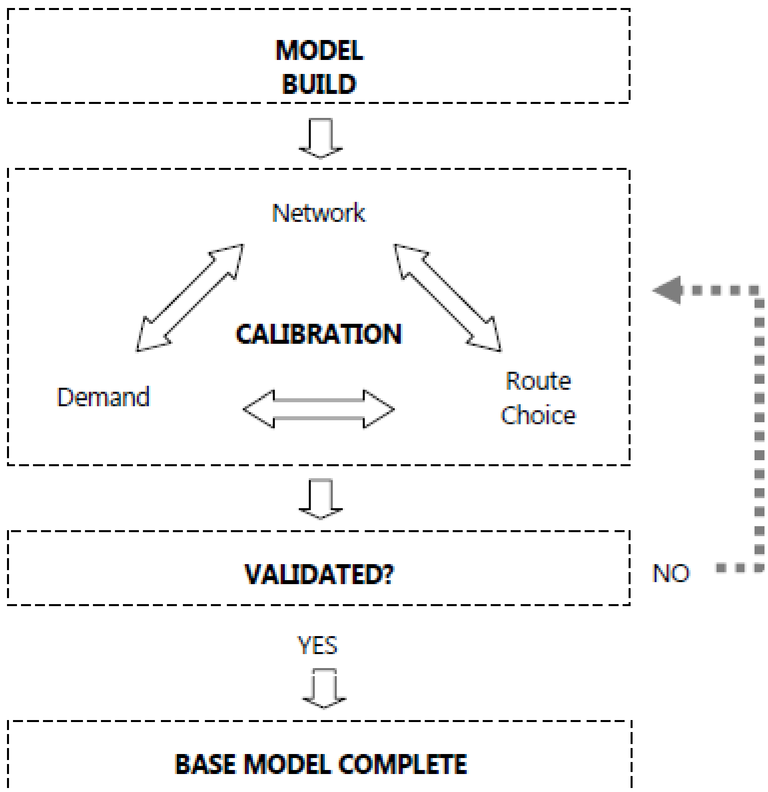
Microsimulation models contain multiple parameters that the analyst can modify to reflect varying degrees of driver behavior, vehicle characteristics, and roadway conditions. Developing a traffic model with a reasonably accurate representation of real-world local traffic conditions requires calibration and validation of the model where, for purposes of WisDOT policy, calibration and validation have the following definitions.

<u>Calibration</u>: The process where the analyst adjusts selected input parameters within the traffic model (typically driver behavior elements including headway and reaction times, driver aggressiveness, etc. and roadway elements like sign posting) such that the traffic model represents field conditions. See TEOpS 16-20-5 for additional details on the calibration process.

<u>Validation</u>: The independent process where the analyst checks the traffic model outputs against benchmark data for traffic volumes, travel speeds, travel times, intersection queuing, and trip-making patterns (e.g., weaving volumes), among others. See TEOpS 16-20-8 for additional details on the validation process.

Calibration and validation are part of an iterative cycle. If, after the initial round of calibration, the model results do not satisfy the validation thresholds, the analyst must conduct additional model calibration and recheck the updated model results against the validation targets. This process continues until the model results meet the validation targets and the traffic model has reached a level of fidelity that is acceptable. Figure 1.1, taken from the New South Wales (NSW) Government Transport Roads & Maritime Services (RMS) 2013 *Traffic Modelling Guidelines* (1), illustrates the iterative relationship between model calibration and validation.

Figure 1.1 Traffic Model Calibration and Validation Process



Source: NSW Transport Roads & Maritime Services 2013 *Traffic Modelling Guidelines*, Figure 11.3 (1)

1.3 Purpose of Calibration & Validation

The process of developing a microsimulation model starts with an existing conditions model and then transitions into the development of various scenarios representing future-year alternatives. The only way to determine that a traffic model depicts real-world traffic conditions is to compare the existing conditions traffic model to traffic conditions observed in the field. If the existing conditions traffic model cannot reproduce the existing traffic conditions with a reasonable degree of accuracy, then analyses of other scenarios will be highly suspect. Therefore, prior to using the model outputs for project or study decisions, especially any related to critical aspects of the design, the analyst **shall** calibrate and validate the microsimulation traffic model in accordance with TEOpS 16-20-5 and TEOpS 16-20-8, respectively. Additionally, the traffic model *should* undergo the peer review process in accordance with TEOpS 16-25, prior to the commencement of work on any other traffic model scenarios or alternatives (e.g., design year no-build traffic model). Conducting the peer review process at the proper time will limit the potential of needing to modify multiple models to address reviewer comments.

After completion of the calibration, validation, and peer review processes, the analyst can use the existing conditions model as the starting point for future-year alternative models. Most of the parameters calibrated in the existing conditions model *should* be transferable to the future-year models; however, the analyst may need to modify some parameters to account for changes in roadway geometry and the associated driver behavior. The calibration, validation, and peer review processes (TEOpS 16-20-5, TEOpS 16-20-8 and TEOpS 16-25, respectively) are applicable for all future-year model alternatives and the analyst *should* apply them as appropriate.

16-20-2 Traffic Model Development May 2021

2.1 Traffic Model Boundaries

Confusion about the purpose, objectives, or physical boundaries of the traffic model can cause delays and other potential problems such as:

- Misunderstandings or ambiguities regarding the purpose/objectives of the traffic modeling effort
- Mission creep or unplanned expansion of the traffic model that could delay the delivery of results, such as unexpected enlargement of the geographical boundaries
- Misapplication of the traffic model (e.g., attempting to use the traffic model beyond the level of detail initially intended)
- Inappropriate sequencing of activities (e.g., starting to develop the build scenarios before the existing conditions traffic model has been properly calibrated and validated)

Although the above problems can apply to all types of traffic analyses, the complexities associated with microsimulation traffic models only exacerbate the issues. To ensure that there is a clear understanding of the traffic analysis requirements, the project team **shall** work with WisDOT regional traffic staff to define the preliminary traffic model boundaries. After coordinating with WisDOT regional traffic staff, the project team *should* organize a meeting with other key stakeholders to finalize the traffic model boundaries and review/update the DT2290 Traffic Model Scope form as appropriate. In addition to the meeting, it may be beneficial to conduct an organized visit to the site to familiarize the team with the current traffic conditions/issues.

Typically, the traffic analysis kick-off meeting will include only those internal stakeholders, and applicable consultant team representatives, who will be involved in the development or review of the traffic model. It may be beneficial to promote early involvement with the Bureau of Traffic Operations – Traffic Analysis and Safety Unit (BTO-TASU) and the Federal Highway Administration (FHWA), as appropriate, by inviting them to this initial meeting. This is especially true for mega projects, high profile projects, and FHWA Projects of Division Interest (PoDI). At a minimum, the project team **shall** invite the FHWA Wisconsin Division Operations Program Manager to the initial kick-off meeting for any interstate project that has a scope of work greater than pavement replacement. Refer to the FHWA/WisDOT "Risk-Based Project Stewardship and Oversight Agreement", provided in FDM 11-5-2-1, for details on FHWA and WisDOT stewardship and oversight of federal-aid projects.

Refer to TEOpS 16-25-2 for additional guidance on determining who *should* participate in the review of the traffic model. In general, BTO-TASU **shall** be involved with the review of all models where FHWA participation is desired or required. It is also advisable to include BTO-TASU when dealing with new, unique, or complex modeling concepts or analysis tools, especially if the region does not have the necessary knowledge or resources. Direct any questions regarding the need to involve BTO-TASU to the DOT Traffic Analysis & Modeling mailbox (DOTTrafficAnalysisModeling@dot.wi.gov).

After the traffic-analysis kick-off meeting and any site visits, key stakeholders, including the consultant team as applicable, *should* have a good grasp on the following:

- Purpose and objective of the traffic model(s)
- Traffic issues/concerns for the study area
- Applicable traffic analysis method(s) and tool(s)
- Temporal and spatial boundaries of the traffic model(s)
- Analysis scenarios (e.g., existing, no-build, build, etc.)
- Potential data needs and sources

If, after the meeting, there are still components of the DT2290 form that are unknown, the project team *should* coordinate further discussions between WisDOT regional traffic staff, the traffic analyst (i.e., consultant team), and BTO-TASU as appropriate. The following provides additional details on how to define the model limits (spatial and temporal) and analysis scenarios.

2.1.1 Traffic Model Spatial Limits

The limits of the microsimulation traffic model *should* encompass not only the limits of the specific transportation project under study, but it *should* also include all parts of the surrounding transportation network (or zone of influence) that may significantly influence the operations of the study area. When setting the limits of the traffic model, the analyst *should* consider the potential impact of planned/proposed roadway improvement projects and strategies, especially if the future improvement may result in a shift in travel patterns. Other adjacent or nearby improvement projects may have a significant impact on the spatial limits of the traffic model, especially if the projects are proceeding concurrently (e.g., it may be necessary to extend the traffic model to incorporate the adjacent projects or portions of the traffic model may overlap with the model of an adjacent project, etc.). Thus, it is critical to have early coordination with any adjacent or nearby projects.

Where practically feasible, the spatial boundaries of the traffic model *should* capture all congestion, existing and future, in the area. Where it is not possible to capture the congestion spatially, evaluate whether extending the temporal limits of the model will allow the traffic model to reflect the traffic congestion (see TEOpS 16-25-2.1.2). In situations where resource or other constraints prevent the extension of the traffic model (spatially or temporally) to capture all congestion, coordinate with WisDOT regional traffic staff and other key stakeholders (BTO-TASU, FHWA, etc.) as appropriate to set the traffic model limits. Include discussion on the potential risk of not being able to identify the full extent of congestion for future/alternative scenarios. All key stakeholders *should* agree on the approach to use to compensate for any congestion that occurs outside the established model limits. Initial discussions on the spatial limits of the traffic model *should* occur during project scoping.

The analyst *should* take care not to extend the model limits out further than necessary, as the larger the model, the more complex and time-consuming it will be to calibrate and validate. One way to measure the complexity of the traffic model is to consider the size of its origin-destination (O-D) matrix, which represents each location (or zone) where vehicles can enter or exit the model. The O-D matrix increases with the square of the number of traffic zones included in a model: a 25-zone model has 625 O-D pairs (25X25 = 625) while a 50-zone model has 2,500 O-D pairs (50X50 = 2,500). The time to complete the network coding, calibration, and validation processes increase with every O-D pair added to the traffic model. Therefore, depending on the size of the study area, it may make more sense to break the traffic model into two or more smaller models rather than to develop one large model. (Coordinate with WisDOT regional traffic staff to assess whether to break one large model into smaller models. Contact BTO-TASU (DOTTrafficAnalysisModeling@dot.wi.gov) for additional support or guidance as needed.) All boundaries of the traffic model *should* occur at logical break points in the roadway network (e.g., locations where the traffic volumes naturally drop-off or locations where traffic attributes such as travel speeds normalize or return to free-flow speeds). Avoid breaking the model at critical study area locations (e.g., avoid breaking the model in the middle of a complex weaving segment between two large interchanges).

Depending on the operational characteristics, it is possible for the limits of the traffic model to extend beyond the end of the project termini. Additionally, microsimulation analysis may only be necessary for a portion of the project study area such that the limits of the microsimulation model are smaller than the project limits. For example, if a project study area encompasses three interchanges (interchange A, B and C), of which only one (interchange A) involves complex weaving maneuvers and requires microsimulation analyses, the limits of the microsimulation model would only need to extend far enough to capture the weaving traffic behavior at interchange A. The analyst could then use an HCM-based analysis tool to evaluate the traffic conditions at interchanges B and C. Due to this variability, there is no standard set of guidance for determining the spatial limits of a traffic model. Rather, the geographical boundaries for a microsimulation traffic model needs to be determined on a project-by-project basis. FHWA's 2004 publication of the *Traffic Analysis Toolbox Volume III (TAT III)* (2) provides some general guidance on determining the spatial limits for a microsimulation model.

The analyst *should not* finalize the spatial limits of the traffic model until field observations document the extent of congestion and length of vehicle queues within the study area. Provide a brief discussion of the geographical traffic model boundaries within DT2290. Document all assumptions and methods regarding the geographical limits for the traffic model within the modeling methodology report and other project memoranda as appropriate.

2.1.2 Temporal Model Limits

The temporal limits of the traffic model are dependent on the location of the project and the experienced levels of congestion, and therefore, must be determined on a project-by-project basis. Some general guidance on defining the temporal model limits follows.

2.1.2.1 Temporal Analysis Periods

Depending on the purpose and objectives of the project, the microsimulation traffic model may need to address two or more temporal analysis periods (TAPs) where each TAP could encompass anywhere from one to six or more consecutive hours. Typical TAPs addressed with microsimulation models include the following, among others:

AM Peak Period (AM): This typically comprises of one or two hours of each weekday between 6 a.m. and 9 a.m., although in severely congested areas it could comprise of four or more hours.

Midday Peak Period (MD): This period is relevant in areas where traffic patterns peak in the non-traditional

	commuting hours such as a school or restaurant district. If applicable, it typically is one hour between 11 a.m. and 3 p.m.
PM Peak Period (PM):	This typically comprises of two or three hours of each weekday between 4 p.m. and 7 p.m., although in severely congested areas it could comprise of six or more hours.
Friday Peak Period (Fri):	This period is relevant in areas that experience higher traffic patterns during the Friday peak period versus the typical weekday commute, typically due to the combination of both commuter and recreational traffic.
Sunday Peak Period (Sun):	This period is relevant in areas where there is higher traffic than the typical weekday commute on a Sunday afternoon/early evening as travelers return home from a recreational weekend trip.
Seasonal/Special Event (SP):	This period is relevant in areas that experience unusual traffic patterns due to holidays, tourism, or special events. This may coincide with the Friday or Sunday peak period.

The length of the TAP is dependent on the extent of congestion in the study area. Although the TAP will vary depending on local field conditions, FHWA's 2004 publication of TAT III (2) and 2007 publication of TAT IV (3) provide general guidance for determining the appropriate TAPs for a traffic model.

When selecting the TAPs, consider existing field data for traffic volumes, speeds, and queues, along with anticipated future traffic volumes and levels of congestion. Where practically feasible, the TAP *should* encompass the entire extent of the congestion (existing and future). If it is not feasible to extend the TAP to capture all congestion, coordinate with WisDOT regional traffic staff and other key stakeholders (BTO-TASU, FHWA, etc.) as appropriate to set the TAPs. Include discussion on the potential risk of not being able to identify the full extent of congestion for future/alternative scenarios. All key stakeholders *should* agree on the approach to use to compensate for any congestion that occurs outside the established TAPs.

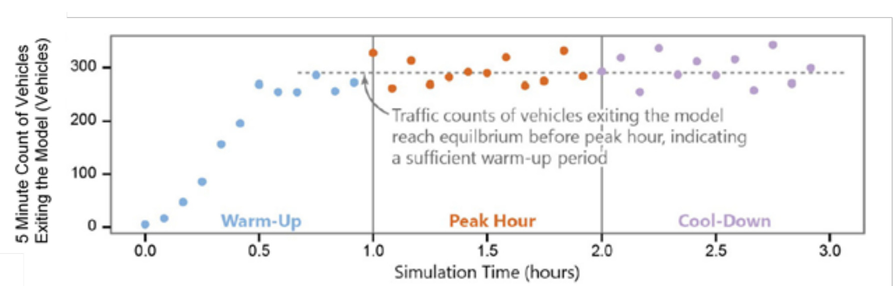
Provide a brief discussion of the TAPs within DT2290. Document all assumptions and methods regarding the TAPs for the traffic model within the modeling methodology report and other project memoranda as appropriate.

2.1.2.2 Warm-Up/Cool-Down Periods

In addition to the analysis period, microsimulation models **shall** also include a warm-up period and *should* include a cool-down period to allow for the build-up and dissipation of congestion. The warm-up period is essential because the roadway network within the traffic model is initially empty and requires some time for the network to reach conditions that reflect the start of the analysis period. Essentially, the first vehicles to enter the study area are driving under free flow conditions. Without a warm-up period, data from the beginning of the analysis period would have a strong bias toward smaller delays (lower congestion) and may not reflect real-world conditions. The exact length of the warm-up period will vary from project-to-project; however, as referenced in FHWA's 2004 publication of TAT III (2), a good way to approximate the minimum warm-up period, for at least the initial model runs, is to double the free-flow travel time from one end of the network to the other. After completing one or more model runs, verify the adequacy of the warm-up period and extend as appropriate.

The warm-up period is adequate when conditions at the end of the warm-up period reflect the field conditions at the start of the analysis period. One way to assess adequacy of the warm-up period is to review the number of vehicles present at any one time on the network to determine whether the model has reached equilibrium. Once the number of vehicles present on the network stays constant or increases by an amount consistent with the applicable profile, the model has reached equilibrium and signifies the conclusion of the warm-up period. Figure 2.1 provides an illustration of how to verify that the warm-up period is adequate by reviewing the number of vehicles exiting the model.

Figure 2.1. Warm-Up Duration Verification Example



The cool-down period allows time for the dissipation of queues created during the analysis period which is typically necessary for the traffic model to replicate real-world conditions. Like the warm-up period, the cool-down period will vary depending on local field conditions but is typically in the range of 15 to 60 minutes. After completing one or more model runs, verify the adequacy of the cool-down period and extend as appropriate.

FHWA's TAT IV (3) provides additional guidance for determining the appropriate warm-up and cool-down periods for a traffic model. Coordinate with WisDOT regional traffic staff and other key stakeholders (BTO-TASU, FHWA, etc.) as appropriate to confirm the warm-up and cool-down periods. Provide a brief discussion of the warm-up and cool-down periods within DT2290. Document all assumptions, methods, and exemptions regarding the warm-up and cool-down periods for the traffic model within the modeling methodology report and other project memoranda as appropriate.

2.2 Analysis Scenarios

It is generally advantageous to identify the anticipated analysis scenarios/alternatives prior to beginning development of the traffic models. Early identification of the analysis scenarios/alternatives aids in determining the level of effort requirements, resource needs, and budget implications. Additionally, by knowing the potential analysis scenarios in advance, the analyst can assess whether the spatial and temporal model limits sufficiently address all analysis scenarios up front, minimizing the chances of rework and model inconsistencies. When assessing the scenarios/alternatives to model, consider the potential impacts of any adjacent planned or pending projects, especially if the adjacent projects will influence the traffic demand in the study area. The analyst *should* coordinate with WisDOT regional traffic staff and other key stakeholders (BTO-TASU, FHWA, etc.) as appropriate to identify the analysis scenarios/alternatives.

Although the specific details of the analysis scenarios are project dependent, there are four basic analysis categories: 1) Existing (EX) Model, 2) Design Year, No-Build (FEC) Model, 3) Design Year with Minor Improvements (FEC+) Model and 4) Design Year, Build Model. A brief description of each of these analysis scenario categories follows.

<ins>Existing (EX):</ins> The existing (or base) year traffic model replicates existing field conditions. Existing year traffic conditions *should* reflect the year that is as close to the original start of the traffic analysis as possible. Whenever possible, traffic data *should* be no more than three years old and ideally, all traffic data *should* be from the same year. Ongoing construction or other extraordinary circumstances may dictate the need to use older data or data from multiple years.

Coordinate with WisDOT regional traffic staff and other key stakeholders (BTO-TASU, FHWA, etc.) as appropriate to select the existing year. Identify the existing year on the DT2290 form and document the rationale for selecting the existing conditions within the modeling methodology report and other project memoranda as appropriate. The analyst **shall** obtain approval of the existing year from the WisDOT regional traffic engineer prior to initiating development of the traffic model.

<ins>Design Year, No-Build (FEC):</ins> The design year, no-build traffic model reflects design year conditions absent of the proposed project. It will reflect design year traffic volumes and existing geometry or existing geometry with other planned and enumerated (or committed) improvement projects and may include signal timing modifications. As such, another name for this scenario is the future with existing plus committed (FEC) scenario. The inclusion of a planned improvement project in the FEC model is contingent on it occurring after the existing year but prior to the proposed project's design year. Note that the FEC conditions for a specific project may not match the no-build conditions reflected in a travel demand model (TDM) used in forecasting traffic. Therefore, coordination with the WisDOT traffic forecasting section (TFS) is essential to verify that the traffic forecasts reflect the FEC scenario assumed in the microsimulation model.

The roadway geometry of the FEC model often limits (or constrains) the volume of traffic entering, traveling through, or exiting the model. The FEC model, is thus a "constrained" model, and may not reflect the true demand on all segments within the model. Depending on the purpose and objectives of the project, full analysis of a true no-build or "constrained" traffic model may not be necessary.

Coordinate with WisDOT regional traffic staff and other key stakeholders (BTO-TASU, FHWA, etc.) as appropriate to identify the need for developing a design year, no-build model and to clarify the need to assess "constrained" conditions.

Document the rationale for including or not including the design year, no-build (FEC) model, or “constrained” conditions within the modeling methodology report and other project memoranda as appropriate. The analyst **shall** obtain approval from the WisDOT regional traffic engineer on how to address the design year, no-build (FEC) conditions prior to initiating development of the traffic model.

Design Year, FEC+: For the traffic model to function with the design year traffic volumes, it may be necessary to include minor geometric improvements (e.g., the extension of an existing right or left turn lane or channelization optimizations such as the removal of shared lane movements within the FEC right-of-way, etc.) beyond the committed projects. In these cases, the traffic model represents future with existing plus committed plus minor improvements (FEC+) conditions. The project team *should* document these minor improvements within the modeling methodology report and other project memoranda as appropriate.

The driving factor for inclusion of a design year with minor improvements (or FEC+) model is frequently the need to eliminate the geometric constraints within or adjacent to the traffic model that prevent the realization of the true demand. Thus, the FEC+ model is typically (but not always) representative of an “unconstrained” model. The analyst may elect to apply other methodologies (such as removing traffic volumes that exit the roadway network prior to the study area) in addition to or instead of including minimum geometric improvements, to develop a design year “unconstrained” traffic model.

Coordinate with WisDOT regional traffic staff and other key stakeholders (BTO-TASU, FHWA, etc.) as appropriate to identify the need for developing a FEC+ model and to clarify the need to assess “unconstrained” conditions. Document the rationale for including or not including the FEC+ model or “unconstrained” conditions within the modeling methodology report and other project memoranda as appropriate. The analyst **shall** obtain approval from the WisDOT regional traffic engineer on how to address the FEC+ conditions prior to initiating development of the traffic model.

Design Year, Build (ALT): The design year, build traffic models capture design year conditions with the proposed project improvements. The build traffic models may reflect “constrained” or “unconstrained” conditions. Typically, the analyst will need to develop a traffic model for more than one project alternative.

Due to the complexity and level of effort and resources required to develop microsimulation models, conduct a high-level review of potential alternatives using HCM-based deterministic analysis tools to narrow down the number of alternatives prior to developing the design year, build traffic model alternative using microsimulation.

Coordinate with WisDOT regional traffic staff and other key stakeholders (BTO-TASU, FHWA, etc.) as appropriate to identify the design year, build model alternatives and to clarify the need to assess “constrained” conditions, “unconstrained” conditions, or both. Document the rationale for including or not including the “constrained” or “unconstrained” conditions within the modeling methodology report and other project memoranda as appropriate. The analyst **shall** obtain approval from the WisDOT regional traffic engineer on the design year build alternatives prior to initiating development of the traffic model.

Depending on the specifics of the project, it may be beneficial to develop a model that represents the conditions that will exist the first year the proposed project improvements will be open to traffic (i.e., opening year conditions model). This scenario reflects the opening year traffic volumes and opening year geometry, which includes the existing geometry with the proposed project improvements and any other completed improvement projects. Discuss the need to develop an opening year model with WisDOT regional traffic staff and other key stakeholders (BTO-TASU, FHWA, etc.) as appropriate.

To ensure consistency, avoid confusion, and aid in the model reviews, use the file naming convention spreadsheet.

2.3 Traffic Model Tree

Prior to development of the microsimulation traffic model, the analyst *should* coordinate with the project team and WisDOT regional traffic staff to develop the traffic model tree. Contact BTO-TASU (DOTTrafficAnalysisModeling@dot.wi.gov) for additional support or guidance as needed.

The purpose of the model development tree is to show all the scenarios to include in the analysis, along with their relationships to one another and the existing conditions model. It formally illustrates the way the model will evolve as the work progresses and establishes the sequence of work activities. Developing the traffic model tree prior to development of the existing conditions model helps avoid unnecessary work. Whenever possible, the analyst *should* use the same transportation network structure for all temporal analysis periods (AM peak, PM peak, Friday peak, Sunday peak, etc.) within the same year. The fewer the number of model variations, the easier it is to maintain consistency between the different analysis scenarios. Figure 2.2 provides an illustration of a basic traffic model tree.

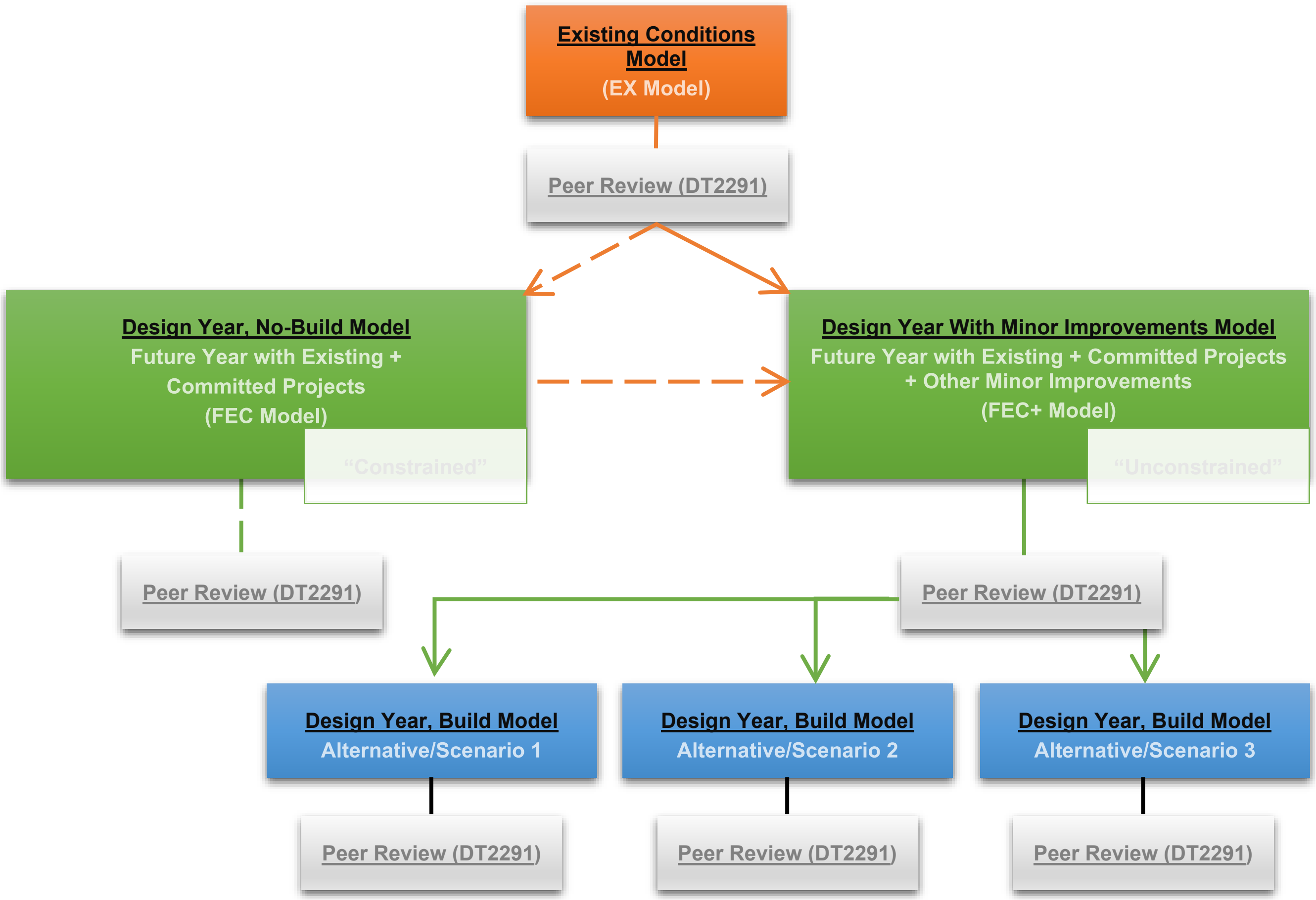
As illustrated in Figure 2.2, each version of the traffic model *should* undergo the peer review process prior to the development of the model for a new scenario. Refer to TEOpS 16-25 for additional details on the peer review process. When the project has a compressed schedule, there may be a temptation to begin development of the design year models prior to completion of the peer review process of the existing conditions model. This is often counterproductive, as the analyst needs to address any comments from the peer review of the existing conditions model in not only the existing (parent) model but also in any of the design year (child) models under development.

2.4 Constructing the Traffic Model

Construct and code the traffic model in accordance with the recommendations of the user guides/manuals for the applicable microsimulation software platform. When developing the model, the analyst *should* consider the following best practices:

- Use aerials or design plans as background images to aid in the review
- Minimize the amount of non-link space (connectors in Vissim) where practical
- Label major roadway segments
- Avoid the use of link-specific adjustment factors as much as possible. When their use is necessary, associate link-specific adjustment factors with roadway geometry or software limitations. This will make it easier to assess whether the adjustment factor is applicable for other modeling scenarios.
- Avoid introducing new driving behaviors in the design year, build (ALT) beyond those previously included in the existing models. When necessary, limit the use of new driving behaviors to locations where there have been significant changes in roadway geometry.

Figure 2.1 Example of a Typical Traffic Model Tree



2.5 Deliverables

It is generally advantageous to establish a list of deliverables prior to beginning development of the traffic models. This list will identify all the documents, videos, computer files, and other items that the project team will need to produce. Early identification of the list of deliverables can clarify project expectations and assist with defining resource needs. Typical deliverables include the following, among others:

- Traffic Forecasting Methodology Report, typically will include the following attachments
  - Design Hour/K-Factor Selection Methodology
  - Forecasting and O-D Development Methodology
  - Traffic Forecasts
  - Traffic Volume Balancing Methodology
- Traffic Analysis Tool Selection Memoranda
- Modeling Methodology Reports for each model, typically will include the following attachments
  - Existing Traffic Data (e.g., traffic volumes, speeds, queuing, etc.)
  - Exhibit Illustrating the Project Design Plans/Improvements
  - Tables Showing Validation Checks
- Microsimulation Software Files (provide for all temporal analysis periods and analysis scenarios/alternatives)
- DT2290
- DT2291 for each model

For sample formats or questions on any of the above deliverables, contact BTO-TASU (DOTTrafficAnalysisModeling@dot.wi.gov).

16-20-3 Measures of Effectiveness (MOEs) September 2019

3.1 Types of MOEs for Validation

The project's purpose, need, and objectives typically dictate which MOEs the analyst *should* use for reporting the performance measures of the traffic model. The MOEs chosen for validation of the traffic model; however, are dependent on several factors including, but not limited to, the availability and quality of data, the size of a model, the capability of the microsimulation software, the purpose of the model, and the project scope. The following focuses on the MOEs chosen for validation of the traffic model.

3.1.1 Traffic Volumes

It is critical to validate traffic volumes on the roadway link level and the turning-movement level for every microsimulation model, regardless of size or complexity. There are several data sources for traffic volumes with varying levels of availability and data quality. Some of these resources include manual counts and various detection methods (e.g., loop, microwave, radar, video, etc.). Sources available in Wisconsin include the following, among others:

- WisDOT interactive count map: WisDOT TCMap (Traffic Count Map) link
- Wisconsin Hourly Traffic Data: WisTransPortal, Wisconsin Hourly Traffic Data Web Access Portal
- V-SPOC detector database: WisTransPortal, V-SPOC: Volume, Speed and Occupancy Application Suite

The BTO-TASU Data Hub provides a list of additional data sources with a brief description of types of data available through each source, a hyperlink to the primary data source, and notes to consider when selecting a particular data source. Prior to conducting specialized counts, contact WisDOT regional traffic staff to determine whether there are other data sources available for the project study area. Review, verify, and document the validity of the volume data prior to developing the traffic model.

3.1.2 Traffic Speeds

Validation tests for traffic speeds may be representative of spot speeds or segment speeds. Common sources for spot speed data include, loop detectors, radar detection, or other resources. Common sources for segment speed data include, Bluetooth detectors, probe data, or floating car studies. Document the methodology used to collect and calculate the spot and segment speeds. Review, verify, and document the validity of the traffic speed data prior to developing the traffic model. Coordinate with WisDOT regional traffic staff as appropriate.

Larger-scale traffic models may rely on a combination of spot speed and segment speed validation, while models that are smaller in length may rely more on spot speed validation. Where possible, collect and report out spot or segment speed in 15-minute intervals.

Discuss the type of speed data required for model validation with WisDOT regional traffic staff during the scoping stage of a project. Contact BTO-TASU (DOTTrafficAnalysisModeling@dot.wi.gov) for additional support or guidance as needed.

3.1.3 Travel Times

Travel time validation is a common MOE used for freeway models and arterial corridors. The availability and quality of travel time data has become better in recent years due to advancement in probe data and Bluetooth technologies. Common sources for travel time data include Bluetooth detectors, probe data, or floating car studies. Where possible, collect and report out travel times in 15-minute intervals. Review, verify, and document the validity of the travel time data prior to developing the traffic model. Coordinate with WisDOT regional traffic staff as appropriate.

If using both segment speeds and travel times for model validation, the roadway limits used for these comparisons *should* be of different lengths. It is desirable to have the travel time comparisons use longer lengths than the segment speed comparisons. The intent of the travel time validation test is to capture vehicle behavior at a larger scale while the intent of the speed validation test, whether spot or segment, is to capture the behavior at a more local level.

Discuss the limits, segmentation, and type of travel time data required for model validation with the regional traffic engineer during the scoping stage of a project. Contact BTO-TASU (DOTTrafficAnalysisModeling@dot.wi.gov) for additional support or guidance as needed.

3.1.4 Intersection Queue Lengths

Intersection queue length is a common MOE used for arterial corridors or smaller freeway/interchange models where collection of other MOEs may not be possible or fiscally feasible. If there is significant congestion at an intersection under existing conditions, the queue lengths may vary significantly day-to-day or even 15-minute period to 15-minute period. Video detection, loop detection, and field observations are common ways to collect intersection queue data. The methodology for the collection of intersection queues involves some subjectivity and requires sound judgment of vehicle speeds and the number of vehicles to include in the queue (e.g., *should* the vehicle queue include slow moving vehicles or just stopped vehicles?). Review, verify, and document the validity of the queue data prior to developing the traffic model. Coordinate with WisDOT regional traffic staff as appropriate.

If using queues for validation, the project team *should* consider the following questions prior to data collection and when performing comparisons to modeled data.

- If analyzing an interchange, do the exit ramp queues extend back to or close to the mainline?
- Do intersection queues spill back into the adjacent intersection(s)?
- Does data collection capture the average, 95th percentile, or maximum queue lengths? Is the desired type of queue length for model validation easily extractable from the selected microsimulation software?
- For multiple lanes, such as triple left-turn lanes, do the queue measurements and comparisons reflect the lane-by-lane queues or the worst-case lane queue?
- How, and at what frequency (every cycle, every 15 minutes, etc.), *should* field measurements of queues occur?

Discuss the locations of intersection queues required for model validation with WisDOT regional traffic staff during the scoping stage of a project. Contact BTO-TASU (DOTTrafficAnalysisModeling@dot.wi.gov) for additional support or guidance as needed.

3.1.5 Lane Utilization

Lane utilization, or the volume/percentage of vehicles using a given lane relative to the other lanes in the same direction, is a common MOE used for freeway corridors or arterial corridors with complex intersection interaction. In Wisconsin, it may be possible to approximate lane utilization from lane-by-lane volume data available through the WisTransPortal, V-SPOC detector database ran by the Wisconsin Traffic Operations and Safety (TOPS) Lab (WisTransPortal, V-SPOC). The V-SPOC database has the most robust coverage in the Madison and Milwaukee metropolitan areas, with more sporadic coverage for other parts of the state. Other methods to collect lane utilization data include manual counts, time-lapse aerial photography, or video detection. Review, verify, and document the validity of the lane utilization data prior to developing the traffic model. When reviewing lane utilization data, be cognizant of the lane numbering scheme (i.e., lane numbering goes from inside/median lane to outside/shoulder lane or vice versa), as the lane number scheme can vary depending on the type of detector or software. Coordinate with WisDOT regional traffic staff as appropriate.

The analyst may use lane utilization as a validation metric for the traffic model; however, they *should* first carefully evaluate and document the quality and availability of the existing data. If used as a validation metric, perform lane utilization comparisons at critical locations within the corridor. Discuss the need for and locations of lane utilization comparisons with WisDOT regional traffic staff during the scoping stage of a project. Contact BTO-TASU (DOTTrafficAnalysisModeling@dot.wi.gov) for additional support or guidance as needed.

3.1.6 Lane Density

Observed density is a less common metric used for model validation. Video detection or time-lapse aerial photography may allow for the collection of lane density information. Coordinate with WisDOT regional traffic staff prior to using lane density as a validation metric. Contact BTO-TASU (DOTTrafficAnalysisModeling@dot.wi.gov) for additional support or guidance as needed.

3.1.7 Bottleneck Locations

Bottlenecks signify where recurring congestion occurs within a network. They have a direct relationship to travel times, traffic speeds, and intersection queue lengths. Validation of bottlenecks in a traffic model typically occurs through conducting visual observations or by creating spatiotemporal graphics displaying observed versus modeled MOEs. If observations indicate the presence of recurring congestion (a bottleneck) under existing conditions, the analyst *should* use this MOE as a validation metric.

3.1.8 Throughput

Throughput is a less common metric related to flow rates through an intersection or freeway segment. Potential ways to observe throughput include manual counts, video detection, or other methods. WisDOT *should* approve throughput as an acceptable MOE for model validation prior to its use.

3.1.9 Visual Observation

Visual observation is a good preliminary or secondary check for validating the model results to field or benchmark data, specifically for bottlenecks or queues, however, visual observations **shall not** be the sole MOE used for model validation. Instead, see the MOE descriptions for bottleneck or intersection queue validation.

3.1.10 Weaving Volumes

If existing O-D data is available, the analyst *should* evaluate weaving volumes. Common sources of O-D data included Bluetooth detection, video detection, time-lapse aerial photography, and field observations. In absence of field data, it may be possible to conduct a high-level evaluation of weaving percentages using data from travel demand models. Comparisons of weaving volumes are typically applicable to freeway weaving; however, it could also apply to arterials with complex intersection interactions.

If field data is the basis of the weaving volumes/patterns used for validation, the project team *should* document the conditions during field data collection. This may include construction activities, atypical congestion, weather, if school is in session, or other pertinent information.

If a travel demand model is the source of the weaving volumes/patterns used for validation, the project team *should* document general inputs and calibration notes about the travel demand model. These may include the version, socioeconomic data, base year, horizon year, anticipated developments in the project area, or other pertinent information.

If used as a validation metric, perform weaving volume comparisons at critical locations within the corridor. Discuss the need for and locations of weaving volume comparisons with WisDOT regional traffic staff during the scoping stage of a project. Contact BTO-TASU (DOTTrafficAnalysisModeling@dot.wi.gov) for additional support or guidance as needed.

Review, verify, and document the validity of the weaving volume data prior to developing the traffic model. Coordinate with WisDOT regional traffic staff as appropriate.

3.1.11 Intersection Delay

Intersection delay dictates the intersection level of service (LOS), noting that if the volume-to-capacity ratio (v/c) exceeds 1.0 the LOS is F regardless of the delay value. Due to the difficulty of the data collection and the variance in day-to-day and minute-to-minute delays at congested intersections, it is not very common to obtain field data on intersection delay. Delay is typically more challenging to quantify than queue lengths, which also provide insight as to how the intersection operates at the approach level. WisDOT *should* approve intersection delay as an acceptable MOE for model validation prior to its use.

3.1.12 Capacity

Like throughput, capacity is a less common metric related to how much traffic an intersection, arterial segment, or freeway segment can handle. It may be possible to gather field capacity data during oversaturated conditions using manual counts, video detection, or other methods. Oftentimes, the analyst will indirectly adjust the capacity as part of the calibration process, therefore capacity may not be a suitable validation MOE. WisDOT *should* approve capacity as an acceptable MOE for model validation prior to its use.

3.1.13 Routing

Vehicle routing checks may be a qualitative exercise based on a project team’s familiarity with a corridor, more of a quantitative exercise supported by O-D or demand modeling data, or a combination of both. Although a critical component of model calibration, vehicle routing checks *should not* be the primary model validation MOE.

3.2 Number of MOEs for Validation

3.2.1 Primary vs. Secondary MOEs

The project team *should* discuss, in detail, the type and number of MOEs to use for model validation with WisDOT regional traffic staff during the scoping of a project as they may have a significant effect on the project budget, schedule, and resource needs. Involve BTO-TASU, and other key stakeholders, in these discussions as appropriate.

The factors that influence the number of MOEs required for microsimulation model validation may include data availability and quality as well as project type, geometric conditions, traffic patterns, and levels of existing and anticipated congestion. The capabilities of the applicable microsimulation software may have implications on the MOEs. For example, SimTraffic has fewer capabilities when it comes to reporting weaving volumes and routing metrics than Vissim, thus these MOEs may not be appropriate for a SimTraffic model.

To assist in formulating recommendations on the type and number of MOEs to use for model validation from the least to most complex models, each MOE (see TEOpS 16-20-3.1) has either a “primary” or “secondary” designation. The validation checks for all models, regardless of the model complexity, **shall** always include a comparison of traffic volumes. Thus, traffic volumes do not have an associated primary or secondary designation.

The primary MOEs include spot speeds, segment speeds, and travel times. The secondary MOEs include lane utilization, weaving, and any other MOE that a project team may request for approval (such as intersection delay, throughput, etc.) based on available data. Depending on the purpose and objectives of a project, intersection queue lengths may be either a primary or a secondary MOE. Table 3.1 shows the primary and secondary MOE designations.

Table 3.1 Summary of MOEs for Model Validation

<table>
<tr><th>Metric (MOE)</th><th>MOE Designation</th><td rowspan="15"><u>Summary of MOEs for Model Validation</u>

• 3 to 4 Primary
• 2 to 3 Secondary
• 6+ Upon WisDOT Approval</td></tr>
<tr><td>Link and Turning Movement Volumes</td><td>Required for all projects</td></tr>
<tr><td>Segment Speeds</td><td>Primary</td></tr>
<tr><td>Spot Speeds</td><td>Primary</td></tr>
<tr><td>Travel Times</td><td>Primary</td></tr>
<tr><td>Intersection Queues</td><td>Primary or Secondary</td></tr>
<tr><td>Lane Utilization</td><td>Secondary</td></tr>
<tr><td>Weaving Volumes</td><td>Secondary</td></tr>
<tr><td>Density</td><td>Secondary Upon Approval</td></tr>
<tr><td>Intersection Delay</td><td>Secondary Upon Approval</td></tr>
<tr><td>Bottleneck Locations</td><td>Secondary Upon Approval</td></tr>
<tr><td>Throughput</td><td>Secondary Upon Approval</td></tr>
<tr><td>Capacity</td><td>Secondary Upon Approval</td></tr>
<tr><td>Routing</td><td>Secondary Upon Approval</td></tr>
<tr><td>Others?</td><td>Secondary Upon Approval</td></tr>
</table>

3.2.2 Scoring System

The number of MOEs required for validation will vary depending on the complexity of the traffic model, which is dependent on the project type, project scope, corridor type, traffic control, roadway congestion level, and type of microsimulation tool used for analysis. To quantify the complexity of the traffic model (specifically a microsimulation traffic model), the department worked with a consultant to establish a scoring system. The same scoring system is applicable for determining the number of MOEs required for validation and defining the level of peer review required. Refer to TEOpS 16-25-2 for details on the model complexity scoring system.

Figure 3.1 provides an illustration of the traffic model level of complexity scoring system. Use Figure 3.1 in conjunction with the Traffic-Model Complexity Scoring Template (a Microsoft Office Excel based worksheet) provided in Attachment 3.1 to develop the overall complexity score for the traffic model. The project team’s traffic lead or project manager, in coordination with WisDOT regional traffic staff, *should* complete the scoring template.

The overall traffic model complexity score defines the minimum number of MOEs required for model validation for the project. Depending on data availability, and the project objectives, it might be appropriate to use more than the minimum required MOEs for model validation. Ultimately, it is up to WisDOT regional traffic staff to define the type and number of MOEs to use for model validation. Refer to Table 3.2 for the complexity score associated with each MOE requirement level.

When assessing the complexity of the traffic model and number of MOEs needed for model validation, keep in mind that, due to modified roadway geometry, increased traffic volumes, reduced levels of congestion, etc., it is possible for the model complexity score to be different under future alternative scenarios than it is under existing conditions. Therefore, it is critical to consider both existing conditions and potential future alternatives (including levels of service) when defining the traffic model complexity score and the associated number of MOEs. The highest traffic model-complexity-score across all the scenarios (existing and future alternatives) dictates the number of primary and secondary MOEs required for base model validation.

Figure 3.1 Traffic Model Complexity Scoring Diagram

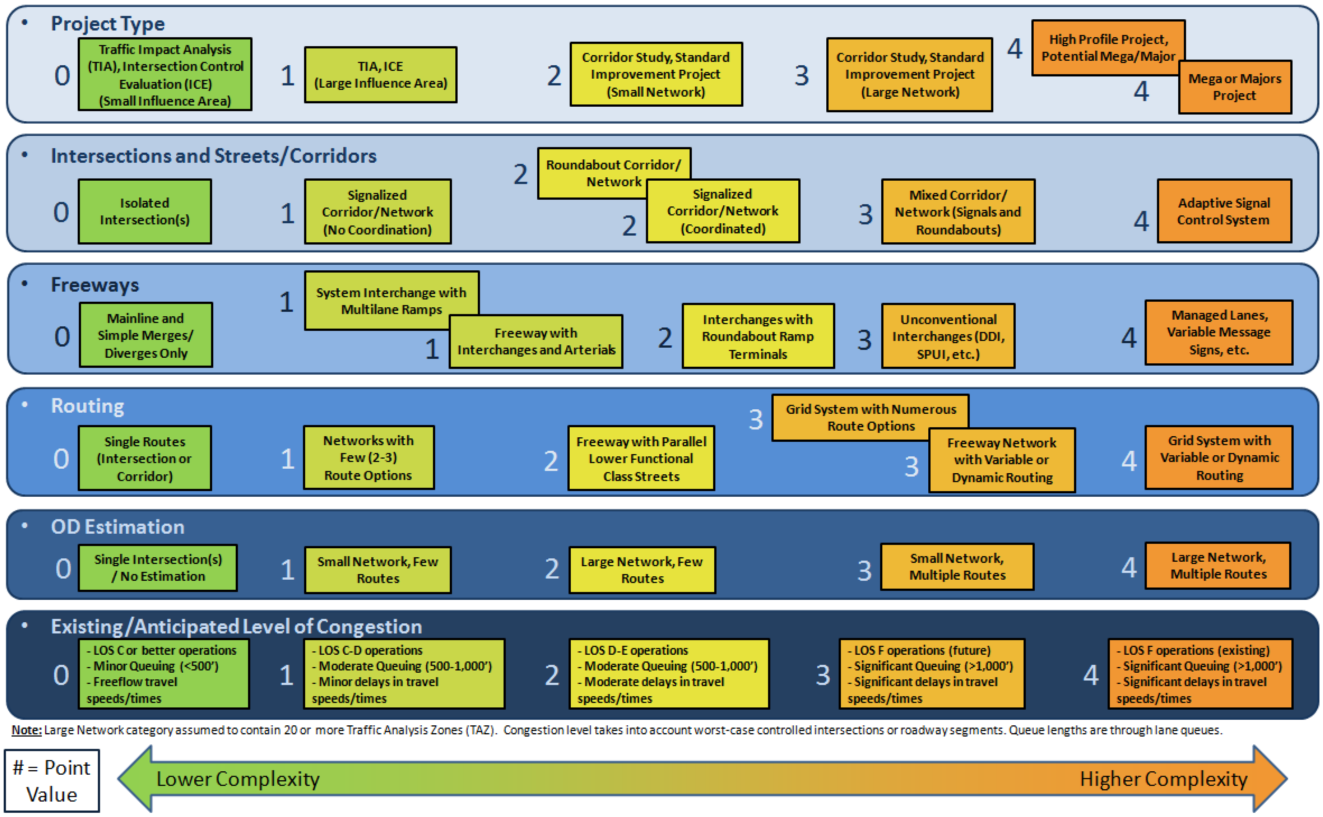


Table 3.2 Number of MOEs Required for Model Validation

Model Complexity Score (a)	Minimum # of MOEs Required for Model Validation (b)
0 – 3	1 to 2 Primary MOEs
4 – 7	1 to 2 Primary MOEs 1 Secondary MOE
8 – 10	2 to 3 Primary MOEs 1 Secondary MOE
11+	2 to 3 Primary MOEs 1 to 2 Secondary MOEs
(a) Model complexity score from the Traffic Model Complexity Scoring Template, Attachment 3.1 (b) Minimum MOEs are those in addition to link and turning movement traffic volumes	

Use the scores and recommendations shown in Table 3.2 as a guide only. Professional judgment and coordination with WisDOT staff needs to factor into the decisions on the number and type of MOEs to use for validation of the traffic microsimulation model. Document all assumptions and decisions regarding the number and type of MOEs to use for model validation within the modeling methodology report and other project memoranda as appropriate.

LIST OF ATTACHMENTS

Attachment 3.1 Traffic Model Complexity Scoring Template

16-20-4 Microsimulation Analysis Software — September 2019

4.1 WisDOT Supported Software

WisDOT currently supports the use of the following programs for microsimulation traffic analysis:

- SimTraffic, Trafficware
- Vissim, PTV Group

Refer to the BTO Traffic Analysis, Modeling and Data Management Program area webpage for the version and build of the above software that WisDOT currently supports.

Prior to January 1, 2018, WisDOT supported the use of Paramics. As such, projects that initiated the microsimulation traffic analysis using Paramics prior to January 1, 2018 may continue to use Paramics for the duration of the project. However, if there is a need to make major revisions to the traffic models (e.g., use of different base year conditions), the analyst should consider switching the traffic models over to Vissim. Consult with the WisDOT regional traffic contact or BTO-TASU to determine whether it is appropriate to switch software programs.

Do not switch from one software platform to another without first consulting with BTO-TASU. TEOpS 16-20-11 provides additional information on when to consider upgrading the software for a microsimulation model that is either already complete or is in the development process.

4.2 SimTraffic Overview

Trafficware, a CUBIC company based out of Sugar Land, Texas, is the developer for both SimTraffic and its companion software Synchro. SimTraffic is the microsimulation platform and Synchro is the macroscopic (or deterministic) platform. Trafficware typically releases major updates to the Synchro/SimTraffic Studio every two to three years.

The Synchro platform is the primary mechanism for drawing the roadway network and coding in several of the parameters for roadway geometry and traffic control. The SimTraffic platform is where the analyst can code in various driver behavior and vehicle characteristics. Both SimTraffic and Synchro use a link-node structure. SimTraffic, tracks every vehicle in the traffic system on a 0.1-second interval. Typical MOEs available through SimTraffic include travel time, vehicle queues, and intersection delay.

WisDOT only accepts SimTraffic for arterial analysis and this software is best suited for signalized corridors. Oftentimes, the analyst will use SimTraffic to observe driver behavior and conduct a “reality check” on the Synchro outputs. SimTraffic may also be beneficial for reporting the vehicle queues, especially when vehicles spill-out of the turn lane and block through traffic. If the primary purpose of the SimTraffic model is to conduct “reality checks”, calibration and validation of the traffic model may not be necessary. However, prior to using the model outputs from SimTraffic (or any other microsimulation analysis tool) for project or study decisions, especially any related to critical aspects of the design, the analyst **shall** calibrate and validate the model in accordance with TEOpS 16-20-5 and TEOpS 16-20-8, respectively.

4.3 Vissim Overview

The PTV Group, a company based out of Karlsruhe, Germany (with U.S. offices in Oregon and Virginia), is the developer for the microsimulation software Vissim. The PTV Group typically releases major updates to the Vissim software once a year.

Vissim uses a link-connector structure. Vissim can model any facility, though it is especially known for being able to accurately represent complex arterial corridors. It provides great flexibility but can be time-consuming to use for modeling due to the many aspects of the software that enable that flexibility. Vissim has many parameters to adjust and ways to replicate real-world driver behaviors, leading to its applicability in almost any situation where deterministic tools and SimTraffic are not sufficient. Typical MOEs available through Vissim include travel time, speed, vehicle queues, intersection delay, and density, though Vissim provides ways to get data from the simulated vehicles at any granularity.

4.4 Other Microsimulation Software

Microsimulation analysis requiring the support, review, or input from BTO **shall** use one of the WisDOT supported microsimulation software packages. BTO-TASU conducts periodic reviews/evaluations of the microsimulation tools to assess the need to add or remove microsimulation tools to/from WisDOT’s traffic analysis toolbox. Contact BTO-TASU (DOTTrafficAnalysisModeling@dot.wi.gov) to request consideration of additional microsimulation software tools.

4.5 Selecting a Microsimulation Software

Consider the needs of the project along with the strengths and limitations of the software when selecting the most appropriate tool to use for developing the microsimulation model. In general, if you already have a Synchro model and you are looking at a relatively small scale/simple arterial network, consider the use of SimTraffic. All other scenarios, specifically freeway models, will typically require the use of Vissim for microsimulation analyses. As of January 1, 2018, do not initiate any new microsimulation analyses using Paramics. See TEOpS 16-10-5 for additional guidance on how to select the most appropriate traffic analysis tool for a specific project.

Document the rationale for choosing the selected microsimulation software tool in the Traffic Analysis Tool

Selection memoranda and submit to the WisDOT regional traffic staff for approval.

16-20-5 Microsimulation Model Calibration May 2021

5.1 Introduction

Calibrating a traffic model requires the analyst to review and potentially adjust various model parameters (e.g., global and local headway and reaction times, driver aggressiveness, etc.) to get the traffic model to reproduce conditions observed in the field. Failure to calibrate a microsimulation model properly can produce unrealistic or misleading results. Therefore, prior to using the microsimulation model outputs for critical design decisions, the analyst **shall** calibrate the traffic model.

5.2 Calibration Process

The model calibration process is often very complex, labor intensive, and resource intensive and may take more time to complete than the initial development of the traffic model. Modifications to the input parameters in one component of the traffic model may have unexpected impacts in other areas of the traffic model. Skipping the model calibration process is not permissible and there is no shortcut to completing model calibration. However, applying the following principles will provide structure and efficiency to the calibration process.

When developing the model, the analyst *should* strive to balance model perfection with practicality. To help achieve this balance, BTO-TASU developed both quantitative and qualitative validation thresholds for microsimulation models that are dependent on the purpose and need of the traffic model. See TEOpS 16-20-8 for additional details on the WisDOT microsimulation validation thresholds.

5.2.1 Global, Categorical and Local Calibration Factors

The analyst can apply and modify the input parameters within a microsimulation model on a global, categorical, or localized level. For the purposes of WisDOT policy, global, categorical, and localized calibration factors have the following definitions:

Global Factors: Global factors are those factors/parameters that affect the entire model.

Categorical Factors: Categorical factors are those factors/parameters that affect a category of the links within the model (e.g., every off-ramp, all weaving segments, major street signalized intersection approaches, etc.).

Localized Factors: Localized (or link-specific) factors are those factors/parameters that only influence vehicles while they are driving on a link, a short series of connected links, or through a specific intersection within the model.

When calibrating a traffic model, the analyst *should* adjust the global and categorical parameters first and *should* use localized/link-specific factors sparingly and only for the final fine-tuning of the model. Document and justify the use of any localized/link-specific factors by associating them to limitations of the microsimulation software or specific geometric conditions that may influence driving behavior (e.g., a short weaving segment). Relating the localized adjustment factors to geometric conditions or software limitations makes it easier to assess whether to carry the adjustments forward from existing year to alternative scenarios.

5.2.2 Unreleased, Blocked, Stuck/Stalled Vehicles

For purposes of WisDOT policy, unreleased, blocked, and stuck/stalled vehicles have the following definitions:

Unreleased Vehicles: Unreleased vehicles represent those vehicles that were able to enter the network but were unsuccessful in traveling through the model and were thus not able to exit the network. Typically, the presence of unreleased vehicles results in a downstream traffic volume undercount and gives the false impression that downstream operations are better than actuality.

Blocked Vehicles: Blocked vehicles are those vehicles that are unable to enter the network at their desired time due to downstream vehicle queues. When vehicle blockage occurs, the traffic model will not be able to capture the true demand on the system and will thus not be able to accurately report out MOEs such as delay and vehicle queues. If the vehicle blockage in the model matches field conditions, it may be necessary to extend the link or temporal limits of the model to accommodate the entire queue (i.e., congestion). See TEOpS 16-20-2 for additional details on the spatial and temporal model limits.

Stuck/Stalled Vehicles: Stuck or stalled vehicles are vehicles that unexpectedly slow or stop partway through their route. They can cause backups that do not exist in the field.

The presence of unreleased, blocked, or stuck/stalled vehicles within the traffic model is an indicator of congestion within the model but may also be a sign of a serious model calibration problem. When calibrating the traffic model, the analyst *should* consider the magnitude and location of the blocking that occurs. If the blocking occurring in the traffic model does not reflect field conditions, or does not meet expectations, reevaluate the spatial and temporal model boundaries, warm-up/cool-down factors, and demand profiles (see TEOpS 16-20-2.1) as they may have a direct effect on issues related to blocked vehicles. It may not be necessary, or realistic, to prevent blocking of all vehicles, specifically for the design year, no-build, or FEC constrained scenario.

Vissim contains a feature, referred to as "diffusion", that allow the analyst to specify a maximum allowable time a vehicle can remain in the same position before removing the stuck/stalled vehicle from the model as if it never existed. Using this feature leads to undercounting vehicles and is not realistic. The use of "diffusion" in the pre-calibration model building can be helpful, but it is not acceptable for a final calibrated model.

5.2.3 O-D Matrix Estimation

Oftentimes the analyst may use a separate O-D matrix estimating software (e.g., Cube by CITILABS, TransCAD by Caliper, Visum by PTV Group, etc.) to develop the O-D matrices for the microsimulation models. Use of a O-D matrix estimating software that is separate from the microsimulation model may be useful, as it will allow the O-D matrix to reflect true demand without influence from network coding problems. However, intersection or other network coding errors within the microsimulation model may affect throughput such that the microsimulation model outputs may not reflect the same volumes as those developed by the O-D matrix estimation tool. Therefore, for preparing the model validation checks, the analyst **shall** run the volumes through the network using the primary modeling software. It is not acceptable to prepare the model validation checks using statistics from the O-D matrix estimation software. Refer to TEOpS 16-5-20 for additional details on the development and use of O-D matrices in microsimulation models.

5.3 Traffic Volume Balancing

Usually the available traffic data for a microsimulation study area is unbalanced. For example, starting at an Automatic Traffic Recorder (ATR) station on a freeway mainline and proceeding in the direction of travel, adding the raw on-ramp volumes, and subtracting the raw off-ramp volumes, the result will rarely match the volume measured at the next downstream ATR. This happens for three main reasons:

- Often, due to limited resources, it may be necessary to collect intersection or ramp traffic counts for multiple locations along the corridor at various times/days.
- There are inherent imperfections in the data collection process. For example, if a vehicle is changing lanes as it drives over a detection loop, the detector loop could count the vehicle twice (or not count it at all) or, with respect to microwave detectors, a larger vehicle could occlude a smaller vehicle making the smaller vehicle undetectable.
- Data collected manually (such as intersection turning counts) is subject to human error.

Microsimulation models cannot account for these imperfections, so the analyst *should* balance the data to create a mathematically consistent volume set. In general, the analyst *should* use balanced volumes as the traffic volume targets for the existing conditions model. The use of balanced volumes usually removes statistical outliers from the target volume set, making it easier to achieve validation targets. Refer to TEOpS 16-5-15 for details on volume balancing methodologies.

5.4 Vehicle Characteristics and Classification

When coding and calibrating the traffic model it is important to verify that the vehicle composition (vehicle type, classification, operating characteristics, etc.) included in the model accurately represents that which is present in the project study area.

When available, the analyst *should* use field data to determine the appropriate vehicle mix or classifications, specifically as it pertains to the volume or percentage of heavy vehicles, buses, high-occupancy vehicles (HOVs), pedestrians/bicycles, and other vehicle types included in the analysis. Oftentimes the microsimulation model will use separate demand profiles or O-D matrices for heavy trucks and passenger vehicles. However, depending on the project purpose, it may be necessary to have additional demand profiles or O-D matrices for other travel modes as well.

The format for entering in the specifics on vehicle characteristics and classifications varies depending on the microsimulation software package. However, most software packages have predefined default values that specify various vehicle characteristics including, but not limited to, vehicle length, vehicle acceleration/deceleration rates, and vehicle occupancy. The default values are a good starting point; however, the analyst *should* adjust the default values as appropriate to reflect local conditions.

SimTraffic automatically includes the default values as part of the initial model set-up. Vissim, however, requires the analyst to load in the vehicle characteristics files. BTO-TASU worked with a consultant team to develop Wisconsin-specific fleet default values for Vissim. Analysts *should* use the Wisconsin-specific fleet default values for the initial input values into Vissim and adjust them based on project-specific field data as appropriate.

Details on the Vissim WisDOT vehicle fleet settings and the “WisDOT Defaults inpx” Vissim input files are available for download on the BTO Traffic Analysis, Modeling and Data Management Program area webpage.

5.5 Route Assignment

The analyst *should* develop the route assignment in coordination with WisDOT regional traffic staff, as well as BTO-TASU and other key stakeholders as appropriate.

16-20-6 Calibration Parameters and Simulation Settings — April 2025

6.1 Overview

Microsimulation models contain many adjustable parameters, and the relevant adjustments vary for each software package. If a model fails to satisfy the validation thresholds, it is essential for the analyst to adjust the appropriate parameters to correct the situation. For example, adjusting driver aggressiveness or link cost factors will not successfully compensate for a flawed O-D matrix. The user manuals and technical support service for each software product provide some guidance on calibration parameters, but these sources may not be privy to the local or specific characteristics for the project study area. Local peer/user groups such as the ITE Simulation and Capacity (SimCap) user group or other independent experts with experience in the relevant software may also provide valuable insight with respect to which model calibration parameters to adjust during the calibration process.

The following text provides details on the key parameters of the traffic model that the analyst *should* consider during the model calibration process. The guidance below is specific for SimTraffic and Vissim; however, the general principles are applicable for all microsimulation software packages. This list is not all-inclusive and *should* only serve as a guide to the project team.

6.1.1 Network Coding

Network coding establishes the horizontal and vertical geometry of the roadway network, including intersection spacing and roadway curvature. Network coding also includes appropriate use of settings such as link free-flow speed and turning speeds.

6.1.2 Intersection Traffic Control and Ramp Metering

Intersection controls are devices that regulate traffic flow at intersections (e.g., signals, roundabouts, stop control, and ramp meters). Elements of the signals/ramp meters may include the controller type, detector placement, signal heads, signal groups, coordination between signals, signal phasing, and signal/ramp meter-timing plans.

6.1.3 Closures, Restrictions, and Incidents

Closures represent temporary or permanent roadway segment, link, or lane closures (i.e., no traffic can use that particular roadway segment, link, or lane). Restrictions represent links or lanes that limit travel, either temporarily or permanently, to specific vehicle types (e.g., lanes designated for HOV or lanes restricting truck use). Incidents include simulated vehicle breakdowns, crashes, etc.

6.1.4 Entrance Ramps

Entrance ramps or freeway merge areas typically require careful coding in microsimulation. This is typically applicable to parallel freeway entrance ramps, although there are instances where this feature is appropriate for arterials as well. The reviewer *should* review the lane utilization upstream of the entrance ramp, the aggressiveness of the merging vehicles (e.g., minimum time on entrance ramp, driver headway factors), and the length of the acceleration lane and taper parallel to the entrance ramp.

6.1.5 Lane Use Parameters

Lane use parameters control the amount and destination of the traffic using each lane. A typical application of these parameters is to pre-position vehicles in advance of a fork in the road.

6.1.6 Zone Structure/Vehicle Inputs

Zone structure and vehicle inputs define where and how traffic loads into the network.

6.1.7 O-D Matrices, Demand Profiles & Time Periods

O-D matrices contain the network demand patterns (number of trips traveling between each pair of zones). Time periods and demand profiles control the timing for the release of vehicles into the network (e.g., are the vehicles released at a steady rate or at a gradually increasing/decreasing rate). In some cases, it is necessary to use multiple O-D matrices or demand profiles (e.g., there may be one matrix for cars and a second matrix for trucks).

6.1.8 Core Simulation Parameters

Core simulation parameters affect fundamental aspects of vehicle behavior in the network, such as driver aggressiveness and the willingness to merge into small gaps. Default values are acceptable for some parameters, but other parameters require project- or area-specific values.

6.1.9 Routing Parameters/Vehicle Routes

Routing parameters influence the way vehicles travel through the network. If coded improperly, these controls can cause unrealistic or erratic routing.

6.1.10 Vehicle Types and Proportions

The proportion and types of vehicles (such as trucks, buses, and HOVs) influence the overall performance of each part of the network.

6.1.11 Stuck/Stalled Vehicles

Stuck or stalled vehicles are vehicles that unexpectedly slow or stop partway through their route. They can cause backups that do not exist in the field.

6.1.12 Special Features

Special features include site or study-specific items such as the use of detectors, car parks, variable message signs, special purpose lanes, speed harmonization, public transit routes, toll lanes, toll plazas, pedestrian modeling, special graphics, plugins, or scripts, among others.

6.2 SimTraffic Calibration Parameters

6.2.1 Interval Settings

A critical component of performing a SimTraffic simulation is to set up appropriate simulation intervals. The default settings for the simulation interval include a 3-minute seeding period and a 10-minute analysis period. To be more compliant with HCM analysis methodologies and common microsimulation practices, the modeler *should* extend the seeding period and analysis period beyond these default values. WisDOT recommends using the interval settings setup shown in Table 6.1 for SimTraffic simulation models if SimTraffic is one of the project's official traffic analysis tools (i.e., the project will rely on SimTraffic volume and operation reports to make critical decisions).

The interval setting shown in Table 6.1 are not necessary for applications such as conducting reality checks on Synchro outputs, creating videos for public involvement, or performing high-level screening of alternatives. For high-level applications, a seeding period and one 15-minute analysis interval may be appropriate.

Table 6.1 Recommended Interval Settings for SimTraffic

Interval	Seeding	Recording	Recording	Recording (Peak)*	Recording
Duration	7 mins**	15 mins	15 mins	15 mins	15 mins
PHF Adjust	No	No	No	Yes	No
Anti-PHF Adjust	No	Yes	Yes	No	Yes
Random Seed	Non-zero for repeatable results; Zero for random seeding				

*Recommendation is to have the peak 15-minute interval be the 2nd or 3rd interval in the simulation.
**Seeding interval *should* be long enough for one vehicle to travel through the network or longer than the maximum cycle length in the network, whichever is greater

6.2.2 Parameter Discussion

Attachment 6.1 provides a list of the parameters, along with recommended ranges, that the modeler will typically adjust while calibrating a SimTraffic model. This list provides a good starting point for the parameter value adjustment. Unless field data or experience supports doing otherwise, modify only those parameters recommended as settings to adjust. Obtain WisDOT staff approval prior to modifying non-recommended adjustment parameters.

Refer to the *Synchro Studio 12User Guide* (4), for some tips on calibrating a SimTraffic model. Departing from the Synchro/SimTraffic defaults may not be necessary to validate modeled traffic volumes at moderately congested locations. However, at highly congested locations, it may be necessary to modify the Synchro/SimTraffic defaults to calibrate and validate the traffic model. If validating to intersection queue data, the analyst may need to make minor adjustments to settings such as turning speeds (based on geometry of the intersection) or local headway factors (change in small increments only) to improve the locations with long queues.

6.2.3 Common Errors and Warnings

Chapter 25 of the *Synchro Studio 12 User Guide* (4) provides a list of common errors and warning messages along with potential causes and tips for resolving the issues. This list of common errors and warnings may serve as a beneficial resource during the calibration process.

6.3 Paramics Calibration Parameters

As noted in TEOpS 16-20-4.3, prior to January 1, 2018, WisDOT supported the use of Paramics. As such, projects that initiated the microsimulation traffic analysis using Paramics prior to January 1, 2018 may continue to use Paramics for the duration of the project. Thus, it is possible that Paramics will still be in use in Wisconsin for several more years necessitating the need to provide some guidance on calibrating Paramics models, specifically for the alternative model development.

Attachment 6.2 provides a list of the parameters, along with recommended ranges, that the modeler will typically adjust while calibrating a Paramics model. This list provides a good starting point for the parameter value adjustment. Unless field data or experience supports doing otherwise, modify only those parameters recommended as settings to adjust. Obtain WisDOT staff approval prior to modifying non-recommended adjustment parameters.

6.4 Vissim Calibration Parameters

Given the complex and iterative nature of model calibration and the vast number of calibration parameters provided in Vissim, it is a good practice to start calibration using parameters that a modeler is certain about based on field data or experience. If additional calibration is still necessary, the analyst may move to parameters that they are less certain about but willing to experiment with using different values. Attachment 6.3 provides a list of the parameters, along with recommended ranges, that the modeler will typically adjust while calibrating the Vissim model. This list provides a good starting point for the parameter value adjustment.

The following typically-used parameters all have direct impacts on model performance. Since different methods with multiple parameter combinations may exist to calibrate a specific modeling condition in Vissim, the analyst *should* first adjust the global parameters and then, only if necessary, adjust the local parameters.

6.4.1 Vehicle Fleet

Use the “WisDOT Defaults inpx” vehicle compositions for the initial input values. Based on local project conditions and road types included in the model, it may be necessary to refine or adjust the vehicle classifications or speed distributions. Direct any specific questions on adjusting the vehicle fleet in Vissim to BTO-TASU (DOTTrafficAnalysisModeling@dot.wi.gov).

6.4.2 Simulation Step

In most cases, use 10 seconds per simulation second.

6.4.3 Car Following Model for Freeways

For freeway segments, apply the Wiedmann 99 car following model. Standstill distances (CC0), headway time (CC1), and following variation (CC2) have significant impacts on the car following behaviors. Higher values represent more cautious driving behaviors and lower roadway capacity.

6.4.4 Car Following Model for Urban Arterials

For urban arterials, apply the Wiedmann 74 car following model. Higher values of average standstill distance, additive part of safety distance, and multiplicative part of safety distance means more distance between vehicles and therefore lower roadway capacity.

6.4.5 Lane Change Parameters

Lane change parameters are the same for both freeway and arterial segments and the analyst *should* adjust them to match field conditions, especially at merging, diverging, and weaving areas.

6.4.6 Local Car Following and Lane Change Parameters

The analyst can define additional car-following and lane-change parameter sets separately as global settings and then only apply them to local links and connectors where driving behaviors are different from global definitions.

6.4.7 Connector Lane Change Distance

The default lane change distance for all connectors is 656 feet and is typically representative of arterials. The analyst can and *should* adjust the default lane change distance higher or lower as needed, especially for freeways and closely-spaced intersections. Additionally, there is an option to have this lane change distance increase for each lane that a vehicle must cross to travel via the connector. The analyst *should* adjust the lane-change distance parameters to avoid unrealistic prepositioning and last-minute lane-changing behavior that may arise.

6.4.8 Other Adjustable Parameters

Unless field data or experience supports doing otherwise, modify only those parameters recommended as settings to adjust. Obtain WisDOT staff approval, prior to modifying non-recommended adjustment parameters.

LIST OF ATTACHMENTS

Attachment 6.1	SimTraffic Calibration Parameters
Attachment 6.2	Paramics Calibration Parameters
Attachment 6.3	Vissim Calibration Parameters

16-20-7 Simulation Runs — April 2025

7.1 Need for Multiple Simulation Runs

Real-world traffic varies considerably from day to day, and even from minute to minute. Microsimulation models attempt to mimic this effect by using stochastic (randomized) variables to account for variations in driver behavior and departure time. The source of this stochasticity is an algorithm within the microsimulation software package known as a pseudo-random number generator. Since purely random generation of numbers is mathematically problematic, pseudo-random number generators require a seed that initiates the underlying algorithm. This algorithm then generates a stream of millions or more apparently random numbers, which determine the release pattern of vehicles (i.e., how many and when) and the distribution of driver characteristics such as speed, among others, for each microsimulation model run. If the microsimulation software is functioning correctly, two model runs with the same seed will produce identical results.

If the analyst were to conduct only one run of the simulation model, there would be no way to assess whether the model was a good representation of reality as, depending on the seed value and the validity of the model, the results could represent a typical day, an abnormal day, or they could mispresent reality altogether. Running multiple runs of the model with different seed values allows the analyst to get a better sense as to whether the model results accurately reflects the range of traffic conditions encountered in the real world. Thus, during the calibration and validation process, the analyst **shall** complete multiple simulation runs.

7.2 Simulation Seeds

Microsimulation software packages use several types of pseudo-random number generating algorithms, potentially including multiple options within each package, but due to their pseudo-random nature, every type of algorithm will eventually begin to repeat if left running continuously. At the point of repetition, the algorithm will start generating the same stream of numbers in the same order. With certain types of pseudo-random number generators, the seed type can dictate the length of the resulting stream of numbers; zero and even numbers can cause some algorithms to repeat quickly or have other undesirable effects. Out of an abundance of caution, WisDOT has historically and will continue to require the use of prime numbers as seeds.

The purpose of this policy is to assure the uniform use of prime numbers as seeds, provide transparency, and allow for the reproducibility of results. It has long been good modeling practice to record the seed number associated with each model run, but this has never been a formal requirement. With adoption of the formal peer review policy (see TEOpS 16-25), it has become necessary to document how the results recorded can be replicated. To ease this process and ensure consistency statewide, WisDOT is specifying the use of the seed values listed in Table 7.1 for all traffic model scenarios. Typically, a calibrated model will not require more than

30 simulation runs. If there is a desire to conduct additional runs, the analyst *should* carefully weigh the potential benefits of conducting additional runs against the additional resource requirements. If warranted, contact BTO-TASU (DOTTrafficAnalysisModeling@dot.wi.gov) to receive seed values for additional runs.

Table 7.1 Seed Values

Run Number	Seed Value	Run Number	Seed Value	Run Number	Seed Value
1	**199**	11	**7**	21	**23**
2	**409**	12	**157**	22	**29**
3	**619**	13	**307**	23	**13**
4	**829**	14	**457**	24	**103**
5	**1039**	15	**607**	25	**193**
6	**1249**	16	**757**	26	**283**
7	**1459**	17	**907**	27	**373**
8	**1669**	18	**5**	28	**463**
9	**1879**	19	**11**	29	**28657**
10	**2089**	20	**17**	30	**514229**

Notes:
1. To simplify the process of running the models using the specified seed numbers (especially for Vissim), the seed numbers above represent prime numbers. The first ten runs are prime numbers that have an increment of 210 between each seed value (runs 11-17 have an increment of 150, runs 18-22 have an increment of 6, and runs 23-28 have an increment of 90). To run the first ten runs in Vissim, enter the first seed (199) in the "Random Seed" box under Simulation>Parameters. Set the "Number of runs" to the desired number (up to 10), and then enter 210 as the "Random seed increment". This allows Vissim to complete runs 1-10 with the seed values shown above.
2. The SimTraffic simulation engine generates sequential seeds for multiple runs, the seed values shown above are **not** applicable

7.3 Number of Simulation Runs - Background

The purpose of this policy is to provide transparency and consistency with the determination of the number of simulation runs. Multiple forms of federal guidance exist on the number of simulation runs. After reviewing the national guidance, BTO-TASU chose to use the methodology outlined in the *Guidance on the Level of Effort Required to Conduct Traffic Analysis Using Microsimulation* (7), published by FHWA in March 2014 as the basis for WisDOT's policy on determining the number of simulation runs. The FHWA 2014 Guidance (7) methodology uses field data to calculate the error tolerance. After completing several (5-10) initial model runs, the analyst can evaluate the number of required runs, and then, if necessary continue conducting additional model runs until the required number of runs is satisfied. The following details WisDOT's policy regarding the number of simulation runs.

7.4 Number of Simulation Runs - Process

7.4.1 Selecting Test Location Sites

To complete the required number of runs calculations, the analyst **shall** select at least one representative location within the model study area for each peak period of analysis. A location is representative if it meets all the following criteria:

- Lies within the area of interest associated with the purpose of the model
- Is on a facility of the highest or second-highest functional class
- Experiences higher-than-average traffic demand during the peak period

Given the data requirements spelled out below, the location(s) selected *should* have enough field data available to complete the required number of runs calculations.

The analyst may use the same location for more than one peak period provided it is representative of the peak period conditions. A location may be directional – that is, the location may reflect only the eastbound direction of a two-way facility. In fact, directional locations that match up with the peak traffic flows may be more representative than a location that reflects both directions of travel.

Although the minimum number of locations is one per peak period, for larger models, the analyst *should* include more than one location. A general rule would be to have one location per five miles of freeway or other principal arterial included in the model, with a practical upper limit of four locations per peak period.

7.4.2 Selecting the MOEs to Test

Volume has historically been the MOE used for calculating the required number of simulation runs. The national publications providing guidance on determining the number of runs cited in the simulation background (TEOpS 16-20-7-3) use volume in their examples. This may be because volume, in the past, has been the most data-rich MOE. Given advances in technology and data collection methodologies, WisDOT has other MOEs (such as travel time and speed) with sufficient field data that may be available for calculating the number of runs. Refer to TEOpS 16-20-3 for details on other potential MOEs.

In general, the analyst has latitude in selecting the MOE to use for determining the number of runs. The analyst *should* use the same MOE for every location and peak period included in the number of runs evaluation. Volume remains a good starting point, though data availability, the nature of the facility, and the model purpose *should* play a role in the MOE selection.

7.4.3 Use of Field Data

Rather than determining *a priori* what level of error is acceptable when calculating the required number of runs, the analyst *should* compute the error tolerance based on the variability observed in field data. To assist with determining the error tolerance using field data and calculating the number of required runs, BTO-TASU developed a Microsoft Excel based workbook.

The number of runs workbook requires the use of between 3 and 365 field data points, which the analyst would enter into the “Variability Analysis of Field Data” area of the workbook. To preserve the integrity of the test, the data entered **shall** be representative of the operating conditions that align with the purpose of the modeling effort. In other words, filter out data points with atypical conditions such as incidents or inclement weather when modeling normal operating conditions. Likewise, use only comparable situations when analyzing a special condition, such as an event at a stadium. Selecting field data for entry in such a way as to unduly influence the resulting calculations, is not permissible.

The field data generates a margin of error, from which the spreadsheet then computes an error tolerance percentage. The workbook then uses this tolerance in combination with the initial model run results to calculate a required number of runs. Through thorough testing of the workbook, to account for the stochasticity inherent in the modeling processing, BTO-TASU set a minimum tolerance of one percent, even if the calculated tolerance from field data is lower. There is no upper limit to the tolerance.

7.4.4 Initial Simulation Runs

After entering the field data into the number of runs worksheet, the analyst must perform a series of initial model runs to allow for comparisons between the field data and model result variability. Historically, seven runs have proven to be a sufficient number of runs to capture the variation observed in the field. It provides enough samples to run summary statistics on and falls within the 5 to 10 initial runs recommended in the most recent national guidance. Accordingly, the analyst **shall** complete seven initial model runs.

To facilitate the consistent use of prime seeds, discussed above in TEOpS 16-20-7.2, the “Initial Runs” portion of the number of runs workbook contains the seeds to use for each simulation run. Using prime number seeds in arithmetic sequence, or primes that are evenly spaced, simplifies the process of running the models using the specified seed numbers, at least in Vissim. To run the initial seven runs in Vissim, enter the first seed, 199, in the “Random Seed” box under Simulation>Parameters. Set the “Number of runs” to 7, and then enter 210 as the “Random seed increment.” This allows Vissim to complete seven successive runs with the appropriate seed values.

After the model runs are complete, enter the results from the first location for the selected MOE for the peak hour of the first peak period into the number of runs workbook. The workbook will automatically eliminate any statistical outliers (at the 95% confidence level) and will update the number of valid (non-outlier) runs accordingly. For additional information on how to address outliers, see TEOpS 16-20-7.4.7.

Using the tolerance from the field data, the workbook will compute an estimated number of runs. If the number of valid runs is greater than or equal to the estimated number of runs, the test is complete for that location. Continue for other locations and other peak periods. If the number of valid runs is less than the estimated number of runs, more runs will be necessary (see the following section, TEOpS 16-20-7.4.5).

7.4.5 Additional Simulation Runs

If additional runs are required, enter the additional results data in the “Additional Runs” part of the number of runs workbook. The results from the first seven runs will automatically transfer over. The workbook will update the required number of runs calculations as appropriate to reflect the additional run data. The analyst *should* continue with additional runs, adding one at a time, until either the number of runs completed exceeds the number of runs required, or they have completed 30 runs. If the analysis indicates a need for more than 30 runs, contact BTO-TASU (DOTTrafficAnalysisModeling@dot.wi.gov).

7.4.6 Number of Runs to Use for Reporting Results

It is likely that the number of runs will vary for each location and peak period of analysis; it may be higher than the seven initial runs for one or more locations and lower for others. The analyst *should* use the highest required number of runs value from any location for reporting model results. This will ensure meeting (and often exceeding) the required number of runs everywhere. If the highest required number of runs is less than seven, use the seeds for the initial seven runs to report results.

Typically, a calibrated model will not require more than 30 simulation runs. However, if the number of runs calculations find that more than 30 runs are necessary, coordinate with WisDOT regional traffic staff to assess whether to conduct additional model runs, as it may be necessary to perform additional model calibration. Contact BTO-TASU (DOTTrafficAnalysisModeling@dot.wi.gov) for additional support or guidance as needed and to request the seed values to use for any additional runs beyond 30.

Unless the results of the model run are determined to be a statistical outlier (see TEOpS 16-20-7.4.5), the analyst **shall** use the results for the appropriate number of runs for the corresponding seed number shown in Table 7.1. See the following section (TEOpS 16-20-7.4.7) for additional information on how to address outliers in both the number of runs calculations and runs used to report model results.

7.4.7 Model Run Outliers

In a non-technical sense, a model run is a statistical outlier if its value is significantly higher or lower than expected given the other model runs. For the purposes of WisDOT microsimulation analyses, WisDOT defines an outlier as anything outside of the 95% confidence interval, or more than 1.96 standard deviations away from the average value assuming a two-tailed normal distribution. Normally, a t-statistic-based test would be most appropriate for data sets with less than 30 samples; however, this would add complexity to the process. More importantly, assuming a normal distribution is consistent with the FHWA 2014 Guidance (7) which serves as the basis for the number of run calculations (TEOpS 16-20-7.3).

Identify model run outliers in both the initial seven runs and in any additional required runs. It is possible for there to be more than one outlier, though this is highly unlikely in the initial seven runs given the significant effect of the outliers themselves on the standard deviation of the sample.

The analyst **shall** remove the statistical outliers from calculations related to the number of runs required, as they overstate the dispersion of results observed in the model and would unnecessarily require a higher number of runs. Identifying outliers in an objective manner eliminates questions surrounding the analyst manually selecting runs to eliminate and will introduce greater consistency across projects.

7.4.8 Model Runs for Future Year Scenarios

The above policy applies to the existing conditions models, as they are the only scenarios with field data. For future scenarios, or for those without any applicable field data, use the same seed numbers associated with the required number of runs from the existing conditions (see Table 7.1 for the seed numbers to use). This includes using the highest required number of runs when reporting results for all other scenarios.

7.4.9 Recommended Process with Limited Field Data

When insufficient field data is available for representative locations, the analyst **shall** use the methodology laid out in Chapter 7 of HCM7 (6). Use volume as the MOE and seven initial runs. For the E_T, the maximum tolerable error, BTO-TASU recommends the use of 2 percent of the average volume at the representative location. If using an alternate maximum tolerable error, document the rationale for using the selected percent tolerable error within the modeling methodology report. Complete this calculation at each location for each peak period. Comply with the “Number of Runs to Use for Reporting Results” section above (TEOpS 16-20-7.4.6).

7.5 Software Considerations

The above policy is applicable for all Vissim models. For SimTraffic models, conduct a minimum of seven runs. The SimTraffic simulation engine generates sequential seeds for multiple runs, the seed values shown in Table 7.1 are not applicable. To ensure the use of the same seed values for all model scenarios, make sure to start the multiple run recording with the same value.

16-20-8 Model Validation — September 2019

8.1 Introduction

This section describes the validation metrics and acceptance thresholds required for the MOEs discussed in TEOpS 16-20-3. This policy addresses the validation process for microsimulation traffic models and replaces the 2014 WisDOT Draft Microsimulation Guidelines previously housed on the www.wisdot.info website. **The policy provided within this document is effective as of January 1, 2018.**

As of January 1, 2018, use of the 2014 WisDOT Draft Microsimulation Guidelines will continue to be acceptable only for those projects that satisfy all the following conditions:

- The completion date of the existing conditions traffic model is prior to January 1, 2018
- The existing conditions traffic model has undergone the peer review process
- The WisDOT regional traffic engineer or BTO-TASU determined that the model was sufficiently calibrated and validated
- No major revisions to the existing conditions model are necessary

If the project satisfies all the above conditions, the 2014 WisDOT Draft Microsimulation Guidelines may be applicable for all traffic modeling scenarios. However, WisDOT strongly encourages the analyst to assess whether the traffic model would satisfy the new validation thresholds as outlined below. Contact BTO-TASU (DOTTrafficAnalysisModeling@dot.wi.gov) to request a copy of the 2014 WisDOT Draft Microsimulation Guidelines.

8.2 Validation Process

To validate that the traffic model reflects real world conditions, the analyst **shall** conduct both quantitative and qualitative checks on the model outputs for the analysis period. The analyst **shall** conduct validation checks of the existing conditions model using field-measured data, including but not limited to, traffic volumes, travel speeds, travel times, intersection queuing, and trip-making patterns (e.g., weaving volumes). The analyst **shall** conduct the validation checks of the alternative models using traffic forecast and other data that is available for the alternative scenario. See TEOpS 16-20-8.3, 16-20-8.4, and 16-20-8.5 for details on the quantitative and qualitative validation thresholds.

During validation, it is also important to confirm that the model meets the purpose and need of the project (e.g., if the purpose of the project is to assess the feasibility of managed lanes, during validation it is important to confirm that the model can capture managed-lane alternatives, etc.).

If the model outputs satisfy the validation thresholds (see TEOpS 16-20-8.3, 16-20-8.4, and 16-20-8.5), and the model meets the purpose and need of the project, the analyst can consider the model to be valid and can use the model to assess various performance measures and MOEs. If the model outputs fail to satisfy the validation thresholds or the model does not meet the purpose and need of the project, additional calibration of the model will be necessary.

8.2.1 Historical Validation Process (pre-January 1, 2018)

The 2014 WisDOT Draft Microsimulation Guidelines validation process consisted of three realism tests, where realism test 1 looked at traffic volumes, realism test 2 assessed travel times and speeds, and realism test 3 considered travel patterns. Realism tests 1 and 2 were quantitative/mathematical tests that used GEH (Geoffrey E. Haver's volume tolerance formula) and absolute or percent differences to assess the differences between observed (field) and modeled data. Realism test 3 was a qualitative test that relied on professional judgement to determine if the modeled travel patterns were a good representation of field conditions. The 2014 WisDOT Draft Microsimulation Guidelines required the traffic model to satisfy all criteria in all three realism tests.

Although the realism tests generally provided a good assessment as to whether a traffic model accurately represented real world conditions, there were some concerns with the methodology. Specifically, WisDOT had the following concerns with the 2014 realism tests:

- Considering that the acceptance targets for GEH were initially developed for travel demand models, are they appropriate for microsimulation models?
- Since the original intent of the GEH formula was to evaluate daily or hourly volumes, was it appropriate to apply the GEH formula to 15-minute volumes?
- Depending on whether the modeled value was higher or lower than the target value, the same incremental difference could result in different GEH values. For example, if the target value was 250, a modeled volume of 325 (75 higher than the target) would yield a GEH of 4 while a modeled volume of 175 (75 lower than the target) would yield a GEH of 5. In this example, it appears that a modeled volume that is 75 vehicles higher than the target volume is a closer match to reality than a modeled volume that is 75 vehicles lower than the target volume. Does this make sense?

- Did it make sense to apply travel time realism tests to short routes, especially if performing travel speed realism tests on the same segment?
- How could BTO-TASU ensure that travel times did not blend in with travel speeds (i.e., the calculation of travel speeds was simply the inverse of travel time)?
- How *should* project teams handle situations where there is no data available for a MOE included in one of the realism tests? Data is not always available for both travel time and travel speeds, making it impossible to conduct all three realism tests.
- Was it appropriate to apply the same validation tests for all types of microsimulation models?

Considering the concerns WisDOT had with the 2014 realism tests, BTO-TASU worked with a consultant team to assess whether there were other Goodness of Fit (GoF) metrics and validation thresholds that would be better suited for assessing whether a traffic model provided a good representation of reality. As part of the assessment, BTO-TASU and the consultant team conducted literature reviews, surveys of other state DOT practices, and evaluation testing. To evaluate the GoF metrics, the consultant team used output from previously developed models, most of which were previously calibrated and validated in accordance with the 2014 realism tests. The evaluation included models from the three WisDOT supported software tools (SimTraffic, Paramics, and Vissim). The SimTraffic models were the only models that did not previously go through the calibration and validation process.

Since most of the models used in the evaluation testing had already undergone the calibration and validation process, the consultant team performed sensitivity testing by modifying model inputs to broaden the sample size of the data sets. After completing the sensitivity testing, the consultant team assigned a ranking system (with 1 being the best and 7 being the worst) for each MOE to determine the quality of validation for each model. This ranking system helped evaluate both the feasibility and acceptance levels for each of the GoF validation tests.

Through the literature reviews, surveys, and evaluation testing; WisDOT determined that an overhaul of the 2014 realism tests were necessary. Although the new validation tests use different GoF metrics, models previously calibrated and validated using the 2014 realism tests *should* still be able to pass the new validation process. The following sections describe the new validation thresholds.

8.2.2 Tiered Validation Process (post January 1, 2018)

Effective January 1, 2018, WisDOT will require the use of a tiered validation approach. In this tiered approach, the Tier 1 test would be a global validation test for a metric and the Tier 2 test would be a local test for that same metric. If a model passes the Tier 1 (global) test, the modeling team would not need to perform the Tier 2 (local) test and a detailed summary of the Tier 2 test would not be necessary. BTO-TASU established the validation acceptance criteria to allow only well calibrated and validated models to pass the Tier 1 (global) test.

Table 8.1 summarizes the tiered validation tests. Refer to TEOpS 16-20-3 to identify the number and type of MOEs on which to perform validation tests, noting that the volume validation tests are required for all traffic models. The analyst *should* satisfy the validation thresholds shown in Table 8.1 for the selected MOEs to the best extent that is practically feasible. If the model is unable to satisfy the validation thresholds outlined in Table 8.1, the analyst **shall** consult with WisDOT regional traffic staff prior to finalizing the modeling methodology report or proceeding with the development of additional modeling scenarios. Contact BTO-TASU (DOTTrafficAnalysisModeling@dot.wi.gov) for additional support or guidance as needed.

8.3 Tier 1 (Global) Validation Tests

The Root Mean Squared Percent Error (RMSPE) is the primary validation metric for the global tests. This metric was based on the results of literature reviews, surveys of other state DOT practices with respect to GoF metrics to apply to microsimulation models and evaluation testing. The equation for RMSPE is as follows:

$$\textbf{RMSPE} = \sqrt{\frac{1}{N}\sum_{i=1}^{N}\left(\frac{M_i - O_i}{O_i}\right)^2}$$

Where:
M = Modeled Data
O = Observed Data
N = Number of Data Points
i = Observation Point

The Tier 1 (global) validation tests are applicable for link/segment volumes, travel times, and travel speeds. Table 8.2 summarizes the Tier 1 (global) validation tests. Refer to TEOpS 16-20-3 to identify the number and type of MOEs on which to perform the Tier 1 (global) validation tests, noting that the Tier 1 volume validation tests are required for all microsimulation traffic models.

Table 8.1 Validation Tests

MOE	Criteria	Validation Acceptance Threshold	
Volume[a]	All Links > 100 vph (Mainline and Critical[b] Arterials)	Tier 1:	RMSPE <5.0%
		Tier 2:	RNSE <3.0% for >85% of links
	All Turns	Tier 1:	Not Applicable
		Tier 2:	RNSE <3.0% for >75% of turns
Speeds	All Segments or Spot-Speed Locations	Tier 1:	RMSPE <10.0%
		Tier 2:	Within ± (Mainline Posted Speed X 20%) for >85% of locations
Travel Times	All Routes > 1.5 Miles	Tier 1:	RMSPE <10.0%
		Tier 2:	Within ± 15% for >85% of routes
Queues	All Critical[b] Queue Locations	Tier 1:	Not Applicable
		Tier 2:	± 150 feet for queues 300 to 750 long, Within ±20% for queues >750 feet long
Lane Use	All Critical[b] Lane Utilization Locations	Tier 1:	Not Applicable
		Tier 2:	RNSE <3.0% for >85% of locations Consistent with field conditions

[a] All traffic models **shall** undergo volume validation (Tier 1) tests
[b] Critical locations are those locations likely to have an impact on operations to the project study area (e.g., locations with higher traffic volumes, existing or projected level of service is at or approaching unstable flow, queues block or impede travel, weaving areas, merge/diverge locations, etc.)
vph = vehicles per hour
RMSPE = Root Mean Squared Percent Error, See TEOpS 16-20-8.4 for equation
RNSE = Root Normalized Squared Error, See TEOpS 16-20-8-5.1 for equation

Table 8.2 Tier 1 (Global) Validation Tests

MOE	Criteria	Validation Acceptance Threshold	
Volume[a]	All Links > 100 vph (Mainline and Critical[b] Arterials)	Tier 1:	RMSPE <5.0%
Speeds	All Segments or Spot-Speed Locations	Tier 1:	RMSPE <10.0%
Travel Times	All Routes > 1.5 Miles	Tier 1:	RMSPE <10.0%

[a] All traffic models **shall** undergo volume validation (Tier 1) tests
[b] Critical locations are those locations likely to have an impact on operations to the project study area (e.g., locations with higher traffic volumes, existing or projected level of service is at or approaching unstable flow, queues block or impede travel, weaving areas, merge/diverge locations, etc.)
vph = vehicles per hour
RMSPE = Root Mean Squared Percent Error, See TEOpS 16-20-8.4 for equation

8.3.1 Traffic Volumes

All microsimulation traffic models **shall** undergo the Tier 1 volume validation test, see Table 8.2. This test requires a global evaluation of the modeled versus observed (field) traffic volumes for all roadway links/segments for which traffic volume data is available. The volume validation tests evaluate the volumes during the peak period analysis times (does not include the warm-up or cool-down periods) included in the model (see TEOpS 16-20-2.1.2 for additional direction on determining the temporal analysis periods).

The traffic model will often be broken into smaller links than what exists in the field, so use the roadway segmentation that exists, or is planned to exist, in the field to identify locations where volume data comparisons are justified. Focus on the mainline segment and other critical arterials and ramps included in the study area, where critical locations are those locations likely to have an impact on traffic operations.

A benefit of the RMSPE is that it considers relative error, so the results will be the same whether the modeled volume is higher or lower than the observed volume. Sensitivity testing, however, found that the RMSPE was somewhat unstable when volumes were less than 100 vehicles per hour (vph). Thus, the Tier 1 volume validation threshold is only applicable for those roadway links with a minimum volume of 100 vph during the analysis period. Values that may be under 100 vph likely include ramps or arterial roadways that have minimal to no effect on the operations of the facility under study.

The acceptance criteria for the global link volume test is a RMSPE of 5 percent (i.e., to pass the Tier 1 volume validation test, the RMSPE for all links must be less than 5 percent). This acceptance criterion was based on the results of the evaluation testing on previously developed, calibrated, and validated models. Only well validated models will pass the 5 percent acceptance criteria. If the model does not pass the 5 percent acceptance criteria, the analyst **shall** proceed onto the Tier 2 volume validation to pinpoint where any issues in the model may exist.

Conduct the Tier 1 volume validation tests by direction for every model run. The analyst *should* conduct the volume validation for the finest resolution that is feasible, with practical bounds from 15 minutes up to one hour. BTO-TASU realizes that using sub-hourly time periods for validation may not be practical (e.g., data is unavailable at the sub-hourly level, the additional value does not justify the added level of effort required, etc.). Consider the volume validation test satisfied if the model passes the tests at the hourly level. Ideally, however, if using sub-hourly data, strive to satisfy the volume validation test at the sub-hourly level.

Summarize and document the results of the volume validation tests. Include a copy of the volume validation tests as an attachment to the modeling methodology report and submit to the regional office for review and comment. The regional office will involve BTO-TASU in the review as appropriate. For sample formats or questions on the volume validation test, contact BTO-TASU (DOTTrafficAnalysisModeling@dot.wi.gov).

8.3.2 Travel Speeds

See TEOpS 16-20-3 to identify whether to apply the Tier 1 travel speed validation test. As shown in Table 8.2, the Tier 1 travel speed validation test requires a global evaluation of the modeled versus observed (field) travel speeds during the analysis period (does not include the warm-up or cool-down period) for all segments where travel speeds are available (either average segment travel speeds or spot speeds). To ensure that the travel speed validation test is independent from the travel time validation test, take care not to use the inverse of travel times to derive the segment travel speeds for the travel speed validation.

The acceptance criteria for the global travel speed test is a RMSPE of 10 percent (i.e., to pass the Tier 1 travel speed test, the RMSPE for all segment/spot speed locations must be less than 10 percent). This acceptance criterion was based on the results of the evaluation testing on previously developed, calibrated, and validated models. Only well validated models will pass the 10 percent acceptance criteria. If the model does not pass the 10 percent acceptance criteria, the analyst **shall** proceed onto the Tier 2 travel speed validation to pinpoint where any issues in the model may exist.

Conduct the Tier 1 travel speed validation tests by direction for every model run. The analyst *should* conduct the speed validation for the finest resolution that is feasible, with practical bounds from 15 minutes up to one hour. BTO-TASU realizes that using sub-hourly time periods for validation may not be practical (e.g., data is unavailable at the sub-hourly level, the additional value does not justify the added level of effort required, etc.). Consider the speed validation test satisfied if the model passes the tests at the hourly level. Ideally, however, if using sub-hourly data, strive to satisfy the speed validation test at the sub-hourly level.

Summarize and document the results of the travel speed validation tests. Include a copy of the travel speed validation tests as an attachment to the modeling methodology report and submit to the regional office for review and comment. The regional office will involve BTO-TASU in the review as appropriate. For sample formats or questions on the travel speed validation test, contact BTO-TASU (DOTTrafficAnalysisModeling@dot.wi.gov).

8.3.3 Travel Times

See TEOpS 16-20-3 to identify whether to apply the Tier 1 travel time validation test. As shown in Table 8.2, the Tier 1 travel time validation test requires a global evaluation of the modeled versus observed (field) travel times during the analysis period (does not include the warm-up or cool-down period) for all study routes greater than 1.5 miles in length. To ensure that the travel time validation test is independent from the travel speed validation test, take care not to use the inverse of the segment travel speeds to derive the travel times for the travel time validation.

It is easier for drivers to relate travel time to longer routes versus shorter routes (i.e., a driver may say they drove ½ mile at an average of 60 miles per hour but typically will not say they took 30 seconds to drive the ½ mile). Further, on shorter segments, travel times and travel speeds tend to blend together (i.e., the travel time is the inverse of travel speed). WisDOT experience with previous projects has shown that it is easiest to make a distinction between travel time and travel speeds when the travel route is at least 1.5 miles long. For these reasons, the Tier 1 validation test for travel times is only applicable to travel routes greater than 1.5 miles long.

Unless the use of shorter segments is logical, the analyst *should* combine short travel time segments (those less than 1.5 miles) together to make one longer travel time segment to use for the Tier 1 travel time validation test. If unsure whether to combine segments for the travel time validation test, contact WisDOT regional traffic staff. Contact BTO-TASU (DOTTrafficAnalysisModeling@dot.wi.gov) for additional support or guidance as needed. Document the rationale for using the shorter travel time routes or combining routes into one longer segment in the modeling methodology report.

The acceptance criteria for the global travel time test is a RMSPE of 10 percent (i.e., to pass the Tier 1 travel time test, the RMSPE for all routes greater than 1.5 miles must be less than 10 percent). This acceptance criterion was based on the results of the evaluation testing on previously developed, calibrated, and validated models. Only well validated models will pass the 10 percent acceptance criteria. If the model does not pass the 10 percent acceptance criteria, the analyst **shall** proceed onto the Tier 2 travel time validation to pinpoint where any issues in the model may exist.

Conduct the Tier 1 travel time validation tests by direction for every model run. The analyst *should* conduct the travel time validation for the finest resolution that is feasible, with practical bounds from 15 minutes up to one hour. BTO-TASU realizes that using sub-hourly time periods for validation may not be practical (e.g., data is unavailable at the sub-hourly level, the additional value does not justify the added level of effort required, etc.). Consider the travel time validation test satisfied if the model passes the tests at the hourly level. Ideally, however, if using sub-hourly data, strive to satisfy the travel time validation test at the sub-hourly level.

Summarize and document the results of the travel time validation tests. Include a copy of the travel time validation tests as an attachment to the modeling methodology report and submit to the regional office for review and comment. The regional office will involve BTO-TASU in the review as appropriate. For sample formats or questions on the travel time validation test, contact BTO-TASU (DOTTrafficAnalysisModeling@dot.wi.gov).

8.4 Tier 2 (Local) Validation Tests

If the model fails to pass the Tier 1 (global) validation tests, the analyst **shall** perform the Tier 2 (local) test for the applicable MOEs. The purpose of the Tier 2 validation test is to pinpoint where potential problems in the model may exist. Since the Tier 2 validation test is a localized test, the GoF metric varies depending on the MOE. The Tier 2 (local) validation tests are applicable for link/segment volumes, turning movement volumes, travel speeds, travel times, queues, and lane use. Table 8.3 summarizes the Tier 2 (local) validation tests. Refer to TEOpS 16-20-3 to identify the number and type of MOEs on which to perform validation tests, noting that if a model passes the Tier 1 (global) tests for a specific MOE, it is not necessary to perform the Tier 2 (local) tests for that same MOE. Document the rationale for excluding the Tier 2 validation tests (e.g., the MOE in question successfully passed the Tier 1 validation test) in the modeling methodology report. The analyst, however, *should* always perform the Tier 2 turning movement volume test for projects that include intersections.

Table 8.3 Tier 2 (Local) Validation Tests

MOE	Criteria	Validation Acceptance Threshold	
Volume[a]	All Links > 100 vph (Mainline and Critical[b] Arterials)	Tier 2:	RNSE <3.0% for >85% of links
	All Turns	Tier 2:	RNSE <3.0% for >75% of turns
Speeds	All Segments or Spot-Speed Locations	Tier 2:	Within ± (Mainline Posted Speed X 20%) for >85% of locations
Travel Times	All Routes > 1.5 Miles	Tier 2:	Within ± 15% for >85% of routes
Queues	All Critical[b] Queue Locations	Tier 2:	± 150 feet for queues 300 to 750 long, Within ±20% for queues >750 feet long
Lane Use	All Critical[b] Lane Utilization Locations	Tier 2:	RNSE <3.0% for >85% of locations Consistent with field conditions

[a] All traffic models that do not pass the Tier 1 validation test **shall** undergo the Link/Segment Volume Tier 2 validation tests. All traffic models that include intersections **shall** undergo the Turning Volume Tier 2 validation tests.
[b] Critical locations are those locations likely to have an impact on operations to the project study area (e.g., locations with higher traffic volumes, existing or projected level of service is at or approaching unstable flow, queues block or impede travel, weaving areas, merge/diverge locations, etc.)
vph = vehicles per hour
RNSE = Root Normalized Squared Error, See TEOpS 16-20-8-5.1 for equation

8.4.1 Traffic Volumes

All microsimulation traffic models **shall** undergo the volume validation test, however, only those models that fail to pass the Tier 1 volume validation test require the completion of the Tier 2 volume validation test for links/segments. Conversely, the analyst **shall** always perform the Tier 2 turning movement volume test for projects that include intersections. A metric named root normalized squared error (RNSE), which is a variation of the GEH (Geoffrey E. Havers) tolerance formula is the validation metric for local volume tests. The RNSE removes the modeled volume from the basis of normalizing error. Literature reviews and evaluation testing informed the development of the RNSE metric. The equations for GEH and RNSE are below.

$$GEH = \sqrt{2\frac{(M-O)^2}{(M+O)}} \qquad RNSE = \sqrt{\frac{(M-O)^2}{O}}$$

Where:

M = Modeled Data

O = Observed Data

The RNSE shares the same general form as the global RMSPE test that is the basis for the global volume test. Additionally, RNSE provides a consistent value above and below a target volume, whereas GEH does not, eliminating some of the concerns BTO-TASU has with the GEH.

Sensitivity testing found that volumes less than 100 vph may erroneously influence the statistics by potentially reducing the impact of critical links with higher volumes not meeting the threshold. Thus, the Tier 2 (local) volume validation threshold is only applicable for those roadway links with a minimum volume of 100 vph during the analysis period. Values that may be under 100 vph likely include ramps or arterial roadways that have minimal to no effect on the operations of the facility under study. The RNSE, however, is applicable to all turning movements (i.e., there is no minimum volume threshold for turning movements).

The local link volume test requires a RNSE of less than 3.0 for greater than 85 percent of links over 100 vehicles per hour. The local turning movement volume test requires a RNSE of less than 3.0 for greater than 75 percent of turns. These acceptance criteria are based on the results of the evaluation testing on previously developed, calibrated, and validated models. Though the RNSE test value is more robust than the WisDOT 2014 local volume criteria (realism test 1.1, 1.2, and 1.3), its use did not result in well-validated models becoming invalid. Other agencies including the Washington Department of Transportation and London Department for Transport use a similarly strict criterion (GEH criteria of 3.0).

Conduct the Tier 2 volume validation tests by direction for every model run. The analyst *should* conduct the volume validation for the finest resolution that is feasible, with practical bounds from 15 minutes up to one hour. BTO-TASU realizes that using sub-hourly time periods for validation may not be practical (e.g., data is unavailable at the sub-hourly level, the additional value does not justify the added level of effort required, etc.). Consider the volume validation test satisfied if the model passes the tests at the hourly level. Ideally, however, if using sub-hourly data, strive to satisfy the volume validation test at the sub-hourly level.

Summarize and document the results of the volume validation tests. Include a copy of the volume validation tests as an attachment to the modeling methodology report and submit to the regional office for review and comment. The regional office will involve BTO-TASU in the review as appropriate. For sample formats or questions on the volume validation test, BTO-TASU(DOTTrafficAnalysisModeling@dot.wi.gov).

8.4.2 Travel Speeds

See TEOpS 16-20-3 to identify whether to apply the Tier 2 travel speed validation test (note Tier 2 is only required if the model fails to pass the Tier 1 validation test). A combination of absolute error and percent error related to the posted speed limit of a roadway segment is the validation metric for local travel speeds (see Table 8.3). These validation metrics are based on the results of literature reviews, surveys of other state DOT practices, and evaluation testing. The range of acceptance for this test is determined by using a threshold of plus or minus 20 percent of the posted speed limit (i.e., a posted speed of 40 mph would have a range of acceptance of plus or minus 8 mph). For the validation testing, the analyst would apply this range of acceptance (plus or minus 20 percent of the posted speed limit) to the observed speed. For example, an observed speed of 31 mph would have a range of acceptance between 23 and 39 mph (31 +/- 8 MPH) if the posted speed were 40 mph.

Since the 2014 realism tests had an acceptance criterion of plus or minus 10 mph regardless of the speed, it was possible for models to pass the realism test even if portions of the study corridor had modeled speeds that were 50% or more higher or lower than the observed speeds. This was most noticeable on arterials. The new local speed test tightens up the travel speed criteria for arterials and provides more flexibility for freeways experiencing congestion as compared to the 2014 realism tests.

Conduct the Tier 2 travel speed validation tests by direction for every model run. The analyst *should* conduct the travel speed validation for the finest resolution that is feasible, with practical bounds from 15 minutes up to one hour. BTO-TASU realizes that using sub-hourly time periods for validation may not be practical (e.g., data is unavailable at the sub-hourly level, the additional value does not justify the added level of effort required, etc.). Consider the travel speed validation test satisfied if the model passes the tests at the hourly level. Ideally, however, if using sub-hourly data, strive to satisfy the travel speed validation test at the sub-hourly level.

Summarize and document the results of the travel speed validation tests. Include a copy of the travel speed validation tests as an attachment to the modeling methodology report and submit to the regional office for review and comment. The regional office will involve BTO-TASU in the review as appropriate. For sample formats or questions on the travel speed validation test, contact BTO-TASU (DOTTrafficAnalysisModeling@dot.wi.gov).

8.4.3 Travel Times

See TEOpS 16-20-3 to identify whether to apply the Tier 2 travel time validation test (note Tier 2 is only required if the model fails to pass the Tier 1 validation test). The 2014 realism test for travel times had separate acceptance thresholds for routes less than seven minutes and routes equal to or greater than seven minutes, where routes less than seven minutes had an acceptance criterion of plus or minus one minute. The one-minute acceptance criterion for short routes was very easy to meet, especially if considering routes with observed travel times of less than one minute. For this reason, BTO-TASU and the consultant team considered several local testing options for travel times to develop a validation threshold that would address the issues the 2014 realism test had concerning short segments.

Percent error is the metric for the local travel time validation test. Literature reviews, surveys of other state DOT practices, and evaluation testing informed the development of this validation metric. The selected travel time criterion requires modeled travel times to be within plus or minus 15 percent of observed travel times (see Table 8.3). WisDOT experience with previous projects has shown that it is easiest to make a distinction between travel time and travel speeds when the travel route is at least 1.5 miles long. Further, a driver is more likely to start noticing slight changes in travel times on routes 1.5 miles long or longer (e.g., at 45 mph, the driver would take 2 minutes to travel 1.5 miles, any changes in travel time less than 2 minutes will likely be unnoticeable), For these reasons, the local travel time test is only applicable for routes over 1.5 miles in length. Unless the use of shorter segments is logical, the analyst *should* combine short travel time segments (those less than 1.5 miles) together to make one longer travel time segment to use for the Tier 2 travel time validation test. If unsure whether to combine segments for the travel time validation test, contact WisDOT regional traffic staff. Contact BTO-TASU (DOTTrafficAnalysisModeling@dot.wi.gov) for additional support or guidance as needed. Document the rationale for using the shorter travel time routes or combining routes into one longer segment in the modeling methodology report.

Conduct the Tier 2 travel time validation tests by direction for every model run. The analyst *should* conduct the travel time validation for the finest resolution that is feasible, with practical bounds from 15 minutes up to one hour. BTO-TASU realizes that using sub-hourly time periods for validation may not be practical (e.g., data is unavailable at the sub-hourly level, the additional value does not justify the added level of effort required, etc.). Consider the travel time validation test satisfied if the model passes the tests at the hourly level. Ideally, however, if using sub-hourly data, strive to satisfy the travel time validation test at the sub-hourly level.

Summarize and document the results of the travel time validation tests. Include a copy of the travel time validation tests as an attachment to the modeling methodology report and submit to the regional office for review and comment. The regional office will involve BTO-TASU in the review as appropriate. For sample formats or questions on the travel time validation test, contact BTO-TASU (DOTTrafficAnalysisModeling@dot.wi.gov).

8.4.4 Queue Lengths

Refer to TEOpS 16-20-3 to identify whether to apply the Tier 2 (local) queue validation test, noting that queues can be either a primary or a secondary validation MOE. Typically, if intersection queuing is critical to the design decisions (e.g., the project is assessing the storage length requirements for a left turn lane), queue lengths will be one of the primary validation MOEs for the arterials. Intersection queue lengths are often the primary MOE for validation of a SimTraffic model. The quantitative metrics for queues shown in Table 8.3 are applicable for all models where queue lengths are a primary validation MOE (typically applicable for arterial segments). The qualitative measures discussed in TEOpS 16-20-8.5 are applicable for models that use queue length as a secondary validation MOE (typically applicable for freeway segments).

The validation metric for intersection queue length is a combination of absolute error and percent error. Literature reviews, surveys of other state DOT practices, and evaluation testing informed the development of this validation metric. The acceptance criterion for the intersection queue validation test is an absolute error of plus or minus 150 feet for all observed queues between 300 and 750 feet and a percent error of plus or minus

20 percent for all observed queues greater than or equal to 750 feet. As with other tests, this metric requires 85 percent of the locations to pass the intersection queue validation criteria.

Although the analyst *should* perform the queue length validation test for all models where queue lengths are a primary validation MOE, BTO-TASU realizes there are potential issues with using queue length as a validation metric including, but not limited to:

- Queue lengths are generally unstable and can fluctuate significantly from one moment to the next, thus the queues observed in the field may not reflect the queues that were present during the time of the turning movement count.
- There is no standard procedure for measuring the length of queue. Queues could include only stopped vehicles or they could include stopped and slow moving (less than 5 mph) vehicles.
- Each microsimulation analysis tool has its own proprietary methodology for reporting on queue lengths, so there is a lack of consistency.

As such, the Tier 2 (local) queue validation test is non-binding, in that failure to meet the queue validation thresholds alone will not necessarily require further calibration and validation of the model. If the model is unable to satisfy the queue validation thresholds outlined in Table 8.3, the analyst **shall** consult with WisDOT regional traffic staff to assess the need for further model calibration. This coordination **shall** occur prior to finalizing the modeling methodology report or proceeding with the development of additional modeling scenarios. Contact BTO-TASU (DOTTrafficAnalysisModeling@dot.wi.gov) for additional support or guidance as needed.

Conduct the Tier 2 queue validation tests by direction for every model run. The analyst *should* conduct the queue validation for the finest resolution that is feasible, with practical bounds from 15 minutes up to one hour. BTO-TASU realizes that using sub-hourly time periods for validation may not be practical (e.g., data is unavailable at the sub-hourly level, the additional value does not justify the added level of effort required, etc.). Consider the queue validation test satisfied if the model passes the tests at the hourly level. Ideally, however, if using sub-hourly data, strive to satisfy the queue validation test at the sub-hourly level.

Summarize and document the results of the queue validation tests. Include a copy of the queue validation tests as an attachment to the modeling methodology report and submit to the regional office for review and comment. The regional office will involve BTO-TASU in the review as appropriate. For sample formats or questions on the queue validation test, contact BTO-TASU (DOTTrafficAnalysisModeling@dot.wi.gov).

8.4.5 Lane Utilization

Refer to TEOpS 16-20-3 to identify whether to apply the Tier 2 (local) lane utilization validation test. Other agencies (such as Oregon DOT, Minnesota DOT, and Washington DOT) use their traffic volume validation criteria and a comparison of modeled and observed lane utilization percentages. Comparable to the criteria used by Oregon DOT, Minnesota DOT, and Washington DOT, the acceptance criterion for lane utilization is a RNSE of less than 3.0 for greater than 85 percent of data points (see Table 8.3). The data points chosen for the lane utilization validation *should* represent those locations where lane usage is critical for the operations of the facility (e.g., weaving areas, upstream of lane drops, etc.).

Although BTO-TASU encourages the analyst to perform the quantitative lane utilization validation test for areas where lane usage has a considerable influence on operations, BTO-TASU acknowledges that data may not always be available to conduct mathematical checks on lane utilization. As such, it may be acceptable to do more of a qualitative assessment to assess that the model reasonably reflects the lane utilization observed in the field. Justify and document the use of any qualitative assessments in the modeling methodology report.

Conduct the lane utilization validation tests by direction for every model run. The analyst *should* conduct the lane utilization validation for the finest resolution that is feasible, with practical bounds from 15 minutes up to one hour. BTO-TASU realizes that using sub-hourly time periods for validation may not be practical (e.g., data is unavailable at the sub-hourly level, the additional value does not justify the added level of effort required, etc.). Consider the lane utilization validation test satisfied if the model passes the tests at the hourly level. Ideally, however, if using sub-hourly data, strive to satisfy the lane utilization validation test at the sub-hourly level.

Summarize and document the results of the lane utilization validation tests. Include a copy of the lane utilization validation tests as an attachment to the modeling methodology report and submit to the regional office for review and comment. The regional office will involve BTO-TASU in the review as appropriate. For sample formats or questions on the lane utilization validation test, contact BTO-TASU (DOTTrafficAnalysisModeling@dot.wi.gov).

8.4.6 Density

Acceptance of quantitative validation testing for density may be acceptable. To use density as a validation check for microsimulation models; the analyst **shall** obtain approval from WisDOT regional traffic staff. Contact BTO-TASU (DOTTrafficAnalysisModeling@dot.wi.gov) for additional support or guidance as needed.

8.5 Qualitative Validation Tests

The goal of the model validation process is to assure that the model is a good representation of the actual traffic conditions. This means that the model must not only meet the mathematical targets related to traffic volumes, speeds, and travel times, but must also be reasonable in terms of overall traffic patterns such as lane choice and routing. Table 8.4 provides a summary of the qualitative validation checks. The analyst **shall** perform the qualitative validation tests for all models, even those that pass the Tier 1 (global) mathematical validation thresholds. Document and justify the decisions made as they pertain to the qualitative validation tests and summarize the findings of the tests in the modeling methodology report.

Table 8.4 Qualitative Validation Tests

MOE	Criteria	Validation Acceptance Threshold
Queues	All Critical Queue Locations	Visually realistic for intersection queues. Quantitative checks required if queues are a primary validation MOE.
Bottlenecks	Replication of Real-World Bottlenecks	Visually realistic for intersection queues and freeway bottlenecks
Routing	All Routes	Represents field conditions and driver behavior. Acceptance of quantitative results require WisDOT approval.
Lane Use	All Critical Lane Utilization Locations	Visually realistic. Quantitative checks encouraged for areas where lane usage has a considerable influence on operations.
Freeway Merging	All Merge Locations	Visually realistic
Vehicle Types and Truck Percentages	All Locations	Represents field conditions.

16-20-9 Design Year Analysis — September 2019

9.1 Recommended Process

Only after calibrating and validating the existing conditions and only after completing the peer review process of the existing conditions model, *should* the analyst proceed with the development of other modeling scenarios. If the analyst chooses to develop the alternatives model prior to calibrating and validating the existing conditions model and prior to having the model go through the peer review process, they take the risk that they must go back and revise not only the alternatives model but the existing conditions model as well. This can lead to potential inconsistencies in the modeling scenarios and could result in the need for additional time to calibrate and perform the peer review(s) of the alternatives model. Although it may be tempting, especially when the project has a compressed schedule, to skip or delay the calibration, validation, or peer review process of the existing conditions model, it may end up being counterproductive and is strongly discouraged.

Refer to TEOpS 16-20-2 for additional details on the model development process, analysis scenarios, and traffic model tree.

9.1.1 Carrying Parameters Forward into Model Scenarios

Unless changes to roadway geometry or traffic conditions are expected to alter the driving behavior, the analyst *should* carry the parameters from the calibrated existing conditions model forward, without any changes, to each subsequent scenario. For example, if it is necessary to use a headway of 0.85 to reproduce the level of congestion in the existing real-world network during the AM peak hour, then the analyst *should* use the same 0.85 headway value for the AM peak hour model in the design year.

Document and justify the rationale for modifying any of the existing conditions parameters. Where possible, associate any modification to the existing conditions parameters to changes in geometric conditions that may influence driving behavior (e.g., the design year build alternative lengthens the weaving area resulting in the need for drivers to be less aggressive thus increasing the headway).

9.1.2 Validation of Design Year Models

The only mathematical validation test that is applicable for design year models is the volume validation (both Tier 1 and Tier 2) tests. When conducting the volume validation tests (see Table 8.1) for the design year models, the analyst *should* compare the modeled volumes (i.e., output from the microsimulation model) to the appropriate design year traffic forecasts. Due to future congestion, the microsimulation model may not be able to sufficiently capture the true design year traffic demand within the analysis period, specifically for the no-build or FEC conditions. Under this scenario, the analyst *should* run the model with only the traffic demand for the analysis period (e.g., do not include the demand from the warm-up or cool-down periods) until all vehicles have exited the network, thereby capturing the full demand reflected in the design year traffic forecasts. Apply the volume validation tests (typically for each one-hour period) to both the seed matrix (full demand, no warm-up or cool-down) and analysis period matrix (includes warm-up, analysis period, and cool-down periods) runs. Running the model with the seed matrix allows the analyst to validate that the peak period demand matrix, when isolated, is sound.

Given the context within which quantitative checks on MOEs (specifically travel speeds, travel times, queue lengths, and lane utilization) are conducted for the design year models, the validation tests for the MOEs for design year models consist of a visual check of the traffic model for reasonableness. Additionally, the analyst *should* perform the qualitative validation tests as summarized in Table 8.4 as appropriate.

In addition to the visual and qualitative tests, the analyst *should* compare the travel times, travel speeds, and queue results from the design year model to existing conditions data to assess whether the relative increase/decrease in each MOE between the scenarios is reasonable.

Conduct the quantitative volume validation tests and qualitative/visual checks by direction for each 15-minute analysis period for every model run. Summarize and document the results of the quantitative volume validation tests and qualitative/visual checks for the average of all (valid) runs. Include a copy the volume validations tests as an attachment to the modeling methodology report and submit to the regional office for review and comment. The regional office will involve BTO-TASU in the review as appropriate. For sample formats or questions on the design year volume validation test, contact BTO-TASU (DOTTrafficAnalysisModeling@dot.wi.gov).

9.2 Traffic Volume Development

Work with the WisDOT regional traffic staff and WisDOT-TFS to develop the forecasts for the design year. Chapter 9 of the WisDOT *Transportation Planning Manual* provides details on the process for obtaining and developing traffic forecasts.

The forecasts developed by WisDOT-TFS typically provide forecasts for the annual average daily traffic (AADT) and peak-hour intersection turning movement volumes (if requested). The microsimulation models, however, often require the use of O-D matrix tables in addition to or instead of turning movement volumes and typically need to capture 15-minute profiles for the warm-up, analysis, and cool-down periods. Further, microsimulation models require the use of a balanced volume data set, and oftentimes the traffic forecasts will reflect unbalanced volumes. Thus, in most cases, it will not be possible to enter the forecasts into the microsimulation model directly as provided by WisDOT-TFS.

Document the methodology used to develop and modify the forecasts for use in the microsimulation models in the Traffic Forecasting Methodology Report and submit to the regional office and WisDOT-TFS for approval. WisDOT-TFS will typically provide any comments on their review of the forecasting methodology report in DT2340. The regional office will involve BTO-TASU in the review as appropriate.

9.2.1 Design Hour Volumes for Microsimulation Models

The analyst **shall** coordinate with WisDOT regional traffic staff, as well as WisDOT-Bureau of State Highway Programs (BSHP), WisDOT-TFS, BTO-TASU, and other stakeholders as appropriate, to develop design-hour volumes (DHV) for microsimulation models.

9.2.2 Origin-Destination Matrix Development for Microsimulation Models

The analyst **shall** coordinate with WisDOT regional traffic staff, as well as WisDOT-TFS, BTO-TASU, and other stakeholders as appropriate, to develop the O-D matrices for microsimulation models.

16-20-10 Documentation/Reporting/Presentation of Results — September 2019

10.1 Modeling Methodology Report

Prior to submitting the traffic model to the WisDOT regional office and other members of the peer review team (see TEOpS 16-25), document the methodology and assumptions used to develop, calibrate, and validate the traffic model. Prepare a separate modeling methodology report for each model scenario. The exact format of the modeling methodology report will vary depending on the specifics of the project; however, the content of the report *should* always include the following:

- Project background – What is the goal/purpose of the project and what is the justification for the use of microsimulation?
- Methodology/assumptions – Identify the methodology used to develop the model, being sure to note any assumptions.
- Calibration parameters – Identify and describe any user-defined parameters (i.e., note where the model includes changes to default parameters). Provide justification for the use of any localized (link-specific) calibration parameters.
- Validation summary – Summarize the findings of the validation tests. Provide the detailed validation testing results as an attachment to the report. Additionally, submit an electronic copy (preferably in Excel format) of the validation tests to the peer review team members.

Reference other reports such as the Traffic Analysis Tool Selection memo or Traffic Forecasting Methodology Report as appropriate, being sure to provide copies of any referenced documents as an attachment to the modeling methodology report.

For sample formats or questions on what to include in the modeling methodology report, contact BTO-TASU (DOTTrafficAnalysisModeling@dot.wi.gov).

10.2 Presentation or Results

It is critical to format the presentation of microsimulation results to the audience because the expectation is that managers, technical staff, public officials, and the traveling public will each have varying levels of comprehension. For example, the average transportation user may understand the impacts on roadway performance through travel times, delay, or congestion levels. If the average commute on a corridor increases from 20 minutes in a current year to 40 minutes in the future, the average user may understand how this is going to affect them. Whereas this same audience may have more difficulty understanding how future traffic conditions are going to affect them if density increases by 100%.

Typically, most audiences can understand pictures, graphical presentations, simulation videos, or screen shots that describe the results. Presentations at public meetings *should* begin by orienting the audience around the modeled scenario. Point out the basic elements of the simulation display and identify traffic conditions that will help to gain the audience's confidence in the model. Animation videos or screen shots are very powerful to display a traffic flow concept that is difficult to grasp using numerical output. For example, depending on the type of data, it may be difficult to identify the start of a freeway bottleneck using numerical output alone. It may be obvious to the analyst where the bottleneck begins but a 30-second video or series of screen shots can convey this message clearly to an audience that is unfamiliar with the model.

10.2.1 Animation Output

Use animation videos or static screen shots exclusively for qualitative assessment. The analyst *should* review the simulation model and focus on the key points of a particular scenario. Before showing the animation videos to an audience outside of the modeling development and review team, verify that the driver behavior is realistic. Most microsimulation tools now provide the option to show a 3D visualization of the model, complete with roadway infrastructure and other architectural features. While these features may help to orient the audience to the project study area, take care not to let the presentation graphics overshadow the fundamental engineering objectives of the model. Discuss the requirements for the needs and emphasis of animation output of the traffic model with the WisDOT project team during the project scoping process.

Choosing an appropriate segment of the model to display during presentations requires professional judgment and an understanding of the project's objectives. Typically, the analyst *should* consider the average condition unless the worst case is realistic and the result causes system failure.

Recording animation output minimizes the chance for software and technology issues during presentations. It is usually best to keep the recorded animation videos relatively short (a run time of 2 to 3 minutes). Overlay text on the simulation videos as appropriate to orient the audience and provide information on the model outputs.

10.2.2 Graphical and Numerical Output

Most microsimulation models can output a seemingly endless amount of data. The importance of such outputs is dependent upon the purpose of the project, operational analysis, and microsimulation model. The objective of the analyst is to focus on a few key performance measures that tell the story of how the transportation facility is operating. The analyst *should* carefully choose numerical output that best addresses the objectives of the simulation model and overall project.

Understanding the strengths of microsimulation software and knowing how the software calculates different performance measures are important aspects of the analysis process. The methods and effectiveness of each software to measure performance may require analysts to use multiple tools to provide a comprehensive evaluation of the traffic operations.

Display graphical or tabular data in a clear and concise format so the intended audience can draw conclusions without becoming overwhelmed with the amount of data. Analysts *should* consider supplementary visual cues to draw the audience's attention to the most important pieces of data. Bolding, indenting, or highlighting text with distinct colors can help to increase discrimination between the various levels of data.

Colored shading typically represents the following conditions:

Color	**Performance Level**
Green / Blue	Good
Yellow	Acceptable
Orange	Poor
Red	Failing or Severe

Analysts *should* be cognizant of common vision deficiencies when presenting results with colors. Consider using redundant visual cues instead of relying on color alone (e.g., use colors along with letters or shapes).

16-20-11 Upgrading Simulation Models — September 2019

Keeping a model relevant and useful often requires upgrading it to the latest release of the simulation software. As noted in TEOpS 16-20-4, the PTV Group typically releases major updates to the Vissim software once a year and Trafficware typically releases major updates to the Synchro/SimTraffic Studio software every two to three years. The software vendor may release minor updates, to address software bugs/errors, as often as once a month.

These releases may or may not affect a specific simulation model, but it is important to understand that no matter how small a change, any change could influence the results and validity of a model. This section will go over the questions to ask and the steps to follow when upgrading a model. The purpose of these steps is to give the analyst the information they need to assess the potential impact of upgrading the traffic model and to identify the additional work that may be necessary to re-calibrate and re-validate the traffic model. Before upgrading to a new model version, the analyst **shall** consult with the WisDOT project team and WisDOT regional traffic engineering staff. Contact BTO-TASU (DOTTrafficAnalysisModeling@dot.wi.gov) for additional support or guidance as needed. When determining whether to upgrade, be cognizant of the version of the software that the peer review team has available to them to review the models (it may not be possible to open/use one version of the software in another version).

11.1 Software Upgrades

The general goals of large-scale projects involving microsimulation models usually involve multiple project stages/phases and may take 12 months or longer to complete. During this extended timeline, a software package may go through one or more updates. These updates usually occur for one or more of the following reasons:

- Software bug or error fix
- Feature addition
- Major version release

These updates can play a critical role in the application of the software to a project and may require the need to update the model. For example, if the software vendor discovers a bug within the latest version of the software, they may release an update to address/fix the bug. Typically, the analyst *should* update the model to apply the bug fix as soon as possible. If the software update includes new or enhanced features, the modeling team may decide that the new features would benefit the project. If the benefit of adding the additional feature outweighs any potential implications (e.g., additional time/resources needed to revise the model), it may be possible to justify updating the model to apply the new features. Since major version releases of the software typically involve larger changes to the analysis methodologies, upgrading the traffic model to the latest version release may introduce problems that did not exist previously. As such, BTO-TASU encourages the analyst to hold off on upgrading the model to a later date.

11.2 When to Upgrade

In most cases, when establishing the project scope and budget, the project team assumes/expects the use of a specific version of the traffic modeling software. Thus, the project scope and budget may not be able to absorb the additional time/costs needed to upgrade the traffic model to a new release of the software.

The stage/phase of the model is the most important thing to consider when evaluating whether it is the correct time to upgrade the model to a new release of the software. The best time to upgrade a model is usually between major stages of a project.

The following list highlights scenarios when the analyst and project team may want to consider upgrading a model:

- A new project is using an older model
- There is a major break in a project schedule
- The latest update feature(s) to the software addresses a geometric element or other concern of the project that the older version of the software could not accurately capture
- The latest version update to the software addresses/fixes major bugs/errors

The following list highlights scenarios when upgrading a model might introduce problems that did not previously exist:

- Current project is almost complete
- Analyst is still using the current model to run test scenarios
- Model is very large and complex
- Newer version if not available to the peer review team

Under the above scenarios, the analyst and project team may decide to upgrade the model later or not at all. Ultimately, before upgrading the model to a new software version, the analyst **shall** consult with the WisDOT project team and WisDOT regional traffic engineering staff. Contact BTO-TASU (DOTTrafficAnalysisModeling@dot.wi.gov) for additional support or guidance as needed.

11.3 Verify Model Calibration and Validation

If the WisDOT project team, WisDOT regional traffic engineering staff, and BTO-TASU all agree that there is enough reason to convert the model to a new release/version of the software, it is often advisable for the analyst to compare the outputs/results of the key MOEs from the upgraded model to those of the original calibrated/validated model. This check *should* give the analyst an idea of how much work is necessary to get the model to the same level of validity as the previous model. A model that does not require an extensive amount of modifications following an upgrade *should* be able to provide results that are similar and close to the original model.

Depending on the software package and the extent of the software modifications, upgrading the traffic model to the newest software version/release may cause a previously calibrated/validated model to fall out of validation. Therefore, the analyst *should* verify that the model still meets the validation thresholds. The analyst *should* first conduct a high-level, qualitative, assessment of the model, focusing on the components most significantly impacted by the software upgrade, to identify where revisions to the model may be necessary. Upon completing any necessary revisions to the model, the analyst *should* verify the validity of the model by performing the quantitative and qualitative validation tests summarized in TEOpS 16-20-8.

Document the results of the validation tests, either as part of the modeling methodology report or as a separate addendum and submit to the regional office for review and comment. The regional office will involve BTO-TASU in the review as appropriate.

16-20-12 References — April 2025

1. **NSW Transport Roads & Maritime Services.** *Traffic Modelling Guidelines.* New South Wales (NSW), Australia: s.n., 2013. ISBN 978-1-922194-21-3.

2. **Federal Highway Administration.** *Traffic Analysis Toolbox Volume III: Guidelines for Applying Traffic Microsimulation Modeling Software.* 2004. FHWA-HRT-04-040.

3.**Federal Highway Administration.** *Traffic Analysis Toolbox Volume IV: Guidelines for Applying CORSIM Microsimulation Modeling Software.* 2007. FHWA-HOP-07-079.

4. **Cubic Transportation Systems.** *Synchro Studio 12 User Guide.* 2023. Published November 24, 2023.

5. **Transportation Research Board.** *Highway Capacity Manual 2010.* Washington D.C. National Academy of

Sciences, 2010. ISBN 978-0-309-16077-3.

6. **Transportation Research Board.** *Highway Capacity Manual, 7th Edition: A Guide For Multimodal Mobility Analysis.* Washington, D.C. National Academy of Sciences, 2022. ISBN 978-0-309-08766-7.

7. **Federal Highway Administration.** *Guidance on the Level of Effort Required to Conduct Traffic Analysis Using Microsimulation.* McLean, VA. Research, Development, and Technology Turner-Fairbank Highway Research Center, 2014. FHWA-HRT-13-026.

SimTraffic Calibration Settings

Last Updated: 11-27-2017

Type of Setting	Parameter Grouping	Parameter Name	Default Settings (per SimTraffic v. 10.1.1.1)	Recommended Parameter Value	Typical Parameters Adjusted During Calibration	Parameter Description
GLOBAL SETTINGS (Adjusted within SimTraffic)	***Driver Parameters***	Yellow Deceleration (ft/s^2)	7.0 - 12.0	8 to 10	Yes	Increase to make drivers less prone to running red lights.
		Speed Factor (%)	0.85 - 1.15	No range specified	Yes	Can be changed to increase or decrease the range of driver speeds (e.g. for a link speed of 50 mph and a speed factor of 1.1, the driver will attempt to maintain a speed of 55 mph).
		Courtesy Deceleration (ft/s^2)	3.0 - 10.0	7 to 9	Yes	Amount of deceleration a vehicle will accept in order to allow a vehicle ahead to make a mandatory lane change. Higher value = more courteous driver.
		Yellow Reaction Time (s)	0.7 - 1.7	No range specified	No	Amount of time it takes a driver to respond to a signal changing to yellow. More aggressive drivers will have a longer reaction time to yellow lights. Longer reaction times tends to reduce red light running for higher speed approaches and vehicles slowing to make a turn, however, may increase red light running for low speed approaches.
		Green Reaction Time (s)	0.2 - 0.8	0.5 to 2.0	Yes	Amount of time it takes the driver to respond to a signal changing green. More aggressive drivers will have a shorter reaction time to green lights.
		Headway at 0 mph (s)	0.35 - 0.65	No range specified	Yes, typically modify last	Interpolation used between these factors. May be necessary to change to match local driver parameters. The default headways provide an Saturation Flow Rate similar to the HCM (1900 vphpl) from 25 to 50 mph.
		Headway at 20 mph (s)	0.80 - 1.80	2 to 2.5		
		Headway at 50 mph (s)	1.00 - 2.20	1.7 to 2.0		
		Headway at 80 mph (s)	1.00 - 2.20	2.0 to 2.5		
		Gap Acceptance Factor	0.85 - 1.15	No range specified	Yes	Gap vehicles will accept at unsignalized intersections, for permitted left-turns, and for right turns on red. Higher values represent more conservative drivers.
		Positioning Advantage (veh)	1.2 - 15.0	Use defaults	No	Drivers will make a positioning lane change when there is $\geq x$ vehicles ahead in the target lane than in the current lane. Higher values are associated with more conservative drivers and cause drivers to line up in correct lane. Lowe values are associated with aggressive drivers and cause drivers to avoid lining up in the correct lane until reaching the mandatory lane change point.
		Optional Advantage (veh)	0.5 - 2.3	Use defaults	No	Drivers will make a desired lane change when $\leq x$ vehicles are ahead in the target lane than in the current lane. Higher values are associated with more conservative drivers and cause drivers to have unbalanced lane use. Lower values are associated with aggressive drivers and cause drivers to use lanes evenly.
		Mandatory Distance Adjustment (%)	50 - 200	No range specified	Yes	Global multiplier for local lane change settings.
		Positioning Distance Adjustment (%)	60 - 150	No range specified	Yes	Global multiplier for local lane change settings.
		Average Lane Change Time (s)	10 - 55	No range specified	No	Average time between lane change maneuvers. Applies only to optional lane changes, which are made to choose a lane with less congestion. Less time applies to more aggressive drivers.
		Lane Change Variance +/- (%)	10 - 30	No range specified	No	Adjustment similar to Average Lane Change Time, but base on driver type. Applies only to optional lane changes, which are made to choose a lane with less congestion. Higher percentage leads to increased awareness of lane change.
	Vehicle Parameters	Vehicle parameters (Occurrence, acceleration, dimensions, etc.)	See Synchro Studio 10 User Guide, Chapter 26 (page 26-7)	Defaults typically acceptable Modify vehicle fleet based on field classification counts if needed	Yes	Modify vehicle percentages based on nearest classification count. Fleet mix should add up to 100% for all truck types and 100% for all car types.

SimTraffic Calibration Settings

Last Updated: 11-27-2017

Type of Setting	Parameter Grouping	Parameter Name	Default Settings (per SimTraffic v. 10.1.1.1)	Recommended Parameter Value	Typical Parameters Adjusted During Calibration	Parameter Description
LOCAL SETTINGS (Adjusted within Synchro)	***Synchro Settings***	Link Speed (Lane Settings)	30	Start with posted. Adjust to reflect free flow speed (typically posted + 5 mph), if needed.	Yes	May be adjusted to match field speeds if data is available and speeds are not being used for validation
		Ideal Saturation Flow Rate (Lane Settings)	1,900	Adjust to match field if field data is available	Yes	Refer to TEOpS 16-15-5 for additional guidance on saturation flow rates for through lanes
		Growth Factor (Volume Settings)	1.0	Use for sensitivity testing or future year scenarios. Do not use for RTOR	No	
		Headway Factor (Simulation Settings)	1.0	0.8 to 1.2	Yes	Can be set on a per-movement basis. Can be used to calibrate the Saturated Flow Rates.
		Turning Speed (Simulation Settings)	9 mph (right-turns) 15 mph (left-turns)	Right turns = 12 to 15 mph	Yes	Default speeds are set for small radius urban intersections. With large suburban intersections, turning speeds may be significantly higher. Right-turns speeds need to be adjusted to or near the freeway speeds when simulating entrance ramps. At low speeds, the Saturated Flow Rate is highly sensitive to small changes in speed. Right-turns: SimTraffic = 9 mph (1545 vph). HCM for protected rights = 1615 vphpl Left-turns: SimTraffic = 15 mph (1883 vph). HCM for protected left-turns = 1805 vph.
		Mandatory Distance (Simulation Settings)	333	Base on field conditions	Yes	Distance ahead vehicle is forced to make lane change. Measured from Stop bar. Increase to allow vehicles to shift into correct lane earlier. Decrease to allow vehicles to shift into lane at the last possible moment. Large cities: Shorter mandatory distances Small towns: Longer mandatory distances. Useful to adjust with congested signals or lane drops after signals. With long turn bays consider setting this to less than the storage distance to allow for some late lane changes.
		Positioning Distance (Simulation Settings)	1320	Base on field conditions	Yes	Distance ahead vehicle starts to attempt lane change. Measured from Stop bar.
		Mandatory Distance2 (Simulation Settings)	880	Base on field conditions	Yes	Additional mandatory distance to make 2 lane changes. Measured from Stop bar. Typically used more for high-speed facilities. See Synchro Studio 10 User Guide, Chapter 28 (pages 28-5 to 28-18)
		Positioning Distance2 (Simulation Settings)	1760	Base on field conditions	Yes	Additional positioning distance to make 2 lane changes. Measured from Stop bar. Typically used more for high-speed facilities. See Synchro Studio 10 User Guide, Chapter 28 (pages 28-5 to 28-18)
		Lane Alignment (Simulation Settings)	Right for right-turns Left for left-turns and thru movements Right-NA for U-turns	Base on field conditions	Yes	
		Enter Blocked Intersection (Simulation Settings)	"No" for intersections	Code 1 vehicle if used Yes for driveways No for high speed movements	Yes	Enter "No" for high speed approaches and movements. "Yes" can help capacity of driveways. In general, controls gridlock avoidance.
		Taper Length (Simulation Settings)	25	Code as part of storage based on field conditions	Yes	Impacts when vehicles can start entering the storage.

Paramics Calibration Settings

Last Updated: 08-31-2017

Type of Setting	Parameter Grouping	Parameter Name	Default Settings (per Paramics v. 6.9.3)	Recommended Parameter Value	Typical Parameters Adjusted During Calibration	Parameter Description
GLOBAL SETTINGS	***Core Settings***	Time steps	2	2 to 4, Typically 4 for models with freeway merging	Yes	Higher Time Step allows vehicles to make decisions based on the car following and lane change logic at a higher frequency.
		Queue gap distance (ft)	32.81	Typically not modified	No	Maximum distance between queuing vehicles.
		Queuing speed (mph)	4.47	Typically not modified	No	Maximum speed of queuing vehicles.
		Heavy vehicles weight (ton)	2.95	Typically not modified	No	Minimum weight of a heavy vehicle.
		Mean target headway (s)	1.00	Urban areas: 0.85 to 0.90 Small Cities: 0.90 to 0.95 Rural areas: 0.95 to 1.00	Yes	Raise to increase distance between vehicles and represent more passive drivers. Lower to decrease distance between vehicles and represent more aggressive drivers.
		Mean driver reaction time (s)	1.00	Urban areas: 0.85 to 0.90 Small Cities: 0.90 to 0.95 Rural areas: 0.95 to 1.00	Yes	Value is associated with the lag in time between a change in speed of the preceding vehicle and the following vehicle's reaction to this change. Raise for more passive drivers. Lower for more aggressive drivers.
		Speed memory	3	1.5x the Time steps value	Yes, if time step value is changed.	Speed Memory is used to store previous vehicle speeds at each Time Step. Speed Memory x time step should be > than the global Driver Reaction Time.
		Minimum gap (ft)	6.56	Typically not modified	No	Minimum gap between stationary vehicles in a queue.
		Loop length (ft)	6.56	Typically not modified on global level	No	Default distance between upstream and downstream edges of a loop detector (2 meters). Detector lengths may be modified locally as well.
		Amber time (s)	3	Typically not modified on global level	No	Default yellow time included in traffic signal phases. This setting should be modified locally based on field signal timing and phasing settings.
		Red time (s)	5	Typically not modified on global level	No	Default red time included in traffic signal phases. This setting should be modified locally based on field signal timing and phasing settings.
		Default curve speed factor	1	Typically not modified	No	Allows vehicles to make turns at a safe speed. Typically not modified.
		Speed drift unit	5	Typically not modified	No	Specifies minimum number of units that the link speed can be altered by in the Link Editor. Typically not modified.
		Wrong lane diversion time (s)	300	Typically not modified	No	Additional cost a vehicle would tolerate in order to reach its destination by choosing an alternative route. Only applies to links that have the "re-route stuck vehicles" flag enabled.
	Assignment Settings	Assignment settings-Time Cost Coefficient	1.000	0.667	Yes, change from default in initial network setup.	Coefficient that defines how travel time affects routing for all vehicles in the network.
		Assignment settings-Distance Cost Coefficient	0.000	0.333	Yes, change from default in initial network setup.	Coefficient that defines how distance affects routing for all vehicles in the network.
		Assignment settings-Toll Price Cost Coefficient	0.000	0	Only if tolling applies. Should be based on prevailing wage rate in the study area.	Coefficient that defines how toll pricing affects routing for all vehicles in the network.
		Assignment settings-Dynamic Assignment: Feedback Period	0	Start with 5 minute feedback period	Yes, change in small increments	Sets period at which link times are fed back into the routing calculations. At the beginning of each feedback period route cost tables are calculated for each viable network node to each destination zone.
		Assignment settings-Dynamic Assignment: Feedback Smoothing	0.500	Adjust to reflect field conditions	Yes, change in small increments	Determines the percentage of historical data to be included in the routing table calculations. The lower the value the more emphasis is placed on historic data.
		Assignment settings-Dynamic Assignment: Feedback Decay	0.995	0.3 to 0.5	Yes, change in small increments	Reduces dynamic feedback costs over time if there is no new data to make new calculations with. This avoids having a rapid oscillation in costs.
		Assignment settings-Dynamic Assignment: Feedback Envelope	0	Adjust to reflect field conditions	Yes, change in small increments	Defines how delay at a distance from a vehicle affects routing decisions. The further away a delay value is from the driver's position, the less weight the driver applies to their route choice decision.
		Assignment settings-Matrix Tuning Level	None	Typically not modified	No	Modifies the demand distribution during simulation. For large networks there is a performance penalty with selection this option.
	Other Parameters	Other parameters-Vehicle types (proportion, familiarity, kinematics, dimensions, etc.)	-	Use Wisconsin-tailored vehicles file. Adjust vehicle type proportions to represent field conditions if possible.	Yes	Adjust to reflect vehicle proportions observed in the field.
		Other parameters-Other global parameters (options menu, etc.)	-	1) Check "Heavies Use All Lanes" 2) TWOPAS HGV climbing model 3) Gap reduction for stopped buses	1) Always check "Heavies Use All Lanes" 2) TWOPAS HGV climbing model use is project specific. 3) Gap reduction for stopped buses use is project specific	1) Allows heavy vehicles (i.e. trucks) to drive in all lanes. WI does not require trucks to stay in right lane. 2) TWOPAS HGV climbing model allows for grades coded in model to affect truck kinematics. Additional effort in coding grades accurately and correctly is needed. 3) Gap reduction for stopped buses should only be used in special-case scenarios where pick ups and drop offs are being modeled.

Paramics Calibration Settings

Last Updated: 08-31-2017

Type of Setting	Parameter Grouping	Parameter Name	Default Settings (per Paramics v. 6.9.3)	Recommended Parameter Value	Typical Parameters Adjusted During Calibration	Parameter Description
LOCAL SETTINGS	Link Parameters	Link Speed	Varies, set by link category	Use field data to code links speeds. If field data is not available, code link speed as posted speed	Yes, changes that stray from posted speed limit should be based on field data.	Drivers typically drive 10% over the posted speed limit in uncongested conditions. Link speed may need to be adjusted to reflect observed travel speeds.
		Link Signpost and Signrange	Varies, set by link category	Base on field conditions. Allow signpost to enter zone on freeways.	Yes	Controls how and when vehicles move to the correct lane upstream of a hazard. Propagation of signposting can be used for widening hazards.
		Link Force Merge	unchecked	Lower priority use	Yes, use sparingly	For links with priority other than major, drivers that have exceeded their patience threshold will force their way into the flow of traffic as long as a conflicting vehicle is not in the driver's path.
		Link Force Across	unchecked	Lower priority use	Yes, use sparingly	For links with priority other than major, drivers that have exceeded their patience threshold will force their way across traffic to join any desired traffic stream as long as a conflicting vehicle is not in the driver's path.
		Link Force Vehicle Aware	unchecked	Could be adjusted if applicable	Yes, if applicable	Used in shared-space pedestrian applications. Can be used to improve the quality of vehicle/pedestrian interaction logic by forcing all vehicles to be aware of pedestrians.
		Link Reaction factor	1.00	Lower priority use, small adjustments only	Yes, use sparingly	Value is associated with the lag in time between a change in speed of the preceding vehicle and the following vehicle's reaction to this change. Raise for more passive drivers. Lower for more aggressive drivers.
		Link Headway factor	1.00	Lower priority use, small adjustments only	Yes, use sparingly	Raise to increase distance between vehicles and represent more passive drivers. Lower to decrease distance between vehicles and represent more aggressive drivers.
		Link Approach Visibility	Normal Link = 0 Roundabout approach = 32.8	Important for roundabouts. Can be used with other unsignalized control.	Yes, typically adjusted with roundabouts.	Aids in vehicles identifying gaps at an unsignalized intersection approach. Important for roundabout calibration.
		Link Stimulus Time	5	Typically not modified based on survey results	No	Lower value results in faster decision time for lane change
		Link Transition Time	5	Typically not modified based on survey results	No	Lower value results in faster lane changing maneuver
		Category Cost Factors	0.8 to 1.0	Typically not modified from defaults	No	Aids in routing control for unfamiliar drivers
		Link Cost Factor	1.00	Adjust as needed to correct local routing issues.	Yes	Aids in routing control for all drivers
	Node Parameters	Node parameters-Allow sneaking	Unchecked	Could be used at congested intersections	Yes	Applies only when multiple vehicles are waiting to transfer to the same outbound link. Allows blocked vehicles to perform their movement before other vehicles of a higher priority. Could be used to reduce queue lengths and simulate more aggressive driving behavior.
		Node parameters-Anticipate gaps	Unchecked	Could be used at congested intersections	Yes	By default vehicles wait for crossing vehicles to complete clear a node before completing their turning movement. This option allows vehicles to complete turning movement once the driver's path across the node is cleared. Could be used to reduce queue lengths and simulate more aggressive driving behavior.
		Turning Penalties	1.00	No range specified	No	Aids in routing control for all drivers
	Entrance Ramp Parameters	Entrance ramp settings-Minimum Ramp Time (s)	2	0 to 2 Typically 1	Yes	Specifies amount of time vehicles must spend on the ramp prior to considering merging maneuver. Use 0 seconds as last resort after modifying headway, ramp aware, or other parameters to calibrate entrance ramp. Use of 0 seconds may be necessary with high volume merges and/or freeway segments.
		Entrance ramp settings-Headway Factor	1.00	0.80 to 1.00	Yes	Target headway for all vehicles on the entrance ramp. Raise to increase distance between vehicles and represent more passive drivers. Lower to decrease distance between vehicles and represent more aggressive drivers.
		Entrance ramp settings-Ramp Aware Distance (ft)	656.2	Modify on case-by-case basis depending on field conditions (topography, visibility of onramp, signing, etc.) and driver behavior or courtesy in study area	Yes	Defines point at which vehicles on the mainline become aware of the entrance ramp. Mainline drivers will only change lanes to allow for merging gaps and will not decelerate or accelerate to create gaps.
	Other Parameters	Other parameters-Gap Acceptance Rules	-	Lower priority use	Yes	Estimation of the minimum time required to clear the theoretical collision point with oncoming vehicles. If time is less than estimation, the driver will complete their movement. Typically used to calibrate queues at unsignalized intersections.
		Other parameters-Variable Speed Limit Rules	-	Typically not modified	No	Controls the speed limit on a route over a set timeframe. Transition times can be specified to avoid abrupt changes.
		Other parameters-Dynamic Tolling Rules	-	Typically not modified	No	May be used in HOT analysis.
		Other parameters-Spatial Test Transfer Rules (Merge or Crossing)	-	Could be used	Yes, typically with roundabouts or short links	Aids in gap acceptance. Generally used with roundabouts or areas with short links.
		Other parameters-Spatial Test Movement Rules	-	Could be used	Yes, typically with roundabouts or short links	Aids in gap acceptance. Generally used with roundabouts or areas with short links.

VISSIM Calibration Settings

Last Updated: 03-30-21
Source: PTV Vissim 2020 User Manual

Type of Setting	Parameter Grouping	Parameter Name	Default Settings (per Vissim v. 2020.00-11)	Recommended Parameter Range	Typical Parameters Adjusted during Calibration	Parameter Description
GLOBAL	*Simulation Settings*	Simulation resolution; Time steps (seconds)/Simulation second	10.00	5 to 10	Yes	The simulation resolution has an impact on the behavior of vehicles, pedestrians, and the way they interact. A higher simulation resolution allows vehicles to make decisions based on the car following and lane change logic at a higher frequency.
		Simulation Speed, Simulation second/second	10	Value 1.0: the simulation is run in real-time Value 2.0: The simulation is run at double real-time speed, etc. Maximum option: Runs the simulation at the maximum speed	No	Corresponds to a time lapse factor. It indicates simulation seconds per real-time second. The simulation speed does not affect the simulation results. The simulation speed can be changed during the simulation run.
	Traffic Settings	Vehicle Composition (Veh Type; DesSpeedDistr; RelFlow)	100: Car, 50:50 km/h, 0.980 200: Car, 50:50 km/h, 0.020	Adjust to represent field conditions	Yes	Adjust relativeflows to represent field conditions
		Pedestrian Composition (Ped Type; DesSpeedDistr; RelFlow)	100: Man, 1022:IMO-M 30-50, 1.000 Woman 1023:IMO-F 30-50, 1.000	Adjust to represent field conditions	Yes	Adjust relative flows to represent field conditions
	Base Settings	Vehicle Fleet		Use "WisDOT Defaults inpx" as default	Yes	Adjust to represent field conditions
		Vehicle/Pedestrian Types	Car, HGV, Bus, Tram, Pedestrian, Bike	Adjust to represent field conditions	Yes	Vehicle/pedestrian type allows you to form a group of vehicles/pedestrians with the same technical driving/walking characteristics
		Vehicle/Pedestrian Classes	Car, HGV, Bus, Tram, Bike Man, Bike Woman, Man, Woman, Woman & Child, Wheelchair	Typically separate into passenger cars and heavy trucks, but may use any of the FHWA 13 vehicle classes	Yes	By default, the data for all vehicle and pedestrian classes is entered together, but you can show the data for certain vehicle classes and/or pedestrian classes separately in the evaluation.
		Functions (Maximum and Desired Acceleration/Deceleration)	-	Use "WisDOT Defaults inpx" as default	No	Impacts how fast or slow a vehicle will accelerate/decelerate. Generally more critical on steeper grades.
		Distributions (vehicle characteristics, function and distribution)	-	2D/3D Model - Use "WIsDOT Defaults inpx" as default, adjust to match field conditions as appropriate	Yes	Allows you to define the specific vehicles (Volkswagen Golf, Audi A4, etc.) that are included in the vehicle fleet.
		Vehicle Characteristics function and distribution		Speed Distribution: left turn 12.4 to 18.6 mph; right-turn 7.5 to 15.5 mph		Adjust to represent field conditions
LOCAL	*Car Following*	Look ahead distance min. (feet)	0.00	Typically not modified	No	Minimum distance that a vehicle can see forward in order to react to other vehicles either in front or to the side of it (within the same link). The minimum look-ahead distance is important when modeling lateral vehicle behavior. If several vehicle can overtake within a lane, this value needs to be greater than 0.00. If several vehicles can overtake within a lane, you can enter a greater look ahead distance to prevent any vehicle from running a red light (when doing so, do not change the number or **Observed vehicles** as this can lead to unrealistic simulation).
		Look ahead distance max. (feet)	820.21	Typically not modified	No	Maximum distance that a vehicle can see forward in order to react to other vehicles either in front or to the side of it (within the same link). May want to extend if modeling rail traffic with block signals.
		Look ahead distance. Observed vehicles	Arterial: 4 Freeway: 2	4	Yes	The number of observed vehicles or number of certain network objects affects how well vehicles in the link can predict other vehicles' movements and react accordingly. Higher value means vehicles can better react to multiple network objects in the network
		Look back distance min. (feet)	0.00	Typically not modified	No	Defines the minimum distance that a vehicle can see backwards in order to react to other vehicles behind (within the same link). The minimum look-back distance is important when modeling lateral vehicle behavior. If several vehicles can overtake with a lane, this value needs to be greater than 0.00. This way you make sure the cars drive in an orderly fashion when two or more vehicles, than specified in the **Observed vehicles** attribute, on the same route want to position themselves at a stop line. This applies in particular to bicycles.
		Look back distance max. (feet)	492.13	Typically not modified	No	Defines the maximum distance that a vehicle can see backwards in order to react to other vehicles behind (within the same link). You can reduce the maximum look-back distance in close-meshed networks (e.g., many connectors over a short distance). This may positively affect the simulation speed.
		Temporary lack of attention duration (s)	0.00	0.00 to 1.00	No	The period of time when vehicles may not react to a preceding vehicle (they do react, however, to emergency braking). With increasing values, the capacity of the affected links decreases.
		Temporary lack of attention probability	0%	0 to 5%	No	Frequency of the lack of attention. With increasing values, the capacity of the affected links decreases.
		Smooth closeup behavior	Selected	Typically not modified	No	If this option **is** checked, vehicles slow down more evenly when approaching a stationary obstacle. If this option **is not** selected, the following vehicle uses the normal following behavior until the speed of the preceding vehicle drops to less than 3.28 feet/second and it comes almost to a halt. The later approach behavior can include a temporary acceleration.
		Standstill distance for static obstacles	Not Selected, 1.64 ft if selected	Typically not modified	No	Standstill distance upstream of static obstacles such as signal heads, stop signs PT stops, priority rules, conflict areas. Not valid for stop signs in parking lots. The attribute **Smooth closeup behavior** must be selected. If this option is not selected, the vehicles us a normally distributed random value [0.5;0.15]. If this option is selected, the vehicles will use the given value.
	Wiedemann 74 Car following model (applicable for arterials)	Wiedemann 74-Average standstill distance (feet)	6.56 ft	3.28 to 9.84 ft.	Yes	Defines the average desired distance between two cars. Higher value means larger standstill distance and lower capacity
		Wiedemann 74-Additive part of safety distance	2.00	1 to 3.75 ft	Yes	Value used for the computation of the desired safety distance. Higher value means larger standstill distance and lower capacity
		Wiedemann 74-Multiplic. Part of safety distance	3.00	2 to 4.75 ft	Yes	Value used for the computation of the desired safety distance. Greater value equals greater distribution (standard deviation) of safety distance. Higher value means larger standstill distance and lower capacity

VISSIM Calibration Settings

Last Updated: 03-30-21
Source: PTV Vissim 2020 User Manual

Type of Setting	Parameter Grouping	Parameter Name		Default Settings (per Vissim v. 2020.00-11)	Recommended Parameter Range	Typical Parameters Adjusted during Calibration	Parameter Description
LOCAL (CONT)	*Car Following (Cont)*	*Wiedemann 99 Car following model (applicable for freeway/highway)*	Wiedemann 99-CC0 (Standstill Distance) (feet)	4.92 ft	Basic segment: 4.0 to 5.5 Weaving/Merge/Diverge: >4.92	Yes	The average desired standstill distance between two vehicles, it has no variation. Higher value means larger standstill distance and lower capacity
			Wiedemann 99-CC1 (Headway Time) (s)	0.90	Basic segment: 0.7 to 3.0 Weaving/Merge/Diverge: 0.9 to 3.0	Yes	Time distribution of speed-dependent part of desired safety distance. Higher value means more cautious driver and lower capacity
			Wiedemann 99-CC2 ('Following' Variation) (feet)	13.12 ft	Basic segment: 6.56 to 22.97 Weaving/Merge/Diverge: 13.12 to 39.37	Yes	Restricts the distance difference (longitudinal oscillation) or how much more distance than the desired safety distance a driver allows before he intentionally moves closer to the car in front. Higher value means more cautious driver and lower capacity
			Wiedemann 99-CC3 (Threshold for Entering 'Following')	-8.00	Typically not modified	No	It controls the start of the deceleration process (i.e., the number of seconds before reaching the safety distance.) At this stage the driver recognizes a preceding slower vehicle.
			Wiedemann 99-CC4 (Negative 'Following' Threshold)	-0.35	Typically not modified	No	Defines negative speed difference during the following process. Low values result in a more sensitive driver reaction to the acceleration or deceleration of the preceding vehicle.
			Wiedemann 99-CC5 (Positive 'Following' Threshold)	0.35	Typically not modified	No	Defines positive speed difference during the following process. Low values result in a more sensitive driver reaction to the acceleration or deceleration of the preceding vehicle.
			Wiedemann 99-CC6 (Speed dependency of Oscillation)	11.44	Typically not modified	No	Influence of distance on speed oscillation while in the following process. If the value is 0, the speed oscillation is independent of the distance. Larger values lead to a greater speed oscillation with increasing distance.
			Wiedemann 99-CC7 (Oscillation Acceleration) (ft/s^2)	0.82 ft/s^2	Typically not modified	No	Oscillation during acceleration
			Wiedemann 99-CC8 (Standstill Acceleration) (ft/s^2)	11.48 ft/s2	Typically not modified	No	Desired acceleration when starting from standstill (limited by maximum acceleration defined within the acceleration curves).
			Wiedemann 99-CC9 (Acceleration with 50 mph) (ft/s^2)	4.92 ft/s2	Typically not modified	No	Desired acceleration when starting at 80 km/h, approximately 50 mph, (limited by maximum acceleration defined within the acceleration curves).
	Lane Change	General behavior		Free lane selection	Free lane selection or Slow lane rule	No	Free lane selection: vehicles may overtake on each lane Slow lane rule: allows overtaking on freeways or similar links according to the rules in road traffic Regardless of option selected, you can model the general behavior more realistically using the settings under Cooperative lane change
		Maximum deceleration - Own (ft/s^2)		-13.12 ft/s2	-15 to -12	Yes	Upper bound of deceleration for own vehicle. Higher absolute value means more aggressive lane changing behaviors
		-1 ft/s2 per distance - Own (feet)		Arterial: 100 Freeway: 200	100 to 250	No	This reduces the **Maximum deceleration** with increasing distance from the emergency stop distance linearly by this value down to the **Accepted deceleration**.
		Accepted deceleration - Own (ft/s^2)		-3.28	-2.5 to -4	No	Lower bound of deceleration for own vehicle for a lane change
		Maximum deceleration - Trailing (ft/s^2)		-9.84 ft/s2	-12 to -8	No	Upper bound of deceleration for trailing vehicle. Higher absolute value means more aggressive lane changing behaviors
		-1 ft/s2 per distance - Trailing (feet)		Arterial: 100 Freeway: 200	50 to 250	No	This reduces the **Maximum deceleration** with increasing distance from the emergency stop distance linearly by this value down to the **Accepted deceleration**.
		Accepted deceleration -Trailing (ft/s^2)		Arterial: -3.28 Freeway: -1.64	-1.5 to -2.5	No	Lower bound of deceleration for trailing vehicle for a lane change
		Waiting time before diffusion (s)		60.00	99999.00	Yes	The maximum amount of time a vehicle can wait at the emergency stop distance for a necessary change of lanes. When this time is reached, the vehicle is removed from the network. Higher value means more tolerance on vehicles waiting at the emergency stop distance for necessary lane changes.
		Min. headway (front/rear), (ft)		1.64	1.5 to 6	No	The minimum distance between two vehicles that must be available after a lane change, so that the change can take place. A lane change during normal traffic flow might require a greater minimum distance between vehicles in order to maintain the speed-dependent safety distance.
		To slower lane if collision time is above (s)		11.00	0 to 0.5	No	Defines the minimum distance to a vehicle in front, in seconds, which must be present on the slower lane, so that an overtaking vehicle switches to the slower lane. Only applicable for **Slow lane rule** or **Fast lane rule**.
		Safety distance reduction factor		0.60	0.1 to 1.0	No	This factor is taken into account for each lane change. During the lane change, Vissim reduces the safety distance to the value that results from the following multiplication: **Original safety distance * safety distance reduction factor.** The default value of 0.6 reduces the safety distance by 40%. Once a lane change is completed, the original safety distance is taken into account again.
		Maximum deceleration for cooperative braking (ft/s^2)		-9.84	-32.3 to -3	No	Specifies to what extent the trailing vehicle is braking cooperatively, so as to allow a preceding vehicle to change lanes into the same lane they are traveling in. The higher the value, the stronger the braking and the greater the probability of changing lanes.
		Overtake reduced speed areas		Not Selected	Typically not modified	No	If this option is selected, vehicles immediately upstream of a reduced speed area may perform a free lane change. The vehicle will acknowledge any reduced speed area of the lane they changed into and adjust their speed accordingly. If the option is not selected (default), vehicles never start a free lane change directly upstream of a reduced speed area and they completely ignore the reduced speed areas on the new lane.
		Advanced merging		Selected	Adjust to match field conditions	Yes	If this option is selected, more vehicles can change lanes earlier, therefore capacity increases
		Vehicle routing decisions look ahead		Selected	Typically not modified	No	If this option is selected, vehicles leaving the route identify new routing decisions on the same link in advance and take them into account when choosing the lane. For routing decisions further downstream that vehicles should identify in advance, the option **Combine static routing decisions** (under "Attributes of static vehicle routing decisions) must be selected.

VISSIM Calibration Settings

Last Updated: 03-30-21
Source: PTV Vissim 2020 User Manual

Type of Setting	Parameter Grouping	Parameter Name		Default Settings (per Vissim v. 2020.00-11)	Recommended Parameter Range	Typical Parameters Adjusted during Calibration	Parameter Description
LOCAL (CONT)	*Lane Change (Cont)*	Cooperative lane change		Not Selected	Adjust to match field conditions	Yes	If this option is selected, trailing vehicles will make necessary lane change to facilitate the lane change of a leading vehicle
		> Maximum speed difference (mph)		6.71	Typically not modified	No	Applicable only if **Cooperative lane change** has been selected. Identifies the maximum possible speed difference.
		> Maximum collision time (s)		10.00	Typically not modified	No	Applicable only if **Cooperative lane change** has been selected. Identifies the maximum collision time (time a vehicle can travel before reaching a preceding vehicle or network object that has an impact on its desired speed)
		Rear correction of lateral position		Not Selected	Typically not modified	No	This causes the vehicle to be aligned to the middle of the lane at the end of the lane change, instead of at an angle in the original lane. This can affect the capacity. Only performed if the **Keep lateral distance to vehicles on next lane(s)** option is selected under "Lateral" behavior.
		> Maximum speed (mph)		1.86	Typically not modified	No	Speed up to which the correction of the rear end position should take place. Lateral correction of the rear end position is not performed for faster vehicles.
		> Active during time period from "x sec" until "x sec" after lane change start		1.00 until 10.00	Typically not modified	No	Time after the start of the lane change at which the lateral movement of the rear end position should start **until** time after the start of the lane change at which the lateral movement of the rear end position should end.
	Lateral	Desired position at free flow		Middle of lane	Typically not modified	No	Lateral orientation of a vehicle within its lane while it is in free traffic flow
		Keep lateral distance to vehicles on next lane(s)		Not Selected	Typically not modified	No	If this option is selected, the vehicles consider the position and therefore the lateral orientation of vehicles on adjacent lanes and keep the **Lateral min. distance**. For this purpose, vehicles even adjust their lateral orientation on their own lane and swerve out of the way. If this option is not selected, vehicles on adjacent lanes are ignored even if they are wider than their lanes, except when they perform a lane change. **Note: using this option can reduce the simulation speed significantly**.
		Diamond shaped queuing		Not Selected	Typically not modified	No	If this option is selected, queues take into account a realistic shape of vehicles with vehicles positioned offset, such as bikes. Vehicles are internally represented not as a rectangle, but as a rhombus.
		Consider next turning direction		Not Selected	Typically not modified	No	Enables more intelligent lateral behavior in case of non-lane-bound traffic. If the option has been selected, a vehicle with this driving behavior does not pass another vehicle on the same lane if this might cause a collision at the next turning connector. To achieve this, attributes that enable passing on the same lane **must** be selected. Note the option **Consider next turning direction** has precedence over option **Desired position at free flow**.
		Collision time gain (s);		2.00	Typically not modified	No	Minimum value of the collision time gain for the next vehicle or signal head, which must be reached so that a change of the lateral position on the lane is worthwhile and will be performed. Calculated based on the desired speed of the vehicle. Smaller values lead to a livelier lateral behavior, since vehicles also have to dodge sideways for minor improvements.
		Minimum longitudinal speed (mph):		2.24	Typically not modified	No	Minimum longitudinal speed which still allows for lateral movements. The default value (2.24 mph) ensures that vehicles can also move laterally if they have almost come to a halt already.
		Time between direction changes (s):		0.00	Typically not modified	No	Defines the minimum simulation time which must pass between the start of a lateral movement in one direction and the start of a lateral movement in the reverse direction. The higher this value, the smaller the lateral movements of vehicles. These lateral movements only take place if overtaking on the same lane is permitted. (Does not affect the lateral movement for a lane change.)
		Default behavior when overtaking vehicles on the same lane or on adjacent lanes	Overtake on same lane	Overtake left (default) - Not Selected Overtake right (default) - Not Selected	Typically not modified	No	When modeling traffic that is not lane-bound, you can allow vehicles to overtake within a lane. **Left:** vehicles are allowed to overtake on a lane to the left; **Right**: vehicles are allowed to overtake on a lane to the right.
			Minimum lateral distance (ft)	Distance standing at 0 mph: 0.66 ft Distance driving at 30 mph: 3.28 ft	Typically not modified	No	Minimum distance between vehicles when overtaking within the lane and keeping the distance to vehicles in the adjacent lanes. **Distance Standing at 0 mph** is the lateral distance of the passing vehicle; **Distance driving at 30 mph** is the lateral distance of the passing vehicles.
		Exceptions for overtaking vehicles of the following vehicle classes		No exceptions listed	Typically not modified	No	Behavior for specific vehicle classes that deviates from the default behavior when overtaking vehicles on the same lane. When modeling traffic that is not lane-bound, you can select vehicle classes which may be overtaken within a lane by vehicles of the defined driving behavior set.
	Signal Control	Reaction after end of green	Behavior at amber signal	Continuous Check	Not typically modified	No	Defines the behavior of vehicles when they approach an amber light. **Continuous check:** driver of vehicle continuously decides whether to continue driving or whether to stop. Vehicles assume that the amber light will only be visible for another two seconds. They then decide continuously, with each time step, whether they will continue to drive or stop. A vehicle will not brake, if its maximum deceleration does not allow it to stop at the stop line, or if it would have to brake for more than 15 ft/s^2. The vehicle will brake, if at its current speed, it cannot drive past the signal head with two seconds. Both braking and stoping are possible for cases that lie in between these two scenarios. **One decision:** The decision made is maintained until the vehicle crosses the stop line. Calculated using the probability factors.
			Probability Factors	Alpha: 1.59 Beta 1: -0.26 Beta 2: 0.27	Only applicable is **One decision model** is selected, Not typically modified	No	Used to calculate the probability (i.e., whether a driver stops at an amber light or not). $p = \frac{1}{1+e^{-\alpha-\beta_1 v-\beta_2 dx}}$ The following settings make a vehicle continue driving for longer when there is an amber light and occasionally even make it run a red light: The **One decision** option is selected, **Alpha** is greater than the default value 1.59; **Beta1** is greater than the default value 0.27; and **Beta2** is greater than the default -0.26 but less than 0.00.
		Reaction after end of red	Behavior at red/amber signal	Go (same as green)	Not typically modified	No	Used to define country-specific or regional behavior at red/amber signal. Options are **Stop (same as red)** or **Go (same as green);** where **Stop (same as red)** means the Go signal is green (the response time is effective from the time step the signal changes to green) and the **Go (same as green)** means the **Go** signal is red-amber (the response time is effective from the time step the signal changes to red-amber).
			Reaction time distribution	Blank	Typically not modified	No	Reaction time of a vehicle to the **Go** signal. It causes a time delay between the time step when the signal switches to **Go** and the time step when the first vehicle upstream of the corresponding stop line starts to move. If no time distribution is selected, the default time is 0 seconds.
		Reduced safety distance close to a stop line	Factor	0.60	0.60	Yes	Higher value reduces the safety distance between vehicles close to the signal stop bar
			Start upstream of stop line (ft)	328.08	Not typically modified	No	Distance upstream of the signal head
			End downstream of stop line (ft)	328.08	Not typically modified	No	Distance downstream of the signal head

VISSIM Calibration Settings

Last Updated: 03-30-21
Source: PTV Vissim 2020 User Manual

Type of Setting	Parameter Grouping	Parameter Name	Default Settings (per Vissim v. 2020.00-11)	Recommended Parameter Range	Typical Parameters Adjusted during Calibration	Parameter Description
LOCAL (CONT)	*Connector-level*	Emergency Stop (feet)	16.4 ft per lane	Adjust to match field conditions	Yes	Distance before the downstream connector where vehicles can make last chance lane changes
LOCAL (CONT)	*Connector-level*	Lane change (feet)	656.20	>656.20	Yes	Distance before the downstream connector where vehicles begin to make lane changes
LOCAL (CONT)	*Connector-level*	Lane change per lane	Not Selected	Adjust to match field conditions	Yes	If this option is selected, the entered lane change attribute value is multiplied by the number of lane changes which a vehicle requires to reach the connector
LOCAL (CONT)	*Point-level*	Speed distributions (mph)	Linear distributions	Adjust to represent the field conditions	Yes	The distribution function of desired speeds is a particularly important parameter, as it has an impact on link capacity and achievable travel times. If not hindered by other vehicles or network objects (e.g., signal controls), a driver will travel at his desired speed. Desired speed distributions are defined independently of vehicle or pedestrian type.
LOCAL (CONT)	*Point-level*	Time distributions (mph)	Linear distributions	Not typically modified	No	You can use dwell time distributions for: 1) standstill time on parking lots 2) waiting times at toll counters through stop signs or 3) for PT stops to allow adequate time for passengers to board and alight the bus/transit vehicle.

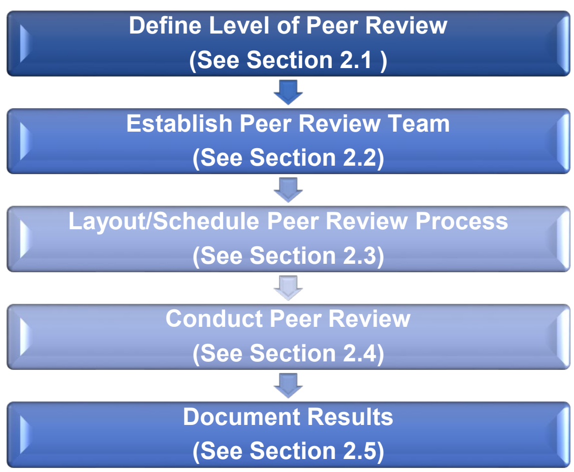
16-25-1 Introduction — September 2019

This policy addresses the peer review process for traffic models utilized to conduct traffic operations analysis for the evaluation and design of all transportation improvement projects. For this policy, traffic models refer to both the Highway Capacity Manual (HCM)-based traffic analyses and microscopic simulation (microsimulation) analyses. This policy does not cover the travel demand models (TDMs) utilized to generate traffic forecasts. Refer to the Transportation Planning Manual (TPM) for additional details regarding traffic forecasting protocols. All projects that include traffic models **shall** follow the peer review process. Coordinate with the WisDOT regional traffic staff to determine how best to implement the peer review process. Contact the Bureau of Traffic Operations (BTO) – Traffic Analysis and Safety Unit (TASU) for additional guidance and support as needed.

1.1 Overview

A peer review is a structured process for reviewing a traffic model to ensure the use of sound engineering judgment. The primary goal of the peer review process is to protect the department's and public's interests by verifying the integrity of the traffic model by assuring that it provides a reasonably accurate representation of traffic conditions that exist in the field. There are four levels of peer review, which are dependent on the complexity of the traffic model. It can take anywhere from six weeks to over four months to conduct a peer review of the traffic model for one analysis scenario. This may significantly affect the overall schedule and budget for a project. Thus, the project team *should* consider time, budget, and other resource requirements of the peer review process early on during project scoping. Figure 1.1 highlights the key steps of the peer review process for HCM and microsimulation traffic models.

Figure 1.1. Traffic Model Peer Review Process Overview



1.2 Background

Historically, there was a lack of consistency in when and how the department reviews the HCM and microsimulation traffic models. To improve consistency across the state concerning the review of these traffic models, BTO-TASU developed the Traffic Model Peer Review policy, focusing on steps 6 and 11 of the overall traffic model (does not include TDMs) development and review process. See TEOpS 16-1-1, Attachment 1.1 for an illustration of the overall traffic model development and review process.

16-25-2 Process — September 2019

2.1 Define Level of Peer Review

It is the responsibility of the project manager to ensure that the traffic model is peer reviewed, while it is up to region traffic operations to define the peer review requirements. To assist with defining the peer review requirements, this policy defines four levels of peer review for traffic models:

1. Project team level review – The WisDOT project team leads the peer review process, providing a high-level (e.g., spot-check) and independent (i.e., the reviewer cannot be part of the team developing the

traffic model) review of the traffic model. The WisDOT regional traffic modeler (if available) or regional traffic staff will provide an in-depth review of the traffic model as needed. If the regional office does not have the available knowledge or resources, they may contact BTO-TASU for assistance with the in-depth review.

2. Region level review – The WisDOT regional traffic modeler/traffic staff lead the peer review process. The WisDOT project team will provide oversight of the peer review process and BTO-TASU, WisDOT Traffic Forecasting Section (TFS), and other statewide bureaus (SWBs) will assist in the peer review as needed. The WisDOT regional office will provide an in-depth review of the traffic model. If the WisDOT regional office does not have the available knowledge or resources, they may contract with an independent consultant (one that is not a member of the consultant team developing the traffic model) to assist as necessary.

3. Independent consultant level review – An independent consultant typically leads the peer review process but works closely with the WisDOT regional traffic modeler/traffic staff on all aspects of the review. The WisDOT project team will provide oversight of the consultant's peer review and BTO-TASU, WisDOT TFS, and other SWBs will assist in the peer review as needed. The independent consultant will provide an in-depth review of the traffic model while the regional traffic modeler/traffic staff will typically provide a high-level review. In cases where the regional office has the knowledge and resources available, they may choose to forego the use of an independent consultant.

4. SWB level review with Federal Highway Administration (FHWA) oversight - An independent consultant typically leads the peer review process but works closely with the WisDOT regional traffic modeler/traffic staff, BTO-TASU, WisDOT TFS, and other SWBs on all aspects of the review. The independent consultant will provide an in-depth review of the traffic model while the regional traffic modeler/traffic staff and SWBs will typically provide a high-level review. In cases where the regional office has the knowledge and resources available, they may choose to forego the use of an independent consultant.

   Projects constructed with federal funds require FHWA oversight of the peer review process to ensure that the traffic model adheres to federal guidelines. The extent of FHWA involvement will vary depending on the specifics of the proposed project.

   Note: See the TPM for details on WisDOT TFS involvement with traffic model peer reviews.

The level of peer review will vary depending on the complexity of the traffic model, which is dependent on the project type (mega/major project, high profile project, routine improvement project, etc.), project scope, corridor type, traffic control, roadway congestion level, and traffic analysis tool(s) utilized. However, a project team or region level review is typically sufficient for most HCM-based traffic models. The SWBs, specifically BTO-TASU and WisDOT TFS, will be involved on high-profile projects, mega/major projects, and those projects that have potential for FHWA involvement.

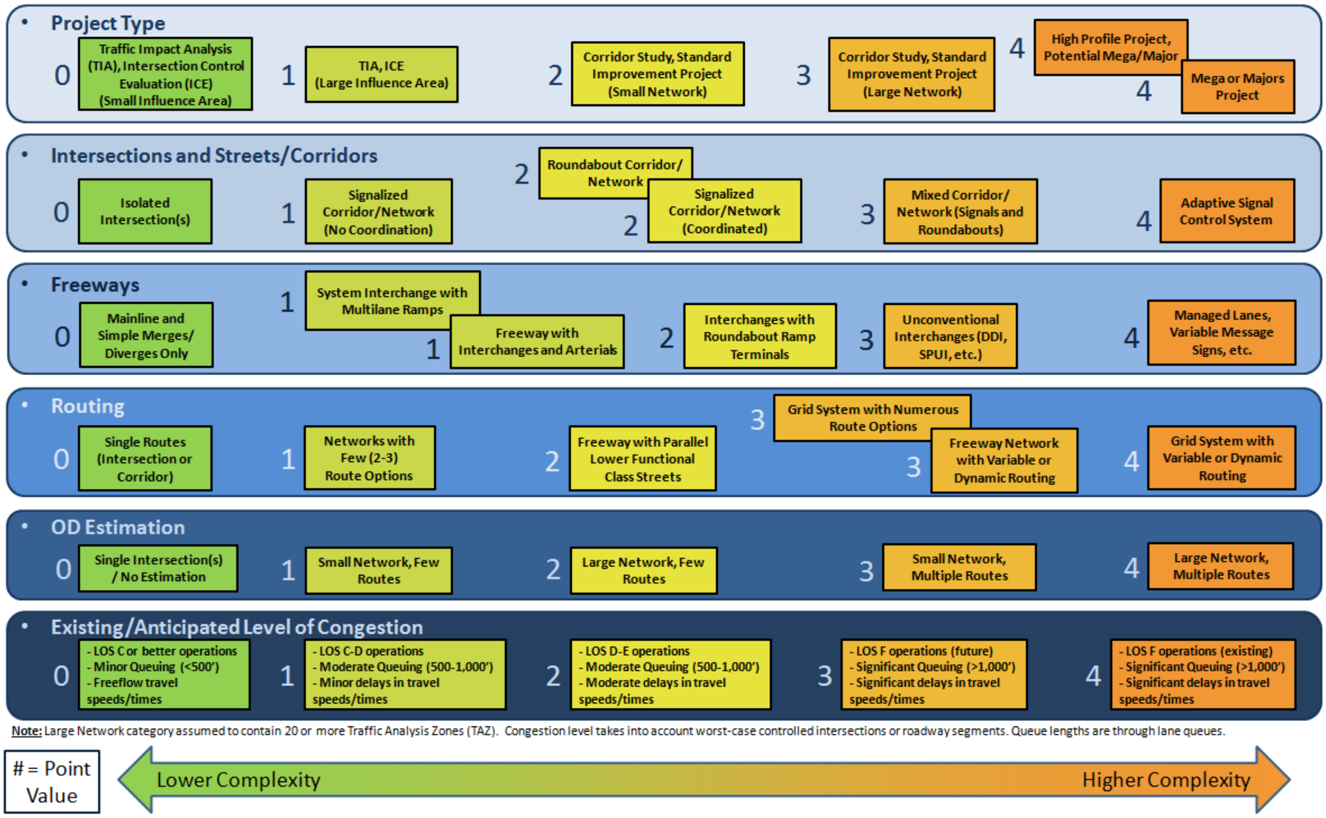
The level of peer review may significantly impact the overall schedule and budget for a project and *should* be determined early on during project scoping. However, the project team often must wait for the initiation of the traffic analysis to define the level of peer review required. Therefore, the project team *should* assume the need for the highest potential peer review level when defining the schedule and budget for a project.

To quantify the level of complexity associated with building and reviewing a traffic model (specifically a microsimulation traffic model), the department worked with a consultant to establish a scoring system. The scoring system defines the level of complexity and the level of peer review required by assigning points within the following categories:

1. Project type
2. Geometric conditions
   a. Arterial corridor
   b. Freeway corridor
3. Traffic pattern/conditions
   a. Routing options
   b. Origin-destination (O-D) matrix development
   c. Level of congestion (existing and future)

Within the geometric conditions category there are two subcategories to define the type of corridor included in the analysis: arterial corridor (includes individual intersections, streets, or corridor segments) and freeway corridor. The traffic pattern/conditions category contains three subcategories: routing options, O-D matrix development, and existing/anticipated level of congestion. Figure 2.1 provides an illustration of the traffic model level of complexity scoring system.

Figure 2.1. Traffic Model Complexity Scoring Diagram



As illustrated in Figure 2.1, there are several factors within each category and subcategory that define the complexity of a traffic model. For example, the complexity of a traffic model for an arterial corridor is dependent on whether the traffic model is an isolated intersection, an uncoordinated signalized corridor, a coordinated signalized corridor, a roundabout corridor, a mixed traffic control corridor (e.g., a corridor with signals and roundabouts), or an adaptive signal control system. Every factor has an associated level of complexity based on a scale of 0 to 4 (an isolated intersection has a complexity score of 0 while an adaptive signal control system has a complexity score of 4). If multiple factors are applicable, the score associated with the highest level of complexity dictates the overall score for that category or subcategory. For example, a Traffic Impact Analysis (TIA) project with a small influence area by itself has a complexity score of 0; however, if the TIA is a high-profile project the score for the “project type” category would be 4. Sum the highest score within each category/subcategory to determine an overall complexity score for the traffic model (maximum score of 24). The higher the overall complexity score, the more likely it is that microsimulation traffic models will be necessary. Refer to Attachment 2.1, an Excel-based template, for assistance with developing the overall complexity score for the traffic model. In coordination with WisDOT regional traffic staff, the WisDOT project team’s traffic lead or project manager *should* complete the traffic model complexity-scoring template.

The overall traffic model-complexity-score defines the minimum peer review requirements for the project. It is possible to complete a higher (more intense) level of peer review. Ultimately, it is up to WisDOT regional traffic staff to define the final peer review requirements. Refer to Table 2.1 for the complexity score associated with each peer review level.

Due to modified roadway geometry, increased traffic volumes, reduced levels of congestion, etc., it is possible for the traffic model-complexity-score to be different under future alternative scenarios than it is under existing conditions. Therefore, it is critical to consider both existing conditions and potential future alternatives (including levels of service) when defining the traffic model complexity score and the associated level of peer review required. The highest traffic model-complexity-score across all the scenarios (existing and future alternatives) dictates the minimum peer review requirements.

Table 2.1. Peer Review Level Requirements

Total Complexity Score (a)	Minimum Required Peer Review	Notes
0-3	Project Team Level Review (b)	• WisDOT project team leads peer review • WisDOT regional traffic staff provides in-depth review as needed
4-7	Region Level Review (b)	• WisDOT regional traffic staff provides in-depth review, • SWBs provide assistance as needed • Independent consultant review as needed
8-10	Independent Consultant Level Review	• Independent consultant leads review (c) • WisDOT regional traffic staff provides high-level review • SWBs provide assistance as needed
11+	SWB Level Review with FHWA Oversight (d)	• Independent consultant leads review (c) • WisDOT regional traffic staff and SWBs provide high-level review • FHWA oversight may be necessary

(a) The scoring system identified within this table **shall** act as a guide and not as a rigid requirement. Ultimately, determination of the necessary level of peer review requires professional judgment.

(b) A project team or region level review is sufficient for most HCM-based traffic models.

(c) If the WisDOT regional office has the required knowledge and resources, they may choose to forego the use of an independent consultant.

(d) This indicates when there is a high probability for FHWA oversight. Prior to developing the traffic models, the WisDOT project team *should* coordinate with FHWA to determine their level of involvement (if any).

2.2 Establish Peer Review Team

Upon defining the peer review requirements, the WisDOT project team *should* meet with WisDOT regional traffic operations to identify the peer review participants and establish all internal and external stakeholders. This meeting *should* occur as early as possible but **shall** occur prior to the initiation of the traffic analysis.

Table 2.2 provides a summary of the stakeholders to consider for inclusion on the peer review team. The peer review process will vary slightly from one project to another, thus Table 2.2 *should* serve as a guide (not a rigid requirement) when establishing the peer review team.

Although Table 2.2 provides insight into when to involve the SWBs or FHWA with the peer review, unique situations not covered in the table may also trigger the need to involve a SWB or FHWA. Thus, the project team *should* coordinate with the SWBs and FHWA during project scoping to verify their level of involvement (if any) in the peer review process. In general, the SWBs (specifically BTO-TASU) will be involved on all mega/major projects and projects where FHWA participation in the peer review process is desired or required.

If the WisDOT regional office does not have the knowledge or resources available to conduct the peer review of the traffic model, the project manager, in all likelihood, will need to select and procure an independent consultant to complete the peer review, regardless of the traffic model complexity. If desired, the WisDOT regional office may contact BTO-TASU for support. BTO-TASU may also be able to conduct the peer review of the simpler traffic models (traffic model-complexity-score of 0-7).

Table 2.2. Potential Peer Review Participants

Stakeholder [a]	**Level of Involvement**	**Notes**
Region		
• WisDOT Regional Traffic Operations • WisDOT Regional Traffic Modeler (if available)	• All levels of peer review	Roles/responsibilities will vary based on level of review required
Statewide Bureaus		
• BTO-TASU • Other SWBs as necessary	• SWB with FHWA oversight level review	Provides assistance as needed on all levels of peer review Provides high-level review of all projects with potential for FHWA involvement
• WisDOT TFS	• All levels of peer review	See the TPM for details on TFS involvement with traffic model reviews
External Stakeholders		
• Independent Consultant	• Independent consultant level review • SWB with FHWA oversight level review	May get involved on lower level reviews if WisDOT regional staff do not have the necessary resources [b]
• FHWA	• FHWA oversight review	Typically involved on mega/major projects and federally funded Interstate Access Justification Reports (IAJRs)
• Local Municipalities, Regional Planning Commissions (RPCs), Metropolitan Planning Organizations (MPOs)	Typically, will not review the traffic model, but may participate in peer review discussions to ensure that the traffic model addresses local concerns[c]	

(a) The peer review team established for a specific project may include more or fewer members than those listed above.

(b) WisDOT regional traffic staff *should* assess whether they have the knowledge and resources to complete the peer review; if not BTO-TASU may be able to help with the peer review for models with a complexity score of 7 or less. If neither WisDOT regional staff nor BTO-TASU has the capability to conduct the peer review, the WisDOT project team **shall** select/procure an independent consultant to complete the peer review regardless of the traffic model complexity.

(c) Early coordination with the Southeastern Wisconsin Regional Planning Commission (SEWRPC) for mega/major projects located in the SE region is highly recommended.

If there is a need for an independent consultant, the WisDOT project team *should* follow the process outlined in the department's Facilities Development Manual Chapter 8, Section 5 (FDM 8-5) to select and procure a consultant team to perform the necessary peer review. The Statewide Master Contract for Traffic Analysis and Modeling (BTO 03) and the Statewide Master Contract for Traffic Engineering Services (BTO 01) identifies the consultants that have been previously selected and authorized to conduct traffic engineering services (including traffic model peer reviews). The list of consultants on the master contracts are updated every two-years and are available through the Contract Administration Reporting System (CARS) application or through BTO-TASU. If desired, BTO-TASU can provide assistance with the selection of the independent peer review consultant.

To ensure a truly independent peer review, it is critical that the consultant chosen to conduct the peer review does not have any affiliation or conflict of interest with the consultant team selected to perform the traffic analysis.

2.3 Layout/Schedule Peer Review Process

Upon establishing the peer review team, the WisDOT project manager **shall** coordinate with the peer review team (typically via a coordination meeting) to identify the following components of the peer review process:

1. Project milestones which will trigger the need for a peer review
2. Roles of the individual peer review members
3. Data requirements

4. Schedule for conducting the peer review(s)
5. Transfer process for traffic model(s) and peer review comments

The following provides additional discussion on each of these components.

2.3.1 Identify Project Milestones

There are typically three major project milestones for a peer review: (1) completion of the existing year traffic model, (2) completion of the design year no-build traffic model and (3) completion of each design year build/project alternative traffic model. Complex traffic models may warrant the need for peer reviews at additional project milestones, such as after the initial coding of the traffic model but prior to the full calibration of the traffic model. At the completion of the coordination meeting, both the project team and peer review team *should* have a clear understanding of where the peer review(s) *should* fall within the overall project timeline.

With HCM-based traffic models, the review of the existing year, design year no-build, and design year build/project alternative traffic models can occur simultaneously. However, due to their complexity, microsimulation traffic models will typically require a peer review at each of the three milestones described above. BTO-TASU strongly encourages the consecutive review of the existing year, the design year no-build, and the design year build/project alternative traffic models.

In other words, only after calibrating and validating the existing conditions, and only after completing the peer review process of the existing conditions model, *should* the analyst proceed with the development of other modeling scenarios (e.g., design year no-build, design year build, etc.). If the analyst chooses to develop the model alternatives prior to calibrating and validating the existing conditions model or prior to having the model go through the peer review process, they take the risk that they must go back and revise not only the alternatives model but the existing conditions model as well. This can lead to potential inconsistencies in the modeling scenarios and could result in the need for additional time to calibrate and perform the peer review(s) of the alternatives model. Although it may be tempting, especially when the project has a compressed schedule, to skip or delay the calibration, validation, or peer review process of the existing conditions model, it may end up being counterproductive, and thus, BTO-TASU strongly discourages doing such.

The subsequent text provides a description of the three major milestones.

<u>Milestone 1: Completion of Existing Year Traffic Model</u>

The existing year traffic model replicates existing field conditions. Existing year traffic conditions *should* reflect the year that is as close to the original start of the traffic analysis as possible. Whenever possible, traffic data *should* be no more than three years old and ideally, all traffic data *should* be from the same year. Ongoing construction or other extraordinary circumstances may dictate the need to use older data or data from multiple years.

This project milestone requires a peer review to ensure that the traffic model provides an accurate representation of field conditions based on data collected by the project team or peer review team. At this milestone, WisDOT TFS *should* verify that the traffic model and traffic forecasts utilize a consistent existing volume data set.

<u>Milestone 2: Completion of Design Year No-Build (FEC) Traffic Model</u>

The design year no-build traffic model reflects design year conditions absent of the proposed project. It will reflect design year traffic volumes and existing geometry or existing geometry with other planned and enumerated (or committed) improvement projects and may include signal timing modification. As such, another name for this scenario is the future with existing plus committed (FEC) scenario. The inclusion of a planned improvement project in the FEC model is contingent on it occurring after the existing year but prior to the proposed project's design year. Note that the FEC conditions for a specific project may not match the no-build conditions reflected in a travel demand model (TDM) used in forecasting traffic. Thus, WisDOT TFS *should* verify that both the traffic model and traffic forecasts reflect the same assumptions (e.g., number of travel lanes).

For the traffic model to function with the design year traffic volumes, it may be necessary to include minor geometric improvements (e.g., the extension of an existing right or left turn lane or channelization optimizations such as the removal of shared lane movements within the FEC right-of-way, etc.) beyond the committed projects. In these cases, the traffic model represents future with existing plus committed plus minor improvements (FEC+) conditions. The project team *should* document these minor improvements within the modeling methodology report and other project memoranda as appropriate.

This project milestone requires a peer review to confirm that the traffic model accurately depicts design year traffic volumes and to verify that the basic structure of the model is consistent with the existing year traffic model. If the analyst properly addresses and carries forward comments from the existing year model, the peer review process at the FEC project milestone *should* be less intensive than the initial peer review.

Milestone 3: Completion of Each Design Year Build/Project Alternative Traffic Model

The design year, build traffic models capture design year conditions with the proposed project improvements. The build traffic models may reflect “constrained” or “unconstrained” conditions. Typically, the analyst will need to develop a traffic model for more than one project alternative.

Each project alternative model requires a peer review. Peer reviews are necessary at this project milestone to ensure that the traffic model is consistent with the previous traffic models and to verify that it accurately captures the proposed improvements. Checking for geometric improvements, changes in travel demand/traffic patterns, and consistency against the existing and no-build traffic models *should* be the focus of the design year alternative model reviews. WisDOT TFS *should* verify that both the design year build traffic models and traffic forecasts reflect the same assumptions (e.g., number of travel lanes).

2.3.2 Outline Roles/Responsibilities

Table 2.1 and Table 2.2 (shown previously) may be able to assist in the assessment of the general roles (e.g., high-level review, assistance as needed, etc.) for each peer review team member. The project manager, however, *should* clarify the specific team member responsibilities (e.g., responsible for reviewing model network, responsible for reviewing traffic volume data, etc.) during the coordination meeting.

2.3.3 Define Data Requirements

In an ideal world, the analyst will collect all the traffic data needed to validate that the traffic model is properly calibrated (i.e., provides an accurate representation of real-world conditions) during the development of the traffic model. In some instances, however, it may be necessary for the peer review team to gather additional data as part of the peer review process. If there is a need to collect additional data, during the initial coordination meeting, the project team *should* define the data collection plan (e.g., how to obtain the data, when to collect the data, and who will collect the data). Refer to TEOpS 16-5 for additional details on data assembly and preparation.

Additionally, the peer review team *should* discuss whether there are any previously developed traffic models (specifically microsimulation traffic models) that could serve as a resource for the development, calibration, validation, and peer review of the proposed traffic model.

2.3.4 Define Preliminary Schedule

The schedule for the peer review is highly dependent on the complexity of the traffic model and level of peer review required. The peer review of a highly complex traffic model that requires FHWA oversight will take longer to complete than the peer review of a relatively simple traffic model that only requires a project team level review. Since the peer review schedule impacts the overall schedule of the project, it is critical for the project team to define the peer review timeline as early in the project as possible, preferably during project scoping. The project team can utilize Table 2.3 to approximate the amount of time within the overall project schedule to allow for the peer review process. The timelines provided in Table 2.3 assume that WisDOT TFS have already generated or reviewed and approved the traffic forecasts utilized within the traffic model.

Except for FHWA, all members of the peer review team may conduct their review of the traffic model(s) simultaneously. With concurrent reviews, the peer review members *should* coordinate often during the review process to avoid unnecessary duplication of review efforts. WisDOT *should* complete all internal department peer reviews (project team, region, independent consultant, statewide bureau reviews) prior to FHWA reviewing the traffic model(s). FHWA, however, may be available to answer questions and to provide suggestions for items to consider during internal department reviews.

Table 2.3. Peer Review Time Requirements

Level of Peer Review	Approximate Time Required to Complete Initial Peer Review (Including data collection, coordination, etc.)
Project Team Level Review	• 1-2 weeks for existing conditions • 1-2 weeks for each additional project milestone/alternative
Region Level Review	• 3-4 weeks for existing conditions • 3-4 weeks for each additional project milestone/alternative
Independent Consultant Level Review	• 4-8 weeks for existing conditions • 4-8 weeks for each additional project milestone/alternative
SWB Level Review *Without FHWA Oversight*	• 4-8 weeks for existing conditions • 4-8 weeks for each additional project milestone/alternative
With FHWA Oversight	• 12-16 weeks for existing conditions • 12-16 weeks for each additional project milestone/alternative

Notes:

- The time ranges shown here are approximate, thus the project team *should* only utilize these timelines to approximate the amount of time within the overall project schedule to allow for the peer review process. Actual timelines are dependent on individual project details such as the amount of data collection and the complexity of the future models.
- All timelines shown here are associated with the review of a microsimulation traffic model. The review time required for HCM-based traffic models is dependent on the WisDOT regional office resources.
- The peer review schedule may assume concurrent review by all internal WisDOT peer review team members (project team, regional traffic staff, independent consultant, SWB). However, the schedule *should* assume that FHWA peer reviews will only occur after the completion of WisDOT's review.
- If an independent consultant is part of the peer review team, add extra time to the schedule to account for scoping/contracting the independent consultant's work.
- Add additional time (a minimum of 6 weeks per milestone/alternative) to account for WisDOT TFS review of the traffic volume demand utilized in the traffic models. See the TPM and DT2340 for additional details on WisDOT TFS's role in the review of microsimulation traffic models.

2.3.5 Detail Traffic Model/Peer Review Comment Transfer Process

During the initial coordination meeting, the peer review team *should* layout the process for handing off the data (traffic model, peer review comments, etc.) between the analyst and the peer review team. It may be helpful for the project manager to set up a schedule for check-in-meetings or conference calls over the course of the peer review to help facilitate the exchange of data. The number and timing of these meetings will vary depending on the complexity of the traffic model, but could include the following:

- A hand-off meeting when the traffic model is ready to go to the reviewer(s),
- A preliminary finding meeting when the reviewer(s) has completed the initial review and developed their first thoughts and questions on the model,
- An ultimate finding meeting when the reviewer(s) has completed the peer review, and
- A response meeting when the analyst has addressed the comments raised by the review team.

2.4 Conduct Peer Review

A key concept of the peer review process is to assess whether the traffic model is suitable for meeting the goals and objectives of the study without violating current WisDOT policies (i.e., is the traffic model fit-for-purpose?). To assist the reviewer with making this decision, the project manager *should* provide the peer review team with a summary of the project scope, project goals, and intended purpose of the traffic model prior to initiating the peer review. It is important to affirm that the project scope is stable and unambiguous, as it will be difficult for the reviewer to assess the traffic model's fitness-for-purpose if the purpose itself is subject to change over the duration of the project. The project manager *should* also emphasize that the role of the reviewer is to identify problems and make suggestions to improve the quality of the traffic model, but not fix problems associated with the traffic model.

The following provides specific details on how to conduct a peer review for both HCM-based and microsimulation traffic models.

2.4.1 HCM Traffic Model Peer Review

A project team or region-level review will be sufficient for most HCM traffic models, although mega/major projects will require SWB involvement. The WisDOT regional traffic modeler/traffic operations **shall** conduct, at a minimum, a high-level review of the HCM traffic model(s) to verify that the analyst has followed standard protocols. To ensure consistency with the review of the traffic models, the reviewer (typically WisDOT regional traffic staff) *should* complete DT1887 – HCM Analysis Review Checklist while conducting their review. The reviewer, as appropriate, *should* insert "not reviewed" on DT1887 to denote which components of the traffic model they did not address during their review. Attachment 2.2 provides a copy of DT1887.

The primary purpose of DT1887 is to provide a coversheet that summarizes the major concerns/issues the reviewer has on the traffic model. The reviewer *should* document the specific/detailed comments on the traffic model in a separate memorandum and attach it to DT1887.

DT1887 provides a mechanism for the reviewer to easily identify whether the specific parameters within the traffic model (e.g., lane geometry, signal timings, etc.) and overall traffic model is acceptable, conditionally acceptable, or unacceptable. With regards to the peer review, these terms have the following definitions:

- Acceptable - The traffic model is acceptable as is without any revisions,
- Conditionally acceptable - The traffic model is acceptable based on the condition that the traffic analyst addresses a few (no more than 5) specific issues or concerns either by revising the traffic model or providing additional justification as to why no additional revisions are necessary,
- Unacceptable – The traffic model needs major revisions.

As illustrated in DT1887, the typical components of the HCM traffic model that the peer review team *should* review include:

Traffic Analysis Tool/Version

Prior to developing the traffic model, WisDOT regional traffic staff and the analyst *should* have agreed upon the appropriate analysis tool to utilize. The reviewer *should* confirm that the analyst used the agreed upon analysis tool, specifically that they used the correct software, software version, and software build (e.g., Synchro 10.3.122, Sidra 8.0.5.7916, etc.) to develop the traffic model. The traffic models *should* only utilize the department-supported software packages. TEOpS 16-10 identifies the explicit software packages that the department supports. Refer to the BTO Traffic Analysis, Modeling and Data Management Program area webpage for the version and build of software that WisDOT currently supports.

The reviewer *should* note any differences in the version or build of the software package utilized during the development and review of the traffic model.

Lane Geometry

The reviewer *should* confirm that the traffic model depicts the proper lane geometry, including lane configurations, turn bay lengths, lane widths, right-turn channelization, and distance between intersections. In some situations, the HCM methodology may not allow the coding of the actual lane geometrics (e.g., the HCM methodology limits the number of approaches/lanes). In these cases, it may be necessary to utilize an alternative tool for the analysis. The analyst **shall** obtain prior approval from WisDOT regional traffic staff prior to utilizing modified lane geometry within the HCM traffic model. Note the agreed upon modifications to actual lane geometries on DT1887 or in the accompanying comment memorandum.

Traffic Volumes/Percent Trucks/Peak Hour Factor (PHF)

The reviewer *should* verify that the analyst accurately coded the appropriate traffic volumes for the defined analysis year into the traffic model. Design year traffic volumes *should* reflect official WisDOT traffic forecasts (i.e., forecasts prepared or reviewed and approved by WisDOT TFS).

If applicable, the analyst *should* provide documentation on the process completed to develop design hour volumes (K30, K100, K250, weekday AM/PM peak, etc.), to produce O-D matrices, and balance the traffic volumes along the corridor. The reviewer *should* look at the documentation and check the volume adjustments for reasonableness.

The reviewer *should* verify that the analysis includes the appropriate percentage of trucks or heavy vehicles. Unless there is one movement that is predominately trucks (e.g., the movement goes into a truck parking facility), as prescribed in the HCM, the traffic model *should* include the percent of trucks/heavy vehicles based on intersection approach and not by the individual turning movement.

Per FDM 11-5-3, in most cases, the analysis *should* utilize a PHF based on data collected in the field, and is typically calculated for the intersection rather than approach or turning movement. If the existing field-derived PHF is less than 0.92 (the recommended HCM default), however, it may be appropriate to utilize a higher PHF for the analyses of design year conditions. Use of any value other than the field-derived PHF requires approval from the WisDOT regional traffic engineer.

Signal Timing Parameters

At a minimum, the reviewer *should* verify that all traffic models that involve traffic signals utilize appropriate signal timing and phasing plans, saturation flow rates, and right-turn-on red (RTOR) volumes. The reviewer *should* refer to the Traffic Signal Design Manual (TSDM 3-2-2) and TEOpS 16-15-5 for guidance on the recommended traffic signal timing parameters, where TEOpS 16-15-5 is the controlling policy for saturation flow rates and right-turn-on-red (RTOR) usage. WisDOT regional traffic staff may have additional guidance on the signal timing parameters.

Stop-Control/Roundabout Parameters

The reviewer *should* verify that all traffic models that involve stop-controlled intersections utilize appropriate and reasonable critical gap, follow-up times, saturation flow rates, vehicle storage in the median, and the presence of an upstream traffic signal. Unless justified otherwise by a field study, the traffic model *should* utilize default values for most parameters.

WisDOT has established Wisconsin specific critical and follow-up headway values for the analysis of roundabouts (see FDM 11-26-20.4, Table 20.3). The reviewer *should* check for proper usage of these headway values for traffic models that include roundabouts.

Freeway/Highway Parameters

For freeway weaving analysis, the reviewer *should* look at the source of the weaving volumes and verify that the assumptions made to determine the volumes are in accordance with the previously agreed upon methodology. Additionally, the reviewer *should* check the weaving segment length, number of maneuver lanes, and the minimum number of lane changes utilized in the analysis.

For freeway merge or diverge analysis, the reviewer *should* inspect the basic number of lanes, acceleration or deceleration lengths, and volume inputs for accuracy.

For basic highway segments, the reviewer *should* examine the road classification, access density, no-passing zone inputs, and free-flow speed for accuracy.

Other

The reviewer *should* note any other aspects of the traffic model (e.g., growth rates, gap acceptance, lane utilization, link speeds, etc.) that they checked during their evaluation. Additionally, the reviewer *should* provide any general comments they have regarding the overall performance of the traffic model.

Upon completion of their evaluation, the reviewer *should* provide a copy of the completed DT1887 to the project team and analyst for their response. The reviewer only needs to complete one DT1887 for an entire corridor; there is no need to complete DT1887 for every intersection along the corridor.

The analyst *should* note on the DT1887 form how they propose to respond to any comments on the traffic model (e.g., revise the traffic model or provide justification for their original assumptions). TEOpS 16-25-2.5 provides additional detail on how to document this correspondence.

2.4.2 Microsimulation Traffic Model Peer Review Overview

Due to their complexity, microsimulation traffic models typically require an independent consultant or SWB level of review. Each member of the peer review team *should* complete DT2291 – Microsimulation Peer Review Report to document their findings, comments, and concerns related to the traffic model. The TFS will document their review in DT2340 – Traffic Forecasting Section Microsimulation Checklist (see TPM for additional details). The reviewer, as appropriate, *should* insert "not reviewed" on DT2291 to denote which components of the traffic model they did not address during their review. The reviewer **shall** complete a peer review after each project milestone; however, they may combine their comments from each milestone onto one form. Attachment 2.3 provides a copy of DT2291.

The first page of DT2291 is where information regarding the peer review and traffic model is denoted (e.g., review date, reviewer, and analyst contact information, model completion/revision date, etc.).

The heart of the DT2291 form (pages 2 through 8) is where the reviewer documents their observations regarding the traffic model features and characteristics. This section of the form uses a three-column format. The left side of the form is where the reviewer identifies the overall acceptably of the traffic model component (acceptable, conditionally acceptable, or unacceptable) and notes the extent of the required revisions (no revisions, minor revisions, moderate revisions, or major revisions).

The center of the form provides space for detailed technical comments including reviewer-to-analyst communications. The reviewer *should* attach or insert additional sketches, screen shots, calculations, or other information that will assist the analyst in understanding the problems identified in the traffic model. Where relevant, DT2291 may include suggested techniques for improving the traffic model.

The right side of the form provides an area for the analyst to address the reviewer's comments. This is where the analyst *should* identify if and how they will revise the traffic model. If the analyst feels that no revisions to the traffic model are necessary, they *should* provide justification for their original assumptions.

The final section of DT2291 is the reviewer's sign-off. In this section, the reviewer *should* unequivocally inform the analyst and project team whether the model is (or is not) suitable for the intended purpose. If the reviewer deems the traffic model unacceptable, they *should* summarize the number and severity of the revisions required (e.g., model requires 2 minor revisions and 1 major revision).

While DT2291 provides documentation of the overall peer review process, it *should* not serve as the sole means of communication between the reviewer and the analyst. The reviewer *should* document all communications with the analyst and attach them to DT2291 for future reference. Ultimately, it is the responsibility of the project manager to monitor the peer review process to ensure efficient communication between the peer review team and the analyst.

2.4.3 Conducting the Peer Review

Regardless of the software program utilized to develop the traffic model, a good first step is to open the traffic model and observe the simulation. This allows for a visual inspection of the traffic model to identify if there is anything that just does not look right (e.g., vehicles make dramatic movements, vehicles suddenly drop off the network, vehicles are turning left from an exclusive right-turn lane, etc.). The visual inspection can help the reviewer identify which portions of the traffic model they *should* concentrate their review efforts.

As illustrated in DT2291, the typical features and characteristics of a microsimulation traffic model that the reviewer *should* review include:

- Network Coding
- Intersection Traffic Control and Ramp Metering
- Closures, Restrictions, and Incidents
- Entrance Ramps
- Lane Use Parameters
- Zone Structure/Vehicle Inputs
- O-D Matrices, Demand Profiles, and Time Periods
- Core Simulation Parameters
- Routing Parameters/Vehicle Routes
- Vehicle Types and Proportions
- Stuck/Stalled Vehicles
- Special Features
- Consistency with Related Traffic Models
- Calibration/Validation
- Documentation

This list is not all-inclusive and *should* only serve as a starting point for the peer review. It is possible for the reviewer to deem a traffic model acceptable based on all features listed above and yet the traffic model may still not be fit-for-purpose. The reviewer *should* keep a clear understanding of the project scope, goals, and intended purpose of the traffic model in mind while conducting the peer review. Additionally, the peer review process *should* always take into consideration the current capabilities and limitations of the software package and version utilized in development of the traffic model as new software features are seldom foolproof. The following text provides details on the key parameters of the traffic model that the reviewer *should* assess during their evaluation.

Currently, the department supports the use of SimTraffic and Vissim, for microsimulation, although prior to January 1, 2018, Paramics was the primary WisDOT-supported microsimulation software. Projects that initiated the microsimulation traffic analysis using Paramics prior to January 1, 2018 may continue to use Paramics for the duration of the project. Thus, it is possible that Paramics will still be in use in Wisconsin for several more years necessitating the need to provide some guidance on peer reviewing Paramics models. Refer to DT2291 for guidance on peer reviewing Paramics models.

The guidance below is specific for SimTraffic and Vissim; however, the general principles are applicable for all microsimulation software packages.

See below for additional information about how to evaluate each key feature of the traffic model.

Network Coding

Network coding establishes the horizontal and vertical geometry of the roadway network, including intersection spacing and roadway curvature. Network coding also includes appropriate use of settings such as link free-flow speed and turning speeds.

Intersection Traffic Control and Ramp Metering

Intersection controls are devices that regulate traffic flow at intersections (e.g., signals, roundabouts, stop control, and ramp meters). Elements of the signals/ramp meters may include the controller type, detector placement, signal heads, signal groups, coordination between signals, signal phasing, and signal/ramp meter-timing plans.

Closures, Restrictions, and Incidents

Closures represent temporary or permanent roadway segment, link, or lane closures (i.e., no traffic can use that roadway segment, link, or lane). Restrictions represent links or lanes that limit travel, either temporarily or permanently, to specific vehicle types (e.g., lanes designated for high-occupancy-vehicles (HOV) or lanes restricting truck use). Incidents include simulated vehicle breakdowns, crashes, etc.

Entrance Ramps

Entrance ramps or freeway merge areas typically require careful coding in microsimulation. This section is typically applicable to parallel freeway entrance ramps, although there are instances where this feature is appropriate for arterials as well. The reviewer *should* review the lane utilization upstream of the entrance ramp, the aggressiveness of the merging vehicles (e.g., minimum time on entrance ramp, driver headway factors), and the length of the acceleration lane and taper parallel to the entrance ramp.

Lane Use Parameters

Lane use parameters control the amount and destination of the traffic using each lane. A typical application of these parameters is to pre-position vehicles in advance of a fork in the road.

Zone Structure/Vehicle Inputs

Zone structure and vehicle inputs define where and how traffic loads into the network.

O-D Matrices, Demand Profiles & Time Periods

O-D matrices contain the network demand patterns (number of trips traveling between each pair of zones). Time periods and demand profiles control the timing for the release of vehicles into the network (e.g., are the vehicles released at a steady rate or at a gradually increasing/decreasing rate). In some cases, it is necessary to use multiple O-D matrices or demand profiles (e.g., there may be one matrix for cars and a second matrix for trucks). The reviewer *should* evaluate the source of the demand profile and time selection. WisDOT TFS *should* weigh in on the appropriate use of these features within the traffic model and may provide suggestions for source data (e.g., annual traffic recorders [ATR] data).

Core Simulation Parameters

Core simulation parameters affect fundamental aspects of vehicle behavior in the network, such as driver aggressiveness and the willingness to merge into small gaps. Default values are acceptable for some parameters, but other parameters require project-or-area-specific values. Thus, the reviewer *should* check all core simulation values for reasonableness.

Routing Parameters/Vehicle Routes

Routing parameters influence the way vehicles travel through the network. If coded improperly, these controls can cause unrealistic or erratic routing.

Vehicle Types and Proportions

The proportion and types of vehicles (such as trucks, buses, and HOVs) influence the overall performance of each part of the network. The reviewer *should* verify that the traffic model utilizes actual field data to the best extent possible.

Stuck/Stalled Vehicles

Stuck or stalled vehicles are vehicles that unexpectedly slow or stop partway through their route. They can cause backups that do not exist in the field. The reviewer *should* note any problems with stuck or stalled vehicles, including intermittent problems.

Special Features

Special features include site or study-specific items such as the use of detectors, car parks, variable message signs, special purpose lanes, speed harmonization, public transit routes, toll lanes, toll plazas, pedestrian modeling, special graphics, plugins, or scripts, among others.

Consistency with Related Traffic Models

Complex projects often involve a series of related traffic models (existing, future no-build, future build alternatives, AM/PM peak period, etc.). To assure the integrity of the study, these traffic models must be consistent. Additionally, adjacent and overlapping model areas *should* utilize consistent analysis methodologies. The results of the traffic model *should* not contradict the results of the TDM.

Calibration/Validation

Calibration refers to the process where the analyst adjusts selected input parameters within the traffic model (typically driver behavior elements including headway and reaction times, driver aggressiveness, etc. and roadway elements like sign posting) such that the traffic model represents field conditions. See TEOpS 16-20-5 for additional details on the calibration process.

Validation is the independent process where the analyst checks the traffic model outputs against field measured or benchmark data including traffic volumes, travel speeds, travel times, intersection queuing, and trip-making patterns (e.g., weaving volumes), among others. See TEOpS 16-20-8 for additional details on the validation process.

A properly calibrated and validated traffic model *should* accurately reflect real-world traffic conditions and *should* meet the purpose and need of the project. The analyst *should* document the methodology and assumptions utilized to calibrate and validate the traffic model and *should* submit the modeling methodology report along with the traffic model to the peer review team for review.

The reviewer *should* spot-check the traffic model outputs and compare them to the results documented in the modeling methodology report. If the reviewer cannot produce similar outputs, it may indicate an issue with the traffic model's calibration. See TEOpS 16-20 for additional details on model calibration and validation.

Documentation

Proper documentation of modeling methods and assumptions establishes accountability and facilitates efficient revision, updating, and follow-up. The review team *should* verify proper documentation of the modeling methods.

2.5 Document Results

It is critical to document any correspondence between the peer review team and traffic analyst regarding the peer review process. The peer review team members and traffic analyst *should* document the correspondence within, or as attachments to, the appropriate review form (DT1887 or DT2291). The correspondence **shall** include how the traffic analyst revised the traffic model to address the peer review comments or provide justification as to why the analyst chose not to revise the traffic model. On projects where the peer review team and traffic analyst interact frequently, it may be necessary to provide a separate document to detail all the correspondences. Attachment 2.4 provides examples of ways to document the communication between the project team and traffic analyst. The project manager **shall** include the additional documentation along with all completed DT1887 and DT2291 forms within the project's records file.

The region **shall** provide a summary of the peer review process for all microsimulation traffic models (including all SimTraffic models used for project or study decisions, especially any related to critical aspects of the design) to BTO-TASU for information and tracking purposes. The summary **shall** identify the following aspects associated with the peer review process:

1. Project information (project identification number, project name, study area, study limits)
2. Name of analyst
3. Name of lead peer reviewer
4. Summary of peer review results (DT1887, DT2291, correspondence documentation)
5. Copy of all FHWA comments on the traffic model

Even if BTO-TASU is not part of the peer review team, it is generally advantageous for the project team to inform BTO-TASU of any pending peer reviews, specifically those for a microsimulation traffic model. This allows BTO-TASU to assess whether there are any potential overlapping peer reviews that may impact the project's schedule.

The project manager or region traffic operations **shall** email a copy of all interim and final DT2291 forms, including FHWA comments, to BTO-TASU (DOTTrafficAnalysisModeling@dot.wi.gov). WisDOT regional traffic staff **shall** also include a copy of the relevant DT1887 and DT2291 forms with the submittal of all Phase II – Alternative Selection Intersection Capacity Evaluation (ICE) reports.

LIST OF ATTACHMENTS

Attachment 2.1	Traffic Model Complexity Scoring Template
Attachment 2.2	DT1887 HCM Analysis Review Checklist
Attachment 2.3	DT2291 Microsimulation Peer Review Report
Attachment 2.4	Sample Correspondence

WisDOT Traffic Model Complexity - Scoring Template

Last Updated: 07-19-17

Applicable for determining the number of MOEs required for model validation and for determining the required level of peer review

__Instructions:__ Fill in gray boxes to determine the model complexity, the number of MOEs needed for validation, and the level of traffic model peer review effort required. Choose appropriate project category in **Table 1: Project type**. Choose primary network type in **Table 2: Geometrics Scoring** and mark applicable categories. Mark all applicable categories in **Table 3: Traffic Pattern and Congestion Scoring**. Final scoring reflects the highest point value in each table (maximum of 24 points). **Table 4** shows the overall model complexity score. **Table 5** shows recommended procedure for identifying the type/number of MOEs to use for model validations and scoping the traffic model peer review. Consider existing conditions and potential future alternatives that the project/study is anticipated to cover.

WisDOT Region:		Ex: SE, SW, NE
Project:		Ex: STH __ Corridor Study
Project ID:		Ex: 1234-56-7890
Project Description:		Ex: City - City
Highway:		Ex: STH __
County:		Ex: Dane County
Traffic Conditions:		Ex: Base (Existing), Base and Future
Modeling Software:		Ex: Paramics, Vissim, SimTraffic

General Project Description:
Ex: Limits of project (Size of Network, # of TAZs), other software used for analysis, anticipated O-D data source, assumptions on Future scenarios, etc.

Table 1: Project Type

Complete (1):	Check a that apply:						
(1) Project Type	Category	Traffic Impact Analysis (TIA), Intersection Control Evaluation (ICE), or similar (Small Influence Area)	Traffic Impact Analysis (TIA), Intersection Control Evaluation (ICE), or similar (Large Influence Area)	Corridor Study/Operational Needs Study or Standard Improvement Project (Small Network)	Corridor Study/Operational Needs Study or Standard Improvement Project (Large Network)	High Profile Project, Potential Mega/Major Project (EA, PEL, EIS)	Mega or Majors Project
	Point Total	0	1	2	3	4	4
	Applicable?	0	0	0	0	0	0

__Note:__ Large Network category assumed to contain 20 or more Traffic Analysis Zones (TAZs).

Table 2: Geometrics Scoring

Choose (1) or (2):	Check a that apply:						
(1) Intersections and Streets/Corridors	Category	Isolated Intersection(s)	Signalized Corridor / Network (No Coordination)	Roundabout Corridor / Network	Signalized Corridor / Network (Coordinated)	Mixed Corridor / Network (Signals and Roundabouts)	Adaptive Signal Control System
	Point Total	0	1	2	2	3	4
	Applicable?	0	0	0	0	0	0
Or							
(2) Freeways	Category	Mainline and Simple Merges/Diverges Only	System Interchange with Multilane Ramps	Freeway with Interchanges and Arterials	Interchanges with Roundabout Ramp Terminals	Unconventional Interchanges (DDI, Echelon, SPUI, etc.)	Managed Lanes, Variable Message Signs, etc.
	Point Total	0	1	1	2	3	4
	Applicable?	0	0	0	0	0	0

Table 3: Traffic Pattern and Congestion Scoring

Complete (1), (2), and (3):	Check a that apply:						
(1) Routing		All-or-Nothing Routing Assignment				Dynamic/Variable Routing	
	Category	Single Routes (Intersection or Corridor)	Networks with Few (2-3) Route Options	Freeway with Parallel Lower Functional Class Streets	Grid System with Numerous Route Options	Freeway Network with Parallel Route Options	Grid System with Numerous Route Options
	Point Total	0	1	2	3	3	4
	Applicable?	0	0	0	0	0	0
(2) OD Estimation	Category	Single Intersection(s) / No Estimation	Small Network, Few Routes	Large Network, Few Routes	Small Network, Multiple Routes	Large Network, Multiple Routes	
	Point Total	0	1	2	3	4	
	Applicable?	0	0	0	0	0	
(3) Existing/Anticipated Level of Congestion	Category	- LOS C or better operations - Minor queuing (<500') - Free flow travel speeds/times	- LOS C-D operations - Moderate queuing (500-1,000') - Minor delays in travel speeds/times	- LOS D-E operations - Moderate queuing (500-1,000') - Moderate delays in travel speeds/times	- LOS F operations (future) - Significant queuing (>1,000') - Significant delays in travel speeds/times	- LOS F operations (existing) - Significant queuing (>1,000') - Significant delays in travel speeds/times	
	Point Total	0	1	2	3	4	
	Applicable?	0	0	0	0	0	

__Note:__ Large Network category assumed to contain 20 or more TAZs. Congestion level takes into account worst-case controlled intersections or roadway segments. Queue lengths are through lane queues.

Table 4: Scoring Results

Project Type	Total	0
Geometrics Subtotal	Intersections and Corridors	0
	Freeways	0
	Total	0
Traffic Pattern and Congestion Subtotal	Routing	0
	OD Estimation	0
	Level of Congestion	0
	Total	0
Total Points		0

Table 5: Recommendations

Point Scale	Minimum # of MOEs Required for Validation	Level of Peer Review Recommendations	
		Recommendation Type	Estimated Schedule for Initial Review (including data collection, coordination, etc.)
0 - 3	1 to 2 Primary MOEs	High-level WisDOT Region review.	1-2 weeks existing conditions 1-2 weeks per alternative
4 - 7	1 to 2 Primary MOEs 1 Secondary MOE	WisDOT Region conducts peer review with assistance from independent consultant or BTO as necessary.	3-4 weeks existing conditions 3-4 weeks per alternative
8 - 10	2 to 3 Primary MOEs 1 Secondary MOE	Independent consultant conducts peer review with WisDOT Region input and BTO assistance as necessary.	4-8 weeks existing conditions 4-8 weeks per alternative
11+	2 to 3 Primary MOEs 1 to 2 Secondary MOEs	Independent consultant conducts peer review with WisDOT Region, BTO, other WisDOT Bureau involvement and FHWA oversight.	2-4 months existing conditions (no FHWA) 2-4 months per alternative (no FHWA) 3-4 months existing conditions (with FHWA) 3-4 months per alternative (with FHWA)

***Note:** A minimum of 6 weeks should be allowed for Traffic Forecasting to review the existing/future volumes for all levels of peer review

Access Excel file via the following link: http://wisconsindot.gov/dtsdManuals/traffic-ops/programs/analysis/trafficmodelpeerreview.xlsx

HCM ANALYSIS REVIEW CHECKLIST

Wisconsin Department of Transportation (WisDOT)
DT1887 3/2019

			Date(s) Reviewed (m/d/yyyy)		
Project ID(s):	Highway(s)/Intersection(s):	Region:	1st Review	2nd Review	3rd Review
Lead Reviewer	Name:	Contact Information:			
Lead Analyst	Name:	Contact Information:			

TRAFFIC MODEL DESCRIPTION

Identify the model completion/revision date, the scope of the model, the analysis year(s), the analysis time period(s), and analysis tool/version

SUMMARY OF REVIEW

	Acceptability	Reviewer Comment(s):	Analyst Response(s):
Traffic Analysis Tool/Version	☐ ☐ ☐ Acceptable/ No Revision Required ☐ ☐ ☐ Conditionally Acceptable/ Minor Revision Required ☐ ☐ ☐ Unacceptable/ Major Revision Required		
Lane Geometry	☐ ☐ ☐ Acceptable/ No Revision Required ☐ ☐ ☐ Conditionally Acceptable/ Minor Revision Required ☐ ☐ ☐ Unacceptable/ Major Revision Required		
Traffic Volumes, % Trucks, Peak Hour Factor (PHF)	☐ ☐ ☐ Acceptable/ No Revision Required ☐ ☐ ☐ Conditionally Acceptable/ Minor Revision Required ☐ ☐ ☐ Unacceptable/ Major Revision Required		

SUMMARY OF REVIEW *(continued)*

Category	Acceptability	Reviewer Comment(s):	Analyst Response(s):
Signal Parameters (Including RTOR)	☐ ☐ ☐ Acceptable/ No Revision Required ☐ ☐ ☐ Conditionally Acceptable/ Minor Revision Required ☐ ☐ ☐ Unacceptable/ Major Revision Required		
Stop Control/ Roundabout Parameters	☐ ☐ ☐ Acceptable/ No Revision Required ☐ ☐ ☐ Conditionally Acceptable/ Minor Revision Required ☐ ☐ ☐ Unacceptable/ Major Revision Required		
Freeway/ Highway Parameters	☐ ☐ ☐ Acceptable/ No Revision Required ☐ ☐ ☐ Conditionally Acceptable/ Minor Revision Required ☐ ☐ ☐ Unacceptable/ Major Revision Required		
Other:	☐ ☐ ☐ Acceptable/ No Revision Required ☐ ☐ ☐ Conditionally Acceptable/ Minor Revision Required ☐ ☐ ☐ Unacceptable/ Major Revision Required		
Overall Model	☐ ☐ ☐ Acceptable/ No Revision Required ☐ ☐ ☐ Conditionally Acceptable/ Minor Revision Required ☐ ☐ ☐ Unacceptable/ Major Revision Required		

MICROSIMULATION PEER REVIEW REPORT

Wisconsin Department of Transportation (WisDOT)

DT2291 9/2015

Reviewer, please email completed form to:

To: Project Manager & Region Contact

CC: DOT Traffic Model Peer Review

Subject: DT2291 for Project ID; Traffic Model Name

	1st Review	2nd Review	3rd Review
Date Reviewed (m/d/yyyy):			
Reviewed By:			
Model Completion/Revision Date(m/d/yyyy):			

CONTACT INFORMATION

Lead Reviewer	Lead Analyst	Region Contact
Name (First, MI, Last)	Name (First, MI, Last)	Name (First, MI, Last)
Organization/Firm	Organization/Firm	Region/Bureau
(Area Code) Telephone Number	(Area Code) Telephone Number	(Area Code) Telephone Number
Email Address	Email Address	Email Address

TRAFFIC MODEL DESCRIPTION

Project ID(s)	Project Name/Description	Region:	Highway(s)
Traffic Model Name/Description	Analysis Scenario/Alternative	Analysis Year(s)	

Analysis Time Period (s)

☐ Weekday AM Peak Hours: ☐ Weekday Midday Peak Hours: ☐ Weekday PM Peak Hours: ☐ Fri Peak Hours: ☐ Sat Peak Hours: ☐ Sun Peak Hours: ☐ Other: Hours:

Analysis Tool(s) Utilized

☐ SimTraffic- Version: ☐ Paramics - Version: ☐ Vissim - Version: ☐ Other: - Version:

SCOPE AND EXTENT OF PEER REVIEW

Purpose & Scope of Review

Description/Limit of Model

Configuration Settings

Number of Zones:	Number of Time Steps:	Speed Memory:	Assignment Type:
Mean Target Headway:	Mean Reaction Time	Matrix Structure	Vehicle Classifications/Splits
Seed Values Used for Calibration:			
Seed Values Used for Review:			
Other:			

Were any changes to the model made by the review team? If yes, please describe.

DIRECTIONS

This form is applicable for the review of all microsimulation traffic models, regardless of the traffic software program utilized to develop the traffic model. However, this form focuses on the SimTraffic, Paramics and Vissim microsimulation software packages.

When noting problems or concerns, identify the severity of the issue and the revisions recommended using the following scale: Minor, Moderate, or Major. Check the appropriate box associated with each review (the blue box for the 1st review, the green box for the 2nd review and the purple box for the 3rd review).

If more than one review of the traffic model is required, use different color text to distinguish the comments associated with each review (e.g., comments from the 1st review should be in blue text, comments from the 2nd review should be in green text, and comments from the 3rd review should be in purple text). Provide any supporting tables, screenshots, or additional images in a separate attachment to this form.

OBSERVATIONS, MODEL FEATURES AND CHARACTERISTICS

Geometrics /Traffic Control

Network Coding	*Network Coding establishes the horizontal and vertical geometry of the network. It also includes the appropriate use of settings such as link free-flow speed.* • *For SimTraffic, this is coded within the Synchro module and includes placement and interconnection of nodes and links, number of lanes, lane widths, lane configurations, roadway curvature, storage lengths, and other intersection and network geometry.* • *For Paramics this includes placement and interconnection of nodes, links and link categories, curb points, curves, turn lanes, merge points, stop bars, signposts, and other network infrastructure.* • *For VISSIM this includes the placement and interconnection of links, connectors, desired speed decisions, reduced speed areas, conflict areas, and priority rules.*	
As a whole, network coding is:	**Observations/Comments:**	**Analyst Response**
☐ ☐ ☐ Acceptable ☐ ☐ ☐ Conditionally Acceptable ☐ ☐ ☐ Unacceptable Extent of Revisions Required: ☐ ☐ ☐ No Revisions Required ☐ ☐ ☐ Minor Revisions Required ☐ ☐ ☐ Moderate Revisions Required ☐ ☐ ☐ Major Revisions Required	1st Review 2nd Review 3rd Review	1st Review 2nd Review 3rd Review
Intersection Traffic Control & Ramp Metering	*Intersection Controls are devices that regulate traffic flow at intersections, such as signals, roundabouts, and stop-controlled intersections. Elements of the signals may include the controller type, detector placement, signal heads, signal groups, and/or coordination between signals. Ramp meters control the rate of entry to a freeway. Comments on signal and ramp meter timing plans may be included in this section.*	
As a whole, intersection controls are:	**Observations/Comments:**	**Analyst Response**
☐ ☐ ☐ Acceptable ☐ ☐ ☐ Conditionally Acceptable ☐ ☐ ☐ Unacceptable Extent of Revisions Required: ☐ ☐ ☐ No Revisions Required ☐ ☐ ☐ Minor Revisions Required ☐ ☐ ☐ Moderate Revisions Required ☐ ☐ ☐ Major Revisions Required	1st Review 2nd Review 3rd Review	1st Review 2nd Review 3rd Review

Geometrics /Traffic Control

Closures, Restrictions, & Incidents	*Closures represent links or lanes that are temporarily or permanently closed to traffic. Restrictions represent links or lanes that are temporarily or permanently closed to specific types of vehicles (such as lanes designated for High Occupancy Vehicles or lanes restricting truck use). Incidents include simulated vehicle break-downs, etc.* • *This feature is **not** applicable for SimTraffic*	
As a whole closures, restrictions & incidents are:	**Observations/Comments:**	**Analyst Response**
☐ ☐ ☐ Acceptable ☐ ☐ ☐ Conditionally Acceptable ☐ ☐ ☐ Unacceptable Extent of Revisions Required: ☐ ☐ ☐ No Revisions Required ☐ ☐ ☐ Minor Revisions Required ☐ ☐ ☐ Moderate Revisions Required ☐ ☐ ☐ Major Revisions Required	1st Review 2nd Review 3rd Review	1st Review 2nd Review 3rd Review

Entrance Ramps	*Driver behavior and lane utilization approaching entrance ramps should be reviewed in this section.* • *For SimTraffic, modifications to the default mandatory distance and positioning distance settings should be reviewed.* • *For Paramics, modifications to default ramp headway, minimum ramp time, and ramp aware distance should be reviewed. The minimum ramp time setting specifies how long a driver will stay on the parallel entrance ramp before beginning to look for a gap to merge onto the freeway.* • *For VISSIM, the effective merging area defined by the positions of the links and connectors should be reviewed.*	
As a whole, the vehicle behavior approaching entrance ramps is:	**Observations/Comments:**	**Analyst Response**
☐ ☐ ☐ Acceptable ☐ ☐ ☐ Conditionally Acceptable ☐ ☐ ☐ Unacceptable Extent of Revisions Required: ☐ ☐ ☐ No Revisions Required ☐ ☐ ☐ Minor Revisions Required ☐ ☐ ☐ Moderate Revisions Required ☐ ☐ ☐ Major Revisions Required	1st Review 2nd Review 3rd Review	1st Review 2nd Review 3rd Review

Lane Use Parameters	*Lane use parameters control the amount and/or destination of the traffic using each lane. A typical application of these parameters is to pre-position vehicles in advance of a fork in the road*	
As a whole, lane use parameters are:	**Observations/Comments:**	**Analyst Response**
☐ ☐ ☐ Acceptable ☐ ☐ ☐ Conditionally Acceptable ☐ ☐ ☐ Unacceptable Extent of Revisions Required: ☐ ☐ ☐ No Revisions Required ☐ ☐ ☐ Minor Revisions Required ☐ ☐ ☐ Moderate Revisions Required ☐ ☐ ☐ Major Revisions Required	1st Review 2nd Review 3rd Review	1st Review 2nd Review 3rd Review

Traffic/Global

Zone Structure/Vehicle Inputs	*Zone structure and vehicle inputs define where and how traffic is loaded into the network.* • *For SimTraffic, the intersection turning movement volumes from the Synchro module determine how the traffic is loaded into the network. If volumes are imbalanced in the Synchro network, SimTraffic will assume a traffic source or sink between nodes (such as driveways). Reviewer should note imbalances that may not be realistic or representative of the network.* • *For Paramics, zone structure relates to the placement of the zones representing the locations where traffic enters or leaves the network. Observations related to sectors and zone connectors should be included in this section. If the microsimulation model zones are derived from a travel demand model, reviewers should use this section to note any issues related to the consistency of the Paramics input data with respect to the travel demand model data.* • *For VISSIM, vehicle inputs control where traffic is loaded into the network and how much is loaded. Reviewer should use this section to note any issues related to the consistency of input data related to the sources.*	
As a whole, zone structure and vehicle inputs are:	**Observations/Comments:**	**Analyst Response**
☐ ☐ ☐ Acceptable ☐ ☐ ☐ Conditionally Acceptable ☐ ☐ ☐ Unacceptable Extent of Revisions Required: ☐ ☐ ☐ No Revisions Required ☐ ☐ ☐ Minor Revisions Required ☐ ☐ ☐ Moderate Revisions Required ☐ ☐ ☐ Major Revisions Required	1st Review 2nd Review 3rd Review	1st Review 2nd Review 3rd Review
O-D Matrices, Demand Profiles, & Time Periods	*Origin-Destination (O-D) matrices contain the network demand patterns (number of trips between each pair of zones). Time Periods and Demand Profiles control the timing of the release of the trips into the network. In some cases multiple matrices are used (for example separate matrices for cars and heavy trucks). The reviewer should evaluate the source of the demand profile and time period selection.* • *For SimTraffic, network-wide O-D Matrices and demand profiles are not applicable. The intersection turning movement volumes, rather than network-wide O-D matrices, determines the origin and destination of the traffic. The Link O-D volumes setting can be modified within Synchro to model the weaving interaction between 2 adjacent intersections (such as zeroing out an off-ramp left-turn to on-ramp left-turn movement at a diamond interchange). Volume adjustment factors, rather than demand profiles, dictate the percentage of peak hour traffic to load into the network for each analysis period. Thus the intersection turning movement volumes, Link O-D volumes, volume adjustment factors (such as growth factor and PHF adjust settings), and the time and duration of the seeding (i.e., warm-up period) and recording (i.e., analysis period) periods should be reviewed.*	
As a whole, O-D matrices, demand profiles, & time periods are:	**Observations/Comments:**	**Analyst Response**
☐ ☐ ☐ Acceptable ☐ ☐ ☐ Conditionally Acceptable ☐ ☐ ☐ Unacceptable Extent of Revisions Required: ☐ ☐ ☐ No Revisions Required ☐ ☐ ☐ Minor Revisions Required ☐ ☐ ☐ Moderate Revisions Required ☐ ☐ ☐ Major Revisions Required	1st Review 2nd Review 3rd Review	1st Review 2nd Review 3rd Review

Traffic/Global

Core Simulation Parameters	*Core simulation parameters affect fundamental aspects of vehicle behavior in the network, such as driver aggressiveness and the willingness to merge into small gaps. Modifications to default software values should be reviewed.* • *For SimTraffic, examples of core simulation parameters to review include driver and vehicle characteristics and behaviors.* • *For Paramics, examples of core simulation parameters to review include mean target headway, mean target reaction time, perturbation, global routing cost coefficients, driver familiarity, time steps, speed memory, allowing heavy vehicles to use all lanes, and matrix tuning.* • *For VISSIM, examples of core simulation parameters to review include Driving Behaviors, Simulation Resolution, and Speed Distributions.*	
As a whole, core simulation parameters are:	**Observations/Comments:**	**Analyst Response**
☐ ☐ ☐ Acceptable ☐ ☐ ☐ Conditionally Acceptable ☐ ☐ ☐ Unacceptable Extent of Revisions Required: ☐ ☐ ☐ No Revisions Required ☐ ☐ ☐ Minor Revisions Required ☐ ☐ ☐ Moderate Revisions Required ☐ ☐ ☐ Major Revisions Required	1st Review 2nd Review 3rd Review	1st Review 2nd Review 3rd Review

Routing Parameters/ Vehicle Routes	*Routing parameters or vehicle routes influence the way vehicles travel through the network. If coded improperly, these controls can cause unrealistic or erratic routing.* • *This feature is **not** applicable for SimTraffic. However, interaction between intersections can be checked as noted with the Link O-D feature in the O-D Matrices, Demand Profiles, & Time Periods section.* • *For Paramics, routing parameters (such as cost factors, turn penalties, modification of the link type hierarchy, and waypoints) override the default routing behavior and profoundly influence the route choice in the network. They are occasionally used to increase or decrease the traffic volume on specific links.* • *For VISSIM, vehicle routes and vehicle routing decisions control the flow of traffic from the entrance points through the network. They can be coded using either actual vehicle flows or percentages.*	
As a whole, traffic routing parameters are:	**Observations/Comments:**	**Analyst Response**
☐ ☐ ☐ Acceptable ☐ ☐ ☐ Conditionally Acceptable ☐ ☐ ☐ Unacceptable Extent of Revisions Required: ☐ ☐ ☐ No Revisions Required ☐ ☐ ☐ Minor Revisions Required ☐ ☐ ☐ Moderate Revisions Required ☐ ☐ ☐ Major Revisions Required	1st Review 2nd Review 3rd Review	1st Review 2nd Review 3rd Review

Traffic/Global

Vehicle Types & Proportions	*The proportion of vehicles (such as trucks, buses, and High Occupancy Vehicles) influences the overall performance of each part of the network. Vehicle lengths (such as heavy truck lengths) should be reviewed.*	
As a whole, vehicle types & proportions are:	**Observations/Comments:**	**Analyst Response**
☐ ☐ ☐ Acceptable ☐ ☐ ☐ Conditionally Acceptable ☐ ☐ ☐ Unacceptable Extent of Revisions Required: ☐ ☐ ☐ No Revisions Required ☐ ☐ ☐ Minor Revisions Required ☐ ☐ ☐ Moderate Revisions Required ☐ ☐ ☐ Major Revisions Required	1st Review 2nd Review 3rd Review	1st Review 2nd Review 3rd Review
Stuck/Stalled Vehicles	*This section should be used to note any problems with stuck or stalled vehicles (including intermittent problems). These are vehicles that unexpectedly slow or stop partway through their route (which can cause backups that do not exist in the field).* • *For Paramics, this section should also be used for comments on the use of blockage removal tools, if used.* • *For SimTraffic, this section should be used to comment on if short links may be resulting in stuck or stalled vehicles within the network.*	
As a whole, stuck/stalled vehicle occurrence is :	**Observations/Comments:**	**Analyst Response**
☐ ☐ ☐ Acceptable ☐ ☐ ☐ Conditionally Acceptable ☐ ☐ ☐ Unacceptable Extent of Revisions Required: ☐ ☐ ☐ No Revisions Required ☐ ☐ ☐ Minor Revisions Required ☐ ☐ ☐ Moderate Revisions Required ☐ ☐ ☐ Major Revisions Required	1st Review 2nd Review 3rd Review	1st Review 2nd Review 3rd Review
Special Features	*Special features include site- or study-specific items such as the use of detectors, car parks, variable message signs, special purpose lanes, speed harmonization, public transit routes, toll lanes, toll plazas, pedestrian modeling, special graphics, Application Programming Interfaces (APIs), etc* • *At present, SimTraffic will not model bus stops, bus routes, bus and carpool lanes, light rail, on-street parking, or short term event; thus, the use of special features is typically not applicable in SimTraffic.*	
As a whole, use of special features is :	**Observations/Comments:**	**Analyst Response**
☐ ☐ ☐ Acceptable ☐ ☐ ☐ Conditionally Acceptable ☐ ☐ ☐ Unacceptable Extent of Revisions Required: ☐ ☐ ☐ No Revisions Required ☐ ☐ ☐ Minor Revisions Required ☐ ☐ ☐ Moderate Revisions Required ☐ ☐ ☐ Major Revisions Required	1st Review 2nd Review 3rd Review	1st Review 2nd Review 3rd Review

<table>
<tr><td rowspan="3">Traffic/Global</td><td>Consistency with Related Traffic Models</td><td colspan="2">Modeling studies often involve a series of related models (base model, future no-build, and build alternatives, different times of day, etc.). To assure the integrity of the study as a whole, these models must be consistent.</td></tr>
<tr><td>As a whole, model consistency is :</td><td>Observations/Comments:</td><td>Analyst Response</td></tr>
<tr><td>☐ ☐ ☐ Acceptable
☐ ☐ ☐ Conditionally Acceptable
☐ ☐ ☐ Unacceptable
Extent of Revisions Required:
☐ ☐ ☐ No Revisions Required
☐ ☐ ☐ Minor Revisions Required
☐ ☐ ☐ Moderate Revisions Required
☐ ☐ ☐ Major Revisions Required</td><td>1st Review

2nd Review

3rd Review</td><td>1st Review

2nd Review

3rd Review</td></tr>
<tr><td rowspan="6">Calibration/Validation/Documentation</td><td>Calibration/Validation</td><td colspan="2">Calibration refers to the process where the analyst adjusts selected parameters within the traffic model (e.g., global and local headway and reaction times, driver aggressiveness, etc.) in order to get the traffic model to reproduce conditions observed in the field. Validation refers to the process where the analyst checks the traffic model outputs against field measured data including traffic volumes, travel speeds, travel times, intersection queuing and trip-making patterns (e.g., weaving volumes). The reviewer should spot-check the traffic model outputs and compare them to the results documented in the calibration/validation report. If the reviewer cannot produce similar outputs, it may indicate an issue with the traffic model's calibration.</td></tr>
<tr><td>As a whole, model calibration is :</td><td>Observations/Comments:</td><td>Analyst Response</td></tr>
<tr><td>☐ ☐ ☐ Acceptable
☐ ☐ ☐ Conditionally Acceptable
☐ ☐ ☐ Unacceptable
Extent of Revisions Required:
☐ ☐ ☐ No Revisions Required
☐ ☐ ☐ Minor Revisions Required
☐ ☐ ☐ Moderate Revisions Required
☐ ☐ ☐ Major Revisions Required</td><td>1st Review

2nd Review

3rd Review</td><td>1st Review

2nd Review

3rd Review</td></tr>
<tr><td>Documentation</td><td colspan="2">Proper documentation of modeling methods and assumptions establishes accountability and facilitates efficient revision, updating, and follow-up. Review team should verify that proper documentation has been provided.</td></tr>
<tr><td>As a whole, model documentation is :</td><td>Observations/Comments:</td><td>Analyst Response</td></tr>
<tr><td>☐ ☐ ☐ Acceptable
☐ ☐ ☐ Conditionally Acceptable
☐ ☐ ☐ Unacceptable
Extent of Revisions Required:
☐ ☐ ☐ No Revisions Required
☐ ☐ ☐ Minor Revisions Required
☐ ☐ ☐ Moderate Revisions Required
☐ ☐ ☐ Major Revisions Required</td><td>1st Review

2nd Review

3rd Review</td><td>1st Review

2nd Review

3rd Review</td></tr>
</table>

MICROSIMULATION PEER REVIEW REPORT *(continued)*

Wisconsin Department of Transportation (WisDOT) **DT2291**

SUMMARY OF REVIEW

Overall Traffic Model	As a whole, the traffic model is :	Summary of the review team's findings and recommendations
	☐ ☐ ☐ Acceptable ☐ ☐ ☐ Conditionally Acceptable ☐ ☐ ☐ Unacceptable Extent of Revisions Required: ☐ ☐ ☐ No Revisions Required ☐ ☐ ☐ Minor Revisions Required ☐ ☐ ☐ Moderate Revisions Required ☐ ☐ ☐ Major Revisions Required	1st Review 2nd Review 3rd Review

REVIEWER'S CONCULSION (Check One)

☐ ☐ ☐ *It is the opinion of the review team that the model as reviewed and tested is an accurate and reasonable representation of the traffic conditions in the study area for the analysis year, time period, and scenario/alternative indicated in the title block of this document.*

☐ ☐ ☐ *It is the opinion of the review team that the model as reviewed and tested requires correction of ______ errors before it can be regarded as a reasonable representation of the traffic conditions in the study area for the analysis year, time period, and scenario/alternative indicated in the title block of this document. (Indicate number and severity of errors: Minor, Moderate, or Major).*

Prepared By (Signature)	Date	Contact Information
	Click here to enter a date.	Phone: Email:
Prepared By (Signature)	**Date**	**Contact Information (Phone, Email)**
	Click here to enter a date.	Phone: Email:
Prepared By (Signature)	**Date**	**Contact Information (Phone, Email)**
	Click here to enter a date.	Phone: Email:

HCM ANALYSIS REVIEW CHECKLIST

Wisconsin Department of Transportation (WisDOT)

DT1887 3/2019

			Date(s) Reviewed (m/d/yyyy)		
Project ID(s): 85-75-3072	Highway(s)/Intersection(s): USH 888 (N/S) & STH 747 (E/W)I	Region: NE	1st Review 3/12/2019	2nd Review 4/11/2019	3rd Review
Lead Reviewer	Name: Review is All We Do (RIAWD)	Contact Information: RIAWD@email.com			
Lead Analyst	Name: Traffic Models 'R Us (TMRU)	Contact Information: TMRU@email.com			

TRAFFIC MODEL DESCRIPTION

Identify the model completion/revision date, the scope of the model, the analysis year(s), the analysis time period(s), and analysis tool/version

Synchro model for USH 888 (N/S) & STH 747 (E/W) in Blue Moose, WI, Analysis is for the 2040 AM (7-9) & PM (3:30-5:30) peak hours for the baseline and alternative #2 (enhanced signal) scenarios. Used Synchro 10.3.28. Model was completed on 11/15/2018

SUMMARY OF REVIEW

Traffic Analysis Tool/Version	**Acceptability**	**Reviewer Comment(s):**	**Analyst Response(s):**
	☒ ☒ ☐ Acceptable/ No Revision Required ☐ ☐ ☐ Conditionally Acceptable/ Minor Revision Required ☐ ☐ ☐ Unacceptable/ Major Revision Required	Used the most recent version of Synchro available at time model was completed. This is acceptable. As a note for future projects, WisDOT is now utilizing Synchro 10.3.122	Thanks for the info about the new version of Synchro.

Lane Geometry	**Acceptability**	**Reviewer Comment(s):**	**Analyst Response(s):**
	☐ ☒ ☐ Acceptable/ No Revision Required ☒ ☐ ☐ Conditionally Acceptable/ Minor Revision Required ☐ ☐ ☐ Unacceptable/ Major Revision Required	WB right turn lane is channelized in the plans but not in the model. Please correct. WBR is now shown as channelized in the model	WBR should be channelized. This has been corrected

Traffic Volumes, % Trucks, Peak Hour Factor (PHF)	**Acceptability**	**Reviewer Comment(s):**	**Analyst Response(s):**
	☐ ☒ ☐ Acceptable/ No Revision Required ☒ ☐ ☐ Conditionally Acceptable/ Minor Revision Required ☐ ☐ ☐ Unacceptable/ Major Revision Required	Heavy vehicle (HV) percentage set to 2% for all approaches. From the 2018 turning movement count, the NB AM has 8% HV and NB PM has 13% HV. Other approaches should also be examined in both peak periods. Truck percentages are now acceptable.	2018 field data now incorporated into both the AM and PM models. These percentages are expected to remain constant.

SUMMARY OF REVIEW *(continued)*

	Acceptability	Reviewer Comment(s):	Analyst Response(s):
Signal Parameters (Including RTOR)	☐ ☒ ☐ Acceptable/ No Revision Required ☒ ☐ ☐ Conditionally Acceptable/ Minor Revision Required ☐ ☐ ☐ Unacceptable/ Major Revision Required	The EBR Saturated Flow Rate (RTOR) is set to 90vph, or half of the 180vph AM demand; it should be set to 68vph per TEOpS 16-15-5.2 (0.38*180 = 68) RTOR volumes were updated and are now acceptable	Saturated Flow Rate (RTOR) has been set to 68 vph. All other RTOR volumes were checked and are in compliance with TEOpS 16-15-5.2
Stop Control/ Roundabout Parameters	☐ ☐ ☐ Acceptable/ No Revision Required ☐ ☐ ☐ Conditionally Acceptable/ Minor Revision Required ☐ ☐ ☐ Unacceptable/ Major Revision Required	N/A	
Freeway/ Highway Parameters	☐ ☐ ☐ Acceptable/ No Revision Required ☐ ☐ ☐ Conditionally Acceptable/ Minor Revision Required ☐ ☐ ☐ Unacceptable/ Major Revision Required	N/A	
Other: Pedestrian Movements	☐ ☒ ☐ Acceptable/ No Revision Required ☒ ☐ ☐ Conditionally Acceptable/ Minor Revision Required ☐ ☐ ☐ Unacceptable/ Major Revision Required	NB pedestrian traffic was included in the base year analysis - why is this not included here? Given the construction of the path, it is acceptable to not consider pedestrian impacts here.	Though not documented here, an off-road paved path will be constructed to the west as part of this alternative. This will serve NB pedestrian traffic destinations and remove almost all NB pedestrian traffic. Please confirm that it is acceptable to not include any NB pedestrian traffic in the analysis.
Overall Model	☐ ☒ ☐ Acceptable/ No Revision Required ☒ ☐ ☐ Conditionally Acceptable/ Minor Revision Required ☐ ☐ ☐ Unacceptable/ Major Revision Required	EBL movement has LOS E in the PM while the NBT/SBT have LOS B. Can signal timings be adjusted to make green time more equitable? See other comments above The adjusted signal timing results in acceptable LOS for all approaches. Overall model is now acceptable.	Signal timings have been adjusted to allocate more green time to the EBL movement. Now EBL is LOS C, NBT is LOS B, and SBT is LOS C, all of which are acceptable.

MICROSIMULATION PEER REVIEW REPORT
Wisconsin Department of Transportation (WisDOT)
DT2291 – 8/2015

Reviewer, please email completed form to:

			1st Review	2nd Review	3rd Review
To:	Project Manager & Region Contact	Date Reviewed (m/d/yyyy):	2/29/2016	3/17/2016	4/20/2016
CC:	DOT Traffic Model Peer Review	Reviewed By:	RIAWD	RIAWD	RIAWD
Subject:	DT2291 for Project ID; Traffic Model Name	Model Completion/Revision Date (m/d/yyyy):	2/15/2016	3/14/2016	4/18/2016

TRAFFIC MODEL DESCRIPTION

Project ID(s)	Project Name/Description	Region:	Highway(s)
0-11-23-68	Cold Corridor - STH 999 & IH-O, Red Bayou, WI	NW	STH 999 & IH-O

Traffic Model Name/Description	Analysis Scenario/Alternative	Analysis Year(s)
Paramics Base Condition Model	AM, PM, FRI, SUN	2013

Analysis Time Period (s)

☒ Weekday AM Peak	☐ Weekday Midday Peak	☒ Weekday PM Peak	☒ Fri Peak	☐ Sat Peak	☒ Sun Peak	☐ Other:
Hours: 6:30-8:30	Hours:	Hours: 3:15-5:15	Hours: 4:30-6:30	Hours:	Hours: 3:00-5:00	Hours:

Analysis Tool(s) Utilized

☐ SimTraffic - Version: ☒ Paramics - Version: 7.01 ☐ Vissim - Version: ☐ Other: - Version:

SCOPE AND EXTENT OF PEER REVIEW

Purpose & Scope of Review

Provide a detailed review of the base condition model coding and calibration

Description/Limit of Model

STH 999 & IH-O, 0.5 miles south of Random Road north to the West River Bridge

Configuration Settings

# Zones:	# Time Steps:	Speed Memory:	Assignment Type:
25	5	8	All-or-nothing
Mean Target Headway:	**Mean Reaction Time**	**Matrix Structure**	**Vehicle Classifications/Splits**
0.87	0.93	2 O-D matrices, 1 for passenger vehicles & 1 for heavy vehicles	Separate matrices

Seed Values Used for Calibration:	113, 683, 23, 149, 593, 1039, 28567
Seed Values Used for Review:	23, 28567
Other: Variable Speed Limit	Variable speed limit (VSL) applied on IH-O

Were any changes to the model made by the review team? If yes, please describe.

No

OBSERVATIONS, MODEL FEATURES AND CHARACTERISTICS

metrics / Traffic Control

Network Coding

Network Coding establishes the horizontal and vertical geometry of the network. It also includes the appropriate use of settings such as link free-flow speed.

- *For SimTraffic, this is coded within the Synchro module and includes placement and interconnection of nodes and links, number of lanes, lane widths, lane configurations, roadway curvature, storage lengths, and other intersection and network geometry.*
- *For Paramics this includes placement and interconnection of nodes, links and link categories, curb points, curves, turn lanes, merge points, stop bars, signposts, and other network infrastructure.*
- *For VISSIM this includes the placement and interconnection of links, connectors, desired speed decisions, reduced speed areas, conflict areas, and priority rules.*

As a whole, network coding is:	1st	2nd	3rd
Acceptable	☐	☒	☐
Conditionally Acceptable	☒	☐	☐
Unacceptable	☐	☐	☐
Extent of Revisions Required:			
No Revisions Required	☐	☒	☐
Minor Revisions Required	☒	☐	☐
Moderate Revisions Required	☐	☐	☐
Major Revisions Required	☐	☐	☐

Observations/Comments:	Analyst Response
1st Review Intersection of This Rd and That Dr - the EB approach currently has an exclusive right turn lane, which is not coded in the model (Link 523:524). It is possible that this exclusive right turn lane was added after the model base year	1st Review Lane appears to have been in place prior to 2012 and is marked for buses, bicycles, and right turns only. An exclusive EB right turn lane has been added that extends back to the WB ramp terminal intersection. This change is not expected to affect the results
2nd Review *An EB exclusive right turn lane was added on link 523:524. This is used only by buses and right turns, since bicycles are not included in this model.*	2nd Review
3rd Review	3rd Review

Routing Parameters/Vehicle Routes

Routing parameters or vehicle routes influence the way vehicles travel through the network. If coded improperly, these controls can cause unrealistic or erratic routing.

- *This feature is __not__ applicable for SimTraffic. However, interaction between intersections can be checked as noted with the Link O-D feature in the O-D Matrices, Demand Profiles, & Time Periods section.*
- *For Paramics, routing parameters (such as cost factors, turn penalties, modification of the link type hierarchy, and waypoints) override the default routing behavior and profoundly influence the route choice in the network. They are occasionally used to increase or decrease the traffic volume on specific links.*
- *For VISSIM, vehicle routes and vehicle routing decisions control the flow of traffic from the entrance points through the network. They can be coded using either actual vehicle flows or percentages.*

As a whole, traffic routing parameters are:	1st	2nd	3rd
Acceptable	☐	☐	☒
Conditionally Acceptable	☒	☒	☐
Unacceptable	☐	☐	☐
Extent of Revisions Required:			
No Revisions Required	☐	☐	☒
Minor Revisions Required	☒	☒	☐
Moderate Revisions Required	☐	☐	☐
Major Revisions Required	☐	☐	☐

Observations/Comments:	Analyst Response
1st Review Link cost factors are applied in 13 locations. It was noted that link 709:708 has an exceptionally high cost factor of 1000. Why is this so high? This link is located on STH 999 between the Random Rd ramp terminal intersections.	1st Review Link 709:708 cost factor will be adjusted. Other cost factors were generally used for routing purposes at interchanges to prevent vehicles from exiting then re-entering the freeway. No additional changes are proposed - please confirm.
2nd Review *This is an acceptable approach.*	2nd Review *Update completed.*
3rd Review The cost factor for link 709:708 was changed to 1 which is acceptable.	3rd Review

Microsimulation Peer Review Form Responses

Date of Last Response: February 29, 2016

Project: 0-11-23-58
Cold Corridor – STH 999 & IH-O
Up North

Analyst: Traffic Models 'R Us (TMRU)

Traffic Model Name/Description: Future Year (2040) AM Model

Analyst's Response Code

A = Agree completely; will revise (no written response required)

RFS = Requires further study in next phase (no written response required)

P = Agree partially; will revise to some degree (see written response)

D = Disagree; will not revise (see written response)

	1st Review:	2nd Review:	3rd Review:
Model Completion/Revision Date(m/d/yyyy):	01/07/16		
Reviewer 1: **An Employee of the State (EOS)**	02/04/16		
Reviewer 2: **Review is All We Do (RIAWD)**	02/11/16		
Reviewer 3: **FHWA**	02/14/16		

Category	Reviewer		Analyst		
	Initials	**Review Comments**	**Response Code**	**Response**	**Markup Complete**
Network Coding	EOS	#1(Link 422:413) # 2 (Link 1109:209 kerb points) #3 (Link 344:229 stopline rotation)	A A A	#1 Link adjusted to provide two lanes	TMRU – 3/02/15
	RIAWD	#1 (Model weave lengths) #2 (Ramp at node 447)	P A	#1 The study team has modified the upstream lane choice rules associated with the mainline weaves between Fake Rd. and False Dr. While there is always a degree of early or late lane changing within the model due to randomly assigned degrees of aggressiveness, awareness, etc., this issue has been mitigated to the greatest extent possible. #2 Ramp parameters modified to mitigate this issue as much as possible. The future AM model should now match the draft PM model, as this issue was more prominent during the future PM peak period.	TMRU – 03/02/15
	FHWA	#1 (Link 29:30 and 29:31) #2 (81st St./St. Peter Ave geometry)	D RFS	#1 The left turn lane here (Link 29:31) has been modeled as separate to prevent vehicles from attempting to move over, therefore blocking the lane and causing a queue. No change is proposed. #2 The design team has indicated that while the DXF does not indicate an allowable movement from SB 81st St to the IH-0 EB entrance ramp, this access could be provided as the team continues to work on design refinements. Movement from SB 81st to IH-0 EB will be modeled, and results of this will help inform the final design decision.	TMRU – 03/02/15

WisDOT Traffic Model Complexity - Scoring Template

Last Updated: 07-19-17

Applicable for determining the number of MOEs required for model validation and for determining the required level of peer review

__Instructions:__ Fill in gray boxes to determine the model complexity, the number of MOEs needed for validation, and the level of traffic model peer review effort required. Choose appropriate project category in **Table 1: Project type**. Choose primary network type in **Table 2: Geometrics Scoring** and mark applicable categories. Mark all applicable categories in **Table 3: Traffic Pattern and Congestion Scoring**. Final scoring reflects the highest point value in each table (maximum of 24 points). **Table 4** shows the overall model complexity score. **Table 5** shows recommended procedure for identifying the type/number of MOEs to use for model validations and scoping the traffic model peer review. Consider existing conditions and potential future alternatives that the project/study is anticipated to cover.

WisDOT Region:		Ex: SE, SW, NE
Project:		Ex: STH __ Corridor Study
Project ID:		Ex: 1234-56-7890
Project Description:		Ex: City - City
Highway:		Ex: STH __
County:		Ex: Dane County
Traffic Conditions:		Ex: Base (Existing), Base and Future
Modeling Software:		Ex: Paramics, Vissim, SimTraffic

General Project Description:
Ex: Limits of project (Size of Network, # of TAZs), other software used for analysis, anticipated O-D data source, assumptions on Future scenarios, etc.

Table 1: Project Type

Complete (1):	Check a that apply:						
(1) Project Type	Category	Traffic Impact Analysis (TIA), Intersection Control Evaluation (ICE), or similar (Small Influence Area)	Traffic Impact Analysis (TIA), Intersection Control Evaluation (ICE), or similar (Large Influence Area)	Corridor Study/Operational Needs Study or Standard Improvement Project (Small Network)	Corridor Study/Operational Needs Study or Standard Improvement Project (Large Network)	High Profile Project, Potential Mega/Major Project (EA, PEL, EIS)	Mega or Majors Project
	Point Total	0	1	2	3	4	4
	Applicable?	0	0	0	0	0	0

__Note:__ Large Network category assumed to contain 20 or more Traffic Analysis Zones (TAZs).

Table 2: Geometrics Scoring

Choose (1) or (2):	Check a that apply:						
(1) Intersections and Streets/Corridors	Category	Isolated Intersection(s)	Signalized Corridor / Network (No Coordination)	Roundabout Corridor / Network	Signalized Corridor / Network (Coordinated)	Mixed Corridor / Network (Signals and Roundabouts)	Adaptive Signal Control System
	Point Total	0	1	2	2	3	4
	Applicable?	0	0	0	0	0	0
Or							
(2) Freeways	Category	Mainline and Simple Merges/Diverges Only	System Interchange with Multilane Ramps	Freeway with Interchanges and Arterials	Interchanges with Roundabout Ramp Terminals	Unconventional Interchanges (DDI, Echelon, SPUI, etc.)	Managed Lanes, Variable Message Signs, etc.
	Point Total	0	1	1	2	3	4
	Applicable?	0	0	0	0	0	0

Table 3: Traffic Pattern and Congestion Scoring

Complete (1), (2), and (3):	Check a that apply:						
		All-or-Nothing Routing Assignment				Dynamic/Variable Routing	
(1) Routing	Category	Single Routes (Intersection or Corridor)	Networks with Few (2-3) Route Options	Freeway with Parallel Lower Functional Class Streets	Grid System with Numerous Route Options	Freeway Network with Parallel Route Options	Grid System with Numerous Route Options
	Point Total	0	1	2	3	3	4
	Applicable?	0	0	0	0	0	0
(2) OD Estimation	Category	Single Intersection(s) / No Estimation	Small Network, Few Routes	Large Network, Few Routes	Small Network, Multiple Routes	Large Network, Multiple Routes	
	Point Total	0	1	2	3	4	
	Applicable?	0	0	0	0	0	
(3) Existing/Anticipated Level of Congestion	Category	- LOS C or better operations - Minor queuing (<500') - Free flow travel speeds/times	- LOS C-D operations - Moderate queuing (500-1,000') - Minor delays in travel speeds/times	- LOS D-E operations - Moderate queuing (500-1,000') - Moderate delays in travel speeds/times	- LOS F operations (future) - Significant queuing (>1,000') - Significant delays in travel speeds/times	- LOS F operations (existing) - Significant queuing (>1,000') - Significant delays in travel speeds/times	
	Point Total	0	1	2	3	4	
	Applicable?	0	0	0	0	0	

__Note:__ Large Network category assumed to contain 20 or more TAZs. Congestion level takes into account worst-case controlled intersections or roadway segments. Queue lengths are through lane queues.

Table 4: Scoring Results

Project Type	Total	0
Geometrics Subtotal	Intersections and Corridors	0
	Freeways	0
	Total	0
Traffic Pattern and Congestion Subtotal	Routing	0
	OD Estimation	0
	Level of Congestion	0
	Total	0
Total Points		0

Table 5: Recommendations

Point Scale	Minimum # of MOEs Required for Validation	Level of Peer Review Recommendations	
		Recommendation Type	Estimated Schedule for Initial Review (including data collection, coordination, etc.)
0 - 3	1 to 2 Primary MOEs	High-level WisDOT Region review.	1-2 weeks existing conditions 1-2 weeks per alternative
4 - 7	1 to 2 Primary MOEs 1 Secondary MOE	WisDOT Region conducts peer review with assistance from independent consultant or BTO as necessary.	3-4 weeks existing conditions 3-4 weeks per alternative
8 - 10	2 to 3 Primary MOEs 1 Secondary MOE	Independent consultant conducts peer review with WisDOT Region input and BTO assistance as necessary.	4-8 weeks existing conditions 4-8 weeks per alternative
11+	2 to 3 Primary MOEs 1 to 2 Secondary MOEs	Independent consultant conducts peer review with WisDOT Region, BTO, other WisDOT Bureau involvement and FHWA oversight.	2-4 months existing conditions (no FHWA) 2-4 months per alternative (no FHWA) 3-4 months existing conditions (with FHWA) 3-4 months per alternative (with FHWA)

***Note:** A minimum of 6 weeks should be allowed for Traffic Forecasting to review the existing/future volumes for all levels of peer review

Access Excel file via the following link: **http://wisconsindot.gov/dtsdManuals/traffic-ops/programs/analysis/trafficmodelpeerreview.xlsx**

HCM ANALYSIS REVIEW CHECKLIST

Wisconsin Department of Transportation (WisDOT)
DT1887 3/2019

			Date(s) Reviewed (m/d/yyyy)		
Project ID(s):	Highway(s)/Intersection(s):	Region:	1st Review	2nd Review	3rd Review
Lead Reviewer	Name:	Contact Information:			
Lead Analyst	Name:	Contact Information:			

TRAFFIC MODEL DESCRIPTION

Identify the model completion/revision date, the scope of the model, the analysis year(s), the analysis time period(s), and analysis tool/version

SUMMARY OF REVIEW

	Acceptability	Reviewer Comment(s):	Analyst Response(s):
Traffic Analysis Tool/Version	☐ ☐ ☐ Acceptable/ No Revision Required ☐ ☐ ☐ Conditionally Acceptable/ Minor Revision Required ☐ ☐ ☐ Unacceptable/ Major Revision Required		

	Acceptability	Reviewer Comment(s):	Analyst Response(s):
Lane Geometry	☐ ☐ ☐ Acceptable/ No Revision Required ☐ ☐ ☐ Conditionally Acceptable/ Minor Revision Required ☐ ☐ ☐ Unacceptable/ Major Revision Required		

	Acceptability	Reviewer Comment(s):	Analyst Response(s):
Traffic Volumes, % Trucks, Peak Hour Factor (PHF)	☐ ☐ ☐ Acceptable/ No Revision Required ☐ ☐ ☐ Conditionally Acceptable/ Minor Revision Required ☐ ☐ ☐ Unacceptable/ Major Revision Required		

SUMMARY OF REVIEW *(continued)*

	Acceptability	Reviewer Comment(s):	Analyst Response(s):
Signal Parameters (Including RTOR)	☐ ☐ ☐ Acceptable/ No Revision Required ☐ ☐ ☐ Conditionally Acceptable/ Minor Revision Required ☐ ☐ ☐ Unacceptable/ Major Revision Required		
Stop Control/ Roundabout Parameters	☐ ☐ ☐ Acceptable/ No Revision Required ☐ ☐ ☐ Conditionally Acceptable/ Minor Revision Required ☐ ☐ ☐ Unacceptable/ Major Revision Required		
Freeway/ Highway Parameters	☐ ☐ ☐ Acceptable/ No Revision Required ☐ ☐ ☐ Conditionally Acceptable/ Minor Revision Required ☐ ☐ ☐ Unacceptable/ Major Revision Required		
Other:	☐ ☐ ☐ Acceptable/ No Revision Required ☐ ☐ ☐ Conditionally Acceptable/ Minor Revision Required ☐ ☐ ☐ Unacceptable/ Major Revision Required		
Overall Model	☐ ☐ ☐ Acceptable/ No Revision Required ☐ ☐ ☐ Conditionally Acceptable/ Minor Revision Required ☐ ☐ ☐ Unacceptable/ Major Revision Required		

MICROSIMULATION PEER REVIEW REPORT

Wisconsin Department of Transportation (WisDOT)
DT2291 9/2015

Reviewer, please email completed form to:

To: Project Manager & Region Contact
CC: DOT Traffic Model Peer Review
Subject: DT2291 for Project ID; Traffic Model Name

	1st Review	2nd Review	3rd Review
Date Reviewed (m/d/yyyy):			
Reviewed By:			
Model Completion/Revision Date(m/d/yyyy):			

CONTACT INFORMATION

Lead Reviewer	Lead Analyst	Region Contact
Name (First, MI, Last)	Name (First, MI, Last)	Name (First, MI, Last)
Organization/Firm	Organization/Firm	Region/Bureau
(Area Code) Telephone Number	(Area Code) Telephone Number	(Area Code) Telephone Number
Email Address	Email Address	Email Address

TRAFFIC MODEL DESCRIPTION

Project ID(s)	Project Name/Description	Region:	Highway(s)
Traffic Model Name/Description	Analysis Scenario/Alternative	Analysis Year(s)	

Analysis Time Period (s)

☐ Weekday AM Peak Hours: ☐ Weekday Midday Peak Hours: ☐ Weekday PM Peak Hours: ☐ Fri Peak Hours: ☐ Sat Peak Hours: ☐ Sun Peak Hours: ☐ Other: Hours:

Analysis Tool(s) Utilized

☐ SimTraffic- Version: ☐ Paramics - Version: ☐ Vissim - Version: ☐ Other: - Version:

SCOPE AND EXTENT OF PEER REVIEW

Purpose & Scope of Review

Description/Limit of Model

Configuration Settings

Number of Zones:	Number of Time Steps:	Speed Memory:	Assignment Type:
Mean Target Headway:	Mean Reaction Time	Matrix Structure	Vehicle Classifications/Splits

Seed Values Used for Calibration:	
Seed Values Used for Review:	
Other:	

Were any changes to the model made by the review team? If yes, please describe.

DIRECTIONS

This form is applicable for the review of all microsimulation traffic models, regardless of the traffic software program utilized to develop the traffic model. However, this form focuses on the SimTraffic, Paramics and Vissim microsimulation software packages.

When noting problems or concerns, identify the severity of the issue and the revisions recommended using the following scale: Minor, Moderate, or Major. Check the appropriate box associated with each review (the blue box for the 1st review, the green box for the 2nd review and the purple box for the 3rd review).

If more than one review of the traffic model is required, use different color text to distinguish the comments associated with each review (e.g., comments from the 1st review should be in blue text, comments from the 2nd review should be in green text, and comments from the 3rd review should be in purple text). Provide any supporting tables, screenshots, or additional images in a separate attachment to this form.

OBSERVATIONS, MODEL FEATURES AND CHARACTERISTICS

Geometrics /Traffic Control

Network Coding	*Network Coding establishes the horizontal and vertical geometry of the network. It also includes the appropriate use of settings such as link free-flow speed.* • *For SimTraffic, this is coded within the Synchro module and includes placement and interconnection of nodes and links, number of lanes, lane widths, lane configurations, roadway curvature, storage lengths, and other intersection and network geometry.* • *For Paramics this includes placement and interconnection of nodes, links and link categories, curb points, curves, turn lanes, merge points, stop bars, signposts, and other network infrastructure.* • *For VISSIM this includes the placement and interconnection of links, connectors, desired speed decisions, reduced speed areas, conflict areas, and priority rules.*	
As a whole, network coding is:	**Observations/Comments:**	**Analyst Response**
☐ ☐ ☐ Acceptable ☐ ☐ ☐ Conditionally Acceptable ☐ ☐ ☐ Unacceptable Extent of Revisions Required: ☐ ☐ ☐ No Revisions Required ☐ ☐ ☐ Minor Revisions Required ☐ ☐ ☐ Moderate Revisions Required ☐ ☐ ☐ Major Revisions Required	1st Review 2nd Review 3rd Review	1st Review 2nd Review 3rd Review
Intersection Traffic Control & Ramp Metering	*Intersection Controls are devices that regulate traffic flow at intersections, such as signals, roundabouts, and stop-controlled intersections. Elements of the signals may include the controller type, detector placement, signal heads, signal groups, and/or coordination between signals. Ramp meters control the rate of entry to a freeway. Comments on signal and ramp meter timing plans may be included in this section.*	
As a whole, intersection controls are:	**Observations/Comments:**	**Analyst Response**
☐ ☐ ☐ Acceptable ☐ ☐ ☐ Conditionally Acceptable ☐ ☐ ☐ Unacceptable Extent of Revisions Required: ☐ ☐ ☐ No Revisions Required ☐ ☐ ☐ Minor Revisions Required ☐ ☐ ☐ Moderate Revisions Required ☐ ☐ ☐ Major Revisions Required	1st Review 2nd Review 3rd Review	1st Review 2nd Review 3rd Review

Geometrics /Traffic Control	***Closures, Restrictions, & Incidents***	*Closures represent links or lanes that are temporarily or permanently closed to traffic. Restrictions represent links or lanes that are temporarily or permanently closed to specific types of vehicles (such as lanes designated for High Occupancy Vehicles or lanes restricting truck use). Incidents include simulated vehicle break-downs, etc.* • *This feature is **not** applicable for SimTraffic*	
	As a whole closures, restrictions & incidents are:	**Observations/Comments:**	**Analyst Response**
	☐ ☐ ☐ Acceptable ☐ ☐ ☐ Conditionally Acceptable ☐ ☐ ☐ Unacceptable Extent of Revisions Required: ☐ ☐ ☐ No Revisions Required ☐ ☐ ☐ Minor Revisions Required ☐ ☐ ☐ Moderate Revisions Required ☐ ☐ ☐ Major Revisions Required	1st Review 2nd Review 3rd Review	1st Review 2nd Review 3rd Review
	Entrance Ramps	*Driver behavior and lane utilization approaching entrance ramps should be reviewed in this section.* • *For SimTraffic, modifications to the default mandatory distance and positioning distance settings should be reviewed.* • *For Paramics, modifications to default ramp headway, minimum ramp time, and ramp aware distance should be reviewed. The minimum ramp time setting specifies how long a driver will stay on the parallel entrance ramp before beginning to look for a gap to merge onto the freeway.* • *For VISSIM, the effective merging area defined by the positions of the links and connectors should be reviewed.*	
	As a whole, the vehicle behavior approaching entrance ramps is:	**Observations/Comments:**	**Analyst Response**
	☐ ☐ ☐ Acceptable ☐ ☐ ☐ Conditionally Acceptable ☐ ☐ ☐ Unacceptable Extent of Revisions Required: ☐ ☐ ☐ No Revisions Required ☐ ☐ ☐ Minor Revisions Required ☐ ☐ ☐ Moderate Revisions Required ☐ ☐ ☐ Major Revisions Required	1st Review 2nd Review 3rd Review	1st Review 2nd Review 3rd Review
	Lane Use Parameters	*Lane use parameters control the amount and/or destination of the traffic using each lane. A typical application of these parameters is to pre-position vehicles in advance of a fork in the road*	
	As a whole, lane use parameters are:	**Observations/Comments:**	**Analyst Response**
	☐ ☐ ☐ Acceptable ☐ ☐ ☐ Conditionally Acceptable ☐ ☐ ☐ Unacceptable Extent of Revisions Required: ☐ ☐ ☐ No Revisions Required ☐ ☐ ☐ Minor Revisions Required ☐ ☐ ☐ Moderate Revisions Required ☐ ☐ ☐ Major Revisions Required	1st Review 2nd Review 3rd Review	1st Review 2nd Review 3rd Review

Traffic/Global

<table>
<tr><td>Zone Structure/Vehicle Inputs</td><td colspan="2">Zone structure and vehicle inputs define where and how traffic is loaded into the network.
• For SimTraffic, the intersection turning movement volumes from the Synchro module determine how the traffic is loaded into the network. If volumes are imbalanced in the Synchro network, SimTraffic will assume a traffic source or sink between nodes (such as driveways). Reviewer should note imbalances that may not be realistic or representative of the network.
• For Paramics, zone structure relates to the placement of the zones representing the locations where traffic enters or leaves the network. Observations related to sectors and zone connectors should be included in this section. If the microsimulation model zones are derived from a travel demand model, reviewers should use this section to note any issues related to the consistency of the Paramics input data with respect to the travel demand model data.
• For VISSIM, vehicle inputs control where traffic is loaded into the network and how much is loaded. Reviewer should use this section to note any issues related to the consistency of input data related to the sources.</td></tr>
<tr><td>As a whole, zone structure and vehicle inputs are:</td><td>Observations/Comments:</td><td>Analyst Response</td></tr>
<tr><td>☐ ☐ ☐ Acceptable
☐ ☐ ☐ Conditionally Acceptable
☐ ☐ ☐ Unacceptable
Extent of Revisions Required:
☐ ☐ ☐ No Revisions Required
☐ ☐ ☐ Minor Revisions Required
☐ ☐ ☐ Moderate Revisions Required
☐ ☐ ☐ Major Revisions Required</td><td>1st Review

2nd Review

3rd Review</td><td>1st Review

2nd Review

3rd Review</td></tr>
<tr><td>O-D Matrices, Demand Profiles, & Time Periods</td><td colspan="2">Origin-Destination (O-D) matrices contain the network demand patterns (number of trips between each pair of zones). Time Periods and Demand Profiles control the timing of the release of the trips into the network. In some cases multiple matrices are used (for example separate matrices for cars and heavy trucks). The reviewer should evaluate the source of the demand profile and time period selection.
• For SimTraffic, network-wide O-D Matrices and demand profiles are not applicable. The intersection turning movement volumes, rather than network-wide O-D matrices, determines the origin and destination of the traffic. The Link O-D volumes setting can be modified within Synchro to model the weaving interaction between 2 adjacent intersections (such as zeroing out an off-ramp left-turn to on-ramp left-turn movement at a diamond interchange). Volume adjustment factors, rather than demand profiles, dictate the percentage of peak hour traffic to load into the network for each analysis period. Thus the intersection turning movement volumes, Link O-D volumes, volume adjustment factors (such as growth factor and PHF adjust settings), and the time and duration of the seeding (i.e., warm-up period) and recording (i.e., analysis period) periods should be reviewed.</td></tr>
<tr><td>As a whole, O-D matrices, demand profiles, & time periods are:</td><td>Observations/Comments:</td><td>Analyst Response</td></tr>
<tr><td>☐ ☐ ☐ Acceptable
☐ ☐ ☐ Conditionally Acceptable
☐ ☐ ☐ Unacceptable
Extent of Revisions Required:
☐ ☐ ☐ No Revisions Required
☐ ☐ ☐ Minor Revisions Required
☐ ☐ ☐ Moderate Revisions Required
☐ ☐ ☐ Major Revisions Required</td><td>1st Review

2nd Review

3rd Review</td><td>1st Review

2nd Review

3rd Review</td></tr>
</table>

<table>
<tr><td rowspan="6">Traffic/Global</td><td>Core Simulation Parameters</td><td colspan="2">Core simulation parameters affect fundamental aspects of vehicle behavior in the network, such as driver aggressiveness and the willingness to merge into small gaps. Modifications to default software values should be reviewed.
• For SimTraffic, examples of core simulation parameters to review include driver and vehicle characteristics and behaviors.
• For Paramics, examples of core simulation parameters to review include mean target headway, mean target reaction time, perturbation, global routing cost coefficients, driver familiarity, time steps, speed memory, allowing heavy vehicles to use all lanes, and matrix tuning.
• For VISSIM, examples of core simulation parameters to review include Driving Behaviors, Simulation Resolution, and Speed Distributions.</td></tr>
<tr><td>As a whole, core simulation parameters are:</td><td>Observations/Comments:</td><td>Analyst Response</td></tr>
<tr><td>☐ ☐ ☐ Acceptable
☐ ☐ ☐ Conditionally Acceptable
☐ ☐ ☐ Unacceptable
Extent of Revisions Required:
☐ ☐ ☐ No Revisions Required
☐ ☐ ☐ Minor Revisions Required
☐ ☐ ☐ Moderate Revisions Required
☐ ☐ ☐ Major Revisions Required</td><td>1st Review

2nd Review

3rd Review</td><td>1st Review

2nd Review

3rd Review</td></tr>
<tr><td>Routing Parameters/ Vehicle Routes</td><td colspan="2">Routing parameters or vehicle routes influence the way vehicles travel through the network. If coded improperly, these controls can cause unrealistic or erratic routing.
• This feature is <u>not</u> applicable for SimTraffic. However, interaction between intersections can be checked as noted with the Link O-D feature in the O-D Matrices, Demand Profiles, & Time Periods section.
• For Paramics, routing parameters (such as cost factors, turn penalties, modification of the link type hierarchy, and waypoints) override the default routing behavior and profoundly influence the route choice in the network. They are occasionally used to increase or decrease the traffic volume on specific links.
• For VISSIM, vehicle routes and vehicle routing decisions control the flow of traffic from the entrance points through the network. They can be coded using either actual vehicle flows or percentages.</td></tr>
<tr><td>As a whole, traffic routing parameters are:</td><td>Observations/Comments:</td><td>Analyst Response</td></tr>
<tr><td>☐ ☐ ☐ Acceptable
☐ ☐ ☐ Conditionally Acceptable
☐ ☐ ☐ Unacceptable
Extent of Revisions Required:
☐ ☐ ☐ No Revisions Required
☐ ☐ ☐ Minor Revisions Required
☐ ☐ ☐ Moderate Revisions Required
☐ ☐ ☐ Major Revisions Required</td><td>1st Review

2nd Review

3rd Review</td><td>1st Review

2nd Review

3rd Review</td></tr>
</table>

Traffic/Global

Vehicle Types & Proportions	*The proportion of vehicles (such as trucks, buses, and High Occupancy Vehicles) influences the overall performance of each part of the network. Vehicle lengths (such as heavy truck lengths) should be reviewed.*	
As a whole, vehicle types & proportions are:	**Observations/Comments:**	**Analyst Response**
☐ ☐ ☐ Acceptable ☐ ☐ ☐ Conditionally Acceptable ☐ ☐ ☐ Unacceptable Extent of Revisions Required: ☐ ☐ ☐ No Revisions Required ☐ ☐ ☐ Minor Revisions Required ☐ ☐ ☐ Moderate Revisions Required ☐ ☐ ☐ Major Revisions Required	1st Review 2nd Review 3rd Review	1st Review 2nd Review 3rd Review
Stuck/Stalled Vehicles	*This section should be used to note any problems with stuck or stalled vehicles (including intermittent problems). These are vehicles that unexpectedly slow or stop partway through their route (which can cause backups that do not exist in the field).* • *For Paramics, this section should also be used for comments on the use of blockage removal tools, if used.* • *For SimTraffic, this section should be used to comment on if short links may be resulting in stuck or stalled vehicles within the network.*	
As a whole, stuck/stalled vehicle occurrence is :	**Observations/Comments:**	**Analyst Response**
☐ ☐ ☐ Acceptable ☐ ☐ ☐ Conditionally Acceptable ☐ ☐ ☐ Unacceptable Extent of Revisions Required: ☐ ☐ ☐ No Revisions Required ☐ ☐ ☐ Minor Revisions Required ☐ ☐ ☐ Moderate Revisions Required ☐ ☐ ☐ Major Revisions Required	1st Review 2nd Review 3rd Review	1st Review 2nd Review 3rd Review
Special Features	*Special features include site- or study-specific items such as the use of detectors, car parks, variable message signs, special purpose lanes, speed harmonization, public transit routes, toll lanes, toll plazas, pedestrian modeling, special graphics, Application Programming Interfaces (APIs), etc* • *At present, SimTraffic will not model bus stops, bus routes, bus and carpool lanes, light rail, on-street parking, or short term event; thus, the use of special features is typically not applicable in SimTraffic.*	
As a whole, use of special features is :	**Observations/Comments:**	**Analyst Response**
☐ ☐ ☐ Acceptable ☐ ☐ ☐ Conditionally Acceptable ☐ ☐ ☐ Unacceptable Extent of Revisions Required: ☐ ☐ ☐ No Revisions Required ☐ ☐ ☐ Minor Revisions Required ☐ ☐ ☐ Moderate Revisions Required ☐ ☐ ☐ Major Revisions Required	1st Review 2nd Review 3rd Review	1st Review 2nd Review 3rd Review

Traffic/Global	***Consistency with Related Traffic Models***	*Modeling studies often involve a series of related models (base model, future no-build, and build alternatives, different times of day, etc.). To assure the integrity of the study as a whole, these models must be consistent.*	
	As a whole, model consistency is :	**Observations/Comments:**	**Analyst Response**
	☐ ☐ ☐ Acceptable ☐ ☐ ☐ Conditionally Acceptable ☐ ☐ ☐ Unacceptable Extent of Revisions Required: ☐ ☐ ☐ No Revisions Required ☐ ☐ ☐ Minor Revisions Required ☐ ☐ ☐ Moderate Revisions Required ☐ ☐ ☐ Major Revisions Required	1st Review 2nd Review 3rd Review	1st Review 2nd Review 3rd Review
Calibration/Validation/Documentation	***Calibration/Validation***	*Calibration refers to the process where the analyst adjusts selected parameters within the traffic model (e.g., global and local headway and reaction times, driver aggressiveness, etc.) in order to get the traffic model to reproduce conditions observed in the field. Validation refers to the process where the analyst checks the traffic model outputs against field measured data including traffic volumes, travel speeds, travel times, intersection queuing and trip-making patterns (e.g., weaving volumes). The reviewer should spot-check the traffic model outputs and compare them to the results documented in the calibration/validation report. If the reviewer cannot produce similar outputs, it may indicate an issue with the traffic model's calibration.*	
	As a whole, model calibration is :	**Observations/Comments:**	**Analyst Response**
	☐ ☐ ☐ Acceptable ☐ ☐ ☐ Conditionally Acceptable ☐ ☐ ☐ Unacceptable Extent of Revisions Required: ☐ ☐ ☐ No Revisions Required ☐ ☐ ☐ Minor Revisions Required ☐ ☐ ☐ Moderate Revisions Required ☐ ☐ ☐ Major Revisions Required	1st Review 2nd Review 3rd Review	1st Review 2nd Review 3rd Review
	Documentation	*Proper documentation of modeling methods and assumptions establishes accountability and facilitates efficient revision, updating, and follow-up. Review team should verify that proper documentation has been provided.*	
	As a whole, model documentation is :	**Observations/Comments:**	**Analyst Response**
	☐ ☐ ☐ Acceptable ☐ ☐ ☐ Conditionally Acceptable ☐ ☐ ☐ Unacceptable Extent of Revisions Required: ☐ ☐ ☐ No Revisions Required ☐ ☐ ☐ Minor Revisions Required ☐ ☐ ☐ Moderate Revisions Required ☐ ☐ ☐ Major Revisions Required	1st Review 2nd Review 3rd Review	1st Review 2nd Review 3rd Review

SUMMARY OF REVIEW

Overall Traffic Model	As a whole, the traffic model is :	Summary of the review team's findings and recommendations
	☐ ☐ ☐ Acceptable ☐ ☐ ☐ Conditionally Acceptable ☐ ☐ ☐ Unacceptable Extent of Revisions Required: ☐ ☐ ☐ No Revisions Required ☐ ☐ ☐ Minor Revisions Required ☐ ☐ ☐ Moderate Revisions Required ☐ ☐ ☐ Major Revisions Required	1st Review 2nd Review 3rd Review

REVIEWER'S CONCULSION (Check One)

☐ ☐ ☐ *It is the opinion of the review team that the model as reviewed and tested is an accurate and reasonable representation of the traffic conditions in the study area for the analysis year, time period, and scenario/alternative indicated in the title block of this document.*

☐ ☐ ☐ *It is the opinion of the review team that the model as reviewed and tested requires correction of ______ errors before it can be regarded as a reasonable representation of the traffic conditions in the study area for the analysis year, time period, and scenario/alternative indicated in the title block of this document. (Indicate number and severity of errors: Minor, Moderate, or Major).*

Prepared By (Signature)	**Date**	**Contact Information**
	Click here to enter a date.	Phone: Email:
Prepared By (Signature)	**Date** ***Click here to enter a date.***	**Contact Information (Phone, Email)** Phone: Email:
Prepared By (Signature)	**Date** ***Click here to enter a date.***	**Contact Information (Phone, Email)** Phone: Email:

HCM ANALYSIS REVIEW CHECKLIST

Wisconsin Department of Transportation (WisDOT)
DT1887 3/2019

			Date(s) Reviewed (m/d/yyyy)		
Project ID(s): 85-75-3072	Highway(s)/Intersection(s): USH 888 (N/S) & STH 747 (E/W)I	Region: NE	1st Review 3/12/2019	2nd Review 4/11/2019	3rd Review
Lead Reviewer	Name: Review is All We Do (RIAWD)	Contact Information: RIAWD@email.com			
Lead Analyst	Name: Traffic Models 'R Us (TMRU)	Contact Information: TMRU@email.com			

TRAFFIC MODEL DESCRIPTION

Identify the model completion/revision date, the scope of the model, the analysis year(s), the analysis time period(s), and analysis tool/version

Synchro model for USH 888 (N/S) & STH 747 (E/W) in Blue Moose, WI, Analysis is for the 2040 AM (7-9) & PM (3:30-5:30) peak hours for the baseline and alternative #2 (enhanced signal) scenarios. Used Synchro 10.3.28. Model was completed on 11/15/2018

SUMMARY OF REVIEW

	Acceptability	**Reviewer Comment(s):**	**Analyst Response(s):**
Traffic Analysis Tool/Version	☒ ☒ ☐ Acceptable/ No Revision Required ☐ ☐ ☐ Conditionally Acceptable/ Minor Revision Required ☐ ☐ ☐ Unacceptable/ Major Revision Required	Used the most recent version of Synchro available at time model was completed. This is acceptable. As a note for future projects, WisDOT is now utilizing Synchro 10.3.122	Thanks for the info about the new version of Synchro.
Lane Geometry	☐ ☒ ☐ Acceptable/ No Revision Required ☒ ☐ ☐ Conditionally Acceptable/ Minor Revision Required ☐ ☐ ☐ Unacceptable/ Major Revision Required	WB right turn lane is channelized in the plans but not in the model. Please correct. WBR is now shown as channelized in the model	WBR should be channelized. This has been corrected
Traffic Volumes, % Trucks, Peak Hour Factor (PHF)	☐ ☒ ☐ Acceptable/ No Revision Required ☒ ☐ ☐ Conditionally Acceptable/ Minor Revision Required ☐ ☐ ☐ Unacceptable/ Major Revision Required	Heavy vehicle (HV) percentage set to 2% for all approaches. From the 2018 turning movement count, the NB AM has 8% HV and NB PM has 13% HV. Other approaches should also be examined in both peak periods. Truck percentages are now acceptable.	2018 field data now incorporated into both the AM and PM models. These percentages are expected to remain constant.

SUMMARY OF REVIEW *(continued)*

	Acceptability	Reviewer Comment(s):	Analyst Response(s):
Signal Parameters (Including RTOR)	☐ ☒ ☐ Acceptable/ No Revision Required ☒ ☐ ☐ Conditionally Acceptable/ Minor Revision Required ☐ ☐ ☐ Unacceptable/ Major Revision Required	The EBR Saturated Flow Rate (RTOR) is set to 90vph, or half of the 180vph AM demand; it should be set to 68vph per TEOpS 16-15-5.2 (0.38*180 = 68) RTOR volumes were updated and are now acceptable	Saturated Flow Rate (RTOR) has been set to 68 vph. All other RTOR volumes were checked and are in compliance with TEOpS 16-15-5.2
Stop Control/ Roundabout Parameters	☐ ☐ ☐ Acceptable/ No Revision Required ☐ ☐ ☐ Conditionally Acceptable/ Minor Revision Required ☐ ☐ ☐ Unacceptable/ Major Revision Required	N/A	
Freeway/ Highway Parameters	☐ ☐ ☐ Acceptable/ No Revision Required ☐ ☐ ☐ Conditionally Acceptable/ Minor Revision Required ☐ ☐ ☐ Unacceptable/ Major Revision Required	N/A	
Other: Pedestrian Movements	☐ ☒ ☐ Acceptable/ No Revision Required ☒ ☐ ☐ Conditionally Acceptable/ Minor Revision Required ☐ ☐ ☐ Unacceptable/ Major Revision Required	NB pedestrian traffic was included in the base year analysis - why is this not included here? Given the construction of the path, it is acceptable to not consider pedestrian impacts here.	Though not documented here, an off-road paved path will be constructed to the west as part of this alternative. This will serve NB pedestrian traffic destinations and remove almost all NB pedestrian traffic. Please confirm that it is acceptable to not include any NB pedestrian traffic in the analysis.
Overall Model	☐ ☒ ☐ Acceptable/ No Revision Required ☒ ☐ ☐ Conditionally Acceptable/ Minor Revision Required ☐ ☐ ☐ Unacceptable/ Major Revision Required	EBL movement has LOS E in the PM while the NBT/SBT have LOS B. Can signal timings be adjusted to make green time more equitable? See other comments above The adjusted signal timing results in acceptable LOS for all approaches. Overall model is now acceptable.	Signal timings have been adjusted to allocate more green time to the EBL movement. Now EBL is LOS C, NBT is LOS B, and SBT is LOS C, all of which are acceptable.

Reviewer, please email completed form to:

			1st Review	2nd Review	3rd Review
To:	Project Manager & Region Contact	Date Reviewed (m/d/yyyy):	2/29/2016	3/17/2016	4/20/2016
CC:	DOT Traffic Model Peer Review	Reviewed By:	RIAWD	RIAWD	RIAWD
Subject:	DT2291 for Project ID; Traffic Model Name	Model Completion/Revision Date (m/d/yyyy):	2/15/2016	3/14/2016	4/18/2016

TRAFFIC MODEL DESCRIPTION

Project ID(s)	Project Name/Description	Region:	Highway(s)
0-11-23-68	Cold Corridor - STH 999 & IH-O, Red Bayou, WI	NW	STH 999 & IH-O

Traffic Model Name/Description	Analysis Scenario/Alternative	Analysis Year(s)
Paramics Base Condition Model	AM, PM, FRI, SUN	2013

Analysis Time Period (s)

- ☒ Weekday AM Peak — Hours: 6:30-8:30
- ☐ Weekday Midday Peak — Hours: °°°°°
- ☒ Weekday PM Peak — Hours: 3:15-5:15
- ☒ Fri Peak — Hours: 4:30-6:30
- ☐ Sat Peak — Hours: °°°°°
- ☒ Sun Peak — Hours: 3:00-5:00
- ☐ Other: °°°°° — Hours: °°°°°

Analysis Tool(s) Utilized

- ☐ SimTraffic - Version: °°°°°
- ☒ Paramics - Version: 7.01
- ☐ Vissim - Version: °°°°°
- ☐ Other: °°°°° - Version: °°°°°

SCOPE AND EXTENT OF PEER REVIEW

Purpose & Scope of Review

Provide a detailed review of the base condition model coding and calibration

Description/Limit of Model

STH 999 & IH-O, 0.5 miles south of Random Road north to the West River Bridge

Configuration Settings

# Zones:	# Time Steps:	Speed Memory:	Assignment Type:
25	5	8	All-or-nothing
Mean Target Headway:	**Mean Reaction Time**	**Matrix Structure**	**Vehicle Classifications/Splits**
0.87	0.93	2 O-D matrices, 1 for passenger vehicles & 1 for heavy vehicles	Separate matrices

Seed Values Used for Calibration:	113, 683, 23, 149, 593, 1039, 28567
Seed Values Used for Review:	23, 28567
Other: Variable Speed Limit	Variable speed limit (VSL) applied on IH-O

Were any changes to the model made by the review team? If yes, please describe.

No

OBSERVATIONS, MODEL FEATURES AND CHARACTERISTICS

metrics / Traffic Control

Network Coding

Network Coding establishes the horizontal and vertical geometry of the network. It also includes the appropriate use of settings such as link free-flow speed.

- *For SimTraffic, this is coded within the Synchro module and includes placement and interconnection of nodes and links, number of lanes, lane widths, lane configurations, roadway curvature, storage lengths, and other intersection and network geometry.*
- *For Paramics this includes placement and interconnection of nodes, links and link categories, curb points, curves, turn lanes, merge points, stop bars, signposts, and other network infrastructure.*
- *For VISSIM this includes the placement and interconnection of links, connectors, desired speed decisions, reduced speed areas, conflict areas, and priority rules.*

As a whole, network coding is:	Observations/Comments:	Analyst Response
☐ ☒ ☐ Acceptable ☒ ☐ ☐ Conditionally Acceptable ☐ ☐ ☐ Unacceptable Extent of Revisions Required: ☐ ☒ ☐ No Revisions Required ☒ ☐ ☐ Minor Revisions Required ☐ ☐ ☐ Moderate Revisions Required ☐ ☐ ☐ Major Revisions Required	1st Review Intersection of This Rd and That Dr - the EB approach currently has an exclusive right turn lane, which is not coded in the model (Link 523:524). It is possible that this exclusive right turn lane was added after the model base year 2nd Review *An EB exclusive right turn lane was added on link 523:524. This is used only by buses and right turns, since bicycles are not included in this model.* 3rd Review °°°°°	1st Review Lane appears to have been in place prior to 2012 and is marked for buses, bicycles, and right turns only. An exclusive EB right turn lane has been added that extends back to the WB ramp terminal intersection. This change is not expected to affect the results 2nd Review °°°°° 3rd Review °°°°°

Routing Parameters/Vehicle Routes

Routing parameters or vehicle routes influence the way vehicles travel through the network. If coded improperly, these controls can cause unrealistic or erratic routing.

- *This feature is **not** applicable for SimTraffic. However, interaction between intersections can be checked as noted with the Link O-D feature in the O-D Matrices, Demand Profiles, & Time Periods section.*
- *For Paramics, routing parameters (such as cost factors, turn penalties, modification of the link type hierarchy, and waypoints) override the default routing behavior and profoundly influence the route choice in the network. They are occasionally used to increase or decrease the traffic volume on specific links.*
- *For VISSIM, vehicle routes and vehicle routing decisions control the flow of traffic from the entrance points through the network. They can be coded using either actual vehicle flows or percentages.*

As a whole, traffic routing parameters are:	Observations/Comments:	Analyst Response
☐ ☐ ☒ Acceptable ☒ ☒ ☐ Conditionally Acceptable ☐ ☐ ☐ Unacceptable Extent of Revisions Required: ☐ ☐ ☒ No Revisions Required ☒ ☒ ☐ Minor Revisions Required ☐ ☐ ☐ Moderate Revisions Required ☐ ☐ ☐ Major Revisions Required	1st Review Link cost factors are applied in 13 locations. It was noted that link 709:708 has an exceptionally high cost factor of 1000. Why is this so high? This link is located on STH 999 between the Random Rd ramp terminal intersections. 2nd Review *This is an acceptable approach.* 3rd Review The cost factor for link 709:708 was changed to 1 which is acceptable.	1st Review Link 709:708 cost factor will be adjusted. Other cost factors were generally used for routing purposes at interchanges to prevent vehicles from exiting then re-entering the freeway. No additional changes are proposed - please confirm. 2nd Review *Update completed.* 3rd Review °°°°°

Microsimulation Peer Review Form Responses

Date of Last Response: February 29, 2016

Project: 0-11-23-58
Cold Corridor – STH 999 & IH-O
Up North

Analyst: Traffic Models 'R Us (TMRU)

Traffic Model Name/Description: Future Year (2040) AM Model

Analyst's Response Code

A = Agree completely; will revise (no written response required)

RFS = Requires further study in next phase (no written response required)

P = Agree partially; will revise to some degree (see written response)

D = Disagree; will not revise (see written response)

	1st Review:	2nd Review:	3rd Review:
Model Completion/Revision Date(m/d/yyyy):	01/07/16		
Reviewer 1: **An Employee of the State (EOS)**	02/04/16		
Reviewer 2: **Review is All We Do (RIAWD)**	02/11/16		
Reviewer 3: **FHWA**	02/14/16		

Category	Reviewer: Initials	Reviewer: Review Comments	Analyst: Response Code	Analyst: Response	Analyst: Markup Complete
Network Coding	EOS	#1(Link 422:413) # 2 (Link 1109:209 kerb points) #3 (Link 344:229 stopline rotation)	A A A	#1 Link adjusted to provide two lanes	TMRU – 3/02/15
	RIAWD	#1 (Model weave lengths) #2 (Ramp at node 447)	P A	#1 The study team has modified the upstream lane choice rules associated with the mainline weaves between Fake Rd. and False Dr. While there is always a degree of early or late lane changing within the model due to randomly assigned degrees of aggressiveness, awareness, etc., this issue has been mitigated to the greatest extent possible. #2 Ramp parameters modified to mitigate this issue as much as possible. The future AM model should now match the draft PM model, as this issue was more prominent during the future PM peak period.	TMRU – 03/02/15
	FHWA	#1 (Link 29:30 and 29:31) #2 (81st St./St. Peter Ave geometry)	D RFS	#1 The left turn lane here (Link 29:31) has been modeled as separate to prevent vehicles from attempting to move over, therefore blocking the lane and causing a queue. No change is proposed. #2 The design team has indicated that while the DXF does not indicate an allowable movement from SB 81st St to the IH-0 EB entrance ramp, this access could be provided as the team continues to work on design refinements. Movement from SB 81st to IH-0 EB will be modeled, and results of this will help inform the final design decision.	TMRU – 03/02/15

16-30-1 Basic Principles — November 2022

1.1 Overview

The Operations Certification Process (OCP) is a performance-based, data-driven process for determining whether to consider the inclusion of operational-driven intersection or mainline improvements as part of a project already prioritized for program approval for non-operational reasons. The process includes quantifying alternatives, monetizing the resulting operational benefits, completing benefit-cost comparisons of the alternatives, and documenting decisions and judgements made throughout the process.

The OCP is for use on locations where a less than desirable level of operation *may* exist and has the potential for improvement through geometric modifications or a change in traffic control. These locations, known as Operational Sites of Promise (OSOP), can be generated through local knowledge, or can be identified through the WisDOT network screening tools.

The OCP applies asset management and traffic operational benefit-cost metrics to determine if the proposed improvements provide sufficient benefit to the State Trunk Network (STN) to validate consideration for prioritization and to justify partial or total State Highway Rehabilitation (SHR) improvement funding.

The regional analyst does not need to complete the OCP for every location identified as an OSOP. However, unless other asset management certification processes (pavement treatment, safety, bike/pedestrian needs, structures, etc.) can justify the improvement, regional staff must complete the OCP to warrant inclusion of any operational-driven improvement as part of a perpetuation or rehabilitation project.

WisDOT's Bureau of Traffic Operations - Traffic Analysis and Safety Unit (BTO-TASU) is the lead for the OCP. Direct any questions regarding the OCP to DOTTrafficAnalysisModeling@dot.wi.gov.

1.2 Purpose

The primary purpose of the OCP is to assess the asset management validity of intersection or mainline improvements solely intended to fix an operational issue on the STN. The improvements must address the operational issue without degrading the overall safety.

1.3 When to Apply

1.3.1 Typical Applications

Identification of an operational site of promise alone does not trigger the need to complete the OCP. The OCP becomes required when there is a desire to include operational-driven improvements as part of a perpetuation or rehabilitation project. These improvements could include geometric modifications or a change in traffic control.

If completed, the OCP is a certification element necessary for the Final Scope Certification (FSC) approval as it helps to define an improvement project's purpose and need. Mainline facilities, intersection, or interchange improvements can have significant impacts on scope, schedule, and budget. WisDOT regional staff *should* apply the OCP as early as possible during the Financial Integrated Improvement Program System (FIIPS) Life Cycle 10 (LC10), the Project Definition phase of scoping, to maximize the time that the Programmatic Scoping and FSC processes have for identifying all the resultant scoping impacts from any OCP justified improvement. If any improvements trigger an Intersection Control Evaluation analysis, complete the OCP in conjunction with that effort. For additional information on the Intersection Control Evaluation process, see FDM 11-25-3.

1.3.2 When Not Applicable

If the proposed improvements do not extend outside the limits of the existing roadway footprint (i.e., does not require additional pavement or grading), then the WisDOT regional staff can likely include the improvement in the project without going through the OCP. For example, retiming an existing signal or restriping an existing 16-foot painted median to a 4-foot painted median and a 12-foot left turn lane would not trigger the need to complete the OCP unless additional pavement or grading is also necessary.

Improvements that include additional pavement or grading, such as modifying an existing raised-median to add or extend a left turn lane or adding pavement to the shoulder to provide a right turn lane, would trigger the need to complete the OCP for funding consideration. Improvements that *may* have a negative safety impact (e.g., narrowing lane widths), even those without the need for additional pavement, would also need to go through the OCP to justify inclusion in a perpetuation or rehabilitation project.

The OCP is not applicable for modernization projects; however, the WisDOT regional analyst can use the OCP benefit-cost tools to evaluate the potential benefit of operational improvement alternatives under consideration.

1.3.3 Local Considerations

Local agencies can follow a process similar to the OCP to evaluate operational improvements along their local roadway network; however, since the focus of the OCP is on the STN, use of the OCP tools *may* require modification to address local needs. WisDOT's BTO-TASU is available to provide guidance to the local agency on the OCP and associated tools; however, completion, review, and approval of any documentation on the analysis methodology and results is the responsibility of the local agency.

1.4 Acronyms

Table 1.1 provides common acronyms used throughout the Operations Certification Process.

Table 1.1 Acronyms

Acronym	Definition
B/C	Benefit-Cost Ratio
BPD	Bureau of Project Development
BSHP	Bureau of State Highway Programs
BTO	Bureau of Traffic Operations
FDM	Facilities Development Manual
FSC	Final Scope Certification
HCS	Highway Capacity Software
HCM	Highway Capacity Manual
IBCT	Intersection Benefit-Cost Tool
MFBCT	Mainline Facility Benefit-Cost Tool
NPMRDS	National Performance Management Research Data Set
OAPM	Office of Asset and Performance Management
OCP	Operations Certification Process
OSOP	Operational Sites of Promise
SCP	Safety Certification Process
SHR	State Highway Rehabilitation
SOBCR	State Trunk Network-Only Benefit-Cost Ratio
SOCD	Safety and Operations Certification Document
STN	State Trunk Network
TASU	Traffic Analysis and Safety Unit

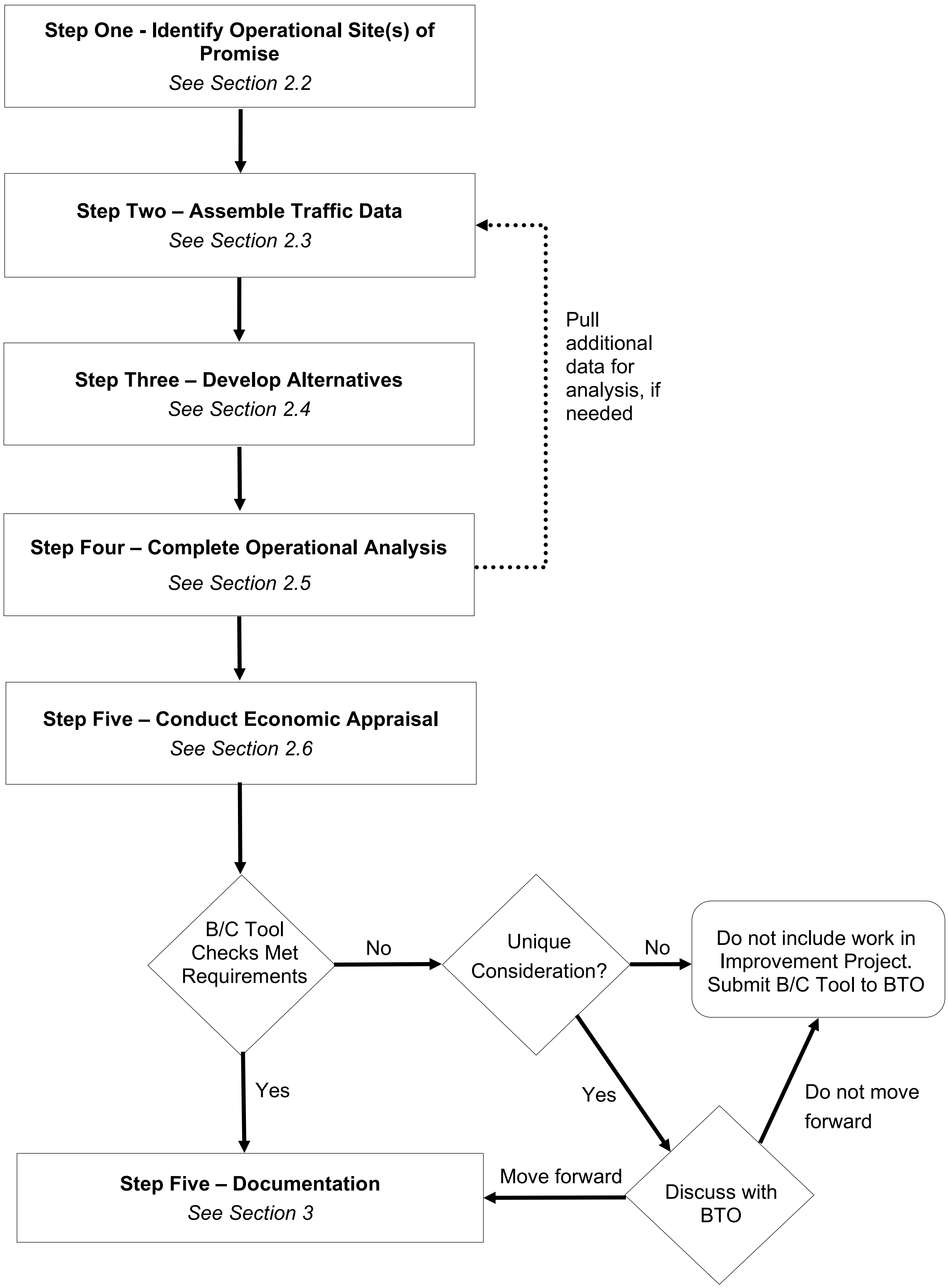
16-30-2 Policy **November 2022**

2.1 General

The purpose of this section is to introduce the methodology and expectations for evaluating the benefits of operational-driven improvements to the STN under performance-based practical design through the implementation of WisDOT's OCP. If applicable, the OCP is a certification element necessary for FSC approval.

Figure 2-1 and the following sections illustrate and define each step within the OCP, respectively.

Figure 2-1 Operations Certification Process Flow Chart



2.2 Identify Operational Site(s) of Promise

2.2.1 OSOP Definition

An Operational Site of Promise (OSOP) is an intersection or mainline location where a less than desirable level of operation *may* exist and has the potential for improvement through geometric modifications or a change in traffic control. Performance metrics that *may* describe locations with less than desirable levels of operation include, but are not limited to, locations with:

- Excessive user delay (e.g., > 50 seconds of delay/vehicle)
- Recurring poor operations (e.g., level of service E or worse)
- Long queues (e.g., queues block adjacent intersections or back onto the freeway, etc.)
- Other factors (e.g., inadequate gaps, poor merge/weave performance).

Refer to FDM 11-5-3.2 for additional performance metrics that could help define a potential OSOP.

2.2.2 Locate and Assess OSOP

The goal of this step is to identify OSOPs that exist within the limits of an improvement project. Identification of an OSOP does not automatically trigger the need to complete the OCP. However, identification of an OSOP *should* encourage additional evaluation to assess the potential benefits of completing the OCP.

WisDOT regional staff can identify an OSOP through network screening or through local knowledge (see below for more details).

2.2.2.1 Identification Through Network Screening

Operational network screening allows for a high-level planning assessment of all intersections and segments on the STN to flag locations that *may* have a less than desirable level of operation and warrant additional evaluation. The purpose of network screening is to identify potential system-wide OSOPs and to support the OCP as part of performance-based practical design. Operational network screening is not a requirement, but rather a highly recommended step within the planning phase of an improvement project.

There currently are two tools available for conducting operational network screening:

- Intersection operations screening tool
- Mainline operations screening tool

Regional analysts can review the results of the network screening tools to identify OSOPs within the limits of an improvement project relatively quickly. They can then make the determination as to whether to conduct an evaluation of the OSOP to verify the level of operations and to assess if completion of the OCP would be beneficial.

Additional details on the intersection and mainline operations screening tools follow.

2.2.2.1.1 Intersection Operations Screening Tool

The *intersection operations screening tool* consists of five Excel-based files (one for each region) that evaluate every intersection on the STN (over 26,000 intersections statewide). The tool applies planning-level methodologies to determine an operational score for each intersection and flags those that *may* be operating at a deteriorated level of service.

The high-level analysis tool utilizes available information and incorporates several assumptions for missing information related to lane configurations, volumes, turning movement percentages, and signal timings to name a few. As such, the regional analyst *should* update the assumptions in the tool with site-specific data where possible and confirm the results of the initial screening. This will allow for a more accurate estimate of the intersection's operational performance and provide a better gauge as to whether further evaluation through the OCP *may* be beneficial.

The *intersection operations screening tool* evaluates and flags intersections following the steps outlined below:

Step 1: Basic data processing (all control types) - The primary objective of this step is to determine peak hour traffic volume per lane for each approach. This step includes assumptions when there is no data available.

Step 2: Estimate volume and capacity (by control type) - The primary objective of this step is to calculate the critical lane volume and capacity per lane, per approach, or both depending upon the control type.

Step 3: Estimate delay and level of service (by control type) - This step follows the guidelines of the Highway Capacity Manual, 7th Edition (HCM7) and the National Cooperative Highway Research Program

(NCHRP) 825 to calculate control delay per approach and per intersection. Level of service is then determined based on the control delay.

Step 4: Flag intersections – Through sensitivity analysis, using the assumptions from above, this step flags those intersections anticipated to operate at a deteriorated level of service.

Additional details on the analysis methodology for the *intersection operations screening tool* is available on the BTO Traffic Analysis, Modeling and Data Management Program area webpage. For support or guidance on the use of the tool, contact BTO-TASU (DOTTrafficAnalysisModeling@dot.wi.gov).

2.2.2.1.2 Mainline Operations Screening Tool

Historically, Meta-Manager Mobility has been the primary source for identifying mainline locations that *may* be operating at a less than desirable level of service. (See FDM 11-5.3.5 for additional discussion on level of service analysis within Meta-Manager). Although this will continue to be the primary source for obtaining a planning-level assessment of operations for multilane highways, rural two-lane highways, and urban arterial roadways, an additional tool, the *mainline operations screening tool*, is available to provide a more detailed assessment for mainline freeway segments.

The *mainline operations screening tool*, developed by the Bureau of State Highway Programs (BSHP), uses Meta-Manager Mobility data, combined with speed data from the National Performance Management Research Data Set (NPMRDS), and crash frequency data for rear-end and same-side, side-swipe crashes to determine an operational score for all basic freeway segments (i.e., no auxiliary lanes) on the STN. Using the operational score, the tool currently flags those locations that *may* benefit from extended acceleration or deceleration lanes or the addition of an auxiliary lane. The results of the *mainline operations screening tool* are available via a map and spreadsheet format.

Future enhancements of the tool *may* allow for its use on other facilities, but until such time, WisDOT regional analysts *should* continue to use Meta-Manager Mobility to identify potential operational issues on non-freeways or freeways with an existing auxiliary lane. The results from Meta-Manager Mobility are an acceptable starting point to flag a segment as an OSOP; however, the WisDOT regional analyst *should* use available data on crashes, delay, and other relevant performance metrics to assess whether additional exploration through the OCP *may* be beneficial.

For support or guidance on the use of the *mainline operations screening tool*, contact BSHP – Program Development and Analysis Section.

2.2.2.2 Identification Through Local Knowledge

The goal of the screening tools is to aid the regions by identifying locations that *may* benefit from operational improvements, but the results are not all inclusive. Outside of the screening tools, regions *may* use local knowledge of areas with operational concerns to identify an OSOP. This could be in the form of comments from the traveling public, local officials, transportation management center observations, or WisDOT personnel knowledge from monitoring and traveling the network.

2.3 Assemble Traffic Data

2.3.1 Site Data

After identifying the OSOP, the regional analyst *should* assemble additional site-specific traffic data for each OSOP within the project limits. Required site-specific data includes:

- Roadway/intersection geometry, such as turn lane storage lengths for intersections and the merge/diverge section lengths for mainline facilities
- Existing and proposed intersection traffic control, including warrant analysis and signal timings
- Posted speeds

Additional site-specific data that could help define the existing user and travel characteristics and support the need for potential operational improvement(s) include, but are not limited to:

- Sight distance data
- Freight routing data
- Traffic generating events
- Existing access
- Multimodal accommodations

2.3.2 Traffic Counts and Forecasts

Consult with BTO-TASU for questions on the appropriate use of existing counts, necessity of getting new counts, and the acceptable forecasting methods for the specific site. In most cases, planning-level forecasts *should* be sufficient for completion of the OCP. Additional guidance on the assembly of traffic data is available in TEOpS 16-05.

The OCP requires the use of two forecasted years – the first year and the last year of the operational analysis period. They are described as follows:

- The first year of the operational analysis period is the first year the roadway is open to traffic after construction (i.e., the analysis period begins the year after completing construction of the improvement)[1].
- The last year of the operational analysis period is determined by adding the fixed service life of the project's improvement concept to the first year of the operational analysis period. For consistency, the OCP **shall** use the following prescribed service life durations:
  - Resurface - 10 years
  - Pavement Replacement using new asphalt - 15 years
  - Pavement Replacement using new concrete - 20 years

2.3.3 Safety Data

Safety data collection and analysis *should* follow the Safety Certification Process (SCP). See FDM 11-38 for details on the data needed and steps to complete the SCP. Direct questions regarding the SCP to DOTBTOSafetyEngineering@dot.wi.gov.

2.4 Develop Alternatives

When developing operational-driven alternatives, WisDOT regional staff *should* focus on improving the operational needs along the STN without degrading safety. In most cases, an alternative with a safety disbenefit will result in denial of the improvement alternative regardless of the funding agency or source. Improvements *should* incorporate performance-based practical design principles.

Often times there are multiple alternatives for addressing the operational needs at an OSOP, where each alternative could consist of one or more improvements to the state highway, the local roadway, or both. Carrying each alternative through the OCP and completing the economic appraisal for each alternative will help to determine which alternative(s) to investigate further based on the benefit-cost metrics.

Improvements to the local roadway will require additional documentation to illustrate how the improvement(s) will provide a direct benefit to the STN. For alternatives that include multiple improvements, the documentation needs to show how each individual improvement will help address an identified operational need while also working together to improve overall operations at the OSOP.

2.5 Complete Operational Analysis

2.5.1 Analysis Periods and Scenarios

Complete the intersection and/or mainline operational analysis for the following scenarios:

- No-build Operational Analysis Start Year (Construction Year + 1)
- No-build Operational Analysis End Year (End of Service Life)
- Build Operational Analysis Start Year (Construction Year + 1)
- Build Operational Analysis End Year (End of Service Life)

Conduct analysis for the time period(s) when there is known or estimated congestion or other operational concerns. This typically is one-hour during the morning and one-hour during the typical weekday afternoon when traffic demand is the highest (i.e., the AM and PM peak hour), but can vary by location.

2.5.2 Analysis Methodology and Tools

In most cases, the traffic analysis for the OCP will utilize HCM-based traffic analysis tools (e.g., Synchro, HCS, SIDRA). Use of microsimulation tools (e.g., SimTraffic, Vissim) are only necessary under certain conditions to get a more accurate assessment of queuing impacts, or when the analysis exceeds the limitations of the HCM-methodology and construction costs are high enough to justify the additional expenditure of resources. Refer to TEOpS 16-10 for additional guidance on the supported analysis software tools for use within the OCP.

[1] For proposed advanceable projects, base the first year of the analysis period on the original letting (LET) date, not the advanceable LET date.

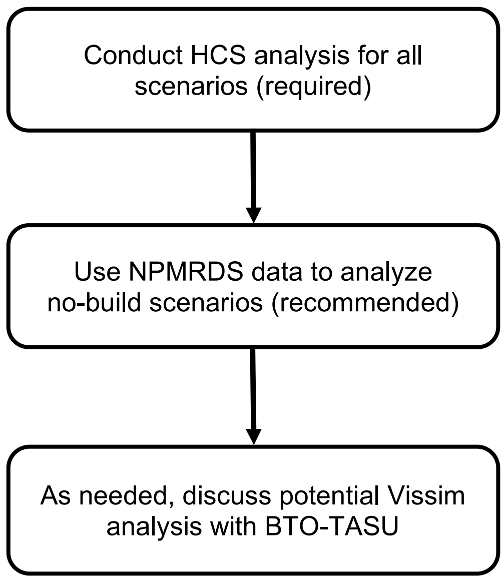
2.5.2.1 Intersection Analysis

The intersection operational performance metrics necessary for completion of the OCP economic appraisal are delay (in vehicles per hour) and 95th percentile queue lengths (in feet). Synchro is the recommended analysis software because the benefit-cost tools used to complete the economic appraisal allow for the automatic input of performance metrics from Synchro. However, the benefit-cost tools allow for the manual entry of this information to accommodate the use of other supported traffic analysis tools.

2.5.2.2 Mainline Analysis

The primary mainline operational performance metric necessary for completion of the OCP economic appraisal is travel speed (in miles per hour). The economic appraisal tool will utilize the travel speed, volume, and segment length to calculate travel time and user delay. The mainline analysis includes a multi-step operational analysis from up to three different sources as presented in Figure 2-2. Refer to TEOpS 16-10 for additional guidance on the supported analysis software tools for use within the OCP.

Figure 2-2 Mainline Operational Analysis Flow Chart



2.5.2.2.1 HCS Analysis

HCS is the recommended software tool to evaluate mainline operations for the OCP. The benefit-cost tools developed to complete the economic appraisal allow for the automatic input of outputs from the HCS freeway facilities module. Users can manually input data into the benefit-cost tool from other HCS mainline analysis modules, such as the HCS two-lane highway or HCS multilane highway modules, or other WisDOT supported traffic analysis tools.

2.5.2.2.2 NPMRDS Analysis

Ideally, the evaluation of the no-build conditions will use a combination of both HCS results and NPMRDS data. Use of NPMRDS data allows the analysts to ground the HCS model results to field data, thus providing a realistic assessment of observed speeds. After completing the HCS analysis and reviewing the results for reasonableness, the analyst *should* pull the raw NPMRDS speed data for the OSOP(s). The benefit-cost tools use volume data from HCS and location code, time stamp, and speed data from NPMRDS to assess the no-build conditions. The benefit-cost tool contains detailed information on the NPMRDS data collection. If NPMRDS data is not available, the analyst can use HCS to calculate the speeds for use in the economic appraisal.

2.5.2.2.3 Vissim Analysis

It is important to determine the appropriateness of using Vissim as the models can be time consuming and expensive to complete. Conduct an initial economic appraisal following HCM-methodologies prior to considering a Vissim analysis. If initial economic appraisal results following HCM-methodologies are well below the thresholds, it is unlikely that a Vissim model will produce results that would meet the thresholds, thus decreasing the potential benefit of the extra level of effort. As such, limit the use of Vissim analysis to only those locations:

- with poor existing operations not accurately captured with higher-level analyses
- that do not fit within the confines of the HCM-methodology
- with improvement costs greater than $2.5 million, and/or
- that have economic appraisal results which border the thresholds

Contact BTO-TASU to discuss the potential use of Vissim before starting the analysis. If justified, use the Vissim models to obtain both the no-build and build results.

2.6 Conduct Economic Appraisal

The OCP uses benefit-cost metrics to determine program prioritization validity of proposed operational improvements. The benefit is determined by comparing the user-delay cost over the typical life expectancy of the perpetuation or rehabilitation improvement concept with and without the proposed operational improvements through calculating the net-present value.

BTO developed two Excel-based tools to calculate the benefit-cost metrics used in the economic appraisal, the *Intersection Benefit-Cost Tool* (IBCT) and the *Mainline Facility Benefit-Cost Tool* (MFBCT), both of which are able to analyze multiple alternatives at one or more OSOPs. The analyst enters information on the operational analysis results, the Safety Certification Process results, and the construction costs into the appropriate tool. The benefit-cost tools use the input to perform the associated safety and operational checks as outlined below (see section 2.6.2).

2.6.1 Construction Cost Estimate

The construction cost is the cost of the proposed operational improvement(s) being evaluated through the OCP, not the total project cost. These costs must include the construction costs and subsequent costs, including noise walls and associated real estate costs for the improvement. The economic appraisal *should* exclude any design or oversight costs and maintenance or operating costs.

If analyzing multiple improvements or locations, the economic appraisal *should* include the construction cost for all proposed improvements. However, the analyst must document and justify each individual improvement within the Operations Certification Summary.

2.6.2 Safety and Operational Checks

Proposed intersection and mainline improvements must pass a set of safety and operational checks in order to be considered for inclusion in a SHR-funded project.

The safety checks provide an assessment on whether the proposed operational improvement generates any safety disbenefits as defined under the Safety Certification Process (SCP), see FDM 11-38. In most cases, a safety disbenefit will result in denial of the improvement alternative regardless of the funding agency or source. BTO recommends conducting the safety check before running the operational analysis as a negative impact to safety for a proposed solution *may* deter further investigation.

The operational checks look at benefit-cost ratios to determine if the project has sufficient operational benefit to justify prioritization for inclusion in an approved SHR-improvement program project. If the proposed improvement does not meet the operational checks, it does not mean the project will not provide any operational benefits. It just means the benefits are not sufficient to justify shifting funding from prioritized projects and accepting a resultant decrease in system health.

There *may* be instances where an improvement does not meet the safety and operational checks but *should* have unique considerations for use of SHR funds. Coordinate with BTO-TASU, Bureau of Project Development (BPD), and Division of Transportation Investment Management (DTIM) – Office of Asset and Performance Management (OAPM) for additional review of these improvements. Unique considerations could include the conversion of an all-way stop-controlled intersection to a signalized intersection or an off-ramp with queues that exceed the ramp length and back out onto the freeway.

2.6.2.1 Safety and Operational Checks

There are three safety and operational checks for applicable for both intersections and mainlines:

1) Safety benefit-cost ratio must be 0 or greater
2) No increase in fatal and injury (KABC) crashes
3) Safety and operations benefit-cost ratio must be 3.0 or greater

Intersections have an additional operational check to assess the benefit to the STN. For intersections to qualify for 100% SHR funding, the STN-only benefit-cost ratio (SOBCR) must be 1.0 or greater. The SOBCR considers operational benefits only and does not take into consideration any potential safety benefits to the STN. A SOBCR less than 1.0 *may* allow for less than 100% SHR improvement funding if all the following conditions are met:

1) All the other safety and operational checks received passing values,
2) A local or other approved non-SHR improvement funding source has been identified to cover the remaining project costs,
3) There is a signed State Municipal Financial Agreement within the FSC that documents the local share for the scope of the operational improvements.

The operational-driven improvements must pass all the above safety and operational checks to be considered for 100% SHR funding. If not all the checks are met, then there *may* still be an opportunity for partial funding. The OCP identifies improvements for funding consideration and does not guarantee funding.

2.6.2.2 Changes to Benefit-Cost Thresholds

DTIM-OAPM is responsible for maintaining the department's asset management metrics which identify system needs for prioritization of approved funding. Depending on level of needs and available funding, program prioritization thresholds can change over time. As DTIM-OAPM regularly performs necessary updates to the system asset management metrics, it will also determine if any adjustments to the benefit-cost thresholds occur.

16-30-3 Documentation — November 2023

3.1 Operations Certification Summary

The purpose of the Operations Certification Summary is to articulate the purpose and need of the proposed improvements. A successful purpose and need clearly defines the system's needs, identifies the negative impacts to the system from those needs, and describes how each proposed improvement works individually and in harmony with any other individually proposed project improvements to cost effectively resolve the need.

The Operations Certification Summary must clearly explain and robustly justify the inter-dependent necessity of each improvement. The Operations Certification Summary **shall** identify the specific existing operational problem(s) at the OSOP, define the proposed improvements, and clearly illustrate how the improvements directly reduce or eliminate the operational problem(s) without degrading the overall safety of the OSOP.

The reason for requiring this type of documentation is illustrated in the following ways:

- It is very possible that one improvement element out of the several proposed for a site could be singularly generating more than the required benefit-cost ratio. Satisfying all the required checks within the OCP, *should not* arbitrarily allow the inclusion of other proposed improvements.
- The Operations Certification Summary must explain how and why all the individual improvement elements are necessary for the totality of the project as proposed.
- Failure to clearly identify and explain those engineering and operational linkages within the Operations Certification Summary could result in the rejection of some or all the proposed improvement elements.
- State Statutes 20.395(3)(cq) and 20.395(3)(cx) prohibit WisDOT from spending SHR-improvement funds on the local system without having documented justification on the direct STN benefits that expenditure provides. If the proposed project includes improvements to the local system, the Operations Certification Summary must clearly articulate the inter-dependent necessity of those improvements to the total project and how they provide direct operational or safety benefit to the STN to justify any expenditure of SHR improvement funds on them.

An Operations Certification Summary template along with the Operations Certification Summary Guidance document are available to guide the user on the content and format for the Operations Certification Summary itself. Submit the Operations Certification Summary as an attachment to the Safety and Operations Certification Document and submit to BTO-TASU for review. See FDM 11-38-15.1 for additional details on the Safety and Operations Certification Document.

3.2 Operations Certification Amendment

An amendment must be submitted if WisDOT regional staff want to consider other alternatives or additional operational improvements after the Safety and Operations Certification Document has been signed and the Operations Certification Summary has been approved. The new alternatives or additional operational improvements will need to follow the OCP. Document the results in the Operations Certification Summary amendment and attach to the Safety and Operations Certification Document amendment. See FDM 11-38-15.2 for additional details on the Safety and Operations Certification Document Amendment. If the project is still within the scoping phase, the WisDOT regional analyst **shall** include the amended Safety and Operations Certification Document within the FSC. The amended Safety and Operations Certification Document will supersede the original. If the amendment occurs after the scoping phase, the WisDOT regional analyst **shall** document the amended Safety and Operations Certification Document within the Design Study Report and environmental document, as appropriate.

An Operations Certification Summary Amendment template and Operations Certification Summary Amendment Guidance document are available to guide the user on the content and format of the amendment itself. Submit the Operations Certification Summary Amendment as an attachment to the Safety and Operations Certification Document Amendment and submit to BTO-TASU for review. See FDM 11-38-15 for additional details on the Safety and Operations Certification Document.

3.3 Project Approval and Funding

The OCP serves as an aid, not an absolute determinant, in the WisDOT SHR Scoping process. The OCP identifies when it is a valid asset management consideration to add the proposed operational improvements to a perpetuation or rehabilitation project. Passing the safety and operational checks during the economic appraisal validates consideration for adding the proposed improvement(s), but it does not automatically guarantee funding for the evaluated improvement(s).

Different variables can impact the SHR Improvement Program in either positive or negative ways with little or no advance notice. World events can trigger sudden economic downturns or upturns that *may* result in funding changes or rapid construction cost inflation which lead to re-calibration of asset management metrics and existing programming priorities. Recent or current OCP approvals *may* require reassessment under re-calibrated benefit-cost ratio values.

Similarly, certain highway segments within the SHR Improvement Program *may* experience unanticipated accelerated deterioration resulting from physical attributes or historically harsh weather conditions. This can require re-prioritization of needs and treatments within the SHR Improvement Program that could negatively impact previous program assumptions within a regional or statewide program.

Inclusion of operational improvements in the project's scope requires BTO-TASU approval of the OCP analysis methodology, Operations Certification Summary, and Safety and Operations Certification Document. BTO approval; however, does not guarantee funding. The regional programing unit (3R Program) or the BSHP (Backbone Program) has the final approval for including operational improvements into the FSC. WisDOT regional staff *should* work with the respective programming sections early in the process to discuss the system health impacts of adding additional operational improvement project costs to the program.

17-1-1 DMS Policies & Procedures — November 2015

INTRODUCTION

This document outlines the policies and procedures for the operation of WisDOT's Traffic Management Center's (TMC) Dynamic Message Signs (DMS), and was created for personnel in state, regional, and local transportation agencies that have responsibility for the operation of and/or message design for permanent DMS.

DYNAMIC MESSAGE SIGN OVERVIEW

Dynamic Message Signs (DMS) are the most visible manifestation of traveler information systems. They are electronic message boards placed in close proximity to roadways that allow traffic system operators to inform drivers on changing traffic conditions. DMS are commonly used for congestion warnings, lane and ramp closure information, alternate route information, and traffic flow diversion. The ability to quickly alert motorists of a problem ahead and provide an alternate route through a DMS is a successful strategy for minimizing the impact of an incident on traffic flow. DMS have demonstrated to provide the following benefits:

- Reduction of speeds as vehicles approach congested areas, resulting in fewer accidents;
- Increased diversion to alternate routes during incidents, resulting in better traffic network performance;
- Increased lane changes away from lanes that are closed downstream, resulting in safer merging operations; and
- Improved traffic operations during special events.

As soon as TMC Control Room Operators verify incidents, they can create and display messages on the appropriate DMS in order to provide drivers with real-time information on traffic conditions, either as advisories or as proactive route guidance. DMS messages aid drivers to make more informed decisions on congestion avoidance and en route diversion.

> *"Paramount to the message design and display, [DMS] must provide timely, reliable, accurate and relevant information and they must be operated properly to be effective. Credibility is an extremely important consideration in properly operating a [DMS] system. Regardless of how well a message is designed, motorists will eventually come to distrust the signing system if the messages are not changed at the correct times and updated to reflect correct traffic conditions."*[1]

The policies and guidelines presented in this chapter have been developed to support these goals. Discrepancies between the acquired information and the travel experience *may* lead drivers to rely less on information over time.

NATIONAL DYNAMIC MESSAGE SIGN OPERATIONAL POLICIES

There are no written DMS operations policies at the national level. However, policies, standards, and guidance are embodied in the MUTCD and in FHWA guidance documents and policy memorandums.

The primary chapters and sections addressing DMS in the MUTCD are:

- *Chapter 2L. Changeable Message Signs*
- *Section 6F.60. Portable Changeable Message Signs*

The MUTCD states that,

> *"…CMS **shall** display only traffic operational, regulatory, warning, and guidance information. Advertising messages **shall not** be displayed…"*

Additionally, FHWA published a document that includes specific guidance for DMS messaging (Guidelines for Disseminating Road Weather Advisory & Control Information) in June 2012. This document includes, but is not limited to road weather information; it includes guidance on DMS content structure, length, phrasing, phase timing, and effective ways to communicate travel times, delay, event locations, degrees of urgency, and degrees of certainty.

(http://ntl.bts.gov/lib/45000/45600/45623/FinalPackage_JPO-12-046_V1.pdf)

---

[1] FHWA's Guidelines for Changeable Message Sign Messages, Page 2-7

WISDOT DYNAMIC MESSAGE SIGN OPERATIONAL POLICIES

1) WisDOT's DMS *may* be used for the following situations as they apply to freeways, ramps, and approved surface streets:
   - Traffic incident management
   - Emergency situations requiring diversion
   - AMBER Alerts and Silver Alerts
   - Recurrent traffic congestion
   - Current roadwork – including lane, ramp and roadway control
   - Future roadwork (up to 10 days in advance)
   - Special event (See TEOpS 17-2-1 for attendance thresholds)

   In addition, DMS *may* be used to display:
   - Current travel times
   - Static travel times
   - Adverse weather conditions
   - Warning of adverse road weather conditions
   - Transportation safety messages
   - Fire prevention purposes in high fire risk areas
   - Other approved transportation-related messages.

2) DMS *should not* be used to display the following information:
   - Advertising products or slogans, whether WisDOT related or not
   - General rules of the road messages that drivers *should* already adhere to (i.e. “Be prepared to stop”)
   - Non-threatening weather reports or temperature
   - Time of day or date
   - Directions for specific user groups

   Note: As an alternative to displaying such of any non-approved messages listed above, the traffic media can be contacted by the TMC to broadcast a “Media Alert” at their discretion.

3) DMS messages for the approved applications *should* be posted in accordance with the prioritized hierarchy listed in Section 3, “Hierarchy for Displaying Messages”, in the Operational Guidelines of this chapter.

4) DMS signing *should* only be done after the operator confirms the conditions/incidents with a reliable source.

5) References to PARK AND RIDE lots *should* only be made when in relation to another approved signing application such as special events.

6) Alternate routes *should* only be signed for, or in the event of, a freeway closure or major incident.

7) Only alternate routes approved by Department staff or the Control Room Shift Supervisor *should* be referenced when using DMS to sign for alternate routes (off the freeway).

8) Arterial DMS (ADMS) *should* primarily be used to inform motorists of conditions on freeways or approved alternate routes.

9) Signs *should* display current Travel Time messages as default messages. Blank signs are allowed at locations where there is little or no reoccurring congestion or commuter traffic (i.e. rural areas). Hybrid DMS *may* be blank when travel time data is unavailable.

10) Message format and content *should* follow guidelines set forth in the Operational Guidelines of this Procedure.

11) Use of DMS for fire prevention purposes is further defined in the Memorandum of Understanding between the Wisconsin DNR and WisDOT in the Fire Prevention Memorandum of this Procedure. Message activation *should* adhere to the guidance provided in the Control Room Operations Manual Red Flag Warning section 8.N.

DYNAMIC MESSAGE SIGN OPERATIONAL GUIDELINES

1) Situations that warrant the use of DMS

a) Current and Future Situations:

i) Current Situations

(1) Planned Situations

- Roadwork (construction and maintenance)
- Special events (See TEOpS 17-2-1 for attendance thresholds)

(2) Unplanned Situations

- Recurrent traffic congestion
- Incidents affecting traffic
- Emergency situations requiring diversion
- AMBER Alerts and Silver Alerts
- Warning of adverse road weather conditions during adverse weather events

(3) In addition, DMS *may* be used to display

- Current travel times
- Static travel times
- Confirmed or imminent adverse or severe weather conditions
- Transportation safety messages
- Other transportation-related messages

ii) Future Situations (up to 10 days in advance)

(1) Future special events

(2) Future roadwork (construction and maintenance)

b) Transit and Park-and-Ride Lots

Messages referencing transit or park-and-ride lots *should* only be displayed during special events such as Summerfest or State Fair to help mitigate congestion resulting from attendees. For example:

SUMMERFEST TRAFFIC USE BARKER RD PARK/RIDE LOT	STATE FAIR TRAFFIC USE WATERTOWN PLANK PARK/RIDE LOT

c) Signing for Alternate Routes

i) Freeways as alternate routes – The freeway system is the preferred alternate route, if practical. An alternate freeway route *should* only be signed for when incidents or roadwork on the primary route cause delays above 30 minutes. For example:

I-43 NB CLOSED AT MARQUETTE INT FOLLOW DETOUR	GREEN BAY TRAFFIC USE I-894 BYPASS TO US 45 NB

ii) Arterial streets as alternate routes – Only pre-approved surface streets *should* be referenced when traffic diversion or detouring is necessary. If diverting or detouring traffic off the freeway is necessary and no pre-approved routes are available, the phrase USE ALTERNATE ROUTE *should* be used.

2) Verifying Conditions and Events that will Utilize DMS

No message *should* be put on a sign until the message information has been verified by a reliable source. CCTV camera images will provide the most common source for verification. Other sources include, but are not limited to, WisDOT staff, or law enforcement.

3) Hierarchy for Displaying Messages

Messages for DMS *should* be displayed in accordance with the guidelines listed below. This section lists the message priority during all times.

a) Incident/Weather/Emergency - Incidents that cause freeway lane closures for at least 15 minutes or conditions lasting at least 15 minutes that are hazardous to motorists and requiring active diversion. Events that block all traffic lanes or cause hazardous conditions *should* be given priority over all other messages. Hazardous conditions include stopped or slowed traffic where sight distance is limited or weather-related hazard conditions exist. Refer to part 6) g) vi) of this section of the policy for information regarding the placement of adverse conditions messages on DMS requested by law enforcement.

b) Amber Alert or Silver Alert – The TMC will utilize the Dynamic Message Signs (DMS) to notify the traveling public of the Amber Alert or Silver Alert.

AMBER ALERT INFO TUNE TO 1610 OR CALL 511	SILVER ALERT MISSING PERSON CALL 511 FOR INFO

In the event that a major incident and an Amber or Silver Alert occur simultaneously, WisDOT will make every effort to display information for the incident and the Amber Alert through a two-phase DMS message

c) Roadwork (construction and maintenance) – Priority *should* be given to events that have the greatest negative impact on traffic and that are expected to last the longest.

d) General traffic flow conditions – General traffic flow information such as levels of congestion or delays.

e) Current travel times.

f) Current special events – During special events, route guidance, exit information, and park-and-ride information *may* be provided to motorists.

g) Future occurrences (according to chronological date) – Priority *should* be given to whichever event is expected to occur first, has the greater impact on traffic, or is expected to last the longest.

h) Transportation-related messages – Other transportation-related messages, including safety messages, *may* be scheduled and provided to motorists.

4) DMS Status

Monitoring messages on DMS – Messages on DMS *should* be continually monitored to ensure that the information presented on each sign is current.

5) DMS Use for Arterial Streets

a) Arterial DMS (ADMS) – All policies and guidelines contained in this chapter apply to Arterial DMS. Arterial DMS *should* only be used for the same applications as freeway DMS. Arterial DMS *should not* be used to provide information for any other routes, incidents, conditions, or events that freeway DMS does not support, with the exception of freeway on-ramp closure information.

b) Signing for arterial conditions – DMS messages on freeway or arterial signs *should not* present information pertaining exclusively to surface street routes. Surface street information *should* only be presented as supplementary information for freeway conditions to allow motorists to make decisions regarding route selection, with the exception of freeway on-ramp closure information.

6) Message Design

a) <u>General</u>

i) Standard Terminology – Messages *should* be designed using standard terminology as defined in the “Message Design Dictionary”. All words in the Message Design Dictionary *should* be stored in the TIS (Traveler Information System) dictionary. Words not found in the Message Design Dictionary *may* be used when necessary. New words *should* be approved and included in the Message Design Dictionary before they are included in the TIS dictionary. MUTCD approved shields, symbols, and graphics *may* be used while following all other applicable operations guidelines. Contact the Statewide Freeway Traffic Operations Engineer or the Control Room Shift Supervisor for the message library.

ii) Message Length Limitations – Messages *should* be kept as short and concise as possible.

Messages *should* generally be no more than 8 words in length (4-8 characters per word) excluding prepositions (to, at, for, etc.).

Messages *should* use no more than two information units per line, three information units per phase, four information units per message read at speeds of 35 mph or more, and five information units per message read at speeds less than 35 mph. Messages *may* reference other sources containing additional information (e.g., 511, Highway Advisory Radio).

An information unit can be defined as the answer to a basic question about the subject of the message. For example, in the bullets below, each answer to the question is a single information unit each.

- What is the problem?
  - FLOODING, SLICK IN SPOTS, BLOWING SNOW
- Where is the problem?
  - AT US 41, PAST WIS 151, MADISON AREA
- Who is affected?
  - BELOIT, ALL TRAFFIC, WEST BOUND TRAFFIC
- What *should* they do?
  - USE I-894 EAST, REDUCE SPEED, TRAVEL NOT ADVISED

iii) Message Phasing – When possible messages *should* be displayed in one phase. Messages *should* be displayed in no more than two phases. If two phases are used, each phase *should* be distinct and understandable by itself. When dividing messages between two phases, compatible information units *should* be kept in the same phase. One line *should not* contain parts of two information units, but *may* contain two whole information units.

Minimum message display time *should* be determined according to posted speeds and units of information to ensure that motorists will be able to read the entire message. The display time should be determined by the lesser of one second per word or two seconds per unit of information. A minimum displaying time of 2 seconds per line per phase *should* be used for speeds of 55 mph. The maximum cycle time of a two-phase message should be eight seconds. When speeds are below 30 mph, a minimum displaying time of 1 second per line per phase *may* be used.

Graphic messages are limited to one phase.

iv) Flashing Messages – Flashing messages **shall not** be used.

v) Indication of Lanes

(1) For messages pertaining to three or fewer lanes, the terms “LEFT,” “CENTER” or “RIGHT” *should* be used to describe the affected lanes.

(2) For messages pertaining to four or more lanes, the following format is recommended:

(a) [n] [LEFT/RIGHT/CENTER] LANE(S) CLOSED where:

LEFT – represents the left lane only

RIGHT – represents the right lane only

CENTER – represents any center lane exclusively

LANES – to be used when the number of affected lanes is not known

n – number of affected lanes

For example:

LEFT LANES CLOSED AT HAWLEY RD MERGE RIGHT	2 RIGHT LANES CLOSED AT 35TH ST USE ALT ROUTE

vi) Shoulders – The phrases “LEFT SHOULDER,” “RIGHT SHOULDER” and “BOTH SHOULDERS” can be used in cases where shoulders are closed.

vii) Freeway Exit Designation – Exit designations *should* be consistent with those specified on static signs in the area.

viii) Use of Local and General Terminology

(1) Local Terminology – Local terminology refers to names or places that are typically recognized only by motorists that frequently drive in the area.

(2) General Terminology – General terminology uses generic terms including distances and abbreviated jurisdictional freeway designations to describe locations that most drivers *should* understand. This section gives examples of situations when common local and general terms *should* be used.

(3) Target Audience – The use of local or general terminology is dependent on target audience. The target audience can be commuter/local traffic, through traffic, special event traffic, or all traffic. Commuter/local traffic *should* be addressed using local terminology. Through/all traffic *should* be addressed using general terminology. The AM (6:00am-9:00am) and PM (3:00pm-6:00pm) peak periods *should* address commuter/local traffic. All other periods *should* address all traffic. During days which special events are being held (Summerfest, State Fair), only general terminology *should* be used throughout the entire day.

(4) Interchanges – The use of local interchange names (Marquette, Zoo, etc.) *may* be used when commuter/local traffic is the target audience. Otherwise, interchanges *should* be referenced to by the abbreviated jurisdictional designation (I-94, US 45, etc.) of the highways and streets that compose the interchange.

(5) Freeways – The use of local freeway names (East-West, Rock, etc.) *should not* be used. Freeways *should* be referenced to by their abbreviated jurisdictional designation (I-94, US 45, etc.). An acceptable exception is the use of Airport Spur instead of STH 119

(6) Streets – Streets *should* be referenced to by their local street name, not by their jurisdictional designation (e.g. use GREENFIELD AVE, not WIS 59) unless the jurisdictional designation is more commonly known (e.g. WIS 100 between Edgerton Ave. and Silver Spring Drive in Milwaukee). In either case, static signing *should* be in place for the referenced street. Names *should* be followed by facility descriptors (Rd, Ave, St, etc.) for clarity. If space on the text line is not available, the descriptor *may* be omitted. Street names that could be confused with directions (North Ave) or cities (Beloit Rd) *should* always be listed with their descriptors.

ix) Abbreviations – Abbreviations *should* be used only when no other formatting or terminology can be used to convey the message. The length of the abbreviation *should not* exceed two-thirds the length of the word.

x) Text Alignment – Text on all signs **shall** be centered, except graphic messages and for travel times, when justified alignment *may* be used.

xi) Font – All the text *should* be displayed in capital letters, using only one font size and only one font type.

xii) Letter Size – For roadways with posted speeds of 45 mph or higher, the minimum letter height *should* be 18”. For roadways with posted speeds of less than 45 mph, the minimum letter height *should* be 12 “.

xiii) Character Spacing – Proportional spacing *should* be used as much as possible. Fixed spacing *may* be used.

xiv) Graphics, Symbols, and Animation – DMS *may* use standard Highway sign and route shield symbols provided they meet the requirements of the MUTCD, Section 2L.04. DMS **shall not** display graphics, symbols, or animation other than those approved by the MUTCD.

xv) Brightness – Operators *should not* change the brightness, unless directed by Department staff or the Control Room Shift Supervisor. Brightness is auto-adjustable and fluctuates during the day to adapt to natural conditions.

b) Messages for Incidents/Current Roadwork/Congestion/Emergency

i) Message Content – Messages about incidents, roadwork, or congestion *should* contain the following minimum information:

- Problem
- Location
- Action

These messages *may* also contain the following additional information:
- Effect on Travel
- Audience for Action
- Good Reason for Following the Action

[Problem] [Location] [Action]

ii) Message Format – Each piece of information *should* be presented in the order shown below:

iii) Problem – This information refers to the reason for posting a message and provides information about the situation that the driver will encounter. Examples include DELAYS AHEAD, LANE CLOSED, and RAMP CLOSED.

(1) Lane/Ramp Closures – Lanes/Ramps *may* be closed due to roadwork or incidents. When roadwork is the cause of a lane/ramp closure, the term CLOSED *should* be used. When incidents are the cause of the lane closure, the term CLOSED *should* be used. The phrases “ALL LANES CLOSED” or “ALL LANES CLOSED” *should* be used when all travel lanes are closed.

(2) General Traffic Flow Conditions – During periods of recurrent congestion, traffic conditions *should* be described as:
- REDUCED SPEEDS – speeds of 36 to 50 mph (yellow on map)
- DELAYS – speeds of 21 to 35 mph (pink on map)
- SEVERE DELAYS – speeds of 0 to 20 mph (red on map)

iv) Location – Describes the location or distance to the situation or the approximate area of the event. The location *should* be specified using cross streets or distances downstream of the DMS.

(1) Local Terminology – Local terminology *should* reference the closest cross street(s) that apply to the event when common cross streets are close together. For example, use AT LOCUST ST, or NEAR HWY 83.

(2) General Terminology – General terminology *should* reference a distance downstream of the DMS to the nearest half mile when common cross streets are far apart. For example, use # MILES AHEAD.

(3) Landmarks and Areas – Landmarks and areas *should not* be used as location references. Exceptions include DOWNTOWN and AIRPORT.

(4) Locations on DMS Upstream of Congestion – When utilizing DMS that are located upstream of the event, the location of the event *may* be specified at one point, or between two points. For

DELAYS AT 35TH ST	DELAYS AHEAD 35TH ST TO 84TH ST

DELAYS CLEAR AT 84TH ST

example:

(5) Locations of DMS in congestion – When utilizing DMS that are located in areas that are congested, messages *should* inform drivers where the congestion clears. For example:

(6) Route Designation – The freeway/highway designation *should* be included as part of the location if the event is located beyond or spans a freeway-to-freeway interchange.

DELAYS I-94 EB AT 84TH ST

For example, if traveling on I-94 EB the sign at Elm Grove Rd. *should* read:

Because motorists could travel on I-894 eastbound or US 45 northbound, the highway must be identified in the message. Phased messages *may* be used to inform motorist of conditions on multiple highways.

v) Action – This refers to what action the motorist *should* take in response to the problem and location information. Examples include USE ALTERNATE ROUTE, EXIT NOW, or MERGE RIGHT. Action statements *should* be used when the tactics prescribe an active response. BE PREPARED TO STOP/SLOW **shall not** be used.

vi) Audience (optional) – This information refers to a specific group of drivers rather than everyone passing the DMS. Examples include TRUCKS, DOWNTOWN TRAFFIC, and NORTHBOUND TRAFFIC. If an audience statement is used, an action statement *should* be included.

vii) Effect on Travel (optional) – Informs the traveler of the severity of the situation by using delay or travel time and helps the traveler form expectations about their trip or decide to change their travel plans. Examples include DELAYS AHEAD or # MIN DELAY.

viii) Good Reason for Following the Action (optional) – Gives a traveler confidence that following the advice on the DMS will result in safer travel and/or significant savings in time. Examples include BEST ROUTE TO AIRPORT or AVOID DELAY.

c) <u>Messages Displaying Travel Times</u>

Current Travel Times *should* only be displayed when the system is accurately calculating travel times. Travel Times less than the static travel times *should not* be displayed. Travel Times *may* be used to display travel time comparisons between alternate routes. For example:

FREEWAY TIME TO AIRPORT	
VIA I-894	15 MIN
VIA I-94	18 MIN

Freeway, arterial and hybrid static-dynamic message signs *may* be used to display travel times.

d) <u>Messages during Special Events</u>

i) General – Directions for specific user groups will not be provided on DMS.

ii) State Fair/Summerfest – DMS *should* be used to provide motorists with park-and-ride information during State Fair/Summerfest. A TMP (Traffic Management Plan) is created for each year's State Fair and Summerfest events. The TMP includes DMS messages that operators *should* use during State Fair and Summerfest events.

iii) Miller Park Events

(1) DMS *should* be used to provide motorists with information regarding traffic conditions around the I-94/US 41 Interchange during Miller Park events. A TMP has been created for Miller Park events. The TMP includes DMS messages that operators *should* use during Miller Park events.

(2) Line DMS (LDMS 50 & 51)) *should* be used to inform motorists about Miller Park Events. LDMS *should not* convey traffic or any other related information that is not Miller Park-event related. Unless otherwise determined by the Department staff or the Control Room Shift Supervisor, messages on LDMS *should* warn drivers to tune their radios to the Miller Park HAR frequency (1180 AM), where complete messages will be broadcast.

e) <u>Messages for Future Roadwork</u>

DMS *should* be used only for future roadwork that involve lane/ramp closures and that will start within 10 days or less. DMS *may* be used in support of traveler information to notify drivers of changes to closures/detours affecting drivers' route choice. DMS message plans are not generated from closure information entered into LCS (Lane Closure System). WisLCS Advance Notification Guidelines *should* be referenced for notification minimums. Message requests *may* be altered to conform to the message design format described in Part 6 of this policy.

Messages for future roadwork *should* follow the general guidelines roadwork scheduled to begin in the next 7 days:

i) Message *should* include the date and time the roadwork will start.

ii) Message *should* use the day of the week rather than the calendar dates. For example, "TUES – THURS"

iii) Message *should not* use the phrase "FOR 1 WEEK" because the start and end dates are ambiguous.

iv) Message *may* use the term "WEEKEND" if the event begins on Saturday morning and ends on Sunday evening.

RAMP CLOSED THUR 9AM – 3PM

Example:

Messages for future roadwork *should* follow the general guidelines roadwork scheduled to begin in more than 7 days, but within 10 days or less:

i) Message *should* use a 3-letter month abbreviation rather than a numerical month representation. For example, "FEB 22."

ii) Message *should* only state the month once if both dates in a range are in the same month. For example, "FEB 22 – 28"

iii) Message *should not* include day, date, and time information.

RAMP TO CLOSE FEB 22 - 28

Example:

f) <u>Messages for Future Special Events</u>

DMS *should* be used only for future special events that are expected to have a negative impact on traffic and that will start within 10 days or less. Messages for future events *should* follow the general guidelines for current special event. In addition, message *should* include the date and time the special event will start.

g) <u>Messages for Adverse Weather Conditions</u>

i) General – DMS *should* only be used to inform drivers of adverse weather conditions that are currently affecting travel. Reliable weather reports of imminent severe weather *may* be displayed. Examples include winter warnings related to ice, storms and blizzards. General weather reports or forecasts **shall not** be displayed.

ii) Evaluating the need for adverse weather messaging – the following *should* be taken into consideration when evaluating the need to message for adverse weather conditions:

- Is there a storm or weather warning in effect for county/area? If so, use the warning's expiration time as a guide for how to long to place the message on the DMS.
- Is there a significant increase in the number of traffic incidents in the county/area? Is the number of incidents unusual for that time of day?

iii) Format for Weather Condition Messages – Messages for severe weather conditions that affect traffic *should* follow the same format as messages for incidents, roadwork, and congestion. The problem statement *should* indicate the weather condition. Examples include ICY ROADS or POOR VISIBILITY.

DMS *should* be used to broadcast Winter Storm Warnings, Blizzard Warnings, Lake Effect Snow Warnings and Ice Storm Warnings issued by the National Weather Service (NWS). When a warning is issued by NWS, notify the Control Room Supervisor or On-Call BTO Management. On-Call BTO Management will provide approval for the warning messages to be deployed. The message *should* include the time frame of the warning, for example MON 6PM TO TUE 5AM. The message *should* include a command for the driver, for example PLAN AHEAD prior to the warning taking effect and REDUCE SPEED during the warning.

Messages *may* provide additional details about the weather event—or its driving impact — to improve the specificity of the prediction and increase the certainty communicated by the message. These details can include information about the location, timing, or impacts of a road weather event.

iv) Communicating Urgency – Messages *should* use command style messages when the situation is urgent and an immediate control action is required by the driver. Examples of command style messages include REDUCE SPEED or MOVE TO RIGHT LANE.

Messages *should* use notification style messages when an immediate control action is not required, or the situation is not urgent. Examples of notification style messages include “ICE AHEAD” “USE ALTERNATE ROUTE” or “STORM WARNING.”

Messages *should* reflect the current roadway conditions or warning status. Monitor the conditions hourly and update the messages when needed. The Control Room Supervisor *should* approve updated messages. Remove messages when not needed for the current conditions.

v) Communicating Certainty – Messages *may* provide a qualitative description, such as CERTAIN, POSSIBLE, or A CHANCE, that will correspond to the likelihood of a road weather event.

vi) Requests from law enforcement - TMC operators *may* consider requests from law enforcement to display spot specific messages. Messages not included in the TIS Library *should* be sent to the TMC Supervisor or On-Call BTO Management for approval before use.

h. <u>Messages for Transportation Safety</u>

Transportation related safety messages *may* be displayed on DMS in accordance with an agency developed safety message calendar. Safety messaging *may* supplement a local or statewide safety media campaign and be of the same topic to communicate timely and relevant information. Safety messages *may* be scheduled in accordance with the National Highway Traffic Safety Administration (NHTSA) campaign schedule. An annual safety message calendar will be developed with coordination among State agencies and Bureaus including but not limited to BOTS, DSP (includes the bureau of public security and communications), BHM, OPA and BTO. Safety messages are secondary priority and *may* be preempted by all other purposed messages at the discretion of the TMC Control Room operator.

i. Schedule - The annual safety message calendar will identify the planned campaigns and their corresponding local or statewide safety media campaign. The safety message calendar will be developed for a 12-month period with approval by the Chief of Local Programs from the Bureau of Transportation Safety, the Director of the Office of Public Affairs and the Freeway operations engineer, Supervisor and Chief in the Bureau of Traffic Operations. Changes to the annual calendar will be minimized for scheduling purposes to allow message planning and sign scheduling. Sign and message selection will be made with consideration for alternate priority messages including but not limited to construction and conditions messaging. Individual safety campaigns *should* be reviewed by regional operations staff for work zone message priorities and comment.

ii. Message Content – Safety messages *may not* repeat the campaign message in order to avoid resemblance to advertising. The message *should* be simple and brief and slogans **shall not** be used. The message *may* contain fatality information that is current. Failure to include current information reduces message credibility. Content will adhere to message format defined in this guidance. TMC staff will determine final message content in accordance with policy, sign size and sign functionality. Safety messages *should* consist of a single phase and *may* be displayed as a second phase with another priority message. Examples of safety messages are included in the Message Guidelines of the WisDOT TMC Control Room Operator’s Manual.

iii. DMS selection – Sign locations **shall** be specified for each safety message plan included on the annual calendar. Locations *should* be selected with consideration for scheduled higher priority messages and construction zones. For example, a travel times should not be replaced by a safety message. Message displays *should* be consistent along a roadway corridor and adjacent corridors. Counties with higher rates of non-compliance per campaign topic *may* be emphasized.

iv. Units of Information – A safety message with two or less units of information *may* be displayed as a second phase with travel times. DMS with travel time messages with five or more units of information on a single phase *should not* be used for safety messaging.

Message content and sign locations **shall** be reviewed by the Statewide Freeway Traffic Operations Engineer for conformance with these guidelines prior to the display of safety messages.

i. Consistency and Credibility

Consistency in message design is a key factor in providing understandable messages. Before displaying a message, operators *should* check the event status, all message elements, and all message attributes in order to ensure that the message is accurate and useful. Inaccurate messages *may* mislead motorists, cause confusion, or reduce public trustworthiness in DMS messages.

Message credibility is also enhanced when messages are updated appropriately and removed promptly as conditions change.

The following message characteristics *should* be avoided because they can damage the credibility of a message:

- Information is inaccurate or not current and can be easily checked by travelers and disproved.
- Information is irrelevant to most travelers.
- Information is obvious, and thus redundant to travelers' visual inspection.
- Information is repetitive, i.e., the same information is presented over a long period of time.
- Information is trivial with regard to the driving task.
- Information is poorly presented and thus difficult to comprehend or confusing.

Message Library - The TIS Library of common messages *should* be maintained and updated as needed. Department staff or the Control Room Shift Supervisor *should* approve any words or abbreviations that are not in the TIS Library before their use. Graphic messages will be maintained in a separate directory. Graphic messages are sign specific by size and content. Contact the Statewide Freeway Traffic Operations Engineer or the Control Room Shift Supervisor for the message library.

Coordination with Other Traveler Information Systems - Care *should* be taken to coordinate all traveler information systems. PCMS guidelines (17-2-1) and use should be considered when DMS messaging supports the same situation. Other traveler information systems include portable changeable message signs, The Wisconsin 511 App, highway advisory radio, the Wisconsin 511 Traveler Information system, the WisDOT main web site, and social media platforms (Facebook, Twitter, etc). The general concepts related to driver expectations and driver comprehension of the different phrases applies to all dissemination tools. Continual monitoring and updating of each system is required.

Note:

The following changes are being submitted for the Fire Safety MOU included on the next page.

Section D part 1, include ***"DNR will notify DOT of areas under watch with high probability of becoming a high fire risk area leading to a safety messaging request".***

And,

Section D part 6, include ***"DOT will provide expense records to DNR of costs for message board use".***

Memorandum of Understanding

by and between the

WISCONSIN DEPARTMENT OF NATURAL RESOURCES

and the

WISCONSIN DEPARTMENT OF TRANSPORTATION

on

Information needs and liaison procedures for installation and maintenance of DNR Smokey Bear fire danger signs and use of DOT Electronic Message Boards

This Memorandum of Understanding ("MOU") by and between the Wisconsin Department of Natural Resources ("DNR")and the Wisconsin Department of Transportation ("DOT")defines the liaison procedures for the review and concurrence on the installation and maintenance of DNR Smokey Bear Fire Danger signs ("Smokey Bear Signs") and use of DOT Electronic Message Boards.

A. Purpose

The purpose of this MOU is to provide mutual departmental procedures for the review of the installation and maintenance of DNR Smokey Bear Fire Danger Signs and use of DOT Electronic Message Boards for fire prevention purposes in high fire risk areas of the state. Both Parties recognize the need for Smokey Bear Signs located directly adjacent to DNR Forest Ranger Stations, DNR facilities, and fire departments, for the safety of DNR staff, partners, and motorists, as well as the need to inform motorists of the dangers of forest fires on roads in the areas to which they are travelling. Both Parties also recognize the need for a safe, aesthetically pleasing and minimally distracting driving experience. Both Parties further recognize DOT's need to control signs adjacent to intertates, federal aid primary highways and the Great River Road as required by 23 USC Part 750 and implemented under Wis. Stats. s. 94.30 and ch. TRANS 201, Wis. Adm. Code. Both Parties believe the following terms achieve these purposes.

B. Applicability

This MOU applies to the installation and maintenance of approved DNR Smokey Bear Fire Danger Signs and use of DOT Electronic Message Boards for fire prevention purposes in high fire risk areas of the state, including but not limited to Red Flag Days, Emergency Burning Restrictions, prolonged drought leading to increased fire danger, Federal or Gubernatorial declared states of emergency, or any other situation where there is a significant risk of fire related danger that threatens life, property and natural resources of the State.

C. Coordination on Smokey Bear Signs

This section defines the process for all interactions between DOT and DNR regarding the installation, maintenance, approval, and identification of Smokey Bear Signs. This process does not include requirements for other state, local or federal permits or approvals that may be required for a project.

1. By March 31, 2013, DNR shall provide DOT with detailed information on the locations and numbers of all Smokey Bear Signs in the state. DOT and DNR will work together to identify which signs are located within the highway right-of-way. DOT and DNR will further work to identify which Smokey Bear signs are adjacent to interstates, federal aid primary highways and the Great River Road. DNR will provide an annual update to the list from the DNR Bureau of Forest Protection central office to DOT central office.

2. Existing DNR Smokey Bear Sign locations shall remain in place at DNR's discretion, but all signs located within highway right-of-ways or new signs to be located within highway right-of-ways must be upgraded or installed in consultation with DOT to established Federal design standards and to meet DOT break-away requirements. Signs which are adjacent to interstates, federal aid primary highways and the Great River Road will further be upgraded in the event they do not meet the applicable legal requirements. DNR will work with DOT to upgrade these signs as funds are available.

3. For all new proposed signs, DNR shall provide the applicable DOT regional office 30 days written notice before erecting new Smokey Bear Signs "...which are visible from any place on the main-traveled way of any portion of an interstate highway or primary highway" (Wis. Stat. s. 84.30(2)(j)). DOT may request consultation for any sign that may be of concern and further may prohibit the initial construction of new Smokey Bear signs adjacent to interstates, federal aid primary highways and the Great River Road that do not meet the requirements of Wis. Stats. s. 84.30(3)(a) or those applicable to official signs in ch. TRANS 201, Wis. Adm. Code.

D. Coordination on DOT Electronic Message Boards for Fire Prevention Purposes in High Fire Risk Areas

This section defines the process for all interactions between DOT and DNR regarding the installation, maintenance, approval, and identification of DOT Electronic Message Boards for fire prevention purposes in high fire risk areas of the state, including but not limited to Red Flag Days, Emergency Burning Restrictions, prolonged drought leading to increased fire danger, Federal or Gubernatorial declared states of emergency, or any other situation where there is a significant risk of fire related danger that threatens life, property and natural resources of the State (Incident). This process does not include requirements for other state, local or federal permits or approvals that may be required for an Incident.

1. DNR will identify the specific Incident that the DOT Electronic Message Board(s) are proposed to be utilized for, including area affected, number and type of federal, state and local roads located within the area, critical DOT Electronic Message Board locations located outside of the area affected, estimated length of use of the DOT Electronic Message Board(s).

2. DNR and DOT will identify the appropriate DNR and DOT Incident Liaisons for coordinating the use of DOT Electronic Message Board(s) for that Incident.

3. DNR and DOT will coordinate their outreach and education regarding the Incident.

4. DOT and DNR will jointly review the information provided by DNR regarding the Incident and DOT will advise DNR as to the appropriate number, location, usage, messages, and length of time to be used of DOT Electronic Message Board(s) that would be necessary and available for the Incident based on that information. DOT will provide the DOT Electronic Message Board(s) necessary and available for the Incident based on that recommendation.

5. DOT has the discretion, at any time, to utilize or reprioritize any DOT Electronic Message Board subject to the terms of this MOU based on any use that DOT deems necessary for the purposes of furthering its mission and responsibilities to the citizen of the State of Wisconsin. Should DOT utilize or reprioritize any DOT Electronic Message Board subject to the term of this MOU, the DOT Liaison shall, as soon as is practicable and without delay, communicate that utilization or reprioritization to the DNR Liaison.

6. DNR agrees to assume any costs associated with the transportation, use or physical damage to the DOT Electronic Message Board(s) used in an Incident, except that DNR shall not indemnify, nor assume any liability beyond that prescribed by statute, and for which both DOT and DNR are protected by the State of Wisconsin.

E. Dispute Resolution

In the event a disagreement over an issue pertinent to this MOU occurs, the appropriate DOT and DNR program staff shall meet to resolve the issue. If necessary, the appropriate DOT and DNR bureau directors shall meet to resolve the issue. Next, if necessary, DOT and DNR Division Administrators will be notified of the times, dates, locations and issues to be resolved at dispute resolution meetings. In the event that the issue cannot be resolved, the division administrators of DOT and DNR will attempt to reach a mutual agreement. The Secretaries of each Department are the final arbiters of any dispute. Unresolved issues will be forwarded to the next level in a timely manner (typically within 30 days of a decision at the prior level). Within 30 days of the decision being made on the disputed issue, the lead agency will prepare a position paper on the specific decision for sign-off by both agencies.

F. Signatures

This MOU shall remain in effect until amended or rescinded by the mutual concurrence in writing of the secretaries of DNR and DOT.

Cathy Stepp, Secretary　　Date 1/29/2014
Wisconsin Department of Natural Resources

Mark Gottlieb, Secretary　　Date 2/13/14
Wisconsin Department of Transportation

4

17-2-1 PCMS Policies & Procedures — December 2022

GENERAL

This policy applies to state owned PCMS. All Portable Changeable Message Signs (PCMS) procured by the Department are solar-powered with a matrix of light-emitting diodes (LED) used to display messages. These signs are mounted on a portable trailer which contains an array of batteries and a mast capable of raising the sign and turning it to any desired position. Currently, PCMS are assigned to and deployed by the Regions, typically through county highway departments, for various approved uses. The Traffic Management Center (TMC) can remotely access PCMS, schedule messages, and track general movements of the signs. The use of these signs **shall** conform to the following guidelines. PCMS are official traffic control devices and NOT a public information tool.

PCMS USAGE

For PCMS placed on the State Highway System, the PCMS **shall** either be:

1. Owned and placed by WisDOT
2. Owned and placed by contractors under contract with WisDOT
3. Owned, rented, or borrowed and placed by county highway departments under contract or permit with WisDOT

County Sheriff's Departments and other local agencies **shall** work with the County Highway Departments to place the signs and display proper messages consistent with WisDOT policy. This includes any PCMS purchased by a County Sheriff's Department and other local agencies through funds received from Bureau of Transportation Safety (BOTS).

APPLICATIONS

Since they are dynamic signs, PCMS must only be used to display "real-time" information such as changing traffic conditions or traffic control information. They are used for traffic incidents and closures, current weather warnings, planned work zone closures and traffic control support, traffic queueing and delay messages, travel times, future weather warnings along with special events that will affect traffic. They *may* also be used to post advisory speeds and alternate routes. An advanced notice is allowable (up to 7 days) prior to projects or events expected to cause congestion or that will require drivers to use alternate routes.

The WisDOT Regions are responsible for oversight of PCMS purchased by the Bureau of Traffic Operations (BTO). The Region will determine the deployment location, PCMS operation, and maintenance responsibilities for the signs. Each Region will designate a PCMS coordinator who will engage counties, determine where signs are deployed and enforce the provisions of this policy.

PCMS *should not* be used to replace static warning or regulatory signs; they *may* be considered as a supplemental device to a required static sign. In the case of a ramp or lane closure, the PCMS would supplement the static warning signs informing motorists of the closure. It is at the discretion of the Region whether static or changeable message signs are more appropriate for specific applications. Refer to TEOpS 6-2-55 for use of PCMS in work zones. Refer to TEOpS 2-10-3 for special event signing applications.

Nonstandard words such as "Danger," "Hazard" or "Caution" **shall not** be used. These words do not contribute any information and *may* overly concern drivers of the changed condition.

Regional PCMS coordinators should document the location of state owned PCMS that the Counties store and maintain, for rapid deployment in case of major incidents. If the Region needs the PCMS, the Counties will be required to move the PCMS to the appropriate State-owned facility. The Counties **shall** provide an emergency phone number to the Regional PCMS coordinator in case of emergency.

PCMS **shall not** be used to display generic safety messages, public service announcements or any other messages that do not require a roadway user to take action. Examples of generic messages not to be used are "Buckle Up", "Welcome to Wisconsin" or "Drive Safely". Use of these types of generic messages will tend to lead to motorist disregard of critical messages and unnecessarily distract driver attention from the roadway.

WEATHER

Where unusual/hazardous conditions are caused by rain, snow, ice, fog or wind, and have been verified by camera at the TMC, pavement weather sensors, law enforcement or maintenance officials, PCMS *may* be used to warn drivers in advance. This applies especially if the condition is significantly different on certain features of the highway, such as structures compared to the roadway. PCMS **shall not** be used for this purpose if the conditions cannot be verified every 2 hours to keep the PCMS message current. Sample messages are located at the end of this document. Some Regions have reported sign malfunctions when temperatures drop below zero.

SPECIAL EVENTS

Local agencies *may* request to have special event messages displayed on the state highway system. Requests should be made to the Regional PCMS Coordinator. They *may* request to have the Region supply the PCMS or *may* request to station their own or contractor-provided equipment on our system. Any of these options are acceptable, provided the following provisions are met:

1. The event **shall** be open to the public and will generate enough traffic to cause congestion and/or guidance problems.
2. The message **shall** be made up of advisory traffic management content, not advertising for the event.
   a. No commercial advertising is allowed on the signs. The inclusion of a brand name within the name of an event, such as "Brand X Racing Event" is not acceptable unless it provides better understanding for attendees. For example, use "Horse Show" rather than "Midwest Horse Show" or use "Golf Event" rather than "PGA Tour Event".
   b. The sign message *may* include the word "Event" or "Parking".
   c. Event names on signs *should* be as clear and concise as possible.
3. Attendance criteria *should* be considered in order to justify use of PCMS. Due to population differences throughout the state, minimum special event attendance thresholds have been established as a guide. Agencies requesting the use of PCMS for a special event shall provide the anticipated attendance to the Regional PCMS coordinator. Refer to Table 1 for minimum attendance recommendations.

Table 1. Special Event Attendance Criteria vs. Location

Location of Special Event	Population of Influence Area	Minimum Attendance (per day)
Major Metropolitan Area	Over 500,000	30,000
Urbanized Area I	50,000 – 500,000	15,000
Urbanized Area II	20,000 – 50,000	10,000
Rural Area	Under 20,000	5,000

   a. If attendance recommendations are not met, PCMS *may* be used to address special traffic movements to inform motorists. Use of PCMS in this case, is at the discretion of the Regional PCMS Coordinator or Traffic Engineer. Factors for determining the use will include, but are not limited to, safety of the traveling public, unique geometry or roadway conditions, potential congestion, unfamiliar drivers, different vehicle types that require special directional information, or potential changes in traffic patterns. It is also important that the Regional PCMS Coordinator or Traffic Engineer look at the capacity of the roadway system in case major congestion and delays are anticipated and PCMS will provide motorist information.
4. The State-owned devices are available and not being used elsewhere for incident management purposes.
5. The local agency has given the Region ample notice, to approve the locations, messages and other details.
6. When the local agency is to supply the PCMS, the locations, messages, and other details are to be approved by the Region beforehand, and the PCMS **shall** be placed by the county highway department, approved traffic control contractor, or by WisDOT.
7. It is the Region's discretion to charge for time spent establishing locations and other conditions of use.

See TEOpS 2-10-3 for the guidelines on Special Event Signing. Any Region *may* elect not to allow this type of activity, for reasons such as lack of personnel to make arrangements, to monitor usage, etc.

For special events with significant traffic impacts and/or duration that will introduce slowed or stopped traffic on interstates, queue warning systems should be investigated for potential deployment through the Bureau of Traffic Operations.

INCIDENT MANAGEMENT/ FLOODING CLOSURES / EMERGENCY EVENTS

PCMS *may* be used to advise travelers of alternate routes around construction or maintenance projects, incidents with closures over 2 hours, emergency events that are long-term closures, or to notify of traffic stoppages, delays, closures or other conditions that *may* require a roadway user to take action. General rules of the road messages *should not* be used (e.g., “Be prepared to stop”); drivers *should* always be prepared for adverse driving conditions. Refer to TEOpS 6-2-55 for more information on the use of PCMS in smart work zone systems.

EMERGENCY BURN RESTRICTIONS OR FIRE DANGER

Upon declaration of an emergency burn restriction or a gubernatorial executive order, PCMS *may* be placed on the highway right of way to warn drivers of extreme fire danger or fire/smoke conditions affecting the roadway. The use of PCMS and the message **shall** be approved by the Director of The Bureau of Traffic Operations and **shall** be remotely accessible to the TMC. When operational issues occur due to low visibility caused by smoke/fire, a gubernatorial executive order is not needed to deploy messages warning drivers of possible traffic impacts. See pages 6 through 7 for acceptable messages.

In order to maintain efficacy, messages *should* be displayed for a limited duration (less than two weeks) and during peak traffic volume periods.

PURCHASE

With limited exceptions, the temporary use of PCMS and portable ITS devices on improvement projects *should* always be included as a bid item in all construction projects, when needed. This equipment *should* be contractor-provided and the equipment **shall** meet all TMC specifications.

On an exception-only basis, any purchase of capital equipment temporarily used on an improvement project, like PCMS, **shall** never be charged as a direct cost to that specific improvement project. “Temporarily used” means equipment whose useful life extends beyond the service period for a particular improvement project. Because this equipment will have a useful life extending beyond the service period of a particular project, it cannot be capitalized as part of the overall infrastructure cost of that initial project.

Instead, the device *should* be accounted for in the manner in which the Department accounts for acquisition of permanent personal property. For any assets to be used exclusively on highway improvement projects and purchased with highway improvement funds, these assets *should* be charged to a construction non-participating ID (e.g., 0657-xx-xx) using an object cost (e.g., 4321) for permanent property acquisition in excess of $5,000. Prior to this kind of acquisition, the purchasing Region or Bureau must also have budget authority on the contractual service line of its operating budget. When the procurement exceeds $10,000, the DTSD

Administrator’s Office must approve it and the purchasing Region or Bureau *should* work with the DTSD budget office to secure the operating budget approval.

Furthermore, the acquisition of PCMS and portable ITS devices under a non-participating improvement ID *should* be a rare occurrence and it **shall**:

(a) Be recognized as either a planned element of the Traffic Operations Infrastructure Plan (TOIP) or as a necessary extension of the TOIP;

(b) Meet all the statewide network needs identified and managed by the TMC; and,

(c) Be approved jointly by DTSD Bureau Director of Highway Maintenance and Bureau Director of Traffic Operations.

In the instance where a PCMS or a portable ITS device is already owned by WisDOT and is provided and deployed on an improvement project, the cost of operating this equipment *may* be charged to the improvement project. However, the cost to maintain or repair this equipment, which extends its useful life, *should* be charged to a nonparticipating project ID. Refer to Program Management Manual 6-10-45, ITS and the TOIP Project Setup for more information regarding the funding of ITS incidental items.

Specification and standards are to be developed by the Department to conform with Federal ITS Architecture requirements. All PCMS provided by contractors for various applications *should* also comply with this requirement, if warranted.

MAINTENANCE

A Memorandum of Understanding (MOU) **shall** be developed for any county highway department operating State-owned PCMS on the state facilities. A sample MOU is included at the end of this policy. Counties who are provided signs are required to provide routine maintenance of the sign trailers including tires, structure and mechanical systems. Inspections of the sign and all components shall be performed every year. The Department will provide technical maintenance for sign electronics, controllers and battery replacements.

LONGITUDINAL PLACEMENT

The longitudinal placement of PCMS, as recommended from the Federal Highway Administration is described below to assist in the driver's ability to read the PCMS and act in a reasonable time frame.

The placement of a PCMS depends on how far upstream it needs to be placed and whether the upstream location has a sufficient sight distance for the PCMS to be viewed before motorist action is required.

The upstream location from the decision point depends on what type of action is required of the motorist. An example of a minor action is a lane change by the motorist. A major action would be the motorist having to make a detour from the current road.

For a minor action, the PCMS should be placed from 500 ft to 1,000 ft upstream of the decision point, regardless of speed.

For a major action, if the speed is less than or equal 40 miles per hour (mph), the PCMS should be placed at least 1,000 ft upstream of the decision point. If the speed is greater than or equal to 45 mph, then the PCMS should be placed at least 1 mi upstream of the decision point.

There should be a minimum spacing of at least 1,000 ft between PCMS units or a PCMS and an arrow panel. Multiple PCMS units should be placed on the same side of the roadway.

If a PCMS is used to provide information on delays, current ramp closures or to inform of alternate routes, place the PCMS in advance of exits to alternate routes so drivers have adequate time to decide whether to exit without making erratic maneuvers.

It is possible to use multiple PCMS for adequate warning or if one PCMS cannot safely display enough information.

LATERAL PLACEMENT

Signs *should* be placed as far away from the live traffic lanes as possible without hampering visibility. In advance of interstate construction projects, the signs *should* be placed on the backslope beyond the ditch. The location selected *should* be at or slightly above the elevation of the roadway. This placement improves visibility, minimizes the chance of a vehicle hit. Where site conditions do not allow otherwise, the signs *may* be placed on the shoulder. The site *should* be reviewed to assure visibility, safety and maintenance considerations. A taper of reflectorized drums **shall** be placed ahead of PCMS placed on the shoulder if it is not shielded by a barrier.

CONTROL

State-owned PCMS are capable of being programmed manually or controlled remotely by the TMC. Manual setup allows a designated user to program the sign using the on-board computer keyboard. Remote control of PCMS is performed by operators located in the control room at the TMC. State-owned PCMS that have a cellular connection and are in good working condition can be programmed and scheduled to display messages remotely. Messages programmed remotely on PCMS should be verified in the field by personnel if camera verification is not available.

PCMS COORDINATION WITH THE TRAFFIC MANAGEMENT CENTER (TMC)

If cellular communication is available and the PCMS is in working condition, a message can be activated remotely. In addition, the GPS coordinates are relayed to the ATMS and the PCMS location can be seen. Messages can be scheduled to display at a future date and scheduled to expire. This is particularly helpful for special events with challenging schedules or locations. When coordinating the use of a PCMS for the TMC to activate messaging, please follow the guidelines listed below:

GUIDELINES: PCMS DEPLOYED ON STATE FACILITIES

Prior to field deployment, call the TMC to put up a test message to confirm PCMS communications are working properly and that the display is in working order.
When the PCMS is deployed, call the TMC with the following information:

a. PCMS number(s) that are going to be used.
b. Roadway name, direction and approximate location of the PCMS.

c. Provide a brief description to the operator about why a PCMS is needed (e.g., lane closure, full closure, special event, road work, flooding, utility/weather closure)
d. Provide contact information for the County Highway Department.
e. Provide start time and end time for the messaging. The TMC can schedule the messages to display at a time in the future and be removed when the event is concluded. Contact TMC with any changes to the schedule or messaging needs (finished earlier or extended).
If the TMC is requested to activate a message on a PCMS and it is powered off in the field without the control room being notified, communications will indicate an error**. It is requested that if you shut off a PCMS, a call be made to the TMC, so an operator can remove the message and incident/closure from their system and not have to trace a communication error.**

TRAINING

Training for staff deploying, maintaining or operating signs is available through the TMC. Training may also be available directly from PCMS vendors under contracts or with special arrangements.

Regional PCMS coordinators are responsible for managing PCMS passwords. Password requirements may be different per PCMS manufacturer and shall be changed from their standard presets, as provided by the manufacturer.

ACCEPTABLE MESSAGES FOR SPECIAL EVENTS, WEATHER, and INCIDENTS

For driver comprehension, messages **shall** be limited to one or two frames (see MUTCD Section 6F.55). Blank or other filler frames between the two frames of text **shall not** be used. It is desirable for the driver to be able to read the entire message sequence twice as they pass by the sign. For an interstate highway application, the total viewing time is about seven seconds. Each frame is usually displayed for 2.0 seconds or less. Do not flash any part of a message.

It is recommended that the first frame describe the traffic condition or problem ahead, which the motorist *may* encounter, and the second frame advises the driver of an appropriate action. Message content should be approved by the WisDOT Regional PCMS coordinator or Traffic Operations Engineer. The message must make sense read in any order.

PROBLEM/DISTANCE

ALL LANES BLOCKED	DELAYS	FLASH FLOODING AHEAD	ICY BRIDGES AHEAD	NO OVERSIZE LOADS	
BRIDGE CLOSED	DENSE FOG	FRESH OIL	LEFT 2 LANES CLOSED	RIGHT 2 LANES CLOSED	SINGLE LANE
BRIDGE SLIPPERY	DISABLED VEHICLE	GRASS FIRE	LEFT SHOULDER CLOSED	RIGHT LANE NARROWS	SLIPPERY ROAD
CENTER LANE CLOSED	DUST STORM	HIGH WINDS	MAJOR DELAYS	RIGHT SHOULDER CLOSED	STALLED VEHICLES AHEAD
COLBY ROAD CLOSED	EMER VEHICLES ONLY	ICE	NEXT EXIT CLOSED	ROAD CLOSED	TOW TRUCK AHEAD
CRASH ROAD CLOSED	EVENT PARKING	ICE ON BRIDGES	ONE-WAY TRAFFIC AHEAD	ROAD CLOSED 6 MILES	VEHICLE FIRE
CRASH 4 MILES AHEAD	EXIT 45 CLOSED	INCIDENT AHEAD	RAMP CLOSED	ROAD FLOODED AHEAD	WATER ON ROAD
CRASH NEAR I-94	FOG 3 MILES	LANE SHIFT	RAMP SLIPPERY	ROAD SLIPPERY	
DEBRIS AHEAD	FREEWAY CLOSED	LEFT LANE CLOSED	RIGHT LANE CLOSED	SHOULDER BLOCKED	

ACTION

ALL TRAFFIC EXIT RT	DO NOT PASS	ONE-WAY TRAFFIC	STOP AHEAD	USE DETOUR ROUTE
ALT ROUTE EXIT 25	FOLLOW ALT ROUTE	PASS TO LEFT	STOP 5 MILES	USE LEFT LANE

AVOID DELAYS USE US53	FOLLOW DETOUR	PASS TO RIGHT	TUNE RADIO 1510 AM	USE NEXT EXIT
BEST ROUTE TO I-94	FOLLOW SIGNS	STAY IN LANE	USE LEFT LANE	USE RIGHT LANE
DETOUR 2 MILES	MERGE RIGHT 2 MILES	STAY ON US 45	USE COLBY ROAD	WATCH FOR FLAGGER

EVENT	**PANEL 1**	**PANEL 2**
Access	CRASH AHEAD	USE ACCS RD NEXT RIGHT
Blocked	RIGHT 2 LANES CLOSED	AHEAD X MILES
Center	I-39 NB TRAFFIC	USE CENTER LANE
Commercial	OVERSIZE TRUCKS	USE EXIT 120
Congestion	MAJOR DELAY	NEXT 3 MILES
Emergency	EMER VEHICLES AHEAD	
Event Parking	EVENT PARKING AHEAD	USE NEXT RIGHT
Fire/Smoke Hazard	EXTREME FIRE HAZARD	NO OPEN BURNING
	EXTREME FIRE HAZARD	BURN BAN IN EFFECT
	SMOKE OVER ROAD	REDUCE SPEED
	FOREST (GRASS) FIRE AHEAD	TRAFFIC STOPPED
Freeway Closed	I-90 CLOSED	DETOUR EXIT 10
Hazmat	HAZMAT SPILL EXIT 130	USE EXIT 125
Traffic Information	TUNE TO 1240 AM	FOR TRAFFIC INFO
Oversize Vehicles	OVER SIZED TRUCKS	USE NEXT EXIT
Prepare	CRASH 3 MILES AHEAD	
Slippery	SLIPPERY ROAD	REDUCE SPEED
Speed	REDUCED SPD ZONE AHEAD	

PORTABLE CHANGEABLE MESSAGE SIGNS (PCMS)
MEMORANDUM OF UNDERSTANDING

This MEMORANDUM OF UNDERSTANDING; issued ____________________________ is designed to establish certain principles and procedures that the County of _________________________, (COUNTY) and the Wisconsin Department of Transportation (DEPARTMENT) agree to follow for the application, storage and maintenance of the PORTABLE CHANGEABLE MESSAGE SIGNS (PCMS) owned by the DEPARTMENT. This MEMORANDUM OF UNDERSTANDING **shall** expire TWO (2) years after the issue date.

PROVISIONS

- The COUNTY will follow the procedures and guidelines in the STATE OF WISCONSIN DEPARTMENT OF TRANSPORTATION'S TRAFFIC ENGINEERING, OPERATIONS AND SAFETY MANUAL CHAPTERS 17-2-1 AND 6-2-55 (ATTACHED) AND THE WISCONSIN DEPARTMENT OF TRANSPORTATION MANUAL ON UNIFORM TRAFFIC CONTROL DEVICES.
- The COUNTY will be responsible for maintenance, storage, minor repair and troubleshooting of the PCMS. A DEPARTMENT supplied maintenance checklist *shall* be performed and submitted by the COUNTY annually. The PCMS will be stored inside a secure location when not in use on the highway. Storage *should* provide cover and protection from weather if at all possible. The DEPARTMENT will respond to functional problems that cannot be solved by the COUNTY during normal business hours.
- If the State-owned PCMS are not being used on State-owned facilities, the Counties *may* contact the Regional PCMS coordinator for permission to use the PCMS on County roads for maintenance or construction activities being done by County forces. It will be up to the discretion of the Region whether or not to allow the usage of the State-owned PCMS for these instances. Counties **shall** keep the Regional PCMS coordinator aware of the PCMS locations at all times. At any given time, the Region has the authority to remove the PCMS in the case of emergency or need elsewhere on State-owned facilities. The Counties are responsible for pick-up, delivery, maintenance and return of the PCMS.
- The COUNTY will be responsible to repair/replace PCMS that are damaged while being used for COUNTY purposes.
- The DEPARTMENT will be responsible to repair/replace PCMS that are damaged while being used for DEPARTMENT purposes.
- The DEPARTMENT **shall** have access to the PCMS at all times. Keys to locks for any secure locations or sign **shall** be provided to the authorized DEPARTMENT personnel.
- The COUNTY will be reimbursed for all expenses related to the use and maintenance of the PCMS for the DEPARTMENT purposes through the Routine Maintenance Agreement (RMA) or other DEPARTMENT agreements.
- The COUNTY **shall** inform the DEPARTMENT contact person when and where the PCMS are in use or scheduled to be used.
- The DEPARTMENT will retain the authority to change messages on the PCMS and move PCMS. The DEPARTMENT will notify the COUNTY prior to the message change or move if time permits.
- The DEPARTMENT **shall** have access to the PCMS by remote telecommunications whenever they are deployed.
- The DEPARTMENT **shall** provide training on use, maintenance, storage, hauling, setup and minor problem troubleshooting. The COUNTY **shall** send a minimum of TWO (2) representatives for training.
- The COUNTY will be responsible for emergency deployment. The DEPARTMENT will decide on emergency deployment if time permits.
- The COUNTY contact for coordination of the PCMS is ___________________________
- The DEPARTMENT contact for coordination of the PCMS is ___________________________

The parties agree to all provisions, which are made a part of this Memorandum of Understanding.

For the DEPARTMENT	For the COUNTY
By: ___________________________	By: ___________________________
Systems Operations Manager	County Highway Commissioner

17-3-1 Real Time Data Sharing Procedures May 2015

POLICY

The Wisconsin Department of Transportation shares freeway status and incident information with news media organizations and governmental and private agencies. WisDOT public records policy indicates that:

- WisDOT allows any agency access to real time traveler information.
- The requestor of the information **shall** pay for the costs of obtaining the information.
- The requestor of the information is required to complete a graphic or verbal acknowledgment to WisDOT. News agencies are contacted regularly to refresh an existing Media Usage Agreement.
- The requestor of the information is required an allocation of time for public service announcements.

WisDOT maintains a Closed Circuit Television (CCTV) network to verify traffic incidents, view traffic impacts as a result of incidents and/or events, and monitor traffic flow on the instrumented roadway segments. WisDOT's Traffic Management Center (TMC) supports the dissemination of CCTV video footage through various partnerships with outside agencies, according to the following practices:

- CCTV video files are stored within TMC servers for 72 hours
- After 72 hours, the video files are automatically overwritten with new video and are no longer available
- TMC operators have the ability to extract specific video segments within the 72-hour timeframe
- Requests for video footage should be responded to within ten (10) business days
- Video segments with recorded incidents must be retained for a minimum of 120 days, or if a legal hold is in place, until the case is closed
- Requested footage will be put on an electronic storage device (CD, USB drive, etc.) and must be picked up by the recipient within 120 days

Retention and disposition information can be found in the Records Retention/Disposition Authorization for Traffic, System Operations and Electrical Engineering (see RDA 00255C) executed in December of 2007.

When using WisDOT provided video, the following policies and guidelines **shall** be adhered to:

- Any time WisDOT-provided video or data is broadcast the Department *should* be acknowledged as the source verbally or graphically. All WisDOT-provided video or data **shall** display a WisDOT logo. The WisDOT logo must be displayed in a prominent location, such as the upper left corner of the image, **shall not** be covered in any way by news banners or other graphics, and **shall** be clearly identifiable. If an agency chooses to develop their own graphics, the agency must contact the WisDOT to coordinate and to ensure that all displays will be consistent and understandable.
- WisDOT provides the video and travel times for the use of traveler information only, and WisDOT video *should not* be used for self-promotion.
- All data or video being broadcast *should* be the most recent and timely information provided, any non-current data **shall** be labeled with the time and date it was recorded. Data and video is intended only for traveler information.
- The Department *may* remove any picture from the video feed if the picture is determined by the Department to be unacceptable due to quality or content. Occasionally picture quality is degraded due to maintenance troubles, or the content of a picture is deemed inappropriate, such as a long-term study where a camera is focused on a single lane or ramp, or sensitive emergency situation.
- Video feeds will be provided to any requesting entity. Any cost associated with providing the video **shall** be the responsibility of the requesting entity.
- The information provided to the media and traffic information providers, including images from CCTV cameras, **shall** be traffic related only.
- Information regarding fatalities or the status of injured individuals **shall not** be provided to the media or other traffic information providers.

- Images showing fatalities, injured individuals or other details that could violate individual privacy **shall not** be released to the media or to any other traffic information providers.

For inquiries regarding video or travel time information, contact the Traffic Management Center at statewide.toc@dot.state.wi.us or (414) 227-2166.

USING VIDEO FOR TRAFFIC ENGINEERING AND OPERATIONS

Archived video can also be used for analyzing new traffic flow patterns, intersection operations and work zone strategies. Prior to the implementation of a new pattern or strategy, the TMC Traffic Management Unit Supervisor *should* be notified of the study location within three days prior to implementation. Notification will provide Control Room operators or shift supervisors preparation time for archiving certain camera footage in such locations.

Cameras *should* be used for the highest value of activity (i.e., capture as much traffic operations related video information as possible rather than focusing on a single lane or movement). All WisDOT personnel have a responsibility to maintain, dispose of, communicate on and release video in line with this overall policy.

Wisconsin Department of Transportation

DATE

BUREAU OF TRAFFIC OPERATIONS
Statewide Traffic Operations Center
433 W. St. Paul Avenue, Suite 300
Milwaukee, WI 53203
Telephone: (414) 227-2166
Facsimile: (FAX): (414) 227-2165

The Wisconsin Department of Transportation (WisDOT) Traffic Operations Center (STOC) agrees to provide a feed from our CCTV system to your agency. By your acknowledgement below, you agree to abide by the WisDOT policies regarding the use of travel times, freeway camera images, and other travel information that goes out to the public that is provided by WisDOT.

This agreement (hereinafter "Agreement") is an Agreement between the Wisconsin Department of Transportation and ____ (hereinafter "USER"), to obtain access to the WisDOT Closed Circuit Television Camera System (hereinafter "CCTV").

This Agreement shall remain in effect until USER or WisDOT gives written notice to terminate the Agreement. Thereafter, access to the CCTV will be terminated, unless a new Agreement is signed by the USER and approved by WisDOT. WisDOT reserves the right to cancel this Agreement at any time and for any reason, upon the giving of 5 days notice to the USER.

The undersigned USER agrees to hold WisDOT harmless from and against any and all liability and expense caused by the omission of the USER, its agents, officers and employees, in the use, possession, or dissemination of information made available from the CCTV system. The obligations assumed by the USER pursuant to this Agreement shall survive the termination of the Agreement. The USER understands and agrees that it has no claim, right, cause of action, or right of recourse based upon WisDOT's election to terminate this Agreement.

"Access to Live Video" is defined as that video provided by the CCTV developed for traffic management and provided by the WisDOT STOC. This Agreement outlines the use of the CCTV system, which provides real-time traffic information to USERS. The following provisions and responsibilities are provided to ensure that the system is accessed and its information used for this purpose and this purpose alone:

- USERS are responsible for set-up of necessary equipment at the WisDOT STOC in order to obtain the video feed. The USER is exclusively responsible for any costs related to the purchase and installation of said equipment. WisDOT personnel have the exclusive right to determine at what location within the STOC a USER'S equipment may be placed, and reserve the right to inspect the installation of all USERS' equipment. Under no circumstances will the placement and installation of said equipment interfere with STOC equipment or the activities of the STOC. The service, maintenance, and upkeep of any and all of USER'S installed equipment, is exclusively the responsibility of USER. WisDOT personnel must be given at least 2 working days' advance notice of any maintenance or repair visits of USER, its employees, agents, or representatives.
- USERS must give proper recognition for the source of the data by displaying a recognizable version of the WisDOT logo on the screen. An authorized logo will be provided upon request.
- USERS of WisDOT provided video or data are required to provide a minimal amount of airtime to WisDOT for Public Service Announcements.
- USERS must refrain from selling, loaning or offering for sale, the video feed received under this Agreement to other persons or entities, not a party to this Agreement, unless expressly authorized in writing by WisDOT to do so.
- USERS must broadcast only the most recent and timely information available, and any non-current data must be labeled with the time and date it was recorded. Data and video is intended only for traveler information.

- USERS must maintain the security and integrity of the CCTV system by limiting use of and access to the system to trained and authorized individuals, and by insuring that the system is used for the specific purposes provided for by this Agreement.
- WisDOT agrees to maintain the CCTV system – although there is not any express or implied representation that WisDOT will continue to provide such data or images.
- WisDOT may remove any picture from the video feed if the picture is determined by the department to be unacceptable due to quality or content. Occasionally picture quality is degraded due to maintenance troubles, or the content of a picture is deemed inappropriate, such as a long-term study where a camera is focused on a single lane or ramp, or sensitive emergency situation.
- USER may not broadcast or otherwise utilize information contained in live video that is “not public record,” including, but not limited to, the names, addresses, phone numbers and/or vehicle/drivers license number. WisDOT will utilize reasonable efforts to prevent the transmission of the information deemed by law and/or agency policy as “not public record”. Using or broadcasting this information is expressly prohibited.
- WisDOT will maintain exclusive control of the information and images released from the CCTV system to each USER including but not limited to: determining whether and when to provide a CCTV system feed, from what location, and for what duration.
- WisDOT provides the video and travel times for the use of traveler information only, and WisDOT video should not be used for self-promotion.

WisDOT agrees to provide the services described in this Agreement and under the terms and provisions herein specified. WisDOT reserves the right to make changes to this Agreement at any time without prior notice to the USER. USERS must comply with all provisions of this Agreement. Violations of this Agreement will entitle WisDOT to cancel the service immediately and without prior notice to the USER.

Thank you for your effort to broadcast the WisDOT traffic data to the traveling public. If you have any questions or concerns please contact Anne Reshadi (414 227-2149, anne.reshadi@dot.wi.gov). If you have any technical questions or concerns, please contact Paul Keltner (414 227-2141, paul.keltner@dot.wi.gov).

Authorized WisDOT Representative

Name ____

Title ____

Signature ____ Date ______________

Acknowledged (Authorized USER Representative)

Name ____

Title ____

Company/Firm Name ________________________________

Signature ____ Date ______________

17-3-2 Floodgate Messages May 2009

DEFINITION

A Floodgate message is an announcement, created as a .wav file and uploaded through a web interface, which plays for a 511 caller prior to any traffic information. Floodgate messages can be placed by the TMC, and are used to notify 511 callers of incidents or events that significantly impact traffic. Floodgate messages can be placed at statewide, county, or roadway level. It is also possible to place floodgate messages for entities such as airports, buses, etc.

CRITERIA

The TMC will place both a county level and roadway level floodgate message for any unplanned incident or event that results in:

- A full road closure of one or both directions
- A detour or alternate route
- A traffic delay in excess of 30 minutes

The TMC will place both a county level and roadway level floodgate message for any planned full freeway closure in one or both directions.

The TMC will place a statewide level floodgate message for the following events:

- Amber alert
- Any unplanned incident or event that involves five or more counties or roadways, or spans across multiple regions

Before placing a statewide level floodgate message, the TMC Control Room Supervisor must authorize and review the message for approval.

Floodgate template

> *As of (time/date), (LE Agency) is reporting that (traffic incident, adverse road conditions, etc) is adversely impacting (directional) traffic on (roadway, location). Currently, (what lanes are affected). To avoid delays, (which direction of traffic) should (list detour)/there is no detour at this time.*

<u>Adverse Weather Conditions</u>

An TMC operator *may* request a statewide or county level floodgate message on the 511 system if the following criteria are met:

1) A Winter Storm or Fog Warning has been issued for the identified area
2) The 511 Winter Road Conditions Map for the corresponding area indicates that a majority of the roadways are either snow covered, ice covered, or impassable.
3) On-site law enforcement can confirm adverse fog conditions
4) The message will provide travel-related information

Statewide floodgates will only be placed when the majority of a region meets the above criteria. The following template *should* be used for adverse conditions floodgate messages:

> *As of (time/date) Wisconsin State Patrol is reporting adverse road conditions in (much of the state, northern/southern part of the state). Motorists are encouraged to use caution, slow down, and avoid travel when possible.*

Due to the frequency of Lake Effect Snow Warnings for Iron and Ashland counties, floodgate messages for these areas will be placed at the county level of all counties identified in the warning and shows poor road conditions on 511.

The audio and text floodgate *should* be removed when the Warning expires.

17-4-1 Policies & Procedures June 2010

PURPOSE

The purpose of this policy is to define the usage and management of the WisDOT optical fiber communications network, referred to as ITSNet. The chief objective of ITSNet is strategic and efficient deployment and management of a communications network that supports traffic operations, intelligent transportation systems (ITS), security, and emergency communications. This network shall be robust enough to accommodate real-time data, voice, and video transmission in emergency situations, and it is not to be used for traditional office automation functions.

ITSNET POLICY

The ITSNet use is for public agency, transportation-supportive purposes. This applies to fiber that WisDOT lights; it does not apply to dark fiber leased to others. Use is limited to statewide traffic management system monitoring and control; emergency transportation operations and response; and public safety communications and dispatch center connectivity for operations.

All requests for use, development, or impact to the ITSNet fiber optic network should be made through the Bureau of Traffic Operations Director. No other Bureaus or Sections in the Department have authority to provide this approval. Any permitted use is subject to available communication network capacity and is also subject to revocation at the discretion of the Bureau of Traffic Operations Director.

ITSNET DESCRIPTION

Shown here is a map of existing fiber and future fiber needs. Contact the TMC with any questions

WISDOT STAKEHOLDERS

DTSD – Bureau of Traffic Operations (BTO) is the home of the ITS program and is the steward of ITSNet. Each of the four sections has roles and responsibilities:

- Traffic Engineering Section guides policy, planning, development, and stakeholder and partner coordination.
- System Operations and Electrical Engineering Section leads all design, engineering, implementation, operations, monitoring, as-builts, local agency agreements, and maintenance, including activity associated with the Traffic Management Center (TMC)
- Highway Maintenance & Roadside Management Section handles all utility and permitting issues, exchange agreements, construction coordination when done via permit, and the collection of fees for the longitudinal occupation of controlled-access right-of-way.
- Program Management Section has authority over revenue, expenditures, and federal grants

Ongoing coordination with and support from the following:

- Division of State Patrol – Bureau of Communications
- DTSD – Regions

RIGHT-OF-WAY FEES & PERMITS

This applies to highways WisDOT charges on when utilities (e.g., telecoms) want to longitudinally occupy any controlled-access highway, including:

- All interstates
- All freeways, e.g., US 41, the Madison Beltline, etc.
- All freeway/expressway combinations (hybrids), e.g., WIS 29, US 18/151, etc.

Refer to the Controlled-Access Highways and Occupation Fees list as published in WisDOT's Utility Accommodation Policy.

If work is in conjunction with a WisDOT contract, a work on highway right-of-way (ROW) or utility permit and corresponding occupation fee is not required. However, WisDOT needs to review each activity as if applying for a permit, including checks for:

- Location of the facility within the ROW
- Potential conflicts with other utilities

- Potential conflicts with maintenance or construction projects
- Potential conflicts with current or future ITS facilities
- Access locations, whether from private property or the shoulder
- Possible lane or shoulder closures needed
- Possible work-time restrictions (e.g., no work during Packer home football games)
- Proper erosion control, restoration, and environmental-related issues (e.g., construction in wetlands)
- Proper traffic control
- Proper handling of trees and other vegetation – especially if needed for snow drift control

This must be done through the Region Utility Permit Coordinator. If it involves controlled-access facilities, the State ROW Accommodation and Permits Engineer in BTO must also be involved, and there may be a fee or fiber exchange involved.

Maintenance and repair activity also requires no permit, but the Region must be informed about work on its ROW.

17-5-1 Federal ITS Continuing Appropriations Process March 2011

INTRODUCTION

The annual process described in this procedure pertains to the Great Lakes ITS appropriations and how federal money is applied for and managed at the Department level. Projects funded by Great Lakes appropriations are for traffic operations and ITS related Department initiatives.

APPLICATION PROCESS

1. FHWA Division office notifies BTO State Traffic Engineer of continuing appropriations funding level eligible for application typically between February and June of every year.
2. BTO completes application and describes prospective project concepts, high-level scope, funding requested and identified soft match. At this time, Operations Managers are solicited for project concepts. Projects identified in application need to be on the BTO Budget list. Sources of matching funds will also be identified at this time. Hard (monetary) match has not been used in recent years. Soft match is either in the form of labor contribution or ITSNet dark fiber asset value.
3. BTO State Traffic Engineer approves application and submits to FHWA Division.
4. FHWA reviews and approves application and notifies BTO when funds are allocated.
5. BTO contacts the BSHP Program Finance Section for project set-up in Financial Integrated Improvement Programming System (FIIPS). The WisDOT charge ID is established and BSHP posts a 15-day STIP notification period. WisDOT sets up one state project ID to one federal ID. Multiple work orders and purchase orders will exist under one state project ID, with different project names. Project IDs must show 100% federal funds in the amount applied for to avoid problems with match accounting.
6. Bureau of Business Services (BBS) Fiscal Services obligates approved federal funds in Fiscal Management Information System (FMIS). FHWA approves the funds requested for federal agreement in FMIS.
7. BBS Fiscal Services updates status in FIIPS indicating authorization and federal agreement has been approved and spending may commence. This process must be completed by the end of the current federal fiscal year in October. BTO and the Regions are notified when funds are available.

ONGOING AUTHORIZATION/MANAGEMENT OF FUNDS

Once the application process is complete and funds are issued, BHO develops contracts, work order scopes, or purchase orders. Approved work orders are routed to Expenditure Accounting for encumbering in EAPS. Spending requests are routed through BTO and the BTO State Traffic Engineer and Director authorize payment of invoices and route to Expenditure Accounting for payment.

BTO project managers manage funds and invoices for each of their assigned projects. Work orders and purchase orders must not be established in excess of appropriation ID. A quarterly bureau spending review of federal funding occurs and projects 75 percent encumbered or spent are flagged. **Project managers must ensure work orders or purchase orders are not overspent.** Expenditure Accounting will not pay invoices if exceeds work order or purchase order.

WRAPPING UP/CLOSING OUT PROJECT

Once an appropriation is exhausted or has ended, BBS liquidates remaining balances on all outstanding encumbrances and closes out all purchase orders prior to closing out project. Project status will then be updated in FIIPS to “7” and the project is held for completion of audit for consultant contracts. BBS processes the final federal voucher and updates FMIS to close out project.

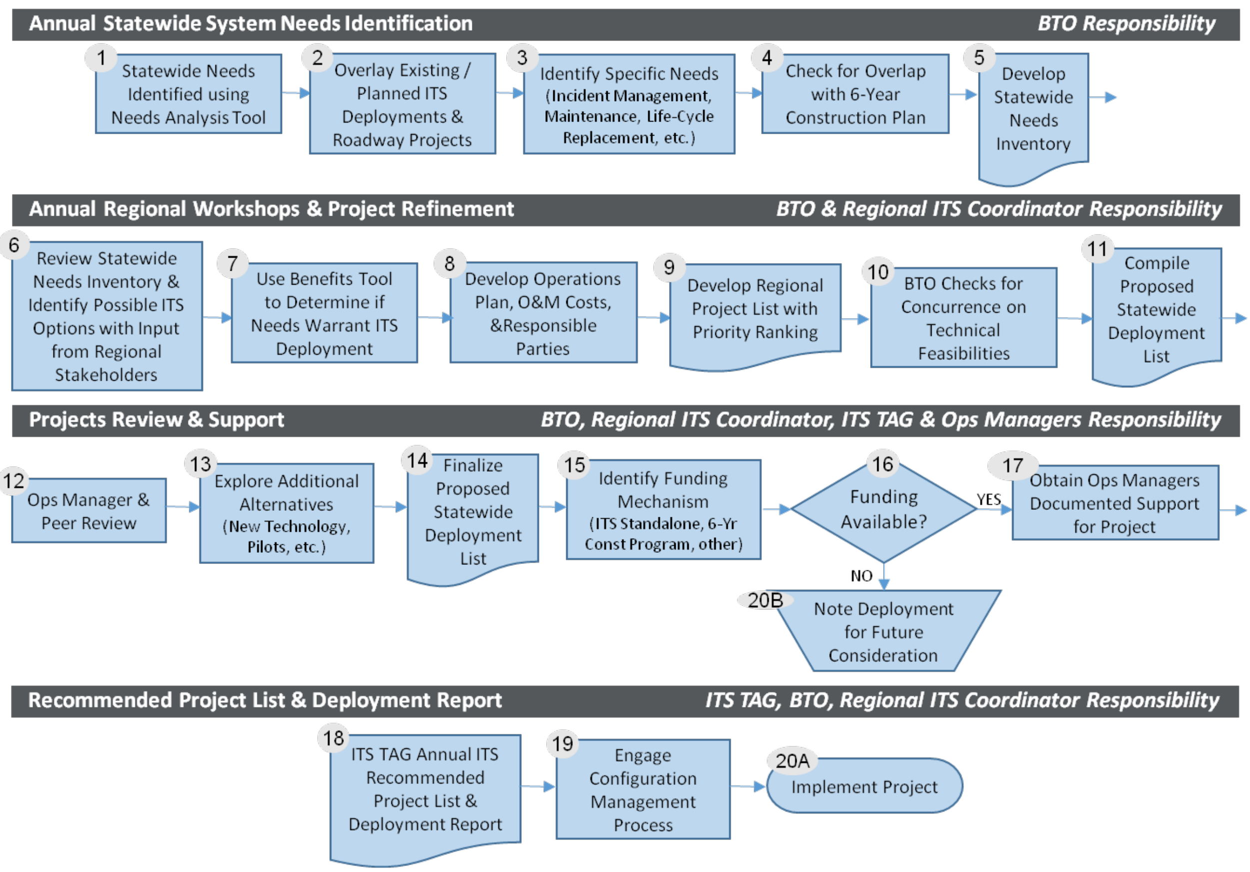
17-6-1 TSM&O Traffic Infrastructure Process (TIP) August 2019

Introduction

The TSMO-TIP process is an annual process to select relevant transportation systems management and operations (TSM&O) deployments for implementation in the next assessment year (AY). The process involves the collaboration and support of many different stakeholders within the Wisconsin Department of Transportation (WisDOT). These stakeholders include the Bureau of Traffic Operations (BTO), regional intelligent transportation system (ITS) coordinators, the operations managers, and the ITS Technical Advisory Group (ITS TAG).

To make the process more streamlined and well-defined, the process has been broken down into a series of 21 steps beginning with a statewide needs analysis and ending with either project implementation or marking a project for future consideration. To make sense of the process, a flowchart is available showing the flow of steps and responsibilities throughout the process.

Each step in the process chart is outlined below and detailed process steps are explained in the remaining document.



Process Task A

Goal: Develop Final Draft of Statewide Needs Inventory

Responsibility: BTO Traffic Systems Unit with stakeholder support

Task A was created to jumpstart the planning process for identifying areas for TSM&O deployments. Although other stakeholders are welcome to submit ideas during this task, the task itself is primarily the responsibility of the BTO Traffic Systems Unit. This group will begin the TSMO-TIP process by creating a draft of the Statewide Needs Inventory which will then be brought to the regions for review. During the first year or two of implementation or as needed, BTO will be a guiding hand through all tasks in this process.

Step 1: Statewide Needs Identified using Needs Analysis Tool

Timeframe: January to February

Result: Draft of the Statewide Needs Inventory with list by region of statewide area needs to be analyzed further

The Needs Analysis Tool is an online mapping tool displaying information about the current safety, mobility, service, and freight performance for most arterials in the state. The majority of this information is processed from MetaManager data, with the support of algorithms to include weather and special event data. The Needs Analysis Tool is available on the TSMO-TIP website (http://www.topslab.wisc.edu/tsmo/tip/) and was developed by the Wisconsin Traffic Operations and Safety (TOPS) Lab.

The tool includes many functions which support the identification of regional needs across the state. Although this tool identifies areas of need, it does not identify which TSM&O solution *should* be implemented to allay the need, assuming any TSM&O deployment will be able to help.

In this step, the BTO Traffic Systems Unit *should* run regional reports for each region using each preset. There are five regions and six presets, so this will result in thirty reports. At present, this task must be done manually, but future updates to the tool will streamline this process. Once all reports are generated, the top five areas identified in each of the reports *should* be marked for further investigation in step two.

Two short video tutorials are provided on the website. The first gives an overview of all capabilities of the needs tool. The second shows an example of generating the reports required for this step. The Needs Analysis Tool also includes internal documentation as well as a document describing all of the tool's data inputs.

Step 2: Overlay Existing / Planned ITS Deployments and Roadway Projects

Timeframe: January to February

Result: Map of each area needs location including existing / planned deployments

This step involves going back into the Needs Analysis Tool and looking precisely at each area of need on the map. To complete this step, existing and planned deployments *should* be overlayed on the area of interest. A copy of each map *should* be attached to the regional list of identified needs areas. An example is shown in a video tutorial on the website.

Step 3: Identify Specific Needs (Incident Management, Maintenance, Life-Cycle Replacement, etc.)

Timeframe: February to March

Result: Revised draft of the Statewide Needs Inventory including a list of specific needs for each need area

Working with BTO stakeholders, specific needs will be identified for the previously determined needs areas. These needs include incident management, maintenance, and life-cycle replacement, among other possibilities. Engineering judgement must be used to identify the specific need for each area.

This step may involve looking at the Needs Analysis Tool for support, although the only outcome of this step will be the appending to the list of specific needs for each needs area.

Step 4: Check for Overlap with 6-Year Construction Plan

Timeframe: February to March

Result: Revised draft of the Statewide Needs Inventory including list of projects overlapping with the 6-year construction plan

Consult with project designers for highway improvement projects in the six-year plan to investigate the possibility of including the installation of operations technologies in tandem with the highway improvement project, providing a cost-effective approach to deployment.

Mark all potential overlaps on the Statewide Needs Inventory document including needs that are fully addressed by construction projects, needs that could be integrated with construction projects, and needs that would need their own financial support to be implemented.

Step 5: Develop Statewide Needs Inventory

Timeframe: April

Result: Final Draft of the Statewide Needs Inventory

This is the final step completed by BTO before bringing the plan forth to the regions for further consideration and development. In this step, the BTO Traffic Systems Unit will pull together all of the resources in the previous steps and present a clean final draft of the Statewide Needs Inventory, presented by region.

Each regional needs area will include

- a sheet of pertinent data by segment, given by the needs tool,
- a map of the area with current and planned deployments shown,
- a specific need to focus the selection of TSM&O deployment(s),
- and a statement of overlap with the 6-year construction plan.

Process Task B

Goal: Develop Regional Project List with Priority Ranking

Responsibility: BTO and Regional ITS Coordinators

During this process, BTO will work directly with each of the five Regional ITS Coordinators to process the Statewide Needs Inventory into a Regional Project List with Priority Ranking. These project lists will be compiled in Task C.

For the first year or two of implementation or as needed, the BTO and each region will have a meeting walking through all steps of this process and specifically focusing on the steps in Task B. The goal of this meeting will be to allow the Regional ITS Coordinators to become comfortable with the Needs Analysis Tool and the overall process to ensure smooth implementation.

Step 6: Review Statewide Needs Inventory and Identify Possible ITS Options with Input from Regional Stakeholders

Timeframe: April-May

Result: Revision of each of the regional sections of the Statewide Needs Inventory to include possible TSM&O / ITS options for deployment

In a meeting between BTO staff involved in the development of the Statewide Needs Inventory and the Regional ITS Coordinator for the given region, the regional Statewide Needs Inventory will be analyzed and potential TSM&O / ITS deployments will be identified. Regions will be involved due to their involvement with the region including their interest in the region and expertise in regional highway issues. With the support of the TOPS Lab and others as needed for engineering judgement, potential TSM&O / ITS deployments will be determined for each area of need in the region.

As part of this step, all regional staff and stakeholders will be encouraged to provide input into better understanding the areas of identified need and ideas for types of deployments.

Step 7: Use Benefits Tool to Determine if Needs Warrant ITS Deployment

Timeframe: April-May

Result: Revision of each of the regional sections of the Statewide Needs Inventory to include warrant information for each possible TSM&O / ITS deployment option

Each Regional ITS Coordinator will be trained and use the Benefits Tool. The Benefits Tool was developed by Kimley-Horn, and is also available on the TSMO-TIP website.

The tool will be used to run a benefits-cost analysis on each of the potential TSM&O / ITS deployments for each needs area. Most of the inputs will come from regional knowledge of the area or the Needs Analysis Tool. There are some inputs into the Benefits Tool that will require engineering judgement and estimation.

Each of the deployments with a positive value for benefit-cost analysis (as determined by the tool) will be listed along with the needs area in a revised Statewide Needs Inventory for each region.

A tutorial of the Benefits Tool is provided for use of the tool on the TSMO-TIP website.

Step 8: Develop Operations Plan, O & M Costs, and Responsible Parties

Timeframe: April-May

Result: Draft of Regional Project List for each region

This step involves creation of an operations plan to document the operating procedure for each deployment, creation of a list of all operating and maintenance costs involved in deployment of the TSM&O solution, and a list of responsible parties for operation and maintenance of the TSM&O solution.

Step 9: Develop Regional Project List with Priority Ranking

Timeframe: May

Result: Regional Project List with Priority Ranking

This is the final step completed by each region with BTO support before merging the regional plans into a statewide list. In this step, each region will pull together all of the resources in the previous steps of this task and present a clean list of projects with priority rankings for their region.

Each project will include:

- all information on the project area as produced in the Statewide Needs Inventory for the region,
- a list of TSM&O solutions to be deployed,
- a benefits-cost analysis summary (from the Benefits tool) for each TSM&O solution,
- and an operations plan with O&M costs and responsible parties listed for each TSM&O solution.

Projects will then be ranked with a priority based on benefits-costs results as well as regional and BTO judgement.

Process Task C

Goal: Compile a Statewide Deployment List

Responsibility: BTO and Regional ITS Coordinators

This is a relatively quick task that involves BTO oversight of the Regional Project Lists. This task culminates with the merger of these lists into a Proposed Statewide Deployment List which will be passed on to the Operations Managers.

Step 10: BTO Operations Unit Checks for Concurrence on Technical Feasibilities

Timeframe: June

Result: Revised Regional Project Lists with projects marked for concurrence with technical feasibilities

In this step, the BTO Operations Unit will go through each of the five Regional Project Lists and verify that all proposed TSM&O deployments are feasible for deployment during the next AY.

Although the main process involved is verifying if deployments can be made given current technical expertise and availability at BTO, this step also offers BTO a chance to review materials before creating a final list to pass on to the Operations Managers.

BTO *should* work with the Regional ITS Coordinators at this point with any projects and/or deployments in question to resolve any issues.

Step 11: Compile Proposed Statewide Deployment List

Timeframe: June

Result: Proposed Statewide Deployment List

This is the final step completed by the BTO Operations Unit with support from the Regional ITS Coordinators. In this step, BTO will pull together the resources from Step 10 and the previous tasks to compile a proposed Statewide Deployment List.

Each deployment in the list will include

- all information on the project area as produced in the Statewide Needs Inventory for the region,
- all information on the specific projects and TSM&O deployments as produced in the Regional Project List including priority rankings,
- and a verification of deployment feasibility.

Process Task D

Goal: Finalize Statewide Deployment List

Responsibility: BTO and Operations Managers

This task allows for a review period to consider all deployments and offer any suggestions of criticisms. At this stage, new technologies will also be considered. This task culminates with the finalization of the Statewide Deployment List which will be passed on to the ITS TAG.

Step 12: Operations Manager and Peer Review

Timeframe: July

Result: Reviewed Statewide Deployment List

In this step, Operations Managers will review all suggested deployments and offer input, concerns, and criticism. Peers including other regions, MPOs, TOPS Lab, and other relevant bodies will also be asked to provide feedback at this stage.

All feedback at this stage *should* be documented and BTO *should* record all feedback and attach it to each proposed deployment's package on the Proposed Statewide Deployment List.

Step 13: Explore Additional Alternatives (New Technology, Pilot Possibilities, etc.) Timeframe: July

Result: Reviewed Statewide Deployment List with suggested alternatives

Using the TOPS Lab's annual evaluation of emerging and current TSM&O technologies, BTO will decide if new technologies *should* be deployed in place of or in addition to the suggested TSM&O deployments for each project.

If any significant changes are made at this point, Regional ITS Coordinators *should* be brought back into the discussion as necessary to provide feedback.

Any changes that are made to the Proposed Statewide Deployment List *should* be recorded and all relevant documentation (including benefits-cost analyses and changes to the operations plan, O&M costs, and responsible parties) *should* be attached to each proposed deployment's package on the Proposed Statewide Deployment List.

Step 14: Finalize Proposed Statewide Deployment List

Timeframe: July

Result: Finalized Statewide Deployment List

This is the final step completed by the BTO before the deployment plan is sent out for funding and support. In this step, BTO will pull together the resources from Steps 13 and 14 as well as the previous tasks to compile a finalized Statewide Deployment List.

Each deployment in the list will include

- all information on the project area as produced in the Statewide Needs Inventory for the region,
- all information on the specific projects and TSM&O deployments as produced in the Regional Project List including priority rankings,
- verification of deployment feasibility,
- and notes from all reviews.

Process Task E

Goal: Identify Funding Sources and Obtain Support Documentation for Statewide Deployments List

Responsibility: ITS TAG, BTO, and Regional ITS Coordinators with Operations Managers oversight

This task involves the selection of a funding mechanism for each project and allows for one final review before passing the list on to ITS TAG for their approval.

Steps 15/16: Identify Funding Mechanism – ITS Standalone, 6-Year Construction Program, Other Funding – Is Funding Available?

Timeframe: August

Result: Append funding mechanism to Final Statewide Deployment List

During this step, each of the projects listed in the Statewide Deployment List will be reviewed and funding mechanisms will be selected. Each deployment will fall be marked with one of the following:

- Funding from 6-Year Construction Program – specific program and timeline will be identified and listed with the deployment
- Funding from ITS Standalone
- Funding from other source – specific source must be identified with timeline
- Not Funded – Reason for lack of funding must be documented and deployment will be marked for future consideration

Step 17: Obtain Operations Managers Documented Support for Project

Timeframe: August

Result: Append Operations Managers Support to the Final Statewide Deployment List

During this step, the Operations Managers will review each project paying particular attention to verified funding sources. Any questions or concerns *should* be directed to all stakeholders.

Operations Managers *should* approve (or deny) all projects and these approvals **shall** be documented and included with Final Statewide Deployment List.

To summarize, this step will include attaching funding mechanisms and approvals to the Final Statewide Deployment List.

Process Task F

Goal: ITS TAG Final Review and Approval of Statewide Deployment List

Responsibility: ITS TAG

This task is the final chance for ITS TAG to review all deployments and place the deployments into the official list for the next AY (or future).

Step 18: ITS TAG Annual ITS Recommended Project List and Deployment (Decision Making / Justification Summary) Report

Timeframe: September

Result: ITS Recommended Project List and Deployment Report

In this step, ITS TAG will review the Statewide Deployment List and use this list to develop their ITS Recommended Project List and Deployment Report. This report will include a list of all deployments for the next AY (as well as any projects marked for future AYs). Each deployment *should* include a short decision making and justification summary.

Process Task G

Goal: Implement Projects

Responsibility: BTO and Regional ITS Coordinators

In this task, BTO will work with Regional ITS Coordinators to successfully implement the projects listed in ITS TAG's ITS Recommended Project List and Deployment Report.

Step 19: Engage Configuration Management Process

Timeframe: October/November

Result: Final Configuration Plan

In this step, the configuration management process *should* be used to determine exactly how the project will be deployed in the field. A configuration management process is one that manages changes to a system, to ensure that a system is operated as it is intended throughout its design life cycle. Configuration management includes documenting upgrades and modifications that are performed and other attributes related to this work, including the date and reasoning why the work was completed.

Step 20A: Implement Project

Timeframe: Next AY during Construction Season

Result: TSM&O solution successfully deployed

The project is implemented by whatever means determined in the previous steps and responsibility is passed on to the identified responsible parties for operations and maintenance.

Step 20B: Mark Deployment for Future Consideration

Timeframe: Any Time During Current AY

Result: List of Deployments for Future Consideration

Any deployment that was taken off the ITS Recommended Project List and Deployment Report at any point during this entire process *should* be moved into the next AY process cycle for consideration. To make this list easier to use, all deployments in this list *should* include all documentation that was created during this process.