



## **Prepare to Stop When Flashing (PTSWF) Systems Pilot Project Interim Guidelines**

### **I. Introduction**

#### **A. Purpose**

To provide guidance to WSDOT personnel in the design, operation, and study of Prepare To Stop When Flashing (PTSWF) systems.

#### **B. References**

*Manual on Uniform Traffic Control Devices for Streets and Highways (MUTCD)*, FHWA, June 2001 Millennium Edition, including the *Washington State Modifications to the MUTCD*, M 24-01, 2003

*Design Manual*, M 22-01

*A Policy On Geometric Design of Highways and Streets 2004*, 5<sup>th</sup> Edition AASHTO

*ITE Traffic Engineering Handbook*, 4<sup>th</sup> Edition

#### **C. Background**

WSDOT is continuously looking for ways to operate our highway facilities in the most efficient and safe way possible. With this goal in mind, WSDOT collected collision data and performed statistical analysis on this information at existing PTSWF operated systems on state highways. Also, research was conducted by reviewing many public records on the subject. Furthermore, State Traffic Departments throughout the country were contacted to poll their experiences with these systems. After completing this analysis, WSDOT concluded that there are potential safety benefits in operating this type of installation at select locations.

## **D. Discussion**

It is the goal of WSDOT to allow PTSWF systems to be installed throughout the state by following the attached PTSWF Pilot Project Interim Guidelines. When a region decides to install a PTSWF system they shall contact the State Traffic Engineer as a means of documenting when the study period begins. The Region Traffic office shall submit a copy of all final drawings and calculations for the PTSWF system to the State Traffic Engineer prior to project implementation. The drawing includes flashing beacon locations, sign locations and mounting details consistent with the pilot study guidelines.

## **II. Instructions**

### **WASHINGTON STATE DEPARTMENT OF TRANSPORTATION PREPARE TO STOP WHEN FLASHING (PTSWF) SYSTEM PILOT PROJECT INTERIM GUIDELINE**

#### **PURPOSE**

The purpose of this document is to provide WSDOT Traffic personnel with uniform guidelines to design, operate and study prepare to stop when flashing (PTSWF) systems. These technical guidelines shall be effective on the date of this pilot project interim guideline.

#### **IMPLEMENTATION**

These guidelines are to be implemented for new PTSWF System installations. For existing systems, flasher timing adjustments should be implemented within six months of the effective date in order to provide consistency of operations with new systems.

#### **INTRODUCTION**

The PTSWF System is a sign/flasher combination that at certain high-speed locations may provide additional information to the motorist describing the operation of the traffic signal. It has been found that the installation of a PTSWF System may assist the driver in making safer and more efficient driving decisions. This additional information is to get the driver's attention, and inform the driver that he or she must prepare to stop for a red light signal indication. The PTSWF System described above is what WSDOT currently uses in select situations to convey this information.

The PTSWF sign may be placed on main line approaches to applicable high-speed signalized intersections. The PTSWF sign is connected to the traffic signal in such a way that prior to the main line green phase changing to yellow, the flasher is turned on to warn the approaching drivers of the impending change. Specific timing intervals will be determined on a case-by-case basis for each signalized intersection.

Some objectives of an optimally designed combination of traffic signal and PTSWF system are:

- to inform the driver that a signal indication will change to yellow or red in advance of a required decision to stop
- to minimize the number of drivers that are required to make that decision in the dilemma zone; and
- to reduce red-light running, particularly by heavy commercial vehicles.

## GENERAL GUIDELINES

PTSWF system implementation is appropriate only at high-speed locations where the posted speed is 45 mph or greater. In addition, it should be considered that the operation of a PTSWF system has the potential to cause increased delay to side street traffic.

Guidelines for a PTSWF system are as follows:

Any one of these categories or other considerations may justify the installation of PTSWF system.

**Table 1  
PTSWF Guidelines**

CATEGORY	CRITERIA	COMMENT
1. Isolated or unexpected signalized intersection.	Where there is a long distance from the last intersection at which the main line is controlled, or the intersection is unexpected.	This guideline may be applicable where the distance from the last intersection is greater than 10 miles, or a freeway terminus, or at other locations where the intersection is unexpected
2. Limited sight distance	<p>Where the distance to the stop bar, D, with two signal heads visible is insufficient:</p> $D \leq 1.47Vt + \frac{V^2}{0.93(a + 32.2(G/100))}$ <p>Where:            D = distance to stop bar in (ft)            V = posted speed (mph)            t = reaction time, 2.5 seconds            a = deceleration rate                10 ft/s<sup>2</sup> (all traffic)*                8 ft/s<sup>2</sup> (Trucks)**            G = Grade %</p>	<p>* <i>Traffic Engineering Handbook</i>, 5<sup>th</sup> Edition, page 481</p> <p>** A deceleration rate of 8 ft/s<sup>2</sup> may be used when the Criteria from the Category <i>Grade and Truck Volume</i> is met. See Category 3</p>
3. Grade/Truck Volume	Where the roadway has a grade of 3% or greater and truck volume exceeds 15%.	
4. Accidents	If an approach has a collision history that is not correctible with other countermeasures.	If no sight distance or dilemma zone problems exist, PTSWF may not be an appropriate countermeasure to accident problems.
5. Engineering Judgment	Approval of Region Traffic Engineer	Approval shall be based on an Engineering Study.

## APPLICATION / PROCEDURE

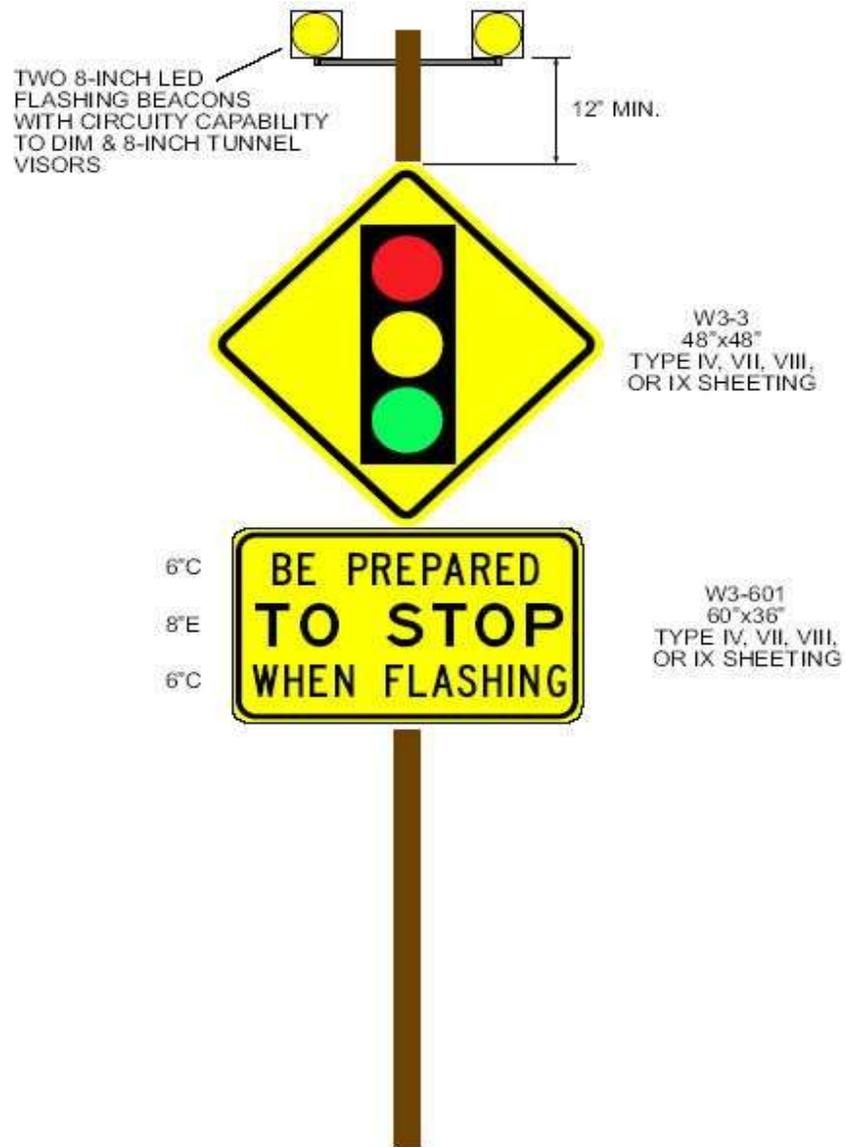
Due to the complex nature of traffic flow characteristics and the various intersection geometric layouts, the following guidelines shall be applied using an engineering study coupled with engineering judgment. Engineering judgment should be based in part on data such as complaints, violations, conformity of practice, and traffic conflicts. Documentation shall be prepared that discusses why decisions were made and how the following countermeasures have been considered prior to installation of a PTSWF system. Although not all inclusive, examples of countermeasures include:

- improving dilemma zone detection
- adjusting existing signal timing parameters such as; yellow clearance time, red interval, passage time, max green time(s) etc.
- installing and enhancing advanced warning signing
- sight distance improvements
- modification of the signal system such as adding additional signal heads
- adjusting speed limits.

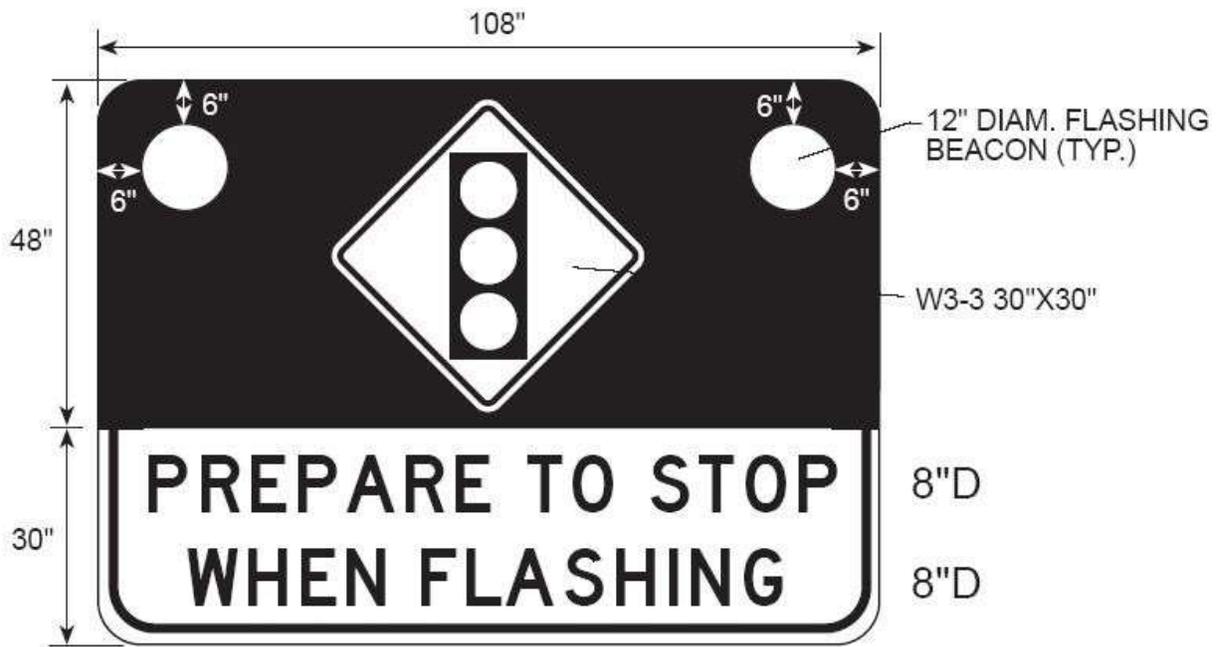
The State Traffic Engineer shall review the proposed installation documentation, with final written approval granted by the Region Traffic Engineer. For study purposes, notice of the installation date shall be forwarded to the State Traffic Engineer.

## DESIGN / INSTALLATION

1. **Details** - Figures 1 and 2 show conceptual drawings of the PTSWF sign/flashing beacon combination for median, shoulder and overhead mounting installation locations. Contact the Headquarters Traffic Design office for special design details. Prior to the termination of the green phase (Advanced Green) and during the yellow and red clearance intervals, the flasher shall flash yellow either alternately or simultaneously (see MUTCD section 4K.03). In addition, consideration should be given to extending the flash while the queue of vehicles begins to move on the following initial green indication. A general rule of thumb for this movement is approximately 4 seconds. The flasher will also flash if the signal goes into flashing operation. In addition, power shall be supplied to the PTSWF System from the signal control cabinet. A backup uninterrupted power supply (UPS) should be considered at each location. For any questions concerning the design of the PTSWF System contact the Headquarters Traffic Design office.
2. **Placement** - Considering the roadway environment, the PTSWF sign should generally be set back from the intersection in accordance with Table 1. At locations on multilane divided roadways, the PTSWF sign shall be placed on both sides of the approach or mounted overhead.
3. **Advanced Green** The Advanced Green is the amount of time; prior to the signal turning yellow that, the flashing beacons on the PTSWF sign flash. The Advanced Green time(s) is shown in Table 1.
4. **Detector Placement** - Consider WSDOT *Design Manual* guidelines when installing signal detection.



**Installation at Median or Shoulder Barrier Locations  
Figure 1**



COLORS

TOP  
STANDARD COLORS FOR W3-3  
BACKGROUND - BLACK (NON REFL)

BOTTOM  
LEGEND - BLACK (NON REFL)  
BACKGROUND - YELLOW (REFL)

**Overhead or Shoulder Mount Installation  
Figure 2**

**Table 2  
Advanced Warning Flasher Sign Placement**

Sign Placement Distance											
	GRADE	45 mph		50 mph		55 mph		60 mph		65 mph	
		D (ft)	Advance Green (sec)								
<b>Downhill</b>	-8%	392	7.0	472	7.4	559	7.8	653	8.2	754	8.6
	-7%	380	6.8	457	7.2	540	7.6	631	7.9	729	8.4
	-6%	369	6.6	443	7.0	524	7.3	611	7.7	705	8.1
	-5%	358	6.5	430	6.8	508	7.2	593	7.5	684	7.9
	-4%	349	6.3	418	6.6	494	7.0	576	7.3	664	7.7
	-3%	340	6.2	407	6.5	481	6.8	560	7.1	645	7.5
	-2%	332	6.1	397	6.4	468	6.7	545	7.0	628	7.3
	-1%	324	6.0	388	6.2	457	6.5	532	6.8	612	7.1
<b>Uphill</b>	0%	317	5.9	379	6.1	446	6.4	519	6.7	597	7.0
	1%	310	5.8	370	6.0	436	6.3	507	6.5	583	6.8
	2%	303	5.7	362	5.9	426	6.1	495	6.4	569	6.7
	3%	297	5.6	355	5.8	417	6.0	485	6.3	557	6.6
	4%	292	5.5	348	5.7	409	5.9	475	6.2	545	6.4
	5%	286	5.4	341	5.6	401	5.8	465	6.1	534	6.3
	6%	281	5.3	335	5.5	393	5.7	456	6.0	523	6.2
	7%	277	5.2	329	5.4	386	5.6	448	5.9	513	6.1
	8%	272	5.2	324	5.4	379	5.6	440	5.8	504	6.0

For situations other than those listed in Table 2, Sign Distance and the Advanced Green Time can be computed by the following equations:

**Distance From Stop-bar to PTSWF Sign**

$$D = 1.47Vt + \frac{V^2}{30 \left[ \left( \frac{a}{32.2} \right) \pm \frac{G}{100} \right]}$$

Where :

*D* = Sign placement distance

*V* = Posted speed (mph)

*t* = Perception / reaction time (1.5 s)

*a* = Deceleration rate (10 ft / sec<sup>2</sup>)

*G* = Grade(%)

**Advanced Green Time**

$$AG = \frac{D + D_p}{V * 1.47}$$

Where:

*AG* = Advance Green Time (s)

*D* = Distance from stop bar to PTSWF sign (ft)

*D<sub>p</sub>* = Minimum distance that flashers can be perceived (70 ft)

*V* = Posted speed (mph)