11-1-1 Initial System Approval May 2015

PURPOSE

This policy describes the requirements for approval of Lighting on the Wisconsin State Highway System.

POLICY

All lighting on the state trunk highway system **shall** require approval in accordance with this policy.

WisDOT Maintained Systems

The State Lighting Systems Engineer in the Bureau of Traffic Operations **shall** approve all proposed new lighting system installations on state trunk highways except as described below. When there is a possibility a project *may* include the installation of lighting, the DOT 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 before any commitments are made concerning the installation of lighting systems.

The following lighting needs are required by the department and are exempt from the formal approval process. However, in these cases the project manager **shall** work with the region lighting engineer to accommodate coordination and oversight of the design:

- signalized intersections
- roundabouts
- metered ramps
- tunnels
- special facilities
    - Weigh stations
    - Park-rides
    - Crash investigation sites
    - Rest areas
    - Waysides

Improvement projects on roads where lighting presently exists are also exempt from the formal approval process.

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 lighting system.

The report **shall** include:

- DT1198 Roadway Lighting System Approval Request.
- Description/discussion of the project and plan drawing of the roadway project under consideration
- Data pertinent to determine the need for 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 lighting relates to this overall safety evaluation
    - analysis based on the minimum warranting conditions as minimum thresholds for further consideration of lighting as described in the current AASHTO Roadway Lighting Design Guide
- Installation cost, maintenance cost, and what agency is funding/maintaining the system
- Discussion, correspondence, and recommendations from local jurisdictions, and any written agreements relating to lighting on the project
- A recommendation with supporting discussion based on the above evaluation

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 lighting systems shall follow the design process described in other TEOpS sections.

Permitted Lighting Systems

All Locally-owned and maintained Lighting systems on the Wisconsin State Highway system shall require a permit in accordance with TEOpS 11-3-1.

Aesthetic Lighting on Structures

Aesthetic lighting shall require approval in accordance with TEOpS 11-3-2.

Connecting Highways

Lighting on connecting highways and permitted lighting maintained by local municipalities on state trunk highways are exempt from submitting a request for approval. However, in these cases the project manager **shall** work with the region lighting engineer to accommodate coordination and oversight of the design.

11-1-2 Lighting System Design Review May 2015

POLICY

All DOT maintained Roadway Lighting System designs **shall** follow the process described in with this document.

POLICY APPLICATION

The purpose of this policy is to prescribe guidelines and procedures that will help ensure consistent lighting system designs statewide and clarify the review requirements.

PROCEDURAL REQUIREMENTS

For all Projects covered under this policy, after receiving the necessary Lighting System Approval described in TEOpS 11-1-1, the lighting designer **shall** submit a Continuous Lighting System Illumination Application DT1886 (or Preliminary Permit Application for locally maintained systems), Roundabout Illumination form, or Signalized Intersection Illumination Form, as applicable to the project, to the DOT Regional Lighting Engineer prior to beginning the design.

The designer **shall** send a copy of all submittals to the State Lighting Engineer.

DESIGN PROCESS

The designer **shall** follow the appropriate WisDOT design standards/parameters described in later sections for the type of lighting system being proposed.

The designer **shall** follow the submittal/review procedures described in the WisDOT lighting review checklist.

DESIGN CHECKLIST FOR ROADWAY LIGHTING

System designed by: ☐ Design consultant ☐ Traffic (In-house) ☐ PDS (In-house)

Project ID (Design / Const) _____

Description _____

Highway _____ County _____

Designer Name (print/type) _____ Signature _____

Coordinate Lighting Design Process @ approximately 30% Plan

☐ Contact Region Traffic Section about the need for a lighting system on the project. Identify project segments.

☐ Prepare description of Lighting System and prepare & submit Roadway Lighting System Request Form DT1198.

☐ **Consult current Chapter 11 of WisDOT Traffic Guidelines Manual**. Determine all Design Guidelines, Roadway and Area Classifications and Target Illumination Thresholds for the various project segments. **Obtain approval from Region Lighting Engineer in Traffic Section.**

☐ Verify Luminaire used in the design.

☐ Prepare Preliminary Permit Application form, Continuous Lighting Illumination Form, Signalized Intersection Illumination Form, or Roundabout Illumination Form. **Obtain necessary Approval(s) before beginning the Design.**

Preliminary Review @ approximately 60% Plan

☐ AGI32 Roadway Optimizer calculations for continuous roadway sections (Avg. Maintained Illumination, Uniformity) showing compliance with Application or Illumination form) ☐ N/A

☐ AGI32 calculations for Roundabouts showing compliance with Application or Illumination form) ☐ N/A

☐ AGI32 calculations for Signalized Intersections showing compliance with Application or Illumination form) ☐ N/A

☐ Preliminary Plan with proposed luminaire/pole locations

Final Review @ approximately 90% Plan

Submit to Region Traffic Section Lighting Engineer, with copy to State Lighting Engineer:

- ☐ Completed Lighting Permit (if applicable) ☐ N/A
- ☐ Lighting Plans (See FDM 15-1 Attachment 5.14 Sample Design Sheet). Include applicable plan details.
  - ☐ Miscellaneous Quantities
  - ☐ SPVs
  - ☐ Wiring Diagram per Sample Design Sheet
  - ☐ List of SDDs included in the Lighting Plan
- ☐ Voltage Drop Calculations for lighting (include festoon outlets where applicable)
- ☐ This Completed Checklist signed by Designer.

The following shall also be verified/checked by designer

- ☐ Miscellaneous Quantities/SPVs match the Plans.
- ☐ SPVs for luminaires on permitted projects specify compliance with permit conditions. ☐ N/A
- ☐ On permitted projects, if banners, holiday decorations, or festoon outlets are to be installed or attached to the poles, the dimensions and locations must be included and shown on a detail drawing. The pole manufacturer needs this information for their pole design calculations. ☐ N/A
- ☐ The Designer has checked the design for completeness and correctness.

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 mph	ADT	Cross Section Rural / Urban	Roadway Width ft

Road Class		Area Class		Pavement Class	
☐ Major	☐ Minor Arterial	☐ Commercial	☐ Residential	☐ R1	☐ R3
☐ Collector	☐ Other	☐ Intermediate		☐ 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 General Overview, Considerations and Parameters May 2015

POLICY

Unless described otherwise, all Roadway Lighting Designs on State Highways **shall** follow the general guidelines described in this section.

TYPES OF ROADWAY LIGHTING

There are a number of different types of roadway and facilities involving the consideration of lighting, most all of which are covered in more detail in the AASHTO Roadway Lighting Design Guide and ANSI / IESNA Roadway Lighting RP-8-00. 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 (stand-alone) Intersections; Signalized Intersections; and Roundabouts. These could include transition lighting and/or coordination with a continuous segment lighting system.
- Aesthetic Lighting

Refer to other sections for specifics on the individual design requirements for these categories.

Continuous lighting is defined as a lighting system incorporating lighting units with overlapping distribution patterns that meet average and uniformity levels as defined by AASHTO for the appropriate roadway area classification and use.

Transition lighting is defined as a gradual increase/reduction in lighting levels when entering or leaving a lighting system, most typically at a Roundabout, when the roadway is not continuously illuminated.

Isolated lighting is defined as lighting at the intersections of non-illuminated roadways or periodic lighting along a roadway where AASHTO defined light level standards for average and uniformity are not applicable.

DESIGN PARAMETERS AND CALCULATIONS

The following design parameters pertain to all roadway lighting systems:

1. Lighting systems *should* be designed in accordance with AASHTO's "Roadway Lighting Design Guide" October 2018, Table 3-5a for required lighting levels. (The IES Design Guide for Roundabout Lighting DG-19-08, and the ANSI/IESNA guide RP-8-00 will be used as references where noted.)
2. Pavement classifications of R1 (concrete) or R3 (asphalt) **shall** be used depending upon the permanent roadway surface.
3. The calculation of roadway lighting levels *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 review if necessary.
    - Unless indicated otherwise, 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 roadways, intersections and roundabouts.
    - 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 AASHTO Roadway Lighting Design Guide.
4. Wire sizing for lighting circuits *should* be calculated with a target of 3.5% voltage drop per branch circuit, and a maximum of 5% for the total of service/feeder and branch circuit.
5. WisDOT does not currently utilize Curfews of lighting systems on DOT maintained lighting installations.

- WisDOT *may* consider curfews on permitted locally owned/maintained lighting installation with the appropriate justification.

GENERAL REQUIREMENTS FOR LUMINAIRES

LED Luminaires **shall** be used for WisDOT maintained lighting systems and **shall** be selected from the Department's Qualified Electrical Products List.

- For permitted Locally Maintained Systems, the Luminaires **shall** be selected on the basis of 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.

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 LED Luminaires on the Department's Qualified Products List **shall** be the value indicated on the List. (This value includes an adjustment for LDD.)
- The LLF for High Pressure Sodium lamps *should* be 0.75.
- When LED luminaires other than those identified on the Qualified Electrical Products List are specified for permitted locally maintained systems, the designer **shall** identify the proposed LLF and furnish justification for it with the permit application.

POLE BREAKAWAY REQUIREMENTS

Poles permitted on the rights-of-way of the State Trunk Highway System for the sole purpose of highway 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 breakaway within the criteria specified for breakaway poles.

Under normal conditions, the use of lighting pole designs conforming to the breakaway requirements above is encouraged for all lighting installations.

ROADWAY AND LAND USE (AREA) CLASSIFICATIONS

There are numerous documents that define Roadway Classifications. These include:

- AASHTO Policy on Geometric Design of Highways and Streets (Green Book)
- ANSI/IESNA RP-8
- WisDOT FDM 4-1-15
- FHWA Highway Functional Classifications

Policy specifies using the AASHTO "Roadway Lighting Design Guide" October 2018, Table 3-5A, which references the Green Book classifications. 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?
- What is the level of development of the surrounding area?
- What is the pedestrian conflict?

This evaluation will determine which of the AASHTO Table classifications provides the best fit for the project.

Table 1 below contains some of the key points from the 2011 AASHTO Green Book to assist the designer in the evaluation.

Table 1. Classification Descriptions

Roadway Classifications	**Description**
Other Principal (Major) Arterials	That part of the roadway system that serves as the principal network for through-traffic flow, with low emphasis on local access. The routes connect areas of principal traffic generation and important roadways entering the city. Posted speeds are generally high.
Minor Arterials	That part of the roadway system that serves as the principal network for through-traffic flow between smaller communities, or as a secondary roadway for through traffic. These routes typically have lower traffic levels than major arterials. Although posted speeds are relatively high, these can provide more local access.
Collectors	Roadways servicing traffic between major and local roadways. These are streets used mainly for traffic movements within residential, commercial, and industrial areas. They do not handle long through trips, but can provide travel between towns not served by other systems. These generally have moderate posted speeds.
Local	Local roadways used primarily for direct access to residential, commercial, industrial, or other abutting property. They do not include roadways carrying through traffic, although an arterial passing through a small community *may* provide local functionality. Posted speeds are low.
Area Classifications (Pedestrian Conflict)	**Description**
Commercial (High)	The portion of the municipality in a business development where ordinarily there are large numbers of pedestrians and a heavy demand for parking spaces during periods of peak traffic or a sustained high pedestrian volume and a continuously heavy demand for off-street parking during business hours. This definition applies to densely developed business areas outside of, as well as those that are within the central part of a municipality. Areas where significant numbers of pedestrians are expected to be on the sidewalks or crossing the streets during darkness. Examples are downtown retail areas, near theaters, concert halls, stadiums, and transit terminals.
Intermediate (Medium)	The portion of the municipality which *may* be outside of a downtown area but generally within the zone of influence of a business or industrial development, often characterized by a moderately heavy nighttime pedestrian traffic and a somewhat lower parking turnover than is found in a larger or more active commercial area. This definition includes densely developed apartment areas, hospitals, public libraries, and neighborhood recreational areas.
Residential (Low)	An area characterized by few pedestrians and low parking demand or turnover at night or portions of the night. Although this definition includes areas with housing, it also includes commercial areas with low pedestrian activity. Regional parks, cemeteries and vacant lands could also be included.

PLACEMENT OF LIGHTING POLES

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 also 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. 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 Traffic Signal Design Manual and the Roundabout section herein give additional information related to pole locations and co-locations for luminaires, etc.

Minimum Lateral Offset

Table 2 below is attached as a reference for the minimum lateral offset for lighting poles on state trunk highways. The values indicated in the table 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 2. Minimum Lateral Offsets

FACILITY TYPE	SPEED LIMIT (MPH)	TRAFFIC VOLUME (ADT**)	MINIMUM RIGID (FEET)	OFFSET BREAKAWAY (FEET)
RURAL				SHOULDER width plus
	35 or less 40	ALL 0 – 1,000 1,500 – 6,000 over 6,000	12 14 16 18	2 2 2 2
	45-50	0 – 1,500 1,500-6,000 over 6,000	20 26 28	2 2 2
	55	0 – 1,500 1,500 – 6,000 over 6,000	24 30 30	2 2 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 in 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 C.O. Traffic. Placement of rigid poles in this situation is discouraged.
2. A reduction in minimum offset requirement by as much as 1/3 *may* be followed where there is a pronounced back slope rising more or less directly from the shoulder. No value **shall** be less than 24 feet for 40 mph or more.
3. 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.
4. 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.
5. 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 walk and roadway *may* be permitted in the event no other alternative is feasible.
6. 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.
7. 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.
8. 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.
9. Lighting control cabinets for distribution of energy to lighting systems *should* be placed in the least vulnerable locations available.

LIGHTING PLANS

All lighting plans **shall** include the following information:

- Roadway, Area, and Pavement Classifications used in the design
- Legend, describing the Luminaires, poles, arms, cabinet, and circuit information.
- Luminaire symbols **shall** include location and circuit information.
- System wiring diagram including conduit, conductor, and circuit information for all conduit segments.
- Maintenance Authority

A sample lighting plan sheet is located in FDM 15.1 attachment 5.14 for reference.

REFERENCE TO STANDARDS

The installation of highway lighting **shall** conform to applicable provisions of Chapter 9, Section 15 of the WisDOT Highway Maintenance Manual, except as modified herein. In addition, the highway lighting installation **shall** comply with the requirements of the latest edition of the following:

- National Electrical Code
- Wisconsin Electrical Code
- Local codes and ordinances

The following guides apply to all highway lighting installations covered by this policy. Unless otherwise indicated, the latest editions of the following guides **shall** be used.

1. American Association of State Highway and Transportation Officials (AASHTO) Roadway Lighting Design Guide, October 2018.
2. American National Standard Institute (ANSI), American National Standard Practice for Roadway Lighting RP-8-00.

The most restrictive, policy, code, standard, or guide **shall** govern. Central Office will make the final decision on the interpretation of conflicting policies, codes, or standards.

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.

11-3-1 Permitted Lighting Systems May 2015

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.

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 DESIGN OF SUCH SYSTEMS.

POLICY APPLICATION

The purpose of this policy is to prescribe guidelines and procedures that will provide for the uniform accommodation of roadway lighting facilities installed and maintained by others within the limits of the public highway rights-of-way of the State Trunk system.

The provisions of this policy **shall** apply to all cities, villages, counties and towns (agencies) which desire to use or occupy rights-of-way of the State Trunk Highway system for locally owned and maintained highway lighting. 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 highway lighting **shall** apply to the city, village, county or town in which the State Trunk Highway in located.

PERMIT REQUIREMENTS

For all Projects covered under this policy, an application for approval to install roadway lighting **shall** be submitted to the DOT Regional Office by the city, village, county or town that will be paying for the maintenance and energy costs associated with the lighting system.

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. Sample copies of the current forms follow this policy.

Permit applications that require State Lighting Engineer approval **shall** be submitted to the attention of the Regional Office.

APPROVAL AUTHORITY

The State Lighting Engineer **shall** review and approve all permits involving new continuous lighting systems.

New permits are required if 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 State Lighting Engineer **shall** also review and approve applications that include:

- decorative lighting installed on the State Trunk Highway system
- lighting for a trail or walkway that is adjacent to the roadway
- receptacles for festoon lighting
- flood lighting proposed for bridges and retaining walls

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 as long as the new lighting units match the existing equipment and generate equivalent lighting levels.

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 (Excludes routine maintenance activities):

- Pole locations
- Pole heights and types
- Luminaire and lamp types
- Operating conditions such as lighting curfews/dimming

- Other items affected by this policy

CONTINUOUS LIGHTING PERMIT APPLICATION

The applicant **shall** follow the following two-part process for Continuous Lighting permit applications, consisting of a preliminary and a final application form:

1. At project scoping or as soon as it is known that lighting will be included, the Applicant **shall** contact the Region 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 begin until the preliminary application is submitted and approved. The Regional Office may review the basic project information, and coordinate with State Lighting Engineer on acceptance of poles and luminaires.

   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 downtown shopping, etc.

2. At or before Pre-PS&E completion, 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.

3. The designer ***shall*** include in the project plans the necessary SPV verbiage that ensures that the final luminaires provided on the project will meet the design parameters of the permit.

ISOLATED LIGHTING PERMIT APPLICATION

Since Isolated Lighting covers numerous situations, such as leased Utility lights at an intersection, the Regional Office may allow substitution of the Isolated Lighting Permit Application as conditions dictate. In any case, the Applicant **shall** contact the Regional Office at project conception to begin the permit process.

DESIGN PARAMETERS

The designer shall follow the appropriate WisDOT design standards/parameters for the type of lighting system being proposed. Unless indicated otherwise, the Illuminance Method of calculation **shall** be used to determine average and uniformity roadway lighting levels.

The designer/engineer **shall** also perform veiling luminance calculations. The specified Veiling Luminance Ratio **should not** exceed that defined in the AASHTO Roadway Lighting Design Guide.

The calculation of roadway lighting levels **should** be performed using AGI32 software.

1. For straight sections of Continuous Roadway lighting, the calculation and submittal/report **shall** be based upon The Roadway Optimizer tool.

2. For intersections, the calculation and submittal/report **shall** be calculated using a grid defining the traffic conflict areas and **shall** include the outside edges of pedestrian crosswalks. Intersection calculations **shall** be independent of any continuous roadway calculations included in the project area.

3. For roundabouts, the calculation and submittal/report **shall** be calculated using a grid defining the traffic conflict areas and **shall** include the outside edges of pedestrian crosswalks. Roundabout calculations **shall** be independent of roadway calculations

The Light Loss Factor to be applied to initial luminaire lumen output to calculate maintained illumination as prescribed in this section **shall** be justified and furnished with the permit application.

The Voltage Drop and related Wire sizing for lighting circuits and festoon receptacles *shall* be calculated in conformance with the NEC, along with any additional requirements of the applicant agency. See TEOpS 11-2-1 for additional information.

Festoon receptacle branch circuits *should* be circuited independent from roadway lighting circuits unless maintaining agency has specific reasons to warrant a combined circuit.

DISTRIBUTION REQUIREMENTS FOR LUMINAIRES

No luminaire **shall** be proposed for use on the State Trunk Highway System that cannot meet the Veiling Luminance Ratio required for the Lighting System.

CURFEWS

Curfews are defined as the switching off or dimming of lights during certain off-peak hours. 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 typically include such items as reductions in traffic volume and/or pedestrians.
- A statement that illumination is not necessary during the proposed curfew hours if the maintaining agency desires to switch off the lights. Although AASHTO does not require roadway lighting, the maintaining agency installed it for a reason, and therefore shall evaluate the proposed switching accordingly.

FINAL PERMIT APPLICATION SUBMITTAL REQUIREMENTS

The following information **shall** be identified on the submittal:

1. Roadway names.
2. Roadway and area classifications.
3. Pavement classification.
4. Posted speed limit of roadways.
5. Local maintaining authority.
6. Catalog cut sheets for pole and luminaire which include manufacturer's luminaire catalog numbers and include wattage, light source, initial luminaire or lamp lumens, voltage, lens type, Illumination Engineering Society (IES) distributions, and options.
7. Light Loss Factor (LLF) used for the design.
8. If banners, holiday decorations or festoon receptacles are to be installed or attached to the poles, the dimensions and location **shall** be included and shown on a detail drawing in the plans.
9. Voltage Drop calculations for lighting and festoon receptacle circuits.
10. Computer design computations for illumination and spacing of computed roadway sections as described above.
11. Summary tables that include both design parameter target values and calculated results.

The Project Electrical/Lighting Engineer **shall** sign and date the final permit application.

REFERENCE TO STANDARDS

The installation of highway lighting **shall** conform to applicable provisions of Chapter 9, Section 15 of the WisDOT Highway Maintenance Manual, except as modified herein. In addition, the highway lighting installation **shall** comply with the requirements of the latest edition of the following:

- National Electrical Code
- Wisconsin Electrical Code
- Local codes and ordinances

The following guides apply to all highway lighting installations covered by this policy. Unless otherwise indicated, the latest editions of the following guides **shall** be used.

1. American Association of State Highway and Transportation Officials (AASHTO) Roadway Lighting Design Guide, October 2018.
2. American National Standard Institute (ANSI), American National Standard Practice for Roadway Lighting RP-8-00.

The most restrictive, policy, code, standard, or guide **shall** govern. State Lighting Engineer will make the final decision on the interpretation of conflicting policies, codes, or standards.

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.

DOT *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.

ISOLATED LIGHTING PERMIT APPLICATION

DT1885 11/2014 s. 84.02(4)(c) Wis. Stats.

Wisconsin ~~Department of Transportation~~

State Project Number

Submit 2 copies to the Regional Office of the Wisconsin Department of Transportation, including:

☐ Attach engineering drawing of lighting installation including all applicable information such as location, spacing of poles, wiring, lighting units, edge of pavement, curblines and shoulders, etc. Include complete proposed installation from sourceline to lighting fixture. Include specifications and special provisions.

Highway			Intersected Highway Name or Number; Area Limits	
Applicant Name (must be a Government Unit)		Applicant Mailing Address, City, State, ZIP Code		(Area Code) Telephone Number
Designer Name		Designer Mailing Address, City, State, ZIP Code		(Area Code) Telephone Number
Maintainer Name		Maintainer Mailing Address, City, State, ZIP Code		(Area Code) Telephone Number
County		Posted Speed Limit mph	ADT and Year vpd	Cross Section ☐ Rural ☐ Urban
Number of Poles	Material and Class	Mast Arm Length ft	Base Type ☐ Breakaway ☐ Non-Breakaway ☐ Direct Bury	Wiring ☐ Overhead ☐ Underground

Number of Luminaires	Mounting Height Above Pavement	Watts Source	IES Distribution Type and BUG Rating	Intitial Lumens

The list of attachments to this permit application includes plan sheets, calculations, specifications, etc.

The designated applicant applies to the Wisconsin Department of Transportation, Division of Transportation System Development for permission to install, operate and maintain, or to contract for the installation, operation and maintenance of highway lighting units within the limits of the right of way of the state trunk highway, all as described above.

The applicant certifies that if the proposed lighting is located in another unit of government, written consent has been obtained as required by Wisconsin Statutes from the other unit of government in which the proposed lighting units and associated power line extensions are located, and that such consent is currently valid and covers all of the proposed work.

The undersigned certifies that s/he is authorized to sign this application on behalf of the designated applicant.

X _____ _____ _____

(Applicant Signature) (Date – m/d/yyyy) (Applicant Title)

Applicant: Do Not Write Below This Line

PERMIT APPROVAL

Permission is granted to the above applicant to install, operate and maintain highway lighting units and associated power lines and poles as described in this application and the attached drawings and specifications, subject to the conditions on the following page of this application.

ISOLATED LIGHTING – Approved for Regional Office

Permit Number	Date Issued (m/d/yyyy)	
		X

(Approval Signature)

ISOLATED LIGHTING PERMIT APPLICATION *(continued)*
Wisconsin Department of Transportation DT1885

Highway Lighting Installation Permit Conditions

1. The installation, including all wiring, supports, equipment, roadway 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.
2. The installation, operation, and maintenance of the highway lighting facilities shall be at the expense of the permittee. Alterations in any part of the installation as are required at any time by the Wisconsin Department of Transportation shall be made by the permittee at his/her own expense within 60 days.
3. Construction and maintenance operations shall be performed without closing the highway to traffic except as may be specifically authorized by authorized representatives of the governmental agency maintaining the highway. Unless otherwise authorized, two-way traffic shall be maintained at all times. Proper barricades, signs, flags, lights, and flagpersons shall be provided and maintained at all locations in accordance with the Manual on uniform Traffic Control Devices.
4. The permittee shall not interfere with the normal use of the adjoining land by the owners in the installation, alteration, maintenance, or removal of the facilities authorized by this permit.
5. A concrete base, if used, shall not extend more than four (4) inches above ground level at any point.
6. The highway lighting facilities installed by authority of this permit may be removed by the permittee, following 30 days written notice to the Wisconsin Department of Transportation, but such removal shall be subject to the conditions governing the installation of the lighting and associated electric power lines.
7. Any excavations necessitated by the proposed work shall be effectively backfilled and subsequent settlements after backfilling repaired to the satisfaction of the highway authority. Roadway surfaces, pavements, structures, vegetation, or other highway facilities damaged shall be repaired or restored to the satisfaction of the highway authority. Temporary sheeting and shoring shall be used as necessary to prevent soil caving in any trenches and tunnels.
8. Following any work on the highway right of way incident to an installation, alteration, or removal under this permit, the permittee shall restore the right of way to its condition previous to the work by the permittee, said restoration to meet with the approval of the Wisconsin Department of Transportation.
9. No trees or shrubs shall be cut, trimmed, or branches cut or broken in the construction or maintenance of the line without the consent of the owner of the trees or shrubs.
10. Any brush, trash, waste, or rubbish resulting from construction or maintenance of the line shall be removed from the highway right of way.
11. All wood and debris from any elm trees or other diseased trees which have been trimmed in performance of the work permitted under this permit shall be disposed of in accordance with approved Wisconsin Department of Transportation's procedure, a copy of which may be obtained from the approving district office.
12. The permittee shall immediately notify the district office when the installation has been completed.
13. Any special provisions attached shall be considered as part of this permit.

PRELIMINARY CONTINUOUS LIGHTING PERMIT APPLICATION

DT1878 10/2013 s.84.02(4)(c) Wis. Stats.

Wisconsin Department of Transportation
State Project Number

Submit 2 copies to the Regional Office of the Wisconsin Department of Transportation, including:

- ☐ Completed Preliminary Information 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.
- ☐ Catalog cut sheets of the Proposed Poles and Luminaries.

Preliminary Information Form (Provide additional forms as necessary for multiple roadways and/or roadway types)

Highway	Lighting Limits
Applicant Name and Mailing Address (Must be a Government Unit)	Project Electrical Engineer Name, Mailing Address and Telephone
Maintainer Name, Mailing Address and Telephone	Project Lighting Engineer Name, Mailing Address and Telephone

County	Posted Speed Limit mph	ADT	Cross Section Rural Urban	Roadway Width 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 Description	IES Distribution and BUG Rating	Mounting Height Above Pavement	Watts/Source	Initial Lumens	LLF

Target Illuminance Values		**Target Luminance Values** (If applicable. See Design Requirements in TGM 11-10-1)			
Average FC	Uniformity Ave/Min	Average cd/m sq	Veiling Luminance Ratio Lv(max)/Lavg	Uniformity Ave/Min	Max/Min

The designated applicant applies to the Wisconsin Department of Transportation, Division of Transportation System Development for permission to begin the design to install, operate and maintain, or to contract for the installation, operation and maintenance of highway lighting units within the limits of the right of way of the state trunk highway, all as described above.

The applicant certifies that the Lighting Engineer has explained the WisDOT Lighting Requirements.

The undersigned certifies that s/he is authorized to sign this application on behalf of the designated applicant.

X _____ _____

(Applicant Signature) (Date) (Title)

Applicant: Do Not Write Below This Line

PRELIMINARY PERMIT APPROVAL

Permission is granted to the above applicant to begin the design to install, operate and maintain highway lighting units and associated power lines and poles as described in this application and the attached drawings and specifications, subject to the conditions on the following page of this application.

CONTINUOUS LIGHTING

Permit Number	Date Issued – m/d/yyyy	Approved for Division of Transportation System Development
		X

(Signature)

Highway Lighting Installation Permit Conditions

1. The installation, including all wiring, supports, equipment, roadway 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.
2. The installation, operation, and maintenance of the highway lighting facilities shall be at the expense of the permittee. Alterations in any part of the installation as are required at any time by the Wisconsin Department of Transportation shall be made by the permittee at his/her own expense within 60 days.
3. Construction and maintenance operations shall be performed without closing the highway to traffic except as may be specifically authorized by authorized representatives of the governmental agency maintaining the highway. Unless otherwise authorized, two-way traffic shall be maintained at all times. Proper barricades, signs, flags, lights, and flagpersons shall be provided and maintained at all locations in accordance with the Manual on uniform Traffic Control Devices.
4. The permittee shall not interfere with the normal use of the adjoining land by the owners in the installation, alteration, maintenance, or removal of the facilities authorized by this permit.
5. A concrete base, if used, shall not extend more than four (4) inches above ground level at any point.
6. The highway lighting facilities installed by authority of this permit may be removed by the permittee, following 30 days written notice to the Wisconsin Department of Transportation, but such removal shall be subject to the conditions governing the installation of the lighting and associated electric power lines.
7. Any excavations necessitated by the proposed work shall be effectively backfilled and subsequent settlements after backfilling repaired to the satisfaction of the highway authority. Roadway surfaces, pavements, structures, vegetation, or other highway facilities damaged shall be repaired or restored to the satisfaction of the highway authority. Temporary sheeting and shoring shall be used as necessary to prevent soil caving in any trenches and tunnels.
8. Following any work on the highway right of way incident to an installation, alteration, or removal under this permit, the permittee shall restore the right of way to its condition previous to the work by the permittee, said restoration to meet with the approval of the Wisconsin Department of Transportation.
9. No trees or shrubs shall be cut, trimmed, or branches cut or broken in the construction or maintenance of the line without the consent of the owner of the trees or shrubs.
10. Any brush, trash, waste, or rubbish resulting from construction or maintenance of the line shall be removed from the highway right of way.
11. All wood and debris from any elm trees or other diseased trees which have been trimmed in performance of the work permitted under this permit shall be disposed of in accordance with approved Wisconsin Department of Transportation's procedure, a copy of which may be obtained from the approving district office.
12. The permittee shall immediately notify the district office when the installation has been completed.
13. Any special provisions attached shall be considered as part of this permit.

☐ Special Provisions are attached, please explain:

11-3-2 Aesthetic Lighting on Structures — May 2015

DEFINITION

Decorative roadway light poles on structures, or aesthetic lighting, is a dynamic lighting system that can be operated and controlled by a central computer using fiber optic and data cable lines and software that is capable of projecting a near limitless variety of colors and color patterns on bridges and other 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. This type of lighting does not impact the illumination level of the roadway.

POLICY

Aesthetic lighting *may* be installed only under conditions referenced in the WisDOT Bridge Manual and DTIM 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 (agencies) which desire to use or occupy rights-of-way of the State Trunk Highway system for locally owned and maintained highway lighting. 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 aesthetic lighting **shall** apply to the city, village, county or town in which the State Trunk Highway in located.

The same permit process shall be followed as stated in TEOpS 11-10-1, Permitted Lighting for Locally Owned & Maintained Lighting Systems. Form DT1885 **shall** be submitted to WisDOT Regional Traffic Operations Section. **The permittee must note that the form is for aesthetic lighting.** Approval of a decorative lighting installation is based on WisDOT Regional Traffic Operations, Bureau of Traffic Operations and Bureau of Structures review.

The installation, including all wiring, supports, equipment, roadway 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 electrical components of the system, including conduit, cabling, pedestals, **shall** be completely separate physically from WisDOT electrical system infrastructure. All electrical systems **shall** be designed under the oversight of the State Electrical 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 the WisDOT **shall** be made by the maintaining agency at his/her own expense within 60 days. 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 by the appropriate regional office prior to any work being done on the right of way.

Aesthetic lighting schemes **shall not** present a distraction to traveling public. The lighting system **shall** be designed to minimize light trespass. When programmed to do so, the colors will remain fixed no less than 8 seconds. When lighting is in close proximity to the traveling public, certain colors (i.e., red, blue, amber), text, or images *may* be prohibited. At no time *may* the lights or colors flash or blink. The WisDOT Regional Traffic Operations Section will conduct a lighting review on driver effects.

Any requests from the public for change in operation of the lighting will be directed to the maintaining agency of the lighting system. The WisDOT Regional Traffic Operations Section in coordination with the Bureau of Traffic Operations will approve all non-standard lighting patterns prior to use. Requests *should* be made at least seven (7) days prior to the event to provide time for WisDOT consideration and approval. WisDOT *may* provide requests to the maintaining agency for certain public awareness campaigns (i.e., orange lighting for Work Zone Awareness Week).

WisDOT *may* require the aesthetic lighting be turned off under conditions or circumstances of adverse weather like heavy snow, fog or accidents which *may* have an impact on the traveling public.

11-4-1 Policy and Design Guidelines **May 2015**

POLICY

All DOT maintained roundabouts ***shall*** be illuminated.

All roundabout roadway luminaires on state maintained highway systems **shall** be LED and selected from the Qualified Products List.

Locally maintained Roundabouts **shall** follow the requirements for permitted lighting.

The designer **shall** submit the completed illumination design to the State Lighting Engineer for review and approval. The illumination design **shall** include:

- Copy of approved roundabout illumination form
- design layout
- photometric calculations with summary information showing compliance with illumination and uniformity criteria
- voltage drop calculations

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 Region Lighting Engineer for approval prior to beginning the design for a roundabout on the state maintained highway system.

ILLUMINATION DESIGN VALUES AND CALCULATIONS

The roundabout intersection illumination area **shall** be calculated by using the illumination method.

TEOpS 11-2-1 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.

The Recommended Illuminance Levels at Roundabouts is the sum of the recommended values for continuously illuminated approaching roadways.

Table 1 below, based on these Roadway and Pedestrian Classifications, for R2 and R3 pavement, summarizes these values. "Minor" is used to identify Minor Arterial.

Table 1. Recommended Illuminance Levels at Roundabouts

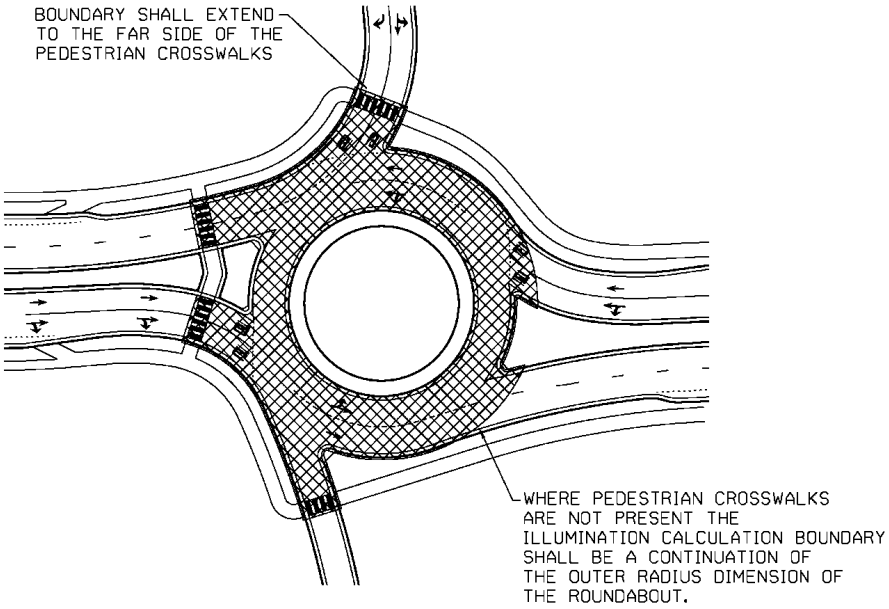
Roadway Classification	**Average Maintained Illumination At Pavement by Pedestrian Area Classification in FC**			E_{avg}/E_{min}
	High	**Medium**	**Low**	
Major/Major	3.16	2.42	1.67	3:1
Major/Minor	2.97	2.23	1.49	3:1
Major/Collector	2.70	2.04	1.39	3:1
Major/Local	2.42	1.86	1.21	3:1
Minor/Minor	2.79	2.04	1.30	4:1
Minor/Collector	2.51	1.86	1.21	4:1
Minor/Local	2.23	1.67	1.02	4:1
Collector/Collector	2.23	1.67	1.12	4:1
Collector/Local	1.95	1.49	0.93	4:1
Local/Local	1.67	1.30	0.74	6:1

For roundabouts where roadways that are not continuously illuminated, the values for Local/Local *should* be used.

ROUNDABOUT CALCULATION BOUNDARIES

The calculation boundary is the area to which the illumination levels in Table 1 apply. This area includes 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 Figure 1.

Figure 1. Roundabout Illumination Calculation Boundary



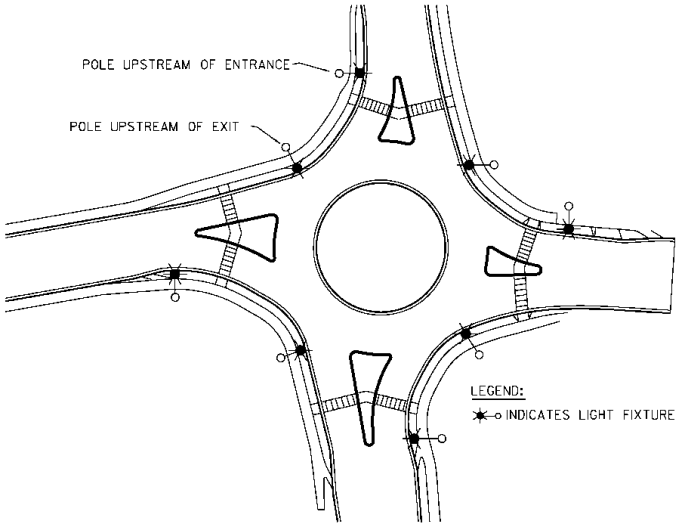
EQUIPMENT PLACEMENT

Light poles *should* be located according to these considerations:

- Minimize the impedance of roundabout approach signage sight lines.
- Place lighting poles on the right hand perimeter just upstream of entrance and exit points.
- Use Engineering judgment to determine appropriate light pole locations and at locations that *may* be too close to errant vehicle paths. In some instances it *may* be necessary to place light poles in larger splitter islands in order to provide good pedestrian recognition.
- Coordinate all clear zone issues with Project Engineer.

Figure 2 below illustrates basic pole placement.

Figure 2. Roundabout lighting placement



TRANSITION LIGHTING

Transition lighting *should* be provided at all roundabouts requiring illumination where the approach roads are not illuminated, and have posted speeds greater than or equal to 35 mph. Transition lighting is implemented to allow the users eyes to adjust from the non-illuminated to the illuminated roadway surface. This gradual lighting adjustment is accomplished incrementally based on the posted speed of the roadway. Recommended transition lighting distances *should* be based on Table 2.

Table 2. Transition Lighting Lengths

Posted Speed Limit (MPH)	30	35	40	45	50	55

Minimum Transition Lighting Distance (Feet)	-	175	200	250	275	325

Transition lighting *should* be measured from the outside limits of the Roundabout calculation boundary as shown in Figure 2.

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 must address this condition in the local agreement.

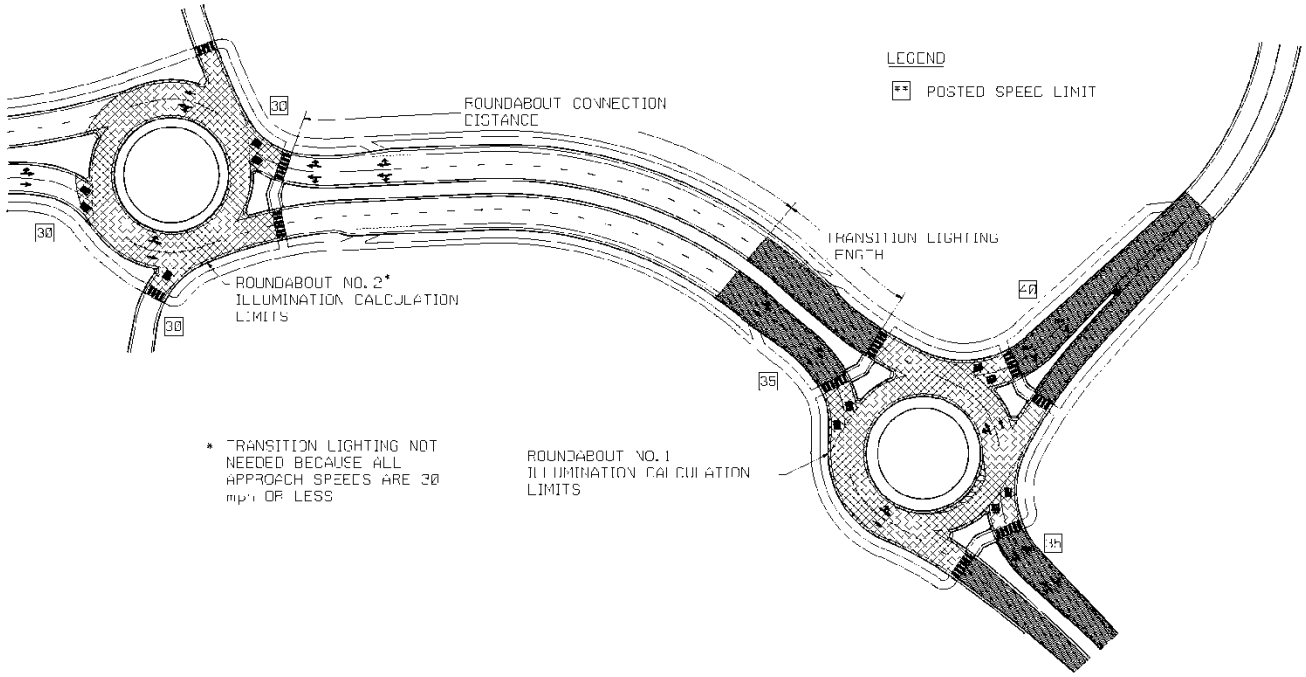
LIGHTING BETWEEN ADJACENT ROUNDABOUTS

If multiple illuminated roundabouts are placed adjacent to each other, e.g., freeway on/off ramps, the area between the roundabouts *should* be illuminated if the distance is less than or equal to that shown in Table 3. Include transition lighting if applicable. Illumination levels for the span of roadway between the roundabouts **shall** be based on the illumination of the roundabouts.

Table 3. Roundabout Connection Lighting Distance Requirements

Posted Speed Limit (MPH)	If Distance <= (Feet)
30 mph or less	500
Over 30 mph to 45 mph	750
Greater than 45 mph	1000

Figure 3. Sample transition and connection distance lighting areas



SOURCES

- Design Guide for Roundabout Lighting, DG-19-08, Illuminating Engineering Society of North America (IESNA), 2008.
- Roundabouts: An Informational Guide – U.S. Department of Transportation, Federal Highway Administration, June 2000.
- Roadway Lighting Design Guide, American Association of State Highway and Transportation Officials (AASHTO), 2018.
- The Illumination of Roundabout Intersections, Technical Guide – Centre d'Etudes des Transports Urbain, France.
- Florida Roundabout Guide, Second Edition, Florida Department of Transportation, May 1998.
- General Guidelines for Lighting Design, Plan Preparation and Highway Lighting by Permit, Illinois Department of Transportation, April 2006.

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**: _____

11-5-1 Policy and Design Guidelines May 2015

APPLICATION

This policy and the related information apply to all State maintained signalized intersections on the Wisconsin State Trunk Highway System.

POLICY

All WisDOT maintained signalized intersections **shall** include lighting in accordance with this document.

Luminaires **shall** be LED.

Power for the lighting of WisDOT maintained signalized intersections *should* be fed from circuits from the signal cabinet. If the amperage of the proposed intersection lighting exceeds the capacity of the traffic signal cabinet, a separate lighting cabinet **shall** be evaluated.

When slotted left turn lanes are illuminated, these *should* be part of the intersection, subject to coordination with locally maintained continuous lighting where applicable.

DESIGN CONSIDERATIONS

Several factors affect the design of lighting for Signalized Intersections. The desired illumination level and the constraints of pole locations are the important factors, and are sometimes incompatible.

Illumination

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 with pedestrians. These are important when considering lighting. These are discussed in IESNA RP-8-00, which is a reference for this document.

Generally, signalized intersections are located in urban areas along continuously lighted streets. The IESNA Recommended Illuminance Levels for the Intersections of continuously illuminated urban streets is, essentially, the sum of the recommended values for the intersecting roadways. The table below, based on Roadway and Pedestrian Classifications, for R2 and R3 pavement, summarizes these values. “Minor” is used to identify Minor Arterial.

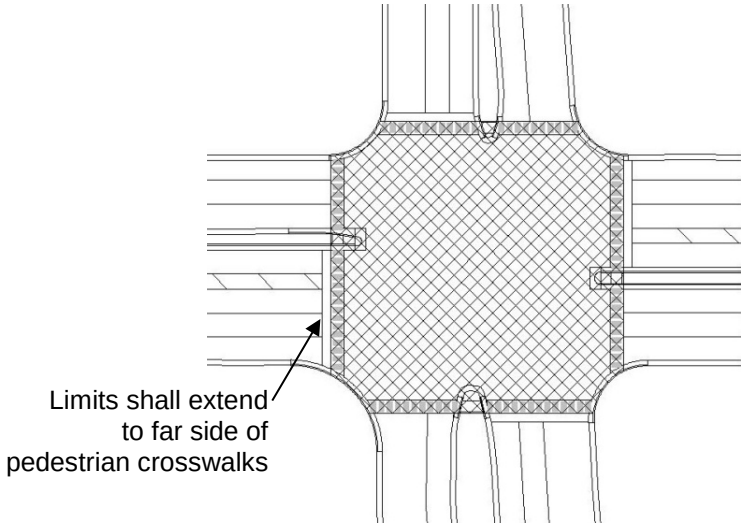
Note: AASHTO refers to the Pedestrian Area Classifications as Commercial, Intermediate, and Residential Land Uses.

Table 1. Illuminance Levels for Intersections

Roadway Classification	Average Maintained Illumination At Pavement by Pedestrian Area Classification in FC			avg/min
	High	Medium	Low	
Major/Major	3.16	2.42	1.67	3:1
Major/Minor	2.97	2.23	1.49	3:1
Major/Collector	2.70	2.04	1.39	3:1
Major/Local	2.42	1.86	1.21	3:1
Minor/Minor	2.79	2.04	1.30	4:1
Minor/Collector	2.51	1.86	1.21	4:1
Minor/Local	2.23	1.67	1.02	4:1
Collector/Collector	2.23	1.67	1.12	4:1
Collector/Local	1.95	1.49	0.93	4:1
Local/Local	1.67	1.30	0.74	6:1

The calculation boundary shown in Figure 1 below is the area to which the illumination levels in the Table apply. This boundary area includes 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 similar to that identified in the figure.

Figure 1. Intersection Illumination Calculation Boundary



Pole Placement

History has 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 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 identified in Table 1 without additional poles. In such cases, it may be necessary to make an engineering judgment and not meet recommended uniformity. In such cases, the designer **shall** consider and prioritize the design considerations:

- Illuminate the far right of the intersection to help clearly identify fixed elements in the path of the vehicle, whether turning or going straight.
- Pedestrians in crosswalks are dark objects, difficult to see, particularly when the vehicle is making a right turn. Illuminating the crosswalk is high priority.
- It is unlikely that the driver will encounter any dark objects in the very center of the intersection or within straight driving lanes, where headlights illuminate the area. If the uniformity is not met, having the low points here *may* be acceptable.

Where illumination of slotted left turn lanes is included, the poles *should* be located in the raised median on the driver's side. The intersection calculations **shall not** include these overlapping luminaires.

DESIGN PROCEDURAL REQUIREMENTS

The designer **shall** contact the Region 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 using the calculation boundaries described in this document.

The designer *should* submit the completed illumination design to the Region Lighting Engineer for review and approval. The illumination design **shall** include:

- Copy of approved illumination form
- design layout
- photometric calculations with summary information showing and uniformity
- voltage drop calculations

SIGNALIZED INTERSECTION LUMINAIRES

LED luminaires **shall** be used for all WisDOT owned and maintained intersection and roadway lighting systems. WisDOT's Qualified Electrical Products List outlines the specific LED luminaires that are permitted to be installed within these systems.

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 11-5-1
Illuminance Value: _____ **Avg/Min Value**: _____

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

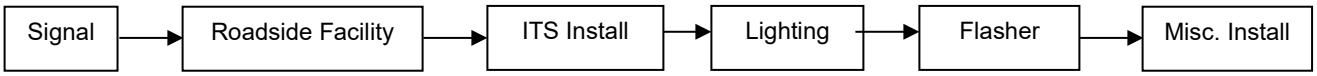
In light of recent inventory tools & new methods of tracking existing equipment, the following outlines the use of installation ID numbers for *state-maintained &/or state-maintained electrical equipment* installed in the field & serviced by WisDOT staff. There are multiple reasons installation numbers 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.

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:



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) **"F" (Flashing Beacon) Numbers** – "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 Regional staff request them of BTO – Electrical.

   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) **"NB" (Navigation Beacon) Numbers** – "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 Regional staff request them of BTO – Electrical.

9) **"PBS" (Portable Bridge Signal) Numbers** – "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 BTO – Electrical.

INSTALLATION ID's FOR ITS

The primary responsibility for WisDOT electrical staff related to ITS facilities are for emergency response only. ID's for ITS facilities are assigned & maintained by the Traffic Management Center (TMC). Work performed by WisDOT electrical staff at these locations is tracked based on the installation type, as described:

10) **"CCTV" (Closed Circuit Television) Numbers** – "CCTV" numbers are used to track closed circuit TV installations used for highway surveillance.

11) **"DMS" (Dynamic Message Sign) Numbers** – "DMS" numbers are used to track permanent dynamic message signs installations. These installations are not the same as PCMS devices listed below.

12) **"PCMS" (Portable Changeable Message Sign) Numbers** – "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) **"GATE" (Traffic Gate) Numbers** – "GATE" numbers are used to track traffic gates used to perform freeway ramp closures.

14) **"RM" (Ramp Meter) Numbers** – "RM" numbers are used to track individual ramp signal installations at freeway entrance points.

15) **"HAR" (Highway Advisory Radio) Numbers** – "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) **"SDS" (System Detector Station) Numbers** – "SDS" numbers are used to track equipment used to collect system traffic data. Such equipment *may* include microwave, video imagining or inductive loops.

17) **"VC" (Vehicle Classification Site) Numbers** – "VC" numbers are used to track equipment used to collect vehicle classification data. Such equipment *may* include overhead microwave detectors or inductive loops.

18) **"RWIS" (Road Weather Information Station) Numbers** – "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
- Owner/Maintainer (State, County, Local)
- Date unique ID was requested
- Unique Installation ID
- Project ID
- RP Number & offset
- Regional Office ID
- Intersection/Location
- Municipality
- 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.