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Originating Organization WSDOT Development Division, Design Office – Design Policy, Standards, and Safety Research Section	

## Remarks and Instructions

### *What's changed in the Design Manual for July 2014?*

For a summary of the 2014 Substantial Revisions and Technical Errata and Spot Corrections, see page 3.

### *How do you stay connected to current design policy?*

It's the designer's responsibility to apply current design policy when developing transportation projects at WSDOT. The best way to know what's current is to reference the manual online.

Access the current electronic WSDOT *Design Manual*, the latest revision package, and individual chapters at: [www.wsdot.wa.gov/publications/manuals/m22-01.htm](http://www.wsdot.wa.gov/publications/manuals/m22-01.htm)

***We're ready to help. If you have comments or questions about the Design Manual, please don't hesitate to contact us.***

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HQ Design Office Signature /s/ Pasco Bakotich III	Phone Number 360-705-7952
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## Remove/Insert instructions for those who maintain a printed manual

**NOTE:** Replace the **Title Page**, **Foreword**, and **Comment Form** in both volumes.

CHAPTER/SECTION	REMOVE PAGES	INSERT PAGES
<b>VOLUME 1</b>		
Contents/Exhibits	1-1 – 1-12	1-1 – 1-12
100 Manual Description	Entire Chapter	Entire Chapter
210 Public Involvement and Hearings	210-1–6, 9&10, 21–24	210-1–6, 9&10, 21–24
225 Environmental Coordination	Entire Chapter	Entire Chapter
300 Design Documentation, Approval, and Process Review	300-15&16	300-15&16
301 Design and Maintenance Coordination	N/A (NEW)	Entire Chapter
305 Managing Projects	Entire Chapter	Entire Chapter
320 Traffic Analysis	Entire Chapter	Entire Chapter-
321 Sustainable Safety	N/A (NEW)	Entire Chapter
400 Surveying and Mapping	Entire Chapter	Entire Chapter
550 Interchange Justification Report	Entire Chapter	Entire Chapter
700 Project Development Roles and Responsibilities for Projects With Structures	700-1&2	700-1&2
730 Retaining Walls and Steep Reinforced Slopes	730-17&18	730-17&18
900 Roadsides	Entire Chapter	Entire Chapter
910, 920, 930, 940	Entire Chapters	All Retired
950 Public Art	Entire Chapter	Entire Chapter
1010 Work Zone Safety and Mobility	Entire Chapter	Entire Chapter
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1150 Context and Modally Integrated Design – Main Streets	N/A (NEW)	Entire Chapter
1300 Intersection Control Type	Entire Chapter	Entire Chapter
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Glossary	Entire Glossary	Entire Glossary

### About revision marks:

- A new date appears in the footer of each page that has changes or new/different pagination.
- When a chapter is new or substantially rewritten (like 950 and 1150), no revision marks are applied.
- Some pages with only deletions and no new text have a new date, but no revision marks.

## Summary of *Design Manual* Changes – July 2014

(Revisions merit careful study beyond this summary)

### Highlights of the More Substantial Revisions

#### **Chapter 100 – Manual Description**

- This revision cycle, we are using Chapter 100 to promote additional information on “practical solutions.” This chapter includes the new section on practical solutions, as well as the usual administrative changes to reflect changes to the *Design Manual* organization.
- Describes new chapters: 301, 321, and 1150.

#### **Chapter 301 – Highway Design and Maintenance Coordination (NEW)**

- New chapter provides project management techniques and timelines to improve coordination needs between design and maintenance staff.
- Provides tools to improve the outcome of maintenance reviews, improving knowledge and planning for project asset placement.
- Improves asset decision making, providing a mechanism for analysis of asset life cycle cost.

#### **Chapter 320 – Traffic Analysis**

- This chapter has been rewritten to bring it up to date with a host of changes that have taken place in the last decade (everything from laws to state-of-the-art and state-of-the-practice traffic analysis) and to better organize the traffic analysis policy and guidance that exists in various organizations of the department (TIA, IJR, Environmental Discipline Report, Development Services).
- The intent now is that this chapter will apply to Washington State highways for such contexts as:
  - WSDOT staff or consultants developing WSDOT projects, and
  - Consultants putting together a project for a developer (private or public agency).

#### **Chapter 321 – Sustainable Safety (NEW)**

- This new chapter provides policy and guidance for WSDOT staff involved in safety analyses. Creation of this chapter follows Secretary’s Executive Order 1085, Sustainable Highway Safety Program.
- The Executive Order sets the overarching policy for the Washington State Department of Transportation to embark on a more targeted and scientifically-based approach for identifying and addressing collision risks. The EO directs WSDOT’s Development Division to bring all design tools and processes in alignment with Sustainable Safety as directed by Highway Safety Executive Committee. Creation of this new chapter advances WSDOT to this end.
- This chapter also provides links to WSDOT websites on Sustainable Safety generally, and to specific procedures, resources, and tools. As Sustainable Safety plays out in practice, we anticipate further updates to Chapter 321 as well as supporting WSDOT websites.

#### **Chapter 550 – Interchange Justification Report**

- This chapter is revised coincident with the rewrite of Chapter 320, Traffic Analysis, and with the development of new Chapter 321, Sustainable Safety.
- Highlights of the changes to Chapter 550 include:
  - The discussion of project description has been updated in IJR Policy Point 1.
  - Collision Analysis, part of IJR Policy Point 3, has been substantially revised to cover safety analysis tools and procedures, and reference use of Chapter 321.

- Review and approval guidance has been moved to the back of the chapter.
- The flow chart exhibits have been updated to emphasize coordination between the IJR and environmental processes.

### **Chapter 900 – Roadsides**

- This chapter has been rewritten by the HQ Roadside and Site Development Section, with input from region peers, to coincide with the new *Roadside Policy Manual* (RPM) published October 2013.
- The intent of revised Chapter 900 is to provide awareness for designers to use the RPM and the *Roadside Manual* and to engage landscape architects in the project development process.

### **Chapters 910, 920, 930, and 940**

- These chapters have been retired from the *Design Manual*. Their covered topics (contour grading, vegetation, irrigation, and soil bioengineering) are found in the *Roadside Manual*.

### **Chapter 950 – Public Art**

- The HQ Roadside and Site Development Section, with input from regions, made revisions to this chapter, recognizing the new *Roadside Policy Manual* published October 2013, the discontinuance of the *Roadside Classification Plan*, and lessons learned regarding public art on WSDOT projects.

### **Chapter 1010 – Work Zone Safety and Mobility**

- This chapter has been reorganized by the HQ Traffic Office. The revisions include:
  - A revised section on Positive Protection Devices
  - Developing Transportation Management Plans
  - Public information strategies
  - Full section numbers added to subsections

### **Chapter 1040 – Illumination**

- The HQ Traffic Office has revised WSDOT illumination policy, removing or modifying required illumination areas, as well as other changes in the chapter.
- Some prior required illumination areas have been dropped. Accordingly, you will note some sections and exhibits are labeled “Vacant” in the chapter.
- A new “Adaptive Lighting” section has been added.
- References have been updated.
- Several new illumination terms were added in the *Design Manual* Glossary.

### **Chapter 1050 – Intelligent Transportation Systems**

- Chapter 1050 has been rewritten by collaboration between the HQ Traffic Office and FHWA, Washington Division. These efforts resulted in a complete update to the ITS chapter, presenting consistent procedures and expectations for all parties involved.
- The same material has recently been published in Chapter 41 of the *Local Agency Guidelines* as well, getting consistent information into the hands of all who may be developing ITS projects.

### **Chapter 1100 – Design Matrix Procedures**

- Revision incorporates Project Delivery Memo #12-01 – Preservation Project Scope of Work, as shown by revision tracking on the design matrices.
- Minor changes made to the chapter text, including updated links and chapter references.

## **Chapter 1120 – Basic Design Level**

- Revision incorporates Project Delivery Memo #12-01 – Preservation Project Scope of Work.
- Chapter rewritten; sections are organized to better align with elements listed on the design matrices.

## **Chapter 1130 – Modified Design Level**

- Revision incorporates Project Delivery Memo #13-03 – Practical Design Speed Policy: revised 1130.02, Design Speed; removed table (Exhibit 1130-1); revised Design Speed row on Exhibits 1130-10 & 1130-11.
- Adds a sentence to the General section referring designers to new Chapter 1150, Context and Modally Integrated Design – Main Streets.

## **Chapter 1140 – Full Design Level**

- Revision incorporates Project Delivery Memo #13-03 – Practical Design Speed Policy: revised 1140.07 and removed table (Exhibit 1140-1).
- Adds a sentence to the General section referring designers to new Chapter 1150, Context and Modally Integrated Design – Main Streets.

## **Chapter 1150 – Context and Modally Integrated Design – Main Streets (NEW)**

- This chapter is an initial phase for “practical design” implementation within WSDOT, emphasizing flexibility based on context sensitive solutions and balancing performance trade-offs for the regional and local needs on state highways serving specific place types characterized as traditional main streets.
- This chapter will assist planners, designers, and local agencies to understand how to build consent in balancing multiple performance needs, and document their influence on the design control/criteria selection.

## **Chapter 1300 – Intersection Control Type**

- Adds references to new Chapter 321, Sustainable Safety.
- Includes additional information and descriptions of alternative intersection types promoted through the Every Day Counts (EDC) Initiative, listed below:
  - Median U-Turn (MUT) Intersection
  - Restricted Crossing U-Turn (RCUT) Intersection
- Removes unsubstantiated “disadvantages” previously listed for the Roundabout intersection type.
- Adds minor text corrections throughout.

## **Chapter 1330 – Traffic Control Signals**

- Removes some redundant text and shifts it to Chapter 1510.
- Directs designers to coordinate with Region Traffic Engineers in design of crossings.
- Directs readers to the WSDOT *Traffic Manual* for additional guidance.

## **Chapter 1510 – Pedestrian Facilities**

- Removes the design deviation requirement associated with midblock pedestrian crossings.
- Directs designers to coordinate with Region Traffic Engineers in design of crossings.
- Removes the tabular Exhibit 1510-32 related to crossings and enhancements.

- Directs readers to the WSDOT *Traffic Manual* for additional guidance, such as what may have been found in removed Exhibit 1510-32.

### **Chapter 1515 – Shared-Use Paths**

- Removes the design deviation requirement associated with midblock pedestrian crossings.
- Directs designers to coordinate with Region Traffic Engineers in design of crossings.
- Directs readers to the WSDOT *Traffic Manual* for additional guidance.
- De-lists chain link fence as a fall protection option.
- Adds chain link fence, and pedestrian rail, as options for vertical drops less than 2'-6".

### **Chapter 1600 – Roadside Safety**

- Adds guidance about installing rumble strips and lane markers.

### **Chapter 1610 – Traffic Barriers**

- The reintroduction of wood guardrail posts for new construction resulted in the elimination of section 1610.06(3), the elimination of a paragraph in section 1610.06(4), and the updating of 1610.06(5)(b).
- Sections are renumbered accordingly due to elimination of 1610.06(3).
- Exhibit 1610-9 changes add transitions to concrete barrier and bridge rail for Type 31 guardrail.
- Updates terminal names in Exhibit 1610-12a.

### **Chapter 1620 – Impact Attenuator Systems**

- Reorganizes content and updates text in many sections.
- Adds full subsection numbers throughout.
- Updates list and descriptions of available attenuator models.
- Uses new Exhibits 1620-1a and 1b to consolidate information from previous Exhibits 1620-1 and 1620-5 and adds detail regarding attenuator system configurations.

## **Technical Errata and Spot Corrections**

### **Chapter 210 – Public Involvement and Hearings**

- Changes *Environmental Procedures Manual* to *Environmental Manual*.
- Replaces link to *Project Management Online Guide*.
- Updates link for Context Sensitive Solutions.

### **Chapter 300 – Design Documentation, Approval, and Process Review**

- Incorporates technical correction (page 15) from January 2014.

### **Chapter 400 – Surveying and Mapping**

- Incorporates *Design Manual* Supplement from December 2013.

## **Chapter 700 – Project Development Roles and Responsibilities for Projects with Structures**

- Replaces link to *Project Management Online Guide*.

## **Chapter 730 – Retaining Walls and Steep Reinforced Slopes**

- Text change removes CAiCE, which is no longer used by WSDOT, and replaces it with InRoads on page 17.

## **Chapter 1020 – Signing**

- Replaces “Directive D 32-20” with “Executive Order 1064” on pages 2 and 6.

## **Chapter 1310 – Intersections**

- Corrects references on pages 20 and 21.

## **Glossary**

- Changes *Environmental Procedures Manual* to *Environmental Manual*.
- Adds more definitions relevant to revised chapters 320 and 1040.





Washington State  
Department of Transportation

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# Design Manual

## Volume 1 – Procedures

M 22-01.11

July 2014

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Division 2 – Hearings, Environmental, and Permits  
Division 3 – Project Documentation  
Division 4 – Surveying  
Division 5 – Right of Way and Access Control  
Division 6 – Soils and Paving  
Division 7 – Structures  
Division 8 – Hydraulics  
Division 9 – Roadside Development  
Division 10 – Traffic Safety Elements

**Engineering and Regional Operations**

Development Division, Design Office

## **Americans with Disabilities Act (ADA) Information**

Materials can be made available in an alternative format by emailing the WSDOT Diversity/ADA Affairs Team at [wsdotada@wsdot.wa.gov](mailto:wsdotada@wsdot.wa.gov) or by calling toll free: 855-362-4ADA (4232). Persons who are deaf or hard of hearing may contact that number via the Washington Relay Service at 7-1-1.

## **Title VI Notice to Public**

It is Washington State Department of Transportation (WSDOT) policy to ensure no person shall, on the grounds of race, color, national origin, or sex, as provided by Title VI of the Civil Rights Act of 1964, be excluded from participation in, be denied the benefits of, or be otherwise discriminated against under any of its federally funded programs and activities. Any person who believes his/her Title VI protection has been violated may file a complaint with WSDOT's Office of Equal Opportunity (OEO). For Title VI complaint forms and advice, please contact OEO's Title VI Coordinator at 360-705-7082 or 509-324-6018.

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## Foreword

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The *Design Manual* is for use by Washington State Department of Transportation engineering personnel and consultant workforces. It provides policies, procedures, and methods for developing and documenting the design of improvements to the transportation network in Washington. It has been developed for state facilities and may not be appropriate for all county roads or city streets that are not state highways.

The *Design Manual* supplements the engineering analyses and judgment that must be applied to Improvement and Preservation projects. It provides uniform procedures for documenting and implementing design decisions.

The Federal Highway Administration has agreed to approve designs that follow the guidance in the *Design Manual*; therefore, following the guidance is mandatory for state highway projects. When proposed designs meet the requirements contained in the *Design Manual*, little additional documentation is required.

The complexity of transportation design requires designers to make fundamental trade-off decisions that balance competing spatial considerations. Although this adds to the complexity of design, it acknowledges the unique needs of specific projects and the relative priorities of various projects and programs. Improvements are designed in light of finite transportation funding. The *Design Manual* emphasizes “practical design” as a means to produce environmentally conscious, sustainable, context-based designs that achieve the purpose and need for the lowest cost. Implementing practical design addresses the needs of all users, fostering livable communities and modally integrated transportation systems used safely by all, including motorists, freight haulers, transit, pedestrians, and bicyclists.

Updating the *Design Manual* is an ongoing process and revisions are issued regularly. The addition of new or modified design criteria to the *Design Manual* through the revision process does not imply that existing features are deficient or inherently dangerous. Nor does it suggest or mandate immediate engineering review or initiation of new projects. Comments, questions, and improvement ideas are welcomed. Use the comment form on the next page or the contact information on the Design Policy Internet Page: [www.wsdot.wa.gov/design/policy](http://www.wsdot.wa.gov/design/policy)

/s/ Pasco Bakotich III

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**Pasco Bakotich III, P.E.**  
Director & State Design Engineer,  
Development Division



## Comment Form

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From:	_____	Date:	_____
	_____	Phone:	_____
	_____		

To: WSDOT Headquarters  
Development Division, Design Office  
Attn: Policy, Standards, and Research Section  
PO Box 47329  
Olympia, WA 98504-7329

Subject: *Design Manual* Comment

Comment (marked copies attached):



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## 100.01 Purpose

The Washington State Department of Transportation (WSDOT) has developed the *Design Manual* to reflect policy, outline a uniformity of methods and procedures, and communicate vital information to its employees and others who develop projects on state highways. When properly used, the manual will facilitate the development of a highway system consistent with the needs of the multi-modal traveling public.

WSDOT designers are required to comply with the *Design Manual*. The Federal Highway Administration (FHWA) has agreed to approve designs that follow guidance in the *Design Manual*; therefore, adherence to the guidance presented is not optional for state highway projects.

The information, guidance, and references contained herein are not intended as a substitute for sound engineering judgment. The *Design Manual* is not a comprehensive textbook on highway engineering, nor does it attempt to cover all the possible scenarios Washington's highways present. It is recognized that some situations encountered are beyond the scope of this presentation.

If you have design questions not answered by the *Design Manual*, contact the Headquarters (HQ) Design Office.

## 100.02 Presentation and Revisions

The *Design Manual* is available on the Internet. It can be accessed through the:

- WSDOT Home Page:  
[www.wsdot.wa.gov/](http://www.wsdot.wa.gov/)
- Design Policy Web Page:  
[www.wsdot.wa.gov/design/policy/](http://www.wsdot.wa.gov/design/policy/)
- Active *Design Manual* Revisions Web Page:  
[www.wsdot.wa.gov/design/manual/activervisions.htm](http://www.wsdot.wa.gov/design/manual/activervisions.htm)
- Publications Services Web Page:  
[www.wsdot.wa.gov/publications/manuals/index.htm](http://www.wsdot.wa.gov/publications/manuals/index.htm)

The online version of the manual enables you to conduct a word search of the entire manual. Opening an individual chapter is faster, but a word search is limited to that chapter.

The *Design Manual* is continually revised to reflect changing processes, procedures, regulations, policies, and organizations. Feedback from users is encouraged to improve the manual for everyone. Comments may be submitted by any method that is convenient for you. There is a comment form in the front of the manual, or comments may be made via the contact names on the Design Policy Internet page (see link above). Note that the Design Policy Internet page includes a link to an errata page, which provides a list of known technical errors in the manual. Manual users are encouraged to view this page on a regular basis.

A contents section lists all chapters and the major headings of the sections/pages. The exhibits section lists all the exhibits in the manual.

Most chapters include a list of references, including laws, administrative codes, manuals, and other publications, which are the basis for the information in the chapter. The definitions for terms used in the *Design Manual* are found in the [Glossary](#).

### **100.03 Practical Solutions**

Transportation infrastructure investment decisions have wide-ranging implications for the long-term sustainability of our communities, economy, and environment. The past approach to transportation system investment is no longer affordable or sustainable. Implementing practical solutions is a means to respond to the complicated task of balancing the needs within a network. “Practical solutions” is an overarching term that encompasses two major initiatives—Least Cost Planning and Practical Design—intended to make more sustainable transportation investment decisions.

#### **100.03(1) Least Cost Planning**

Least cost planning is an approach to making planning decisions that considers a variety of conceptual solutions to achieve the desired system performance targets for the least cost. Central to least cost planning is a process that engages the public, and applies methods to evaluate planning options and how to select those options.

A key step early in the planning process is to create a vision and goals that reflect a community’s values and that stakeholders agree to support. It is the first opportunity for public stakeholders to provide their input. In order to facilitate collaboration, local and regional planning goals are also reviewed and considered. At the systemwide level, a broad range of transportation, community, and environmental goals are studied. At a corridor level, the key decisions are determined by the goals approved in the system planning process, but they are tailored to reflect the unique characteristics of the corridor under study. This in turn informs the purpose and need for projects in environmental review.

The outcome of least cost planning is a recommended set of multimodal strategies that are cost-effective and still meet the goals and objectives set early in the planning process. Recommended capital investment concepts carry forward to the project development stage.

### 100.03(2) *Practical Design*

Practical design is an approach to making project decisions that focuses on the need for the project and looks for lowest-cost solutions. It engages local stakeholders at the earliest stages of defining scope to ensure their input is included at the optimal stage of project design. Using practical design optimizes the functional scope and cost of projects, but it does not cut costs at the expense of safety, the community, or the environment. It seeks collaborative solutions that are sufficient without being excessive.

With practical design, decision making focuses on maximum benefit to the *system*, rather than maximum benefit to the *project*. Focusing on the specific project need minimizes the scope of work for each project. The goal is to allow more needs to be addressed systemwide by reducing spending on the lesser-priority items on each project.

Context Sensitive Solutions is the primary mechanism to implement practical design. A majority of practical design solutions find flexibility using a site-specific contextual constraint for justification. Impacts to the project constraint are weighed against the value of applying a nominal design standard for a particular criterion. Placing emphasis on understanding contextual factors, such as the modal environment and adjacent land use, is essential to understanding how design contributes to project goals. Concepts found in NCHRP Report 642, *Quantifying the Benefits of Context Sensitive Solutions*, serve as a template for achieving design flexibility through well-documented project decisions.

The *Highway Safety Manual* (HSM) provides a scientifically-based evaluation of safety performance related to different criteria dimensions and represented design elements. The incorporation of the HSM into planning, programming, and design is called Sustainable Safety (see [Chapter 321](#)). Sustainable Safety is an essential component of practical design implementation, allowing engineers to more effectively assess the value of applying nominal standards for certain project criteria. Sustainable Safety support tools can provide a measure of relative safety performance when comparing design options, providing a greater level of confidence in balancing the desired safety performance trade-offs with other design elements and project performance objectives.

In 2014, new [Chapters 321](#) and [1150](#) provide tools and policies to incorporate the agency's goals with respect to practical design. Additional changes in the *Design Manual* will emerge over time to fully integrate the practical design approach within WSDOT's project development and design policies. In the interim, implement practical design at the project level by examining design criteria values through corridor analyses or other appropriate documentation processes. Use the results of these analyses and design variances where needed to achieve practical design results. For more information and examples of practical design, see:

<http://www.wsdot.wa.gov/projects/practicaldesign/>

### 100.04 **Manual Applications**

*Design Manual* guidance is provided to encourage the statewide uniform application of design details under normal conditions. It also guides designers through the project development process used by WSDOT. The *Design Manual* is used by the department to:

- Interpret current design principles, including American Association of State Highway and Transportation Officials (AASHTO) and other appropriate policy sources, findings, and federal and state laws.

- Develop projects that meet driver and community expectations.
- Balance the competing performance needs of highway construction projects.
- Design for the best return on investment.

The *Design Manual* is designed to allow for flexibility in design for specific and unusual situations. For unusual circumstances, the manual provides mechanisms for documenting the reasons for the choices made.

The *Design Manual* is developed for use on Interstate and state highways and may not be suitable for projects on county roads or city streets.

### 100.05 Manual Use

The WSDOT *Design Manual* is intended to be used for design of department-owned facilities, especially the transportation facilities associated with state highways as designated by [RCW 47.17](#).

For state highway routes, all projects must be designed using the *Design Manual* geometric control criteria (see [Chapter 1100](#) and Division 11). If WSDOT guidance is not used on a project, appropriate documentation and approvals are required (see Chapters [300](#) and [1100](#)).

When WSDOT designs facilities that will be turned over to local jurisdictions, those facilities are to be designed using appropriate local geometric design criteria.

When local jurisdictions design any element of state highway facilities, the *Design Manual* must be used. Local jurisdictions are free to adopt this manual for their local criteria or to develop their own specialized guidance for facilities not on state highway routes.

### 100.06 Manual Organization

The *Design Manual* is split into the following two volumes:

- Volume 1 contains *procedural topics*, including project documentation, permitting and hearings, site data, project investigation, and guidance for coordination with specialty group functions such as traffic, right of way, bridge and structures, and geotechnical design.
- Volume 2 addresses *design criteria and geometrics*. The design matrices are included in this volume because they communicate expectations for which elements are included in projects.

Each volume is divided into a series of divisions that address a portion of the project development and design processes. The divisions are comprised of chapters that address the general topic in detail and are, in some cases, specific to a particular discipline.

## 100.06(1) Volume 1: Procedures

**Division 1 – General Information:** Presents general background on planning, managing project delivery, project development, and programming.

- **Chapter 100 – Manual Description:** Chapter content/resources within the *Design Manual*.
- **Chapter 110 – Design-Build Projects:** How the *Design Manual* applies to design-build projects: includes terminology and reference to design-build contract documents.
- **Chapter 120 – Planning:** Critical information, such as corridor studies and route development plans, relating to the corridor in which the project resides.
- **Chapter 130 – Project Development Sequence:** The project development sequence from the Washington Transportation Plan through the contract document: emphasizes the Project Summary and Change Management process.

**Division 2 – Hearings, Environmental, and Permits:** Provides the designer with information about the public involvement and hearings process, the environmental documentation process, and the permit process.

- **Chapter 210 – Public Involvement and Hearings:** Developing a project-specific public involvement plan; the ingredients of an effective public involvement plan; and methods for public involvement.
- **Chapter 225 – Environmental Coordination:** Provides a summary of the relevant provisions in the [Environmental Manual](#). Gives designers a brief overview and direction to environmental resources.

**Division 3 – Project Documentation:** Provides designers with information on value engineering, traffic analysis, design documentation, and approvals.

- **Chapter 300 – Design Documentation, Approval, and Process Review:** Building the Project File (PF) and the Design Documentation Package (DDP) and recording the recommendations and decisions that lead to a project by preserving the documents from the planning, scoping, programming, and design phases (includes permits, approvals, contracts, utility relocation, right of way, advertisement and award, and construction).
- **Chapter 301 – Design and Maintenance Coordination – Best Practices:** Means and methods for coordinating design with maintenance concerns and needs.
- **Chapter 305 – Managing Projects:** Brief description and links to WSDOT design and project development resources.
- **Chapter 310 – Value Engineering:** A systematic, multidisciplinary process study early in the project design stage to provide recommendations to improve scope, functional design, constructability, environmental impacts, or project cost—required by federal law for high-cost, complex projects.
- **Chapter 320 – Traffic Analysis:** Procedural guidance and general requirements for conducting traffic analyses.
- **Chapter 321 – Sustainable Safety:** Informational and procedural guidance for conducting safety analyses, within the current extent of the applications.

**Division 4 – Surveying:** Includes criteria for surveying, mapping, and monumentation requirements.

- **Chapter 400 – Surveying and Mapping:** The procedures within WSDOT for project surveying.
- **Chapter 410 – Monumentation:** The requirements and procedures for Monumentation.

**Division 5 – Right of Way and Access Control:** Provides guidance on right of way considerations; interchange justification reports; limited/managed access; and fencing.

- **Chapter 510 – Right of Way Considerations:** The right of way and easement acquisition process.
- **Chapter 520 – Access Control:** WSDOT Access Control program information.
- **Chapter 530 – Limited Access Control:** Clarification on full, partial, and modified limited access control.
- **Chapter 540 – Managed Access Control:** The classes of managed access highways and the access connection permitting process.
- **Chapter 550 – Interchange Justification Report:** The process for access point revisions on limited access controlled highways and the steps for producing an interchange justification report.
- **Chapter 560 – Fencing:** The purpose of fencing, types of fencing, and fencing design criteria.

**Division 6 – Soils and Paving:** Presents guidance for investigating soils, rock, and surfacing materials; estimating tables; and guidance and criteria for the use of geosynthetics.

- **Chapter 610 – Investigation of Soils, Rock, and Surfacing Materials:** The requirements for qualifying a materials source, geotechnical investigations, and the documentation to be included in the Project File.
- **Chapter 620 – Design of Pavement Structures:** Estimating tables for the design of pavement structures.
- **Chapter 630 – Geosynthetics:** The types/applications of geosynthetic drainage, earthwork, erosion control, and soil reinforcement materials.

**Division 7 – Structures:** Provides guidance for the design of structures for highway projects, including site data for structures, bridges, retaining walls, and noise walls.

- **Chapter 700 – Project Development Roles and Responsibilities for Projects With Structures:** WSDOT's project development process: roles and responsibilities for projects with structures during the project development phase of a project.
- **Chapter 710 – Site Data for Structures:** Information required by the HQ Bridge and Structures Office to provide structural design services.
- **Chapter 720 – Bridges:** Basic design considerations for developing preliminary bridge plans and guidelines on basic bridge geometric features.
- **Chapter 730 – Retaining Walls and Steep Reinforced Slopes:** Design principles, requirements, and guidelines for retaining walls and steep reinforced slopes.
- **Chapter 740 – Noise Barriers:** Factors considered when designing a noise barrier.

**Division 8 – Hydraulics:** Addresses the issue of hydraulics and serves as a guide to highway designers to identify and consider hydraulic-related factors that may impact the design.

- **Chapter 800 – Hydraulic Design:** Hydraulic considerations for highway projects involving flood plains, stream crossings, channel changes, and groundwater.

**Division 9 – Roadside Development:** Provides guidance on the portion of state highways between the traveled way and the right of way boundary.

- **Chapter 900 – Roadside Development:** Managing the roadside environment, including the area between the traveled way and the right of way boundary, unpaved median strips, and auxiliary facilities such as rest areas, wetlands, and stormwater treatment facilities.
- **Chapter 910 – Contour Grading:** Retired – See the [Roadside Manual](#).
- **Chapter 920 – Vegetation:** Retired – See the [Roadside Manual](#).
- **Chapter 930 – Irrigation:** Retired – See the [Roadside Manual](#).
- **Chapter 940 – Soil Bioengineering:** Retired – See the [Roadside Manual](#).
- **Chapter 950 – Public Art:** Policies and procedures for including public art in state transportation corridors.

**Division 10 – Traffic Safety Elements:** Introduces the designer to traffic safety elements such as work zone traffic control, signing, delineation, illumination, traffic control signals, and Intelligent Transportation Systems (ITS).

- **Chapter 1010 – Work Zone Safety and Mobility:** Planning, design, and preparation of highway project plans that address work zone safety and mobility requirements.
- **Chapter 1020 – Signing:** The use of signing to regulate, warn, and guide motorists.
- **Chapter 1030 – Delineation:** The use of pavement markings to designate safe traffic movement.
- **Chapter 1040 – Illumination:** Illumination design on state highway construction projects.
- **Chapter 1050 – Intelligent Transportation Systems (ITS):** Applying computer and communication technology to optimize the safety and efficiency of the highway system.

### **100.06(2) Volume 2: Design Criteria**

**Division 11 – Project Design Criteria:** Provides design criteria guidance for basic design, modified design, and full design that are part of the design matrices in [Chapter 1100](#).

- **Chapter 1100 – Design Matrix Procedures:** Includes design matrices that provide consistency across projects according to funding type and highway system. Each design matrix sets forth the design levels for a given type of need, which would be automatically approved by the department and FHWA. The chapter also discusses deviation approvals and how to apply the appropriate design level for the majority of Improvement and Preservation projects.
- **Chapter 1110 – Minor Operational Enhancement Projects:** Design matrices for low-cost, quick-fix projects that improve the operation of a state highway facility.

- **Chapter 1120 – Basic Design Level:** The required basic safety work and minor preservation and safety work included in the preservation of pavement structures and pavement service life while maintaining safe operation of the highway.
- **Chapter 1130 – Modified Design Level:** Design guidance unique to the modified design level of preserving and improving existing roadway geometrics and safety and operational elements.
- **Chapter 1140 – Full Design Level:** Guidance for the highest level of highway design, used on new and reconstructed highways to improve roadway geometrics and safety and operational elements.
- **Chapter 1150 – Context and Modally Integrated Design – Main Streets:** Guidance for developing projects within a specific land use context known as main streets. Informational text on how to define the geometric cross section and respond to local and community visions by balancing performance categories and needs at the regional and local levels.

**Division 12 – Geometrics:** Covers geometric plan elements; horizontal alignment; lane configurations and pavement transitions; geometric profile elements; vertical alignment; geometric cross sections; and sight distance.

- **Chapter 1210 – Geometric Plan Elements:** The design of horizontal alignment, lane configuration, and pavement transitions.
- **Chapter 1220 – Geometric Profile Elements:** The design of vertical alignment.
- **Chapter 1230 – Geometric Cross Section:** Roadway width and roadside slope design.
- **Chapter 1240 – Turning Roadways:** Widening curves to make the operating conditions comparable to those on tangent sections.
- **Chapter 1250 – Superelevation:** Superelevating curves and ramps so design speeds can be maintained.
- **Chapter 1260 – Sight Distance:** Stopping, passing, and decision sight distance design elements.
- **Chapter 1270 – Auxiliary Lanes:** Auxiliary facilities such as climbing lanes, passing lanes, slow-vehicle turnouts, shoulder driving for slow vehicles, emergency escape ramps, and chain-up areas.

**Division 13 – Intersections and Interchanges:** Addresses the design considerations of at-grade intersections, roundabouts, road approaches, railroad grade crossings, and traffic interchanges.

- **Chapter 1300 – Intersection Control Type:** Guidance on preliminary intersection analysis and selection of control type.
- **Chapter 1310 – Intersections:** Designing intersections at grade, including at-grade ramp terminals.
- **Chapter 1320 – Roundabouts:** Guidance on the design of roundabouts.
- **Chapter 1330 – Traffic Control Signals:** The use of power-operated traffic control devices that warn or direct traffic.
- **Chapter 1340 – Driveways:** The application and design of road approaches on state highways.

- **Chapter 1350 – Railroad Grade Crossings:** The requirements for highways that cross railroads.
- **Chapter 1360 – Traffic Interchanges:** The design of interchanges on interstate highways, freeways, and other multilane divided routes.
- **Chapter 1370 – Median Crossovers:** Guidance on locating and designing median crossovers for use by maintenance, traffic service, emergency, and law enforcement vehicles.

**Division 14 – HOV and Transit:** Provides design guidance on HOV lanes and transit facilities.

- **Chapter 1410 – High-Occupancy Vehicle Facilities:** Evaluating and designing high-occupancy vehicle (HOV) facilities.
- **Chapter 1420 – HOV Direct Access:** Design guidance on left-side direct access to HOV lanes and transit facilities.
- **Chapter 1430 – Transit Benefit Facilities:** Operational guidance and information for designing transit facilities such as park & ride lots, transfer/ transit centers, and bus stops and pullouts.

**Division 15 – Pedestrian and Bicycle Facilities:** Provides guidance on pedestrian and bicycle facility design.

- **Chapter 1510 – Pedestrian Facilities:** Designing facilities that encourage efficient pedestrian access that meets ADA.
- **Chapter 1515 – Shared-Use Paths:** Guidance that emphasizes pedestrians are users of shared-use paths and accessibility requirements apply in their design.
- **Chapter 1520 – Roadway Bicycle Facilities:** Selecting and designing useful and cost-effective bicycle facilities.

**Division 16 – Roadside Safety Elements:** Addresses design considerations for the area outside the roadway, and includes clear zone, roadside hazards, safety mitigation, traffic barriers, and impact attenuator systems.

- **Chapter 1600 – Roadside Safety:** Clear zone design, roadside hazards to consider for mitigation, and some roadside safety features.
- **Chapter 1610 – Traffic Barriers:** Design of traffic barriers based on the design levels identified in the design matrices.
- **Chapter 1620 – Impact Attenuator Systems:** Permanent and work zone impact attenuator systems.

**Division 17 – Roadside Facilities:** Provides design guidance for the area outside the roadway, including rest areas and truck weigh sites.

- **Chapter 1710 – Safety Rest Areas and Traveler Services:** Typical layouts for safety rest areas.
- **Chapter 1720 – Weigh Sites:** Guidance on designing permanent, portable, and shoulder-sited weigh sites.



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**210.01 General**

The Washington State Department of Transportation (WSDOT) strives to keep the public informed about transportation issues, involve the public in transportation decision making, and make transportation decisions based on the public's best interests.

One of the best ways to achieve WSDOT's goals is to collaborate with the public, community groups, and various agencies. These participants often have differing, and sometimes conflicting, perspectives and interests. In addition, many participants and organizations are not able to spend the time and effort required to fully engage in transportation decision making. Despite these challenges, active collaboration:

- Gives WSDOT access to important information and new ideas.
- Puts us in a position to help solve problems and resolve conflicts.
- Creates a sense of community.
- Fosters greater acceptance of projects.
- Helps us build and sustain a credible and trusting relationship with the public.
- Ultimately leads to transportation improvements that better meet the public's needs and desires.

When collaborating with the public about transportation projects or issues, WSDOT uses more formal techniques like public hearings, direct mail, and presentations to city councils and legislators; as well as less formal but equally important techniques, like telephone and e-mail discussions, meetings with community groups, media relations, and project Internet pages.

Law requires that many types of capital transportation projects go through a formal public hearing process; thus, the legal procedures necessary for public hearings is the primary focus of this chapter. Public involvement plans are briefly discussed, and referrals to WSDOT's communications resources are included to further guide their development and implementation.

## 210.02 References

### (1) Federal/State Laws and Codes

United States Code (USC) Title 23, Highways, Sec. 128, Public hearings

USC Title 23, Highways, Sec. 771.111, Early coordination, public involvement, and project development

23 Code of Federal Regulations (CFR) 200.7, FHWA Title VI Policy

23 CFR 200.9(b)(4), Develop procedures for the collection of statistical data of participants and beneficiaries of state highway programs

23 CFR 200.9(b)(12), Develop Title VI information for dissemination to the general public

23 CFR 450.212, Public involvement

28 CFR Part 35, Nondiscrimination on the basis of disability in state and local government services

49 CFR Part 27, Nondiscrimination on the basis of disability in programs or activities receiving federal financial assistance

Americans with Disabilities Act of 1990 (ADA) (28 CFR Part 36, Appendix A)

Civil Rights Restoration Act of 1987

Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations

Executive Order 13166, Improving Access to Services for Persons with Limited English Proficiency

Revised Code of Washington (RCW) 47.50, Highway Access Management

RCW 47.52, Limited Access Facilities

Section 504 of the Rehabilitation Act of 1973, as amended

Title VI of the Civil Rights Act of 1964

### (2) Design Guidance

*Design Manual*, Chapter 225, for environmental references, and Division 5 chapters for access control and right of way references

*Environmental Manual*, M 31-11

[www.wsdot.wa.gov/publications/manuals/m31-11.htm](http://www.wsdot.wa.gov/publications/manuals/m31-11.htm)

WSDOT Headquarters (HQ) Development Services & Access Manager,  
(360) 705-7251 – home page:

[www.wsdot.wa.gov/design/accessandhearings](http://www.wsdot.wa.gov/design/accessandhearings)

### (3) Supporting Information

*Improving the Effectiveness of Public Meetings and Hearings*, Federal Highway Administration (FHWA) Guidebook

*Public Involvement Techniques for Transportation Decision-Making*, FHWA September 1996; provides tools and techniques for effective public involvement:

☞ [www.fhwa.dot.gov/reports/pittd/cover.htm](http://www.fhwa.dot.gov/reports/pittd/cover.htm)

Relocation brochures: ☞ [www.wsdot.wa.gov/realestate](http://www.wsdot.wa.gov/realestate)

WSDOT *Communications Manual* for public involvement:

☞ [www.wsdot.wa.gov/Communications/](http://www.wsdot.wa.gov/Communications/)

WSDOT Context Sensitive Solutions Internet site and national context sensitive site:

☞ <http://www.wsdot.wa.gov/design/policy/csdesign>

☞ [www.contextsensitivesolutions.org/](http://www.contextsensitivesolutions.org/)

### 210.03 Definitions

***affidavit of publication*** A notarized written declaration stating that a ***notice of hearing*** (or ***notice of opportunity for a hearing***) was published in the legally prescribed manner.

***affidavit of service by mailing*** A notarized written declaration stating that the limited access hearing packet was mailed at least 15 days prior to the hearing and entered into the record at the hearing.

***auxiliary aids and services*** (1) Qualified interpreters, notetakers, transcription services, written materials, telephone handset amplifiers, assistive listening devices, assistive listening systems, telephones compatible with hearing aids, open and closed captioning, telecommunications devices for deaf persons (TDDs), videotext displays, or other effective methods for making aurally delivered materials available to individuals with hearing limitations; (2) Qualified readers, taped texts, audio recordings, Brailled materials, large print materials, or other effective methods for making visually delivered materials available to individuals with visual impairments; (3) Acquisition or modification of equipment or devices; (4) Other similar services and actions; and (5) Providing and disseminating information, written materials, and notices in languages other than English, where appropriate.

***context sensitive solutions (CSS)*** *A collaborative, interdisciplinary approach that involves all stakeholders to develop a transportation facility that fits its physical setting and preserves scenic, aesthetic, historic, and environmental resources while maintaining safety and mobility. CSS is an approach that considers the total context within which a transportation improvement project will exist.\* (See 210.02 and 210.04(2) for more information.)*

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\*From "Understanding Flexibility in Transportation Design – Washington," WSDOT, April 2005

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***court reporter*** A person with a license to write and issue official accounts of judicial or legislative proceedings.

***findings and order*** A document containing the findings and conclusions of a limited access hearing approved by the Assistant Secretary, Engineering & Regional Operations (see 210.09(12) and (13)).

***hearing*** An assembly to which the public is invited and at which participation is encouraged. Types of hearings include:

- ***administrative appeal hearing*** A formal process whereby a property owner may appeal WSDOT's implementation of access management legislation. The appeal is heard by an administrative law judge (ALJ), who renders a decision. (See Chapter 540 for administrative appeal hearing procedures.)

- **combined hearing** A hearing held when there are public benefits to be gained by combining environmental, corridor, design, and/or limited access subjects.
- **corridor hearing** A formal or informal hearing that presents the corridor alternatives to the public for review and comment before a commitment is made to any one route or location. This type of hearing is beneficial for existing corridors with multiple Improvement projects programmed over a long duration.
- **design hearing** A formal or informal hearing that presents the design alternatives to the public for review and comment before the selection of a preferred alternative.
- **environmental hearing** A formal or informal hearing documenting that social, economic, and environmental impacts have been considered and that public opinion has been solicited.
- **limited access hearing** A formal hearing that gives local public officials, owners of abutting properties, and other interested persons an opportunity to be heard about the limitation of access to the highway system.
- **formal hearing format** A hearing conducted by a moderator using a formal agenda, overseen by a hearing examiner, and recorded by a court reporter, as required by law. Limited access hearings require the use of the formal hearing format (see 210.05(3)).
- **informal hearing format** A hearing where oral comments are recorded by a court reporter, as required by law. An informal hearing often uses the “open house” format (see 210.04(1)(a)). A formal agenda and participation by a hearing examiner are optional.

**hearing agenda** An outline of the actual public hearing elements, used with formal hearings. (See 210.05(9)(a) for contents.)

**Hearing Coordinator** The Development Services & Access Manager within the HQ Access and Hearings Section, (360) 705-7251.

**hearing examiner** An administrative law judge from the Office of Administrative Hearings, or a WSDOT designee, appointed to moderate a hearing.

**hearing script** A written document of text to be presented orally by department representatives at a hearing.

**hearing summary** Documentation prepared by the region and approved by Headquarters that summarizes environmental, corridor, and design hearings. (See 210.05(10) for content requirements.)

**hearing transcript** A document prepared by the court reporter that transcribes verbatim all oral statements made during the hearing, including public comments. This document becomes part of the official hearing record.

**NEPA** National Environmental Policy Act.

**notice of appearance** A form provided by WSDOT for anyone wanting to receive a copy of the findings and order and the adopted limited access plan (see 210.09(3) and (8)).

**notice of hearing (or hearing notice)** A published advertisement that a public hearing will be held.

**notice of opportunity for a hearing** An advertised offer to hold a public hearing.

**order of hearing** The official establishment of a hearing date by the Director & State Design Engineer, Development Division.

**prehearing packet** A concise, organized collection of all necessary prehearing data, prepared by the region and approved by the HQ Development Services & Access Manager prior to the hearing (see 210.05(4) and Exhibit 210-3).

**project management plan** A formal, approved document that defines how the project is executed, monitored, and controlled. It may be in summary or detailed form and may be composed of one or more subsidiary management plans and other planning documents. For further information, see the *Project Management Online Guide*:  
<http://www.wsdot.wa.gov/projects/projectmgmt/pmog.htm>

**public involvement plan** A plan to collaboratively involve the public in decision making, tailored to the specific needs and conditions of a project and the people and communities it serves. It is often part of a broader communications plan.

**relocation assistance program** A program that establishes uniform procedures for relocation assistance that will ensure legal entitlements and provide fair, equitable, and consistent treatment to persons displaced by WSDOT-administered projects, as defined in the *Right of Way Manual*.

**résumé** An official notification of action taken by WSDOT following adoption of a findings and order (see 210.09(14)).

**SEPA** State Environmental Policy Act.

**study plan** A term associated with environmental procedures, this plan proposes an outline or “road map” of the environmental process to be followed during the development of a project that requires complex NEPA documentation. (See 210.06 and the *Environmental Manual*.)

## 210.04 Public Involvement

Developing and implementing an effective plan for collaboration with the public:

- Is critical to the success of WSDOT’s project delivery effort.
- Provides an opportunity to understand and achieve diverse community and transportation goals.

Effective public involvement must begin with clearly defined, project-related goals that focus on specific issues, specific kinds of input needed, and specific people or groups that need to be involved. The more detailed a public involvement plan, the greater its chances of obtaining information WSDOT can use in decision making.

Transportation projects with high visibility or community issues or effects often attract the attention of a broad range of interested people. These types of projects will best benefit from early public involvement, which can influence the project’s success and community acceptance.

Developing a profile (through demographic analysis) of the affected community is critical to achieving successful public involvement and should be the first order of business when developing a public involvement plan. The profile will enable the department to tailor its outreach efforts toward the abilities and needs of the community.

Individuals from minority and ethnic groups and low-income households, who are traditionally underserved by transportation, often find participation difficult. While these groups form a growing portion of the population, particularly in urban areas, historically they have experienced barriers to participation in the public decision-making process and are therefore underrepresented. These barriers arise from both the historical nature of the public involvement process and from cultural, linguistic, and economic differences. For example, a community made up of largely senior citizens (with limited mobility/automobile usage) may mean:

- Meetings/open houses are planned in locations easily accessible to them, such as senior centers and neighborhood community centers.
- Meetings are scheduled in the mornings or midday to accommodate individuals who prefer not to leave home after dark.
- Meetings are scheduled in the evenings to accommodate persons who work during the day.

A project's affected area might consist of a population with limitations in speaking or understanding English. This may entail:

- Developing/disseminating materials in other languages, as appropriate.
- Having a certified translator on hand at the meetings.

Extra effort may be needed to elicit involvement from people unaccustomed to participating in the public involvement process. They often have different needs and perspectives than those who traditionally participate in transportation decision making, and they may have important, unspoken issues that should be heard. They not only may have greater difficulty getting to jobs, schools, recreation, and shopping than the population at large, but also they are often unaware of transportation proposals that could dramatically change their lives.

NEPA and SEPA environmental policies and procedures are intended to provide relevant environmental information to public officials, agencies, and citizens, and allow public input to be considered before decisions are made. There are also various other laws, regulations, and policies that emphasize public involvement, including 23 CFR, Title VI of the Civil Rights Act, the Americans with Disabilities Act, and Executive Orders 12898 and 13166.

WSDOT's collaborative process with the public should be open, honest, strategic, consistent, inclusive, and continual. Initiating a project in an atmosphere of collaboration and partnership can go a long way toward providing equal opportunities for all parties (local, state, tribal, private, nonprofit, or federal) to participate in a project vision. This collaboration requires an intensive communications effort that is initiated during project visioning and extends through construction and eventual operation of the facility.

Department specialists in public communications, environmental procedures, traffic engineering, real estate services, and limited access control are routinely involved with public outreach efforts and project hearings. Depending on the scale and complexity of a project, the region is encouraged to engage the participation of interdisciplinary experts when developing a public involvement plan and communicating project details.

- Individual e-mails and letters
- Advisory committees and groups
- Public hearings

(a) **Public Meetings and Open Houses**

Public meetings range from large informational workshops to small groups using one-on-one meetings with individuals. They are less formal than hearings. The region evaluates the desired outcome from a meeting, decides how the input will be tracked, and then plans accordingly.

- Open house meetings can be effective for introducing a project to the public and stimulating an exchange of ideas.
- Small meetings are useful for gaining information from community groups, underrepresented groups, neighborhood groups, and advisory committees.
- Workshop formats, where large groups are organized into small discussion groups, serve to maximize the participation of all attendees while discouraging domination by a few groups or individuals.

(b) **Follow-Up Procedures**

Effective public involvement is an ongoing collaborative exchange, and it is necessary to provide follow-up information several times during a large project to maintain a continuing exchange of information.

At significant stages, the region provides information about the project. Follow-up information conveys, as accurately as possible, how public input was considered during development of the project.

It may become necessary to revise the public involvement plan as the project evolves, conditions change, oppositional groups emerge, or new issues arise. Sometimes innovative methods must be used to ensure the inclusion of affected community members. This is especially important for underrepresented groups, such as minority and low-income groups, and in communities where a significant percentage of the affected population does not speak English. Consider the need for translators, interpreters, and providing written information in languages other than English. Reference information on limited English proficiency is provided in 210.04(2)(d). A resident advisory committee can often help identify community issues and concerns as well as recommend effective methods for public involvement.

**(2) Public Involvement References**

Following are a number of recommended publications, references, and training courses available to assist regions in developing public involvement plans for their projects.

(a) **WSDOT Project Management Online Guide**

A project's public involvement plan is an essential element of the overall project management plan. The WSDOT *Project Management Online Guide* is an Internet resource intended to support delivery of transportation projects through effective project management and task planning. The guide includes best practices, tools, templates, and examples to enhance the internal and external communication processes: [www.wsdot.wa.gov/projects/projectmgmt/onlineguide/preconstruction.htm](http://www.wsdot.wa.gov/projects/projectmgmt/onlineguide/preconstruction.htm)

**(b) WSDOT Communications Intranet Page**

The WSDOT Communications Intranet page provides guidance for effective communications. This resource includes a *Communications Manual*, key messaging, and WSDOT's communications philosophy, and is an excellent resource for developing a public involvement plan:

☞ <http://www.wsdot.wa.gov/communications/>

**(c) Context Sensitive Solutions and Community Involvement**

A proposed transportation project must consider both its physical aspects as a facility serving specific transportation objectives and its effects on the aesthetic, social, economic, and environmental values within a larger community setting. context sensitive solutions is a collaborative, interdisciplinary approach that involves the community in the development of a project. WSDOT's philosophy encourages collaboration and consensus-building as highly advantageous to all parties to help avoid delays and other costly obstacles to project implementation. WSDOT endorses the context sensitive solutions approach for all projects, large and small, from early planning through construction and eventual operation of the facility. For further information, see WSDOT Executive Order E 1028 on context sensitive solutions:

☞ <http://www.wsdot.wa.gov/publications/policies/fulltext/1028.pdf>

☞ <http://www.wsdot.wa.gov/design/policy/csdesign.htm>

☞ <http://www.wsdot.wa.gov/design/policy/csdesignresources.htm>

Additionally, the following HQ Design, Highways and Local Programs, and Environment Internet pages offer an excellent array of publications, training, and resources for public involvement:

☞ [www.wsdot.wa.gov/environment/ej/](http://www.wsdot.wa.gov/environment/ej/)

**(d) Federal Highway Administration References**

*Improving the Effectiveness of Public Meetings and Hearings*, FHWA Guidebook, provides a variety of techniques and processes based on the practical community involvement experience of its authors:

☞ [www.ntl.bts.gov/docs/nhi.html](http://www.ntl.bts.gov/docs/nhi.html)

*Public Involvement Techniques for Transportation Decision-Making*, FHWA September 1996, provides tools and techniques for effective public involvement:

☞ [www.fhwa.dot.gov/reports/pittd/cover.htm](http://www.fhwa.dot.gov/reports/pittd/cover.htm)

*How to Engage Low-Literacy and Limited-English-Proficiency Populations in Transportation Decisionmaking*, FHWA 2006, provides tools and techniques for identifying and including these populations:

☞ [www.fhwa.dot.gov/hep/lowlim/index.htm](http://www.fhwa.dot.gov/hep/lowlim/index.htm)

23 CFR 630, Subpart J, Final Rule on Work Zone Safety and Mobility, Work Zone Public Information and Outreach Strategies. This Internet guide is designed to help transportation agencies plan and implement effective public information and outreach campaigns to mitigate the effects of road construction work zones:

☞ [www.ops.fhwa.dot.gov/wz/info\\_and\\_outreach/index.htm](http://www.ops.fhwa.dot.gov/wz/info_and_outreach/index.htm)

**5. Statements, Plans, or Counterproposals From the Public**

Accept public views or statements regarding the proposal presented, the alternatives, and the social, economic, and environmental effects identified. Avoid evaluating the views presented while conducting the hearing.

**6. Relocation Assistance Program**

Explain the relocation assistance program and relocation assistance payments available. At all hearings, the relocation assistance brochure must be available for free distribution, including (if appropriate) brochures in languages other than English. Real Estate Services personnel should be available.

If the project does not require any relocations, the relocation assistance discussion may be omitted. Make a simple statement to the effect that relocation assistance is provided, but currently no relocations have been identified for the project. The relocation brochure and personnel should still be available to the public at the hearing.

**7. Acquisition**

Discuss right of way acquisition, estimated cost, and currently proposed construction schedules and critical activities that may involve or affect the public.

**8. Closing**

Summarize the hearing and announce proposed future actions.

**9. Adjournment**

Adjourn the hearing with sincere gratitude for the public's valuable participation.

**(10) Hearing Summary and Adoption**

Upon completion of a public hearing, a documentation and approval procedure leads to official adoption of the hearing proceedings. After the hearing, a summary is prepared by the region. There are two types of summary documents used, depending on the type of hearing. For environmental, corridor, and design hearings, a hearing summary is produced. Following a limited access hearing, a findings and order document is prepared. Each of these packages is comprised of documentation assembled by the region and approved by Headquarters.

**(a) Hearing Summary Contents**

The hearing summary includes the following elements:

1. Hearing transcript.
2. Copy of the affidavit of publication of the hearing notice.
3. Hearing material:
  - Copies of the letters received before and after the hearing.
  - Copies or photographs of, or references to, every exhibit used in the hearing.

4. Summary and analyses of all oral and written comments. Include consideration of the positive and negative social, economic, and environmental aspects of these comments.

(b) **Limited Access Hearing Findings and Order**

Following a limited access hearing, the “summary” document is labeled the findings and order. Refer to [210.09\(12\)](#) for the process description and required documentation for findings and order documents.

(c) **Adoption and Approval**

For specific hearing types, see subsequent sections in this chapter related to adoption procedures.

[Exhibit 210-6](#) identifies the Headquarters approval authority for hearing summary and findings and order documents.

## 210.06 Environmental Hearing

Early coordination with appropriate agencies and the public may help to determine the appropriate level of environmental documentation, the scope of the document, the level of analysis, and related environmental disciplines to be analyzed.

Environmental documents address the positive and negative social, economic, and environmental project effects, as described in [Chapter 225](#) and the [Environmental Manual](#). The project environmental documentation is the first step in the environmental hearing procedure. Each step of the hearing procedure is dovetailed into the environmental process and is important in achieving the appropriate project documentation. Corridor and design hearings are not normally required for Environmental Assessments, SEPA Checklists, and categorically excluded projects. However, the opportunity for an environmental hearing might be required or advisable for controversial proposals. When an environmental hearing is not required, an informational meeting may serve as a useful forum for public involvement in the environmental process. Consult with region environmental staff and the HQ Hearing Coordinator for specific project requirements.

Projects requiring an Environmental Impact Statement (EIS) must use an evaluation process called *scoping* in the NEPA and SEPA requirements. This process helps the project proponents identify the significant issues and possible alternatives analyzed and documented in the Draft EIS, and it must follow the public involvement plan included in the environmental study plan for the project.

After the project has been thoroughly analyzed through the environmental evaluation process and discussed within the community using informal public involvement methods, a hearing is held to present and gather testimony. The hearing is timed to fall within the comment period for the Draft EIS.

For an environmental hearing, the hearing notice must be published at least 15 days prior to the hearing. The timing of additional publications is optional (see [Exhibit 210-4](#)).

Responses to comments on the Draft EIS must be addressed in the Final EIS.

### **(1) Environmental Hearing Summary**

The environmental hearing summary includes the items outlined in [210.05\(10\)](#).

### **(2) Adoption of Environmental Hearing**

[Chapter 225](#) and the [Environmental Manual](#) provide guidance on NEPA and SEPA procedures, documentation requirements, and approvals.

## **210.07 Corridor Hearing**

A corridor hearing is a public hearing that:

- Is held before WSDOT is committed to a preferred alternative establishing the final route corridor.
- Is held to ensure opportunity is afforded for effective participation by interested persons in the process of determining the need for and location of a state highway.
- Provides the public an opportunity to present views on the social, economic, and environmental effects of the proposed alternative highway corridors.

A corridor hearing is required if any of the following project actions would occur:

- Proposed route on new location.
- Substantial social, economic, or environmental impacts.
- Significant change in layout or function of connecting roads or streets.

When a corridor hearing is held, the region must provide enough design detail on the proposed alignment(s) within the corridor(s) that an informed presentation can be made at the hearing. Justification to abandon an existing corridor must also be presented.

For general procedures and notification requirements, see [210.05](#) and [Exhibit 210-4](#).

### **(1) Corridor Hearing Summary**

After the hearing, the region:

- Reviews the hearing transcript.
- Responds to all questions or proposals submitted at or subsequent to the hearing.
- Compiles a corridor hearing summary.
- Transmits three copies (four copies for Interstate projects) to the HQ Access and Hearings Section.

When appropriate, the hearing summary may be included in the FEIS. If not included, submit the complete corridor hearing summary to the HQ Access and Hearings Section within approximately two months following the hearing.

The corridor hearing summary includes the items outlined in [210.05\(10\)](#).

### **(2) Adoption of Corridor Hearing Summary**

The HQ Access and Hearings Section prepares a package that contains the corridor hearing summary and a formal description of the project and forwards it to the Assistant Secretary, Engineering & Regional Operations, for adoption. The HQ Hearing Coordinator notifies the region when adoption has occurred and returns an approved copy to the region.

## 210.08 Design Hearing

A design hearing is a public hearing that:

- Is held after a route corridor is established and approved, but before final design of a highway is engineered.
- Is held to ensure an opportunity is afforded for the public to present its views on each proposed design alternative, including the social, economic, and environmental effects of those designs.

A design hearing is required if any of the following project actions will occur:

- Substantial social, economic, or environmental impacts.
- Significant change in layout or function of connecting roads or streets.
- Acquisition of a significant amount of right of way results in relocation of individuals, groups, or institutions.

For general procedures and notification requirements, see [210.05](#) and [Exhibit 210-4](#).

### (1) Design Hearing Summary

The design hearing summary includes the elements outlined in [210.05\(10\)](#).

Submit the complete hearing summary to the HQ Access and Hearings Section within approximately two months following the hearing.

If new studies or additional data are required subsequent to the hearing, the region compiles the information in coordination with the HQ Design Office.

### (2) Adoption of Design Hearing Summary

After the hearing, the region reviews the hearing transcript, responds to all questions or proposals submitted at or subsequent to the hearing, compiles a hearing summary, and transmits three copies (four copies for Interstate projects) to the HQ Access and Hearings Section. When appropriate, the design hearing summary may be included in the final environmental document. The HQ Access and Hearings Section prepares a formal document that identifies and describes the project and submits it to the Director & State Design Engineer, Development Division, for approval. One approved copy is returned to the region. The HQ Hearing Coordinator notifies the region that adoption has occurred.

On Interstate projects, the Director & State Design Engineer, Development Division, (or designee) submits the approved design hearing summary to the FHWA for federal approval. If possible, this submittal is timed to coincide with the submittal of the Design Decision Summary to the FHWA.

### (3) Public Notification of Action Taken

The region prepares a formal response to individuals who had unresolved questions at the hearing. The region keeps the public advised regarding the result(s) of the hearing process, such as project adoption or revision to the plan. A project newsletter sent to those on the interest list is an effective method of notification. Project news items can be sent via e-mail or by more traditional methods.

- 225.01 General
- 225.02 References
- 225.03 Determining the Environmental Documentation
- 225.04 Identifying the Project Classification
- 225.05 Environmental Commitment File
- 225.06 Environmental Permits and Approvals
- 225.07 Documentation

### 225.01 General

The term “environmental documentation” refers to the documents produced for a project to satisfy the requirements contained in the National Environmental Policy Act (NEPA) and the State Environmental Policy Act (SEPA). The [Environmental Manual](#) and supporting web pages provide detailed instructions on how to determine what level of documentation is required and how to prepare the documents. This chapter provides a summary of the relevant provisions in the [Environmental Manual](#).

The purpose of the environmental document is to provide decision makers, agencies, and the public with information on a project’s environmental impacts, alternatives to the proposed action, and mitigation measures to reduce unavoidable impacts. Final environmental documents identify and evaluate the project to be constructed. Because projects vary in their level of environmental impacts, the rules on environmental documentation allow for different levels of documentation. As a project’s impacts increase, so does the level of documentation.

The region Environmental Office and the NEPA/SEPA Compliance Section of the Headquarters Environmental Services Office routinely provide environmental documentation assistance to designers and project engineers.

### 225.02 References

#### 225.02(1) Federal/State Laws and Codes

- 42 United States Code (USC) [4321](#), National Environmental Policy Act of 1969 (NEPA)
- 23 Code of Federal Regulations (CFR) Part [771](#), Environmental Impact and Related Procedures
- 23 CFR Part [774](#); 49 USC Section [303](#), Policy on Lands, Parks, Recreation Areas, Wildlife and Waterfowl Refuges, and Historic Sites
- 36 CFR Part [800](#), Protection of Historic and Cultural Properties
- 40 CFR Parts [1500-1508](#), Council for Environmental Quality Regulations for Implementing NEPA
- Chapter [43.21C Revised Code of Washington](#) (RCW), State Environmental Policy Act (SEPA)
- Chapter [197-11 Washington Administrative Code](#) (WAC), SEPA Rules
- Chapter [468-12 WAC](#), WSDOT SEPA Rules

## 225.02(2) WSDOT Environmental Resources

WSDOT region environmental staff

Environmental Permitting webpage:

[www.wsdot.wa.gov/environment/permitting/default.htm](http://www.wsdot.wa.gov/environment/permitting/default.htm)

*Environmental Manual*, M 31-11, WSDOT

[www.wsdot.wa.gov/publications/manuals/m31-11.htm](http://www.wsdot.wa.gov/publications/manuals/m31-11.htm)

## 225.03 Determining the Environmental Documentation

The Environmental Review Summary (ERS) provides the first indication of what form the environmental documentation will take. The ERS is developed as part of the Project Summary, which is prepared during the scoping phase of all projects in the construction program. The Project Summary (see [Chapter 300](#) for additional information) includes three components:

- Project Definition
- Design Decision
- Environmental Review Summary

The ERS is part of the Project Summary database. The ERS describes the potential environmental impacts, proposed mitigation, and necessary permits for a project. It establishes the initial environmental classification and identifies the key environmental elements addressed in the NEPA/SEPA process. The ERS database includes fully integrated “Help” screens. Contact your region Environmental Office or Program Management Office to get set up to work in the database.

The typical process for classifying projects and determining the level of environmental documentation is as follows:

- Once the project has been sufficiently developed to assess any environmental impacts, the region completes the ERS based on the best information available at the scoping phase of development.
- The region Environmental Manager then concurs with the classification by approving the ERS, which enables the completed form to be included in the Project Summary package.
- For NEPA, if a project has been determined to be a Categorical Exclusion (CE), the Environmental Classification Summary/SEPA Checklist (ECS/SEPA Checklist) is completed. The NEPA environmental review process is considered complete when the region Environmental Manager approves the ECS package (guidance is provided in the online Help in the ECS/SEPA Checklist database). If it is determined that a Documented Categorical Exclusion (DCE), Environmental Assessment (EA), or Environmental Impact Statement (EIS) is required, the region evaluates the project schedule and arranges for preparation of the appropriate document.
- For SEPA, the signing and submittal of the ECS/SEPA Checklist completes the environmental classification process. On projects that are categorized as exempt from SEPA, the environmental process is complete unless the project requires consultation under the Endangered Species Act. On projects that do not meet the criteria for a SEPA Categorical Exemption (WACs [197-11-800](#) and [468-12](#)) and require a SEPA checklist ([WAC 197-11-960](#)) or an EIS, those documents are prepared as necessary prior to Project Development Approval.

At this early stage, the ERS allows environmental staff to consider potential impacts and mitigations and required permits. For many projects, the WSDOT Geographic Information System (GIS) Workbench coupled with a site visit provides sufficient information to fill out the ERS (see the GIS Workbench online Help).

For most WSDOT projects, the Federal Highway Administration (FHWA) is the lead agency for NEPA. Other federal lead agencies on WSDOT projects are the U.S. Army Corps of Engineers, Federal Aviation Administration, Federal Railroad Administration, and Federal Transit Administration.

## 225.04 Identifying the Project Classification

Based on the environmental considerations identified during preparation of the ERS, WSDOT projects are classified for NEPA/SEPA purposes to determine the type of environmental documentation required. Projects with a federal nexus (using federal funds, involving federal lands, or requiring federal approvals or permits) are subject to NEPA and SEPA. Projects that are state funded only, with no federal nexus, follow SEPA guidelines. Since many WSDOT projects are prepared with the intent of obtaining federal funding, NEPA guidelines are usually followed. (See Chapter 300 of the [Environmental Manual](#) for more information.)

## 225.05 Environmental Commitment File

As an initial part of project development, the region establishes a project commitment file. Establishment of this file generally coincides with preparation of the environmental documentation. The file consists of proposed mitigation measures; commitments made to regulatory agencies, tribes, and other stakeholders; and other documented commitments made on the project. Further commitment types (right of way, maintenance, and so on) may be added at the region's discretion.

The region Environmental Office is responsible for creating and maintaining the commitment file as a project progresses through its development process. Whenever commitments are made, they are incorporated into project documents and added to the environmental commitment file once they are finalized. Commitments are typically included within, but not limited to, the following documents or approvals and any of their supplements or amendments:

- Memoranda, Agreements, Letters, Electronic Communications
- No-Effect Letters
- Biological Assessments
- Biological Opinions
- Concurrence Letters
- SEPA Checklists
- NEPA Categorical Exclusions
- NEPA Environmental Assessments
- NEPA/SEPA Environmental Impact Statements
- Finding of No Significant Impact (FONSI)
- Record of Decision (ROD)

- Section 106 Concurrence Letter from Tribes and Department of Archaeology & Historic Preservation
- Mitigation Plans
- Environmental Permits and Applications, and Associated Drawings and Plans

Additional information (see [Procedure 490-a](#)) for establishing a commitment file is available online at WSDOT's [Tracking Commitments](#) webpage. WSDOT has a Commitment Tracking System to organize and track commitments from the commitment file. Refer to the [Environmental Manual](#) (Chapter 490) for policies associated with tracking commitments.

## 225.06 Environmental Permits and Approvals

WSDOT projects are subject to a variety of federal, state, and local environmental permits and approvals. Understanding and anticipating what permits and approvals may be required for a particular project type will assist the designer in project delivery. The [Environmental Permitting](#) website provides guidance on the applicability of permits and approvals. Because the facts of each project vary and the environmental regulations are complex, reliance on either the *Design Manual* or the [Environmental Manual](#) is insufficient. Consult region environmental staff.

The Environmental Review Summary, which is prepared as part of the Project Summary, identifies some of the most common environmental permits that might be required based on the information known at that stage. As the project design develops, additional permits and approvals can be identified. Conducting project site visits for engineering and environmental features may reduce project delays caused by late discoveries. Coordinate with and communicate any project changes to region environmental staff.

The permit process begins well in advance of the actual permit application. For some permits, WSDOT has already negotiated permit conditions through the use of programmatic and general permits. These permits typically apply to repetitive, relatively simple projects, and the permit conditions apply regardless of the actual facts of the project type. For complex projects, the negotiations with permit agencies often begin during the environmental documentation phase for compliance with the National Environmental Policy Act (NEPA) and the State Environmental Policy Act (SEPA). The mitigation measures developed for the NEPA/SEPA documents are captured as permit conditions on the subsequent permits.

Environmental permits require information prepared during the design phase to demonstrate compliance with environmental rules, regulations, and policies. To avoid delays in project delivery, it is necessary for the designer to understand and anticipate this exchange of information. The timing of this exchange often affects design schedules, while the permit requirements can affect the design itself. In complex cases, the negotiations over permit conditions can result in iterative designs as issues are raised and resolved.

## 225.07 Documentation

Refer to [Chapter 300](#) for design documentation requirements.

Item	New/Reconstruction (Interstate only)	NHS and Non-NHS
DBE/training goals * **	(a)	(a)
Right of way certification for federal-aid projects	FHWA (b)	FHWA (b)
Right of way certification for state-funded projects	Region (b)	Region (b)
Railroad agreements	(c)	(c)
Work performed for public or private entities *	[1][2]	Region [1][2]
State force work *	FHWA [3][4](d)	Region [3](d)
Use of state-furnished materials *	FHWA [4]	Region [3](d)
Work order authorization	[5](d)	[5](d)
Ultimate reclamation plan approval through DNR	Region	Region
Proprietary item use *	[6]	[6]
Mandatory material sources and/or waste sites *	FHWA [4]	Region [4]
Nonstandard bid item use *	Region	Region
Incentive provisions	FHWA	(e)
Nonstandard time for completion liquidated damages *	FHWA (e)	(e)
Interim liquidated damages *	(f)	(f)

**Notes:**

- [1] This work requires a written agreement.
- [2] Region approval subject to \$250,000 limitation.
- [3] Use of state forces is subject to \$60,000 limitation and \$100,000 in an emergency situation, as stipulated in RCWs [47.28.030](#) and [47.28.035](#). Region justifies use of state force work and state-furnished materials and determines if the work is maintenance or not. HQ CPDM reviews to ensure process has been followed.
- [4] Applies only to federal-aid projects; however, document for all projects.
- [5] Prior FHWA funding approval required for federal-aid projects.
- [6] FHWA approves only for federal-aid projects and only when other equally suitable alternatives exist. In all other cases, the HQ Design Office is required to certify that the proprietary product is either:  
(a) necessary for synchronization with existing facilities, or (b) a unique product for which there is no equally suitable alternative.

**Region or Headquarters Approval Authority:**

- (a) Office of Equal Opportunity
- (b) HQ Real Estate Services Office
- (c) HQ Design Office
- (d) Capital Program Development and Management approves all work order authorizations; Region approves state force work and state-furnished materials.
- (e) HQ Construction Office
- (f) Statewide Travel and Collision Data Office

**References:**

\* [Plans Preparation Manual](#)

\*\* [Advertisement and Award Manual](#)

**PS&E Process Approvals**  
*Exhibit 300-4*

1. **Design Element Upgraded to the Level Indicated in the Matrix**
  - (a) Design element information
    - Design element
    - Location
    - Matrix number and row
  - (b) Cost estimate [1]
  - (c) B/C ratio [2]
  - (d) Summary of the justification for the upgrade [3]
  
2. **Design Element Not Upgraded to the Level Indicated in the Matrix**
  - (a) Design element information
    - Design element
    - Location
    - Matrix number and row
  - (b) Existing conditions
    - Description
    - Collision summary
    - Advantages and disadvantages of leaving the existing condition unchanged
  - (c) Design using the *Design Manual* criteria
    - Description
    - Cost estimate [1]
    - B/C ratio [2]
    - Advantages and disadvantages of upgrading to the level indicated in the matrix
  - (d) Selected design, if different from existing but less than the level indicated in the matrix
    - Description
    - Cost estimate [1]
    - B/C ratio [2]
    - Advantages and disadvantages of the selected design
  - (e) Summary of the justification for the selected design [3]

**Notes:**

- [1] An estimate of the approximate total additional cost for the proposed design. Estimate may be based on experience and engineering judgment.
- [2] Include only when B/C is part of the justification. An approximate value based on engineering judgment may be used.
- [3] A brief (one or two sentence) explanation of why the proposed design was selected.

**Evaluate Upgrade (EU) Documentation Contents List**  
*Exhibit 300-5*

- 301.01 Introduction
- 301.02 Communication
- 301.03 Incorporating Maintenance Considerations in Design
- 301.04 Documentation
- 301.05 References

### 301.01 Introduction

Maintenance plays an important role in the Washington State Department of Transportation's (WSDOT's) asset management program by meeting the daily requirements of maintaining and operating over 18,000 lane miles, approximately 2,000 miles of ramps and special-use lanes, and over 3,700 bridge and culvert structures, as well as hundreds of other special-use sites vital to the state's transportation system. Activities in the highway maintenance program protect the public infrastructure as well as provide services necessary for daily operation of the highway system. Typical maintenance activities include patching potholes, cleaning ditches, painting stripes on the roadway, repairing damage to guardrail, and controlling noxious weeds. In addition to maintaining assets, operational services are also provided. They include plowing snow, cleaning rest areas, responding to incidents, operating structures like draw bridges, and operating traffic signals, lighting, and Intelligent Transportation Systems (ITS). This limited list of maintenance and operational activities highlights the significant undertaking of maintaining and operating the State Highway System as designed.

Highway maintenance and operations staff are unique stakeholders, because they utilize, maintain, and operate the facilities' engineering designs and constructs. Given the nature and cost of maintenance work, as well as the exposure inherent in maintenance and operational activities, it is important for designers to consider maintenance and operations staff as major stakeholders in every project. It is also important for maintenance and operations staff to understand the purpose of the project and to participate in determining the best method(s) to keep it functioning as designed while maintaining their responsibilities outside of the specific project limits.

This chapter provides multiple options to help improve coordination with maintenance and operations staff during project design. These "best practices" are a culmination of responses from *Design Manual* user surveys, interviews with maintenance and operations superintendents, and various regional practices that have demonstrated potential improvement related to the coordination of design and maintenance efforts and personnel. **Note:** The concepts and methods presented herein do not replace any approved communication or documentation processes that may be currently required by a WSDOT region during the project development process.

### 301.02 Communication

Communication is the most fundamental component of coordination. Executing communication is often oversimplified by the phrase "communicate early and often." In reality, effective communication is significantly more complex. For example: *Who are you communicating with, what methods of communication are being used, what is being communicated, how are you responding to communication, where is the communication taking place, and when does the communication need to occur to maximize effectiveness?*

The following sections highlight areas that may increase the necessary communication between design and maintenance staff.

### 301.02(1) Maintenance Organizational Roles

The most important component of communication is knowing who you are communicating with and what their role is within the organization. Just as engineering has multiple disciplines that cover specific areas within engineering, WSDOT's maintenance organization is also divided into multiple discipline areas, each with focused expertise and specific needs that may be relevant to a particular project.

When asking for maintenance input, it is not sufficient to contact just the Area Maintenance Office that covers that physical geographic area. Depending on the scope of the project, engineering must consult with the appropriate maintenance discipline area. It is a project management responsibility to properly identify and communicate with the appropriate project stakeholders (see [EO 1032 – Project Management](#)). It should not be assumed that the Area Maintenance Office will coordinate with all other maintenance disciplines, unless agreed to organizationally or identified within a particular Project Management Plan (PMP). The PMP is the documentation mechanism for identifying the various contacts and their roles within the project. Each region maintenance organization is different, but in general, the following discipline areas are present:

- Area Maintenance
  - Pavement
  - Roadside vegetation control
  - Rest area management
  - Seasonal and emergent maintenance needs
- Signal, Illumination, and ITS Maintenance
- Bridge
- Traffic Operational Maintenance
  - Pavement markings
  - Sign management
  - Incident response



Access to maintain luminaire is provided through use of full shoulder



Striping crew restriping after patching pavement

To access a list of superintendents, go to:

<http://wwwi.wsdot.wa.gov/maintops/pdf/maintenanceofficephonenumberlist.pdf>

To access a list of maintenance performance measures, go to:

<http://www.wsdot.wa.gov/maintenance/accountability/default.htm>

### 301.02(2) **Communicating Expectations**

Project design is heavily influenced by the subprogram and scope of a particular project. While this becomes a learned experience within engineering design, maintenance staff does not routinely work within these types of funding and project constraints. It is important to identify the type of project and elements that can be addressed under the particular subprogram, in order to effectively manage expectations for maintenance stakeholders participating in the project. It is also important to redirect issues presented by maintenance staff that may not be appropriate for your project, but may meet a future need. The project team should work together with maintenance to redirect identified issues to region Program Management to evaluate their relevance for other subprograms or future identified projects, or determine if there are funding mechanisms to include the requested feature(s) on the project in question.



Traffic control needs to maintain the roadside

### 301.02(3) **Communication Timing**

There are multiple constraints to consider when establishing the timing of maintenance stakeholder input. *What is the project timeline, when will maintenance involvement be most effective, and which work season(s) are maintenance and operations staff involved with when you need to communicate with them?* Each one of these questions needs to be understood to yield the most effective communication result.



This procession of snow plows clearing the roadway demonstrates the urgency of labor and equipment necessary to maintain operations on the highway during certain seasons

Maintenance staff has identified scoping through the 30% design phase as a critical period for their input. The scoping phase presents opportunities to identify maintenance concerns and adequately address them within the project scope and budget. The period between scoping and 30% design presents opportunities to evaluate and refine options, as well as gain more understanding of project constraints that may impact a previously identified or requested maintenance feature. As the constraints and design trade-offs become evident, it is necessary to review the impacts to maintenance needs and requests that were originally captured in the project scope and ensure they are not impacted by constraints or the options under evaluation.

Maintenance staff are obligated to respond to immediate incidents and weather conditions. They are not often able to delay their work functions and activities to make time for a design project review. It is essential that designers understand this issue and plan for reviews through scheduling techniques (see [301.03\(1\)\(a\)](#)). In general, the best time to involve maintenance staff is during their slower work seasons.



Maintenance responds to emergencies, which are more likely to occur during certain seasons

#### **301.02(4) Communication Methods**

Maintenance has identified field reviews as the primary and most effective method of communication for their staff. Designers are strongly encouraged to perform multiple field reviews with the appropriate maintenance disciplines. Depending on the size, scope, and location of the project, it may be appropriate to first meet in the office and review the project scope and plans, confirm and endorse the Pre-Activity Safety Plan, then proceed with the field review. Field reviews are recommended at the following periods:

- Scoping phase
- Prior to the 30% design milestone (may need multiple meetings to evaluate design options)
- Each time a previously agreed-to maintenance feature is impacted through design iterations, as appropriate
- Prior to other major design review milestones



Maintenance clearing highway from rockfall overburdening catchment area

A primary purpose for performing field reviews with maintenance is to assist with visualizing the project and to understand existing conditions. When performing the field review, it is important to emphasize the following:

- Reiterate the purpose of the project and subprogram, and discuss maintenance expectations.
- Determine the deficiency being corrected and the understood contributing factors. It is important to gain an understanding from maintenance staff on any other contributing factors or physical conditions that engineers may not be aware of.
- Visualize the project with maintenance:
  - What will be new?
  - What will be removed?
  - What will be replaced, and what is the replacement?
  - Where will new features be located?
  - How will project changes affect neighbors?

- Determine whether the project can be operated and maintained with existing equipment.
  - It is necessary for design and maintenance staff to fully understand the impacts to both the maintenance and project budgets to analyze and balance the obligations for the investments as assets are identified on a project. For example, new lighting means maintenance will be billed for the utility costs. Generally, this increased cost has not resulted in increased funding.
    - Will proprietary item requests be needed so maintenance can maintain the project items with the tools and equipment they currently have?
    - Will new equipment be needed, and who will fund that equipment acquisition?
  - What is the maintenance frequency for affected assets? Will this change?
  - What are the environmental and permit restrictions related to the asset or feature?
  - How might maintenance physically maintain features to understand safety and access needs for the asset or feature?
- Identify explicit action items for design and maintenance staff to follow up on as design iterations continue.
- Document the outcomes of the field meeting, and follow up to ensure maintenance needs are addressed, or provide specific explanations.

In order for maintenance to assist in brainstorming alternative options, engineering design must explain the reasons and constraints behind the previous design options considered and abandoned through the design iteration process.

- Provide maintenance stakeholders the reasons and justification behind design decisions.
- Allow for the time and discussions necessary to brainstorm other options to provide the desired accommodations and features, given the constraints and conflicting performance outcomes identified.
- Before removing any previously discussed maintenance features, always discuss and work on the issue with maintenance staff first.



Cleaning bridge drains requires special equipment and traffic control

While independent reviews of plan sheets are meaningful for engineers, it may be an inappropriate expectation that maintenance staff will see the same value. The repeated familiarity of reviewing plan sheets is not necessarily present within the maintenance staff, and plan review training may or may not be feasible for a given regional maintenance organization based on staffing, workloads, and skill retention.

In some larger regional maintenance organizations, a liaison position has been designated for designers to coordinate plan reviews. This approach has seen some success. However, this liaison cannot possibly be aware of all comments/concerns for every maintenance discipline. Don't assume that coordinating plan reviews through the liaison meets the expectation for maintenance stakeholder input. Always check with the various maintenance disciplines for their preferred contacts and include those contacts within the PMP.

### 301.03 Incorporating Maintenance Considerations in Design

The intent of this section is to provide some project management options and potential strategies or products to help manage the incorporation of maintenance considerations into a design project.

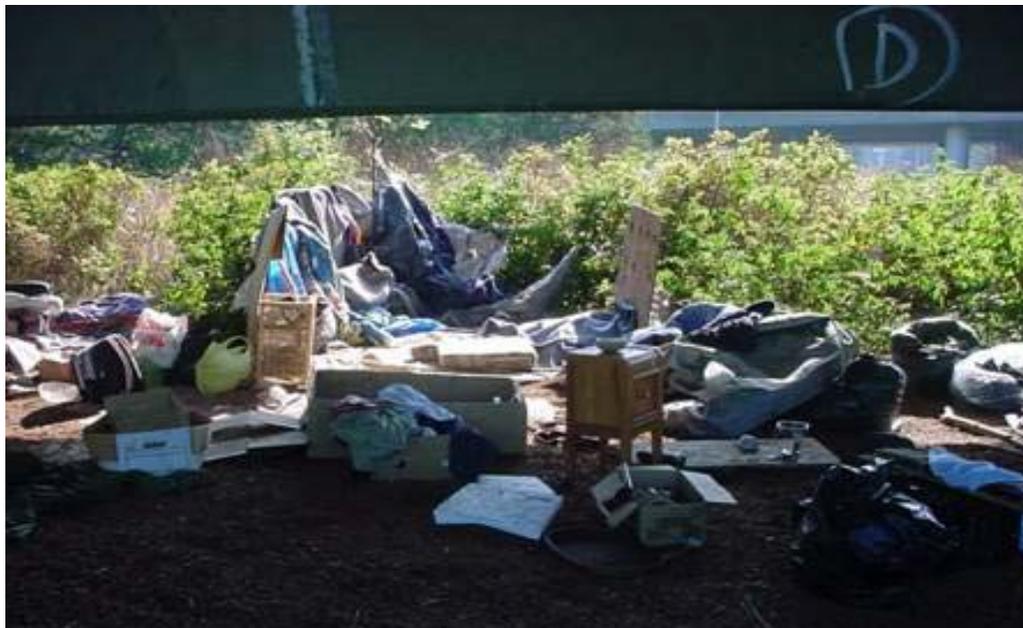
#### 301.03(1) *Project Management and Review Strategies*

Design iterations are necessary as information is gained throughout the design process. Designers are constantly forced to balance competing stakeholder needs, regulatory requirements, design criteria, performance outcomes, and physical and political constraints. The following subsections include some recommended strategies for designers throughout the course of a design project.

### 301.03(1)(a) Project Management and Schedules

1. Include maintenance discipline representatives within the PMP, and identify their specific roles and responsibilities within the design project.
  - This is important for team members, to ensure their inclusion on interdisciplinary decision making and brainstorming options for specific features that may affect only a single or all maintenance disciplines.
2. Schedule the appropriate duration and timing within the project schedule to complete the necessary field reviews with maintenance staff.
  - There are multiple scheduling techniques that may assist you, ensuring this will be well planned based on maintenance staff availability and changing work priorities. Contingency activities, providing more activities detailing the effort, or expanding the duration for single activities may all be appropriate. If uncertain how to best represent the needed time within the schedule, consult the Region Project Management and Reporting System (PMRS) Coordinator for options.
3. As the project works toward constructability reviews, be sure to include appropriate durations for procuring materials.
  - There have been reported instances where maintenance and operations staff has been contacted to temporarily provide equipment while awaiting procurement and acceptance. This creates additional work efforts for maintenance staff to install and remove their equipment to keep a project operational, because inadequate procurement timelines were identified during the design phase.

**Note:** Some regions have an internal policy that prohibits use of maintenance equipment on a temporary basis due to poor execution and management of procurement timelines. Designers should verify what options exist if procurement timelines appear problematic in construction staging exercises.

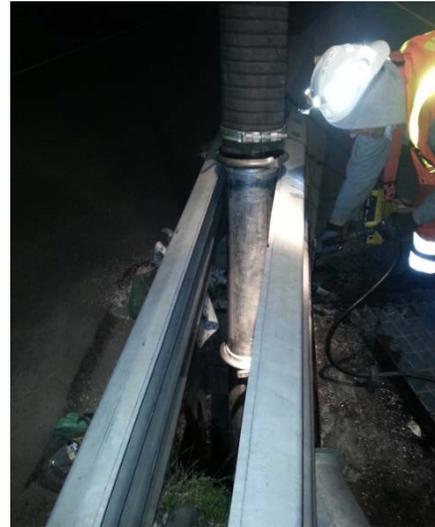


Whenever possible, design should avoid creating environments that might be desirable to the homeless, both for their safety and the safety of maintenance staff

### 301.03(1)(b) Project Reviews

The skill sets of individuals throughout the department vary with experience and training. Strictly utilizing independent plan reviews to gain maintenance stakeholder input may be inappropriate. While field reviews are an optimal means of communicating and visualizing the project with maintenance, it is not prudent to meet in the field for every change or design iteration of a specific feature. However, design engineers frequently engage multiple stakeholders on a project, and those stakeholders are generally provided visual aids and descriptions in addition to a set of plans.

The same effort can be applied to the maintenance stakeholders. Use pictures of completed products, or generate 3D PDFs and/or working drawings, to better illustrate and visualize the features under discussion. Take the time to understand what matters regarding a particular feature and how it will be maintained, and ensure the illustrations provided depict the worst case for their concerns, not the average. For example, if the steepness of side slopes matters regarding how the feature will be accessed or maintained, be sure to depict how the slope will vary, including the steepest portion, not the typical slope. Every effort should be made to ensure stakeholders understand the balancing act design is working through and how it affects the various maintenance features or assets.



Vector truck cleaning a catch basin placed directly under guardrail run

Maintenance staff should never be in a position to review project details from a plan sheet without a meeting/discussion, examples, or other means of communicating what feature or issues they are reviewing on the plan sheet. This effort will help ensure there are “no surprises” for maintenance and operations staff when the planned project enters construction.

### 301.03(2) Maintenance Design Considerations –Tips, Tools, and End Products

There are multiple potential products that design teams should consider to effectively document maintenance considerations. Note that some options presented in the following subsections may be more effective if implemented on a statewide basis. However, all options can be described as project procedures and should be identified and explained within the PMP.

#### 301.03(2)(a) Establish Maintenance Performance Measures

For a given corridor or project location, it may be advantageous to identify desired performance measures and their established goal(s). Providing a performance-based outcome provides something tangible for designers to evaluate when exploring options. These performance objectives should be specific and state the actual needed outcome, not necessarily a proposed solution (see annotated example in [Exhibit 301-1](#)).

Exhibit 301-1 General Input Form with Listed Performance Objectives

<b>MAINTENANCE CONCERNS AND INPUT</b>				
WIN	SR	REGION	COUNTY	
D00521I	005	Southwest	Clark	
				DATE
				5/21/2014
PROJECT: I-5/Widen and Construct Interchange				
TYPE OF WORK: Widening for a additional lane and construct two overcrossings, one overcrossing will be a half diamond interchange.				
BEGIN MP:	30.0	END MP:	50.0	LENGTH OF PROJECT: 20 miles
FUNCTIONAL CLASS: Interstate – Principal Arterial				
NHS STATUS: NHS				
ROADWAY IS: (check one)		2 lane	multi-lane <input checked="" type="checkbox"/>	other
NEW/RECONSTRUCTION: (check one)		YES <input checked="" type="checkbox"/>	NO	
STATEMENT OF PURPOSE: (brief description of work to be completed by the Design Engineer)				
This section of Interstate 5 needs additional capacity and improved auto mobility. Capacity will be provided in three ways; improving local circulation by constructing a new overcrossing at Y Street which will remove local auto trips from the Interstate, providing for a additional half interchange at Z Street to improve existing X Street Interchange, as well as providing an a additional lane on the interstate.				
STATEMENT OF CONCERNS: (known maintenance issues within the scope of the proposed project)				
It is unclear at this time what assets will remain and what new assets will be installed along this urbanizing location. Since this facility is high speed and high ADT, maintenance offices' primary concern is locating protected access to assets placed and maintaining or improving access to assets planned to remain. Maintenance anticipates significant collaboration needs consisting of multiple site visits with all maintenance disciplines (not just this area office). We have prioritized a list of maintenance performance outcomes to consider when weighing specific asset design options as follows:				
<ul style="list-style-type: none"> <li>• Reduction in Maintenance Exposure to Traffic</li> <li>• Reduction in Maintenance Frequency to Maintain and Operate</li> <li>• Lowest Maintenance Life Cycle Cost</li> </ul>				
Area Superintendent:		Date:		
John Doe		5/21/2014		
Area Supervisor:		Date:		
Jonny Smith		5/15/2014		
Lead Tech:		Date:		
Jane Smith		5/1/2014		

**301.03(2)(b) Evaluate Maintenance Lifecycle Cost**

Designers should work with maintenance to understand the full life cycle cost for maintaining a certain feature. Maintenance will need to provide and explain to design:

- The frequency of maintaining the asset
- Labor costs
- Material costs
- Traffic control costs
- Utility costs
- Additional equipment costs (cost to repair if equipment owned, rental costs, or purchase cost of new equipment needed)
- Cost of procuring replacement parts for the asset

Additionally, maintenance and operations staff should identify some qualitative risks and opportunities associated with certain assets. Some opportunities, like the one presented in [Exhibit 301-2](#), may not be possible depending on material availability or funding restrictions.

It is important for designers to understand that some products may have a short shelf-life. Procuring new replacement parts in the future may not be possible, which may result in a search for used parts or the total replacement of the particular asset. These are future risks that need to be identified so design engineers will understand what options or special provisions may be required to help address the potential risks. Maintenance staff can help design understand the history of different assets and determine options that have been successful for a given maintenance location. Design engineers also need to communicate the requirements and disadvantages of proprietary items specifically requested by maintenance. While it may be the desired product that maintenance is familiar with, it may not be the best product for what is being designed.



Replacing a guardrail is not a simple activity

It is necessary to both determine the life span for a particular asset and utilize discounted cash flow techniques to understand the present worth of the future expenditures. The discounting process can be complex; however, for the purposes of evaluating maintenance life cycle cost, it is acceptable to use a flat discount rate applied to the sum of all future maintenance expenditures. In [Exhibit 301-2](#), the asset life span is 20 years, and the discount rate is approximately 80% (based on a 4% interest rate per year). If the asset life span is different, then the discount rate will also change. To determine the life span of a particular asset type and the approximate discount rate for that life span, contact the Asset Management Group within the Capital Program Development and Management Office.

After analyzing the life cycle cost to maintain a particular asset, and demonstrating an understanding of the associated risks, design and maintenance staff can justify the best return on the construction investment. While the primary intent of this process is to document justification for an asset decision, it is important that region Maintenance is supplied with the information as well. Providing this information during the design process can inform maintenance budgetary scenarios. Allow sufficient time for maintenance to capture budget impacts and apply for the necessary funding in the bi-annual maintenance budgeting process.

Exhibit 301-2 Design Option Worksheet Showing Example of Life Cycle Cost Assessment

**Design Options Worksheet**

Engineer: Jane Smith

Maintenance Representative: John Doe



**Project Information:**

Title: SR Rural Highway/BST and Guardrail Repair

Design Speed: 60 mph

2 lane rural arterial highway

P1 – Paving and P3 – Guardrail Replacement

Project Deficiencies: Pavement degradation due to normal wear; non-standard guardrail height at various locations

Proposed Scope: pavement repair, BST travelled way from MP 15 to MP 32, and replace identified guardrail priorities from MP16.5 to 17; 20.2 to 20.3; 30.6 to 31.1

**Segment Problem Statement:**

Maintenance has identified this segment of highway as a high frequency repair location. Maintenance records for the past 3 years has indicated location requires guardrail repair on average twice a year. Collision data does not show any run off the road collision reporting. The lack of shoulder and work area behind the guardrail requires one way traffic control operations, and exposes maintenance staff to traffic. Maintenance staff has requested additional analysis of design options at this location.

**Segment Location Information:**

300 ft Guardrail section on outside of horizontal curve

Natural Land use

Lane widths are 12 ft

Shoulder widths vary from 0.5 to 1 ft

ADT is 5000 with 11% trucks

**Typical Section:**

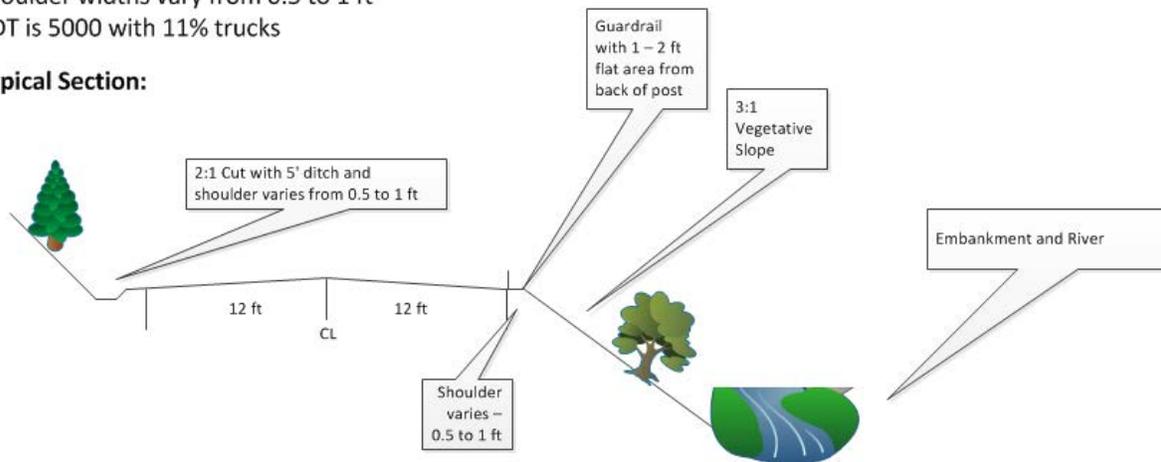


Exhibit 301-2 Design Option Worksheet Showing Example of Life Cycle Cost Assessment (continued)

On May 20, 2014, the project team, materials engineer and area maintenance staff performed a second scoping visit to develop pavement repair quantities and methods. We also discussed the maintenance concern for the guardrail repair location at MP 20.2 to 20.3, together we brainstormed and vetted potential contributing factors and design options for this location.

**Potential Contributing Factors:**

- Geometric cross section: Lack of shoulder and sight distance around the curve, outside orientation of the curve may be a factor for drivers negotiating this area. There may be a tendency for driver concern about opposing direction of travel, and to position the vehicle on the outside of the curve. This could result in the minor unreported collisions with the close proximity of guardrail to the travelled way.

**Potential Solutions:**

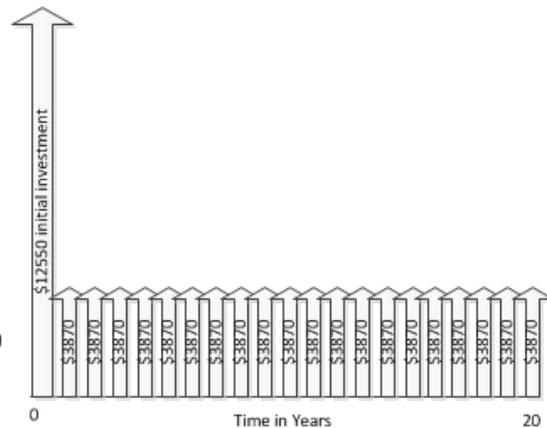
- Replace guardrail at same location
- Replace with pinned pre-cast concrete barrier
- Widen for 2' shoulder, install shoulder rumble strip and install long post guardrail run
- Widen for an 8' shoulder, install rumble strips and install long post guardrail
- Cut into slope and widen pavement section (will require realignment and/or superelevation change)

**Design Option Evaluation:**

Option 1 – Replace guardrail in kind

**Contract Investment Calc:**

Materials and Labor from UBA  
 6757 @ 27.5 LF for 300 ft = \$8250  
 Traffic Control Costs  
 Flaggers @ \$50/hr x 4 hr x 2 persons = \$400  
 TCS @ \$100/hr x 4 hr = \$400  
 Portable Attenuator = \$3500  
 Total Traffic Control = \$3500 + \$400 + \$400 = \$4300  
 Total Contract Investment = \$8250 + \$4300 = **\$12550**



**Maintenance Costs Calc (per repair):**

Maintenance records show repairs consist of two sections of guardrail and two posts or post blocks need replacement each repair. Records average repairs 2x each year.

**Materials and Labor from Area Maintenance:**

26' beam @ \$27.5/LF = \$715  
 2 posts or blocks @ \$80/ea = \$160  
 3 persons @ \$35/hr x 4 hr (includes PASP and travel) = \$420  
 Traffic Control Labor  
 2 persons @ \$35/hr x 4 hr (includes PASP and travel) = \$280  
 All equipment necessary for repair @ \$90/hr X 4 hr = \$360  
 Total Maintenance per repair = \$360 + \$715 + \$160 + \$420 + \$280 = \$1935 x 2/yr = \$3870  
 Total Maintenance Net Present Worth = (\$3870 X 19)(0.8) = **\$58824**

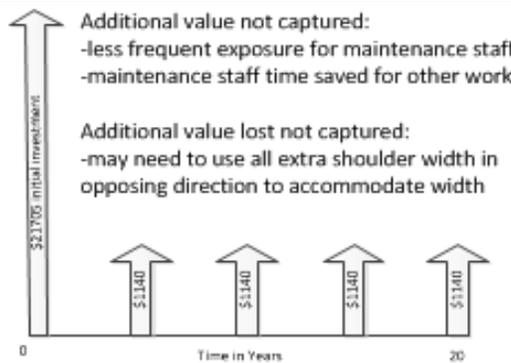
Total Life Cycle Cost = \$12550 + \$58824 = **\$71374**

Exhibit 301-2 Design Option Worksheet Showing Example of Life Cycle Cost Assessment (continued)

**Option 2 – Install pinned pre-cast concrete barrier**

**Contract Investment Calc:**

Materials and Labor from UBA  
 6776 @ \$39/LF for 300 ft = \$11700  
 5767 @\$85/ton for 33tons = \$2805  
 5100 @\$50/ton for 30 tons = \$1500  
 Other costs = \$1000  
 Traffic Control Costs (TC for HMA placement assumed incidental to BST)  
 Flaggers @\$50/hr x 6 hr x 2persons = \$600  
 TCS @\$100/hr x 6 hr = \$600  
 Portable Attenuator = \$3500  
 Total Traffic Control = \$3500+\$600+\$600 = \$4700  
 Total Contract Investment = \$11700+\$2805+\$1500+\$1000+\$4700 = **\$21705**



Additional value not captured:  
 -less frequent exposure for maintenance staff  
 -maintenance staff time saved for other work

Additional value lost not captured:  
 -may need to use all extra shoulder width in opposing direction to accommodate width

**Maintenance Costs Calc (per repair):**

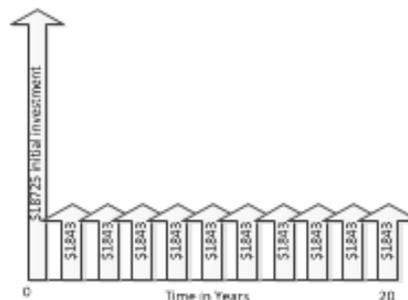
Maintenance records for a similar location and context show repairs consist of resetting a barrier section once every 5 years.  
 Materials and Labor from Area Maintenance:  
 3 persons @ \$35/hr x 4 hr (includes PASP and travel) = \$420  
 Traffic Control Labor  
 2 persons @ \$35/hr x 4 hr (includes PASP and travel) = \$280  
 All equipment necessary for repair @ \$110/hr X 4 hr = \$440  
 Total Maintenance per repair = \$440+\$420+\$280 = \$1140 every 5 yrs  
 Total Maintenance Net Present Worth = (\$1140 X 4)(0.8) = **\$3648**

Total Life Cycle Cost = \$21705 + \$3648 = **\$25353**

**Option 3 – Widen shoulder, install rumble shoulder rumble strips and long post guardrail**

**Contract Investment Calc:**

Materials and Labor from UBA  
 6711 @ \$34/LF for 300 ft = \$10200  
 5767 @\$85/ton for 25tons = \$2125  
 5100 @\$50/ton for 22 tons = \$1100  
 Other costs = \$1000  
 Traffic Control Costs (TC for HMA placement assumed incidental to BST)  
 Flaggers @\$50/hr x 4 hr x 2persons = \$400  
 TCS @\$100/hr x 4 hr = \$400  
 Portable Attenuator = \$3500  
 Total Traffic Control = \$3500+\$400+\$400 = \$4300  
 Total Contract Investment = \$10200+\$2125+\$1100+\$1000+\$4300 = **\$18725**



**Maintenance Costs Calc (per repair):**

Maintenance records for a similar location and context (but higher ADT) show repairs consist of two sections of guardrail and two posts or post blocks need replacement each repair. Records average repairs 1 every other year.  
 Materials and Labor from Area Maintenance:  
 26' beam @ \$27.5/LF = \$715  
 2 long posts or blocks @ \$100/ea = \$200  
 3 persons @ \$35/hr x 3.5 hr (includes PASP and travel) = \$368  
 Traffic Control Labor  
 2 persons @ \$35/hr x 3.5 hr (includes PASP and travel) = \$245  
 All equipment necessary for repair @ \$90/hr X 3.5 hr = \$315  
 Total Maintenance per repair = \$715+\$200+\$368+\$245+\$315 = \$1843 every other year  
 Total Maintenance Net Present Worth = (\$1843 X 10)(0.8) = **\$14744**

Total Life Cycle Cost = \$18725 + \$14744 = **\$33469**

## Exhibit 301-2 Design Option Worksheet Showing Example of Life Cycle Cost Assessment (continued)

**Options 4 & 5** - Widen for an 8' shoulder, install rumble strips and install long post guardrail & Cut into slope and widen pavement section (will require realignment and/or superelevation change). Field visit participants determined these options would be significantly out of scope for the project. Additionally all parties agreed that initial costs are significantly more than the three previous options. Other concerns were permitting, specialty design needs, and potential need to add a ROW phase makes these design options fatally flawed.

**SUMMARY:**

Field participants agreed that Design Option 2 presents the best maintenance performance outcome; with potential to reduce the maintenance frequency, and thereby reducing the exposure of maintenance staff to the inherent risks of working on the roadway. The option also presents the lowest long term costs associated with maintaining the asset. However, the option does create an potential project funding issue at approximately \$10,000 higher costs than option 1.

**Next steps:**

This project is currently within the scoping stage and the final project budget is yet to be determined. The design team will seek endorsement for Option 2 with the project PE, responsible maintenance superintendent and region program manager. Following this endorsement the design office will facilitate a project funding meeting with region program management, region project development, maintenance, and CPDM to confirm budget endorsement for Option 2. Assuming confirmation of budgeting, this option will be identified on the project summary and carried into the design scope for the project.

**CONCLUSION:**

On June 23, 2014, the endorsed Option 2 was discussed for budgeting. The P3 program was determined to have minimal flexibility to fund the additional cost without impacting other projects or other locations on the same project. Maintenance identified a surplus stockpile of the appropriate type of pre-cast concrete barrier, that could be utilized for state supplied materials on the contract, reducing the initial investment by \$5000-6000. Parties agreed to move forward with Option 2 with state supplied material from the area maintenance stockpile.

**301.03(2)(c) CAE Design Tools**

Projects create assets that need to be maintained. The various CADD and modeling programs used for engineering design allow for significant flexibility to show maintenance considerations related to the project. This is true even if a feature won't be physically built by the project, but we want to ensure its visibility throughout the design. Indicate maintenance work zones and access routes within the working files. Refer to the [Electronic Engineering Data Standards Manual](#) for symbology requirements and standards.



Ideal utility vault and Variable Message Sign access

### 301.03(2)(d) Maintenance Review and Quality Control Products

There are a number of different ways to support design reviews and quality control for maintenance features associated with a project. Some regions use maintenance review checklists to remind designers and reviewers of common maintenance needs on projects (see example in [Exhibit 301-3](#)).

Worksheets for each asset are another means to document the discussion, options considered, and the decided outcome for a particular asset placed or retained within the project limits (see example in [Exhibit 301-2](#)).

Even if these review and documentation options are not specifically required by region documentation and approval processes, a decision to utilize these tools can be made at the project level.

The established quality control and quality assurance (QA/QC) procedure within each region provides an additional process for ensuring maintenance comments and concerns have been addressed and the agreed-on features are in place. This procedure becomes increasingly important at the 60%, 90%, and constructability review milestones, where design iterations may have neglected to account for impacts to previously agreed-on features or treatments specific to maintenance and operational needs. Discuss increasing the visibility of maintenance-related quality control within the project or region QA/QC plan and identify the assigned staff responsible for quality control and quality assurance.



Poor utility vault access

Exhibit 301-3 Excerpts from Olympic Region Review Checklist

Maintenance Review Checklist			
Considerations for Scoping, Design and Construction			
Project Title: I-5/Shoulder Widening and Bridge Replacement		Ad Date: 4/1/2024	
Project Type: I-1 and P-2		PIN/WIN: 300520I & 300521B/C00520I & C00521B	
Maintenance Preferred Outcomes	Reason	General Outcome Notes	Discussed(Y/N) & Comments
<b>Shoulders</b>			
<ul style="list-style-type: none"> <li>12-foot shoulders at locations where electrical equipment (HAR stations, VMS signs, light poles, CCTV cameras, data stations and RWIS are installed)</li> </ul>	This allows man-lift and other service equipment to park and safely work, may be gravel area in combination with standard paved shoulder.	Could be in the form of widened gravel area.	12 foot shoulders provided for maintenance of multiple assets (ie closed system drainage, walls, illumination, etc.
<ul style="list-style-type: none"> <li>Parking area (access areas) for maintenance to load and unload</li> </ul>	Safety, negates need to take lanes for maintenance work.	Could be in the form of widened gravel area.	Yes – agreed that this project will not be able to create parking areas for some assets given the right of way constraints. Foot access and 12' shoulders provided for project
<ul style="list-style-type: none"> <li>Full depth shoulders</li> </ul>	This would allow the use of the shoulder when detouring traffic		Yes – Provided for multiple reasons including hard running shoulder use.
<ul style="list-style-type: none"> <li>Tapered shoulder edge (safety) edge</li> </ul>	Improved water runoff. Keeps sod and debris from blocking shoulder drainage.	Reduced maintenance practices and herbicide use. <a href="#">Attachment A</a>	Not discussed yet, revisit at 60% design
<b>Electrical</b>			
<ul style="list-style-type: none"> <li>Junction boxes</li> </ul>	It is best to place J-boxes out of the traveled area (4-foot off pavement edge). Use traffic bearing J-boxes as a last resort.		Yes – box type TBD. Attempting to widen within existing ROW, creating need for retaining walls and J-boxes for illumination will need to be relocated. See design options worksheet for initial options discussed, but this and other roadside needs have resulted in a terraced wall design allowing for J boxes and other equipment to be accessed by foot on the terrace. Fall protection system will be needed.
<ul style="list-style-type: none"> <li>Lighting on outside of multi-lane highways</li> </ul>	Median lights are not being constructed in 2010. Keep in mind access (a safe area) for repairing and re-lamping.		Yes – Luminar foundations will be placed behind the first terraced retaining wall. Full shoulder provided for bucket truck to access luminar head. However, project plans on using Hard Running Shoulders for transit priority and maintenance work requiring the shoulder will likely result in night work and/or coordination with transit authority. Night work is acceptable and typical for interstate work on this segment of the corridor
Maintenance considerations for Scoping, Design and Construction Olympic Region Maintenance and Operations Office		5/21/14 1	

<b>Endorsement</b>	
This checklist has been reviewed, and issues have been discussed as noted. This checklist should be filed within the Design Documentation Package.	
OR Maintenance:	<u>Jonny Appleseed</u> <small>name</small> <span style="float: right;"><small>date</small></span>
Design PEO:	<u>Jane Smith, PE</u> <small>name</small> <span style="float: right;"><small>date</small></span>

### 301.03(2)(e) Asset Management and Maintenance Owner's Manual

Maintenance and operations staff will need to maintain the assets placed or retained within a project location. It is important to be aware of the various asset management systems:

- Highway Activity Tracking System (HATS)
- Roadside Features Inventory Program (RFIP)
- Signal Maintenance Management System (SIMMS)
- Maintenance Productivity Enhancement Tool (MPET)
- Traffic Sign Management System (TSMS)

The asset management system reviews are necessary to confirm the assets present on a project, as well as any identification numbers associated with the assets to track and list those that will be removed, replaced, or remain. Work with the appropriate maintenance staff and confirm the assets identified during field reviews with maintenance staff. Post-construction, any new assets placed will need to be logged into the appropriate asset management system(s) by maintenance or construction staff, depending on region procedures.

Maintenance and operations personnel have experience maintaining a variety of products and features on state highways. However, not every asset is strictly typical for the maintenance discipline or area responsible for maintaining or operating it. Review the assets planned for placement within a project and understand what information maintenance crews may need to adequately maintain the asset or feature. This should include the following:

- Recommended equipment
- Frequency of maintenance activities
- Limits or boundaries (particularly for stormwater BMPs)
- Access location and route
- Any other relevant information discussed with maintenance or supplied by the product provider, including information on brand, make, and model of the asset



Well-designed access for luminaire maintenance

Information about these assets should be compiled into an *Owner's Manual* for maintenance to reference.

- The *Owner's Manual* will be provided in hard copy, an editable electronic copy, and static electronic versions.
- Electronic versions of the *Owner's Manual* must be titled in the following format: [YYYYMMDD]\_Owner's Manual\_[route]\_[MP Limits]\_[Contract Number].
- Hard copies will be bound in a binder and labeled on the cover and binding with the same information provided in the required PDF title.

The *Owner's Manual* versions will be supplied to both maintenance and the construction office, upon contract advertisement. **Note:** This may not be necessary if needed content is captured within the area's Integrated Vegetation Management (IVM) Plan.

If changes occur during post advertisement for a particular asset or feature listed in the *Owner's Manual*, it is the responsibility of the construction office and maintenance to coordinate an update of the *Owner's Manual*, as appropriate. As the construction phase ends, after punch list items are resolved, Maintenance staff should undergo a final review to ensure the *Owner's Manual* is complete and accurate.

### 301.03(2)(f) Maintenance Agreements

Some project locations may have multiple maintenance jurisdictions, at both the state and local levels. In these circumstances, involve all maintenance jurisdictions throughout the planning and design process. They can help you understand their capabilities and the reasonable accommodations necessary for frequent maintenance operations. To understand the likely split between local and state jurisdictions, refer to [1600.03](#) and the Conformed Agreement... for the Construction, Operations and Maintenance Responsibilities...

 [www.wsdot.wa.gov/localprograms/lag/construction.htm](http://www.wsdot.wa.gov/localprograms/lag/construction.htm)

Some maintenance and operations agreements between state and local agencies exist for streets that are also state highways, and are important to the success of these projects. These agreements may need to be created, updated, or replaced due to the nature of the project. The potential agreements need to identify the maintenance, operational, and jurisdictional boundaries, roles, and responsibilities of the parties entering into the agreement, including liability, indemnification, and insurance. The Conformed Agreement (above) lists the likely split of jurisdictional responsibilities. However, maintenance jurisdiction(s) may want to create an operational plan or agreement for the infrequent maintenance functions that designs may not be able to accommodate. It is also possible that one maintenance jurisdiction will be better equipped to handle certain maintenance elements than another. It will be necessary to document the split of maintenance responsibilities even if responsibilities remain the same as those listed within the Conformed Agreement.

Agreements require a level of detail that will not be known early in project development, so it is important to document trade-offs, benefits, and impacts with the affected maintenance jurisdictions while early decisions are being made.



Maintenance patching pavement at an intersection requires significant planning, night work, and traffic control

### 301.04 Documentation

Refer to [Chapter 300](#) for design documentation requirements. Examples of documentation and checklists can be found at: [www.wsdot.wa.gov/design/policy/default.htm](http://www.wsdot.wa.gov/design/policy/default.htm)

### 301.05 References

#### 301.05(1) Federal/State Laws, Codes and Agreements

*City Streets as Part of State Highways Guidelines Reached by the Washington State Department of Transportation and the Association of Washington Cities on Interpretation of Selected Topics of RCW 47.24 and Figures of WAC 468-18-050 for the Construction, Operations and Maintenance Responsibilities of WSDOT and Cities for such Streets*, 4-30-1997, amended 4-2-2013

[www.wsdot.wa.gov/localprograms/lag/construction.htm](http://www.wsdot.wa.gov/localprograms/lag/construction.htm)

#### 301.05(2) Design Guidance and Supporting Information

*A Policy on Geometric Design of Highways and Streets*, AASHTO, current edition

*Cost Estimating Manual for WSDOT Projects*, M 3034, WSDOT

*Electronic Engineering Data Standards*, M 3028, WSDOT

*Highway Runoff Manual*, M 31-16, WSDOT

*Maintenance Manual*, M 51-01, WSDOT

*Roadside Design Guide*, AASHTO, current edition

*Roadside Policy Manual*, M 3110, WSDOT

Secretary's [Executive Order 1032](#), Project Management

- 305.01 Introduction
- 305.02 References
- 305.03 Definitions
- 305.04 Design Project Management Overview
- 305.05 Cost Estimating for Design Project Development
- 305.06 Value Engineering
- 305.07 Context Sensitive Solutions (CSS)
- 305.08 Additional Design Resources

## 305.01 Introduction

This chapter outlines the principles and methodology adopted by the Washington State Department of Transportation (WSDOT) for successful project management. WSDOT's project management process is the standard practice adopted by the department to manage projects, and it provides a method to meet WSDOT's management principles. This chapter focuses on preconstruction activities such as cost estimating, risk management, task planning, schedule development, and budgeting, as well as managing scope, schedule, and budget.

The WSDOT Secretary's Executive Orders 1028, 1032, 1038, and 1053 were issued to ensure a consistent process for context sensitive solutions (CSS), design project management, and risk-management statewide. (See [Chapter 130](#) for more information about CSS.)

WSDOT's project management process includes "best management practices" and the tools, templates, examples, and guidance necessary to successfully deliver Capital Transportation projects. The process will enhance communications when designers hand off projects to construction project management.

Following are brief discussions about and links to other WSDOT project development resources. These include technical manuals, research reports, and online design-related websites.

## 305.02 References

### 305.02(1) *Federal/State Laws and Codes*

[23 United States Code \(USC\) 106](#), Project approval and oversight

### 305.02(2) *WSDOT Policies*

Directives, Executive Orders, Instructional Letters, Manuals, and Policy Statements

<http://wwwi.wsdot.wa.gov/publications/policies/default.htm>

Executive Order E 1028, Context Sensitive Solutions

<http://wwwi.wsdot.wa.gov/publications/policies/fulltext/1028.pdf>

Executive Order E 1032, Project Management

<http://wwwi.wsdot.wa.gov/publications/policies/fulltext/1032.pdf>

Executive Order E 1038, Enterprise Risk Management

🔗 <http://wwwi.wsdot.wa.gov/publications/policies/fulltext/1038.pdf>

Executive Order E 1053, Project Risk Management and Risk Based Estimating

🔗 [www.wsdot.wa.gov/publications/fulltext/cevp/1053policy.pdf](http://www.wsdot.wa.gov/publications/fulltext/cevp/1053policy.pdf)

Instructional Letter IL 4071, Risk-Based Project Estimates for Inflation Rates, Market Conditions, and Percentile Selection

🔗 <http://wwwi.wsdot.wa.gov/publications/policies/fulltext/4071.pdf>

Project Delivery Memos

🔗 [www.wsdot.wa.gov/design/projectdev/memos.htm](http://www.wsdot.wa.gov/design/projectdev/memos.htm)

### 305.03 Definitions

For a complete glossary of project management terms, see:

🔗 [www.wsdot.wa.gov/publications/fulltext/projectmgmt/pmog/pm\\_glossary.pdf](http://www.wsdot.wa.gov/publications/fulltext/projectmgmt/pmog/pm_glossary.pdf)

For a complete glossary of cost estimating and risk assessment terms, see:

🔗 <http://www.wsdot.wa.gov/nr/rdonlyres/d10b9b96-9c03-479c-8b52-17ff7bff9a0f/0/glossaryofterms.doc>

For cost estimating definitions, see:

🔗 [www.wsdot.wa.gov/publications/manuals/m3034.htm](http://www.wsdot.wa.gov/publications/manuals/m3034.htm)

### 305.04 Design Project Management Overview

WSDOT's project management process provides the framework for project managers to deliver projects on time and within scope and budget. WSDOT employs a number of tools to manage projects effectively and efficiently.

#### 305.04(1) Project Management Process

##### 305.04(1)(a) Overview

For an overview of project management, with links to the WSDOT project management process for delivering the WSDOT Capital Construction Program, see the following website:

🔗 [www.wsdot.wa.gov/projects/projectmgmt](http://www.wsdot.wa.gov/projects/projectmgmt)

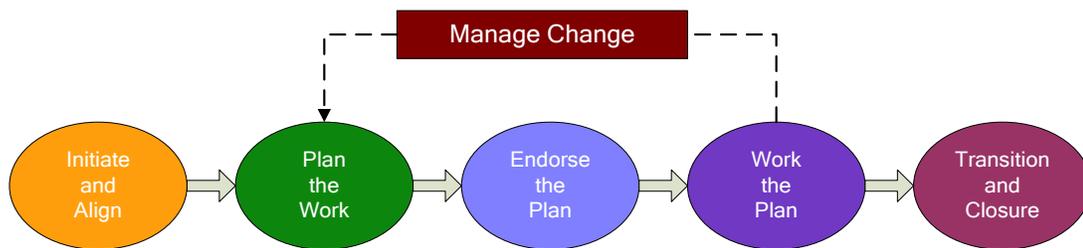
Exhibit 305-1 shows the five steps in the project management process used to deliver Capital Transportation projects. The following link takes you to a table with a more detailed description of the five steps: 🔗 [www.wsdot.wa.gov/nr/rdonlyres/a76c71ef-c926-4a13-9615-c9f341f3baaf/0/wsdotproj\\_mgmt\\_process.pdf](http://www.wsdot.wa.gov/nr/rdonlyres/a76c71ef-c926-4a13-9615-c9f341f3baaf/0/wsdotproj_mgmt_process.pdf)

##### 305.04(1)(b) Design Process Deliverables

The following website will take you to the Deliverable Expectation Matrix, which identifies the appropriate design process deliverable cells in the Master Deliverables List (see 305.04(2)(b)):

🔗 [www.wsdot.wa.gov/publications/fulltext/design/demintro.pdf](http://www.wsdot.wa.gov/publications/fulltext/design/demintro.pdf)

Exhibit 305-1 WSDOT Project Management Process



### 305.04(2) Project Management Tools

#### 305.04(2)(a) Project Management and Reporting System (PMRS)

The PMRS is a tool for effective and efficient management of design project schedules, resources, and costs. The following website provides tools for project planning, work breakdown structure (WBS) development, scheduling, and resource and cost management:

<http://wwwi.wsdot.wa.gov/planning/cpdmo/pmrs.htm>

#### 305.04(2)(b) WSDOT's Master Deliverables List (MDL)

The Master Deliverables List (MDL) is a comprehensive listing of project elements. This list is agreed upon across WSDOT and is intended as a starting point for the creation of the project Work Breakdown Structure (WBS) and to ensure:

- All appropriate project elements are included in the project management plan and schedule.
- The MDL activity codes, related titles, and descriptions provide a common vocabulary across all projects and between project teams, region and Headquarters (HQ) management, and specialty/support groups.

For additional information, see:

[www.wsdot.wa.gov/projects/projectmgmt/masterdeliverables.htm](http://www.wsdot.wa.gov/projects/projectmgmt/masterdeliverables.htm)

### 305.05 Cost Estimating for Design Project Development

Cost estimating guidance has been developed by the Strategic Assessment and Estimating Office (SAEO) and WSDOT Project Development.

#### 305.05(1) Project Phases

There are four main phases or levels of design project development:

- Planning
- Scoping
- Design
- Plans, Specifications, and Estimates (PS&E)

The estimate for each level of project development has a specific purpose, methodology, and expected level of accuracy. As the project progresses, more data are available and the expected accuracy range narrows. For more information, see the [Cost Estimating Manual for WSDOT Projects](#).

### 305.05(1)(a) Planning

The planning-level estimate is used to estimate the funding needs for long-range planning and to prioritize needs for the Highway System Plan. These estimates are typically prepared with little project definition detail.

### 305.05(1)(b) Scoping

A scoping-level estimate is used to set the baseline cost for the project and to program the project. A project is programmed when it is entered into the Capital Improvement and Preservation Program (CIPP) and the Biennial Transportation Program. The scoping estimate is important because it is the baseline used by the Legislature to set the budget, and all future estimates will be compared against it.

### 305.05(1)(c) Design

Estimates prepared at the various design levels, including Geometric Review, General Plans Review, and Preliminary Contract Review, are used to track changes in the estimated cost to complete the project in relation to the current budget (CIPP or “Book” amount).

Design Approval is an important stage of design for estimating purposes. At Design Approval, the configuration of the project is known. This will solidify many items in the scope, such as right of way needs, likely permit conditions, environmental mitigation, quantities of major items, and outside stakeholders. As scope definition improves, the accuracy of the estimate will likewise improve. The work effort required to prepare, document, and review the estimate also increases.

An important element of the project is the Basis of Estimate (BOE). The BOE is a documented record of pertinent communications that have occurred and agreements that have been made between the estimator and other project stakeholders. The BOE, which is to be included in the Project File, is characterized as *the one deliverable that defines the scope of the project, and it ultimately becomes the basis for change management*. For guidance in developing the BOE, and a template to help in its preparation, see the [Cost Estimating Manual for WSDOT Projects](#).

### 305.05(1)(d) PS&E

The Engineer’s Estimate (part of PS&E) is prepared for the Final Contract Review in preparation for advertisement, and it is used to obligate construction funds and evaluate contractors’ bids.

## 305.05(2) Risk Management

Project risks can be “opportunities” (positive events) as well as “threats” (negative events) that might affect scope, schedule, or budget. Risk assessment is the first phase of project risk management. Its purpose is to maximize the results of positive events and minimize the consequences of adverse events. For more information on risk assessment, see:

🔗 [www.wsdot.wa.gov/projects/projectmgmt/riskassessment/](http://www.wsdot.wa.gov/projects/projectmgmt/riskassessment/)

**305.05(2)(a) Design Project Risk Management Process****305.05(2)(a)(1) Risk Management Planning**

Using a systematic process, determine how to approach, plan, and execute risk management activities throughout the life of a design project.

**305.05(2)(a)(2) Identify Risk Events**

Determine which risks might affect the design project and document their characteristics. It may be a simple risk assessment organized by the design project team or an outcome of the CEVP/CRA workshop process.

**305.05(2)(a)(3) Qualitative Risk Analysis**

Assess the impact and likelihood of the identified risk and develop prioritized lists of these risks for further analysis or direct mitigation. The design team should elicit assistance from subject matter experts or functional units to assess the risks in their respective fields.

**305.05(2)(a)(4) Quantitative Risk Analysis**

Numerically estimate the probability that the design project will meet its cost and time objectives. Quantitative analysis is based on a simultaneous evaluation of the impacts of all identified and quantified risks.

**305.05(2)(a)(5) Risk Response Planning**

Develop options and determine actions to enhance opportunities and reduce threats to the design project's objectives.

**305.05(2)(a)(6) Risk Monitoring and Control**

Track and monitor the impact of identified risks, monitor residual risks, and identify new risks, ensuring the execution of risk plans, and evaluate their effectiveness in reducing risk or enhancing opportunities. Risk Monitoring and Control is an ongoing process for the life of the design project.

For more information on risk planning and risk management, see:

 [www.wsdot.wa.gov/publications/fulltext/cevp/projectriskmanagement.pdf](http://www.wsdot.wa.gov/publications/fulltext/cevp/projectriskmanagement.pdf)

**305.05(2)(b) Inclusion of Formal Risk: CRA, CEVP**

WSDOT policy requires a cost risk assessment (CRA) for projects over \$25 million and a cost estimate validation process (CEVP) for projects over \$100 million. Both of these processes include an estimate review.

It is recommended that all projects undergo at least an internal project team review for each estimate update.

- Consider a peer review or region review for each estimate that is complex or includes significant changes to scope or design development.
- Consider a region/HQ or external estimate review for all projects over \$10 million or for projects that are complex during the design phase.

Document each estimate review in the Project File, and clearly show any changes made to the estimate as a result of the review.

As of July 2014, the *Project Risk Management Guide* is planned to be combined with the *CRA/CEVP Workshop Guide*. Completion of this combined document has been extended to FY 2015. In the interim, for more information about risk, CRAs, and CEVPs, see:

 [www.wsdot.wa.gov/projects/projectmgmt/riskassessment/default.htm](http://www.wsdot.wa.gov/projects/projectmgmt/riskassessment/default.htm)

## 305.06 Value Engineering

Value engineering (VE) is a systematic process that uses a team chosen from a variety of disciplines to improve the value of a project through the analysis of its functions. The VE process incorporates, to the greatest extent possible, the values of design; construction; maintenance; contractor; state, local and federal approval agencies; other stakeholders; and the public.

For additional information about value engineering, see [Chapter 310](#).

## 305.07 Context Sensitive Solutions (CSS)

CSS is a model for transportation project development that considers the total context of a transportation project. Essentially, the CSS approach is that transportation projects must be designed for the physical aspects of facilities serving specific transportation objectives, as well as for a project's effect on the aesthetic, social, economic, and environmental needs and constraints.

Key issues for designers include:

- Access management
- Urban median design
- Bike and pedestrian access and safety
- Streetscaping
- Transit and freight
- Traffic calming
- Business access
- Operational intent of the facility
- Urban forestry

For guidance on incorporating Context Sensitive Design, see:

 [www.wsdot.wa.gov/design/policy/csdesign](http://www.wsdot.wa.gov/design/policy/csdesign)

## 305.08 Additional Design Resources

### 305.08(1) Technical Manuals

There are many WSDOT technical manuals used in project development. A collection of the most recent versions is available at the Engineering Publications Services Index website:

 [www.wsdot.wa.gov/publications/manuals/index.htm](http://www.wsdot.wa.gov/publications/manuals/index.htm)

### **305.08(2) Administrative Manuals**

Some administrative manuals (such as the Advertisement and Award Manual and the Agreements Manual) are used in project development. These manuals are available on WSDOT's internal Administrative Manuals website:

🔗 <http://wwwi.wsdot.wa.gov/publications/manuals/>

### **305.08(3) Transportation Research and Reports**

The following WSDOT Research websites may be of interest during project development:

*Understanding Flexibility in Transportation Design – Washington* guidance manual:

🔗 [www.wsdot.wa.gov/research/reports/600/638.1.htm](http://www.wsdot.wa.gov/research/reports/600/638.1.htm)

Transportation Research home page: 🔗 [www.wsdot.wa.gov/research/](http://www.wsdot.wa.gov/research/)

Research Reports Index: 🔗 [www.wsdot.wa.gov/research/reports](http://www.wsdot.wa.gov/research/reports)

### **305.08(4) Online Design Guidance**

The Design Office's website provides links to various design-related resources and contacts: 🔗 [www.wsdot.wa.gov/design/](http://www.wsdot.wa.gov/design/)

The Project Development home page is a design-related resource:

🔗 [www.wsdot.wa.gov/design/projectdev/](http://www.wsdot.wa.gov/design/projectdev/)

### **305.08(5) Project Management Online Guide**

The WSDOT Project Management Online Guide (PMOG) is an interactive website that includes links to project management tools and templates, to manuals and specifications, and examples of good practice.

🔗 [www.wsdot.wa.gov/projects/projectmgmt/onlineguide/preconstruction.htm](http://www.wsdot.wa.gov/projects/projectmgmt/onlineguide/preconstruction.htm)

### **305.08(6) Project Management and Reporting System (PMRS) Web Portal**

WSDOT implemented the Project Management and Reporting System (PMRS) to assist with managing and reporting the status of capital transportation projects. PMRS provides WSDOT project managers with current business practices and integrated tools to assist with making good decisions on management of project scope, schedule, and cost.

🔗 <http://wwwi.wsdot.wa.gov/planning/cpdmo/pmrs.htm>



- 320.01 General
- 320.02 References
- 320.03 Design Year and Forecasting Considerations
- 320.04 Definitions
- 320.05 Traffic Analysis Software
- 320.06 Travel Demand Forecasting
- 320.07 Traffic Impact Analysis (TIA)
- 320.08 TIA Scope
- 320.09 TIA Methods and Assumptions Document
- 320.10 TIA Methodologies
- 320.11 TIA Mitigation Measures
- 320.12 TIA Report

## 320.01 General

This chapter is intended to address policy-related issues associated with Washington State Department of Transportation (WSDOT) multimodal traffic analysis. It is not intended to address the specifics of demand forecasting; mesoscopic, analytical/deterministic, stochastic microsimulation; or safety performance analyses. For those items, see the latest versions of the *Highway Capacity Manual*, *Traffic Analysis Procedures Manual* (TAPM), and *Highway Safety Manual* (HSM).

Traffic analysis is intended to produce information for decision makers; it is not intended as a stand-alone tool for making decisions. Consideration of empirical data, similar traffic situations, studies, local knowledge, and seasoned traffic engineering and planning experience can also add to a pool of traffic information that is provided to decision makers.

Traffic analysis is either “operational” or “planning” in nature. Operational analysis is associated with engineering concepts focusing on near-term or existing/opening year, while planning analyses are generally focused on a future design year or interim phase years. Planning-level analyses are also used to determine impacts for environmental documentation phases of Environmental Assessment (EA) or Environmental Impact Statement (EIS) work. Much caution should be used when operational tools are used with planning-level future year projection data.

Be aware that operational models were not primarily intended for use with planning-level future year projected volumes, but there is a need to understand the difference between proposed future scenarios. Therefore, operational models need to use data from forecasting models, but analysts need to do so with an understanding of the imperfections.

Forecasting demand volumes 20 years into the future can be difficult to do well, so there should be little expectation that intersection turning movement projection-related traffic analyses by themselves will be sufficient to produce actionable designs. Consequently, some future year Measures of Effectiveness (MOEs) such as turn lane queue length should not be considered accurate, but they may be useful when comparing various scenarios if the reported differences are substantial.

With the aforementioned limitations, project-specific traffic volumes, forecasts, and system capacities are used to establish the extent of improvements needed for facilities to operate acceptably from year of opening or through interim phases and, eventually, through to the design year; for example:

- Number of general purpose/HOV/HOT lanes
- Length and number of ramp or auxiliary lanes
- Intersection or interchange spacing
- Channelization
- Signal timing
- Right of way needs
- Roundabout design parameters
- Width of sidewalks
- Extent of bike lanes
- Ferry holding lanes

Traffic analysis should examine multimodal access, mobility, and safety objectives; project benefits and costs; development impacts; and mitigation needs.

Not all projects will require the same level of effort. The specific depth and complexity of a traffic analysis will depend on a variety of factors, including:

- Project proponents (federal, tribal, state, local, and private sector)
- Legal requirements (laws, regulations, procedures, and contractual obligations)
- Lead agency
- Purpose or scope of the traffic analysis
- Data availability
- Time of day (am/pm peak hour or other)
- Funding
- ROW availability

For projects that fall under [300.06](#) (FHWA approval), coordinate with the Headquarters (HQ) Traffic Office for concurrence on traffic analysis details. Other projects can be coordinated through region Traffic offices.

## 320.02 References

### 320.02(1) *Federal/State Laws and Codes*

[42 United States Code 4321](#), National Environmental Policy Act (NEPA) of 1969

[Revised Code of Washington \(RCW\) 43.21C](#), State environmental policy ([Chapter 197-11 WAC](#) and [Chapter 468-12 WAC](#))

[RCW 36.70a](#), Growth Management Act

[RCW 36.70A.070](#), Comprehensive plans – Mandatory elements

[RCW 47.06.140](#), Transportation facilities and services of statewide significance – Level of service standards

[Washington Administrative Code \(WAC\) 365-196-430](#), Transportation elements of comprehensive plans

*Manual on Uniform Traffic Control Devices for Streets and Highways*, USDOT, FHWA; as adopted and modified by [Chapter 468-95 WAC](#) “Manual on uniform traffic control devices for streets and highways” (MUTCD)

### **320.02(2) Design Guidance**

*Design Manual*, [Chapter 321](#), for sustainable safety

*Design Manual*, [Chapter 550](#), for access management guidelines

Federal-Aid Highway Program Stewardship and Oversight Agreement

<http://www.wsdot.wa.gov/nr/rdonlyres/Of8eaddb-7fcc-4ea0-8609-5bca74634ebd/0/fhwawsdotstewardshipagreement.pdf>

*Highway Capacity Manual (HCM)*, latest edition, Transportation Research Board, National Research Council

[Level of Service Standards for Washington State Highways](#)

*Roadside Design Guide* and *A Policy on Geometric Design of Highways and Streets*, latest editions, American Association of State Highway and Transportation Officials (AASHTO)

*Standard Plans for Road, Bridge, and Municipal Construction (Standard Plans)*, M 21-01, WSDOT

*Traffic Analysis Procedures Manual (TAPM)*

WSDOT Traffic Analysis web page

### **320.02(3) Supporting Information**

*Development Services Manual*, M 3007.00, WSDOT

FHWA Traffic Analysis Toolbox

<http://www.ops.fhwa.dot.gov/trafficanalysistools/index.htm>

*Traffic Manual*, M 51-02, WSDOT

“Trip Generation,” Institute of Transportation Engineers (ITE)

WSDOT’s Highway Segment Analysis Program

WSDOT’s *Mobility Project Prioritization Process Manual* and Workbook

[www.wsdot.wa.gov/mapsdata/travel/mobility.htm](http://www.wsdot.wa.gov/mapsdata/travel/mobility.htm)

WSDOT’s Planning Level Cost Estimation (PLCE) Tool

### 320.03 Design Year and Forecasting Considerations

Project evaluation requirements can be (1) focused on near-term functionality, (2) contain interim phases, and/or (3) require a long-term focus. The project proponent can be the state (WSDOT or other state agencies) or developers (other public agencies or private concerns).

For Interchange Justification Reports (IJRs), the design year and multimodal travel demand forecasting methodologies are to be documented by the project stakeholders in both the “Project” and “Traffic Analysis” Methods and Assumptions (M&A) Documents.

**Note:** Traffic Impact Analyses (TIA) will require only a Traffic Analysis M&A Document.

The minimum design year for new roadway construction and reconstruction projects is given in [Chapter 1140](#).

When selecting design and interim year phases, stakeholders need to consider the regional significance of a proposed project, how it functions within the existing system, and the expected lifespan. The traffic analysis for developer-related projects will typically focus on existing conditions and the build-out year of the proposed project. Some larger developer projects will need to be evaluated in multiple phases, as they have the potential to significantly impact the transportation system and will thus require a longer-term focus. Mitigation measures may also be phased with these projects.

Project teams are encouraged to consider the strategic importance, economic potential, network constraints, and investment scale when determining the analysis methodologies for project phasing, design year, and forecasts. With acceptance/concurrence by the Traffic Office of purview,<sup>1</sup> the following are possible approaches to be used individually or in concert to develop future year demand volumes:

- Travel demand models
- Trend line projections
- Cumulative impacts
- Limitations of the surrounding network

### 320.04 Definitions

The following terms are defined in the [Glossary](#): *design year*, *Highways of Statewide Significance (HSS)*, *level of service (LOS)*, *Measures of Effectiveness (MOEs)*, *National Highway System (NHS)*, and *Quality of Service (QOS)*.

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<sup>1</sup> See [Chapter 300](#) and the Federal-Aid Highway Program Stewardship and Oversight Agreement: Generally, region for non-Highways of Statewide Significance (HSS) or non-National Highway System (NHS), and Headquarters for HSS and NHS.

## 320.05 Traffic Analysis Software

With acceptance by the Traffic Office of purview, use the least complex and data-intensive software deemed reasonable for any given project. Use the latest software versions.

Agreement for software and versions must be documented in the study's Traffic Analysis M&A. If MPO/RTPO<sup>2</sup> PTV models are greater than the aforementioned versions, regions may purchase and use matching versions.

- For near-term analysis of locations that do not require an understanding of interactions between various transportation systems, Sidra, Rodel, Synchro, and HCS are the primary analytical tools.
- For systemwide multimodal complex forecasting, EMME3, TransCad, and Visum are the primary tools.
- For choosing between scenarios involving multimodal traffic and/or where various transportation system elements interact, CORSIM, Vissim, or Dynameq are the primary tools.

The software mentioned above may have version limitations due to WSDOT purchased rights and contract limitations. For details about these and other traffic analysis software used by WSDOT, see the [Traffic Analysis Procedures Manual](#) or contact the region or HQ Traffic Office.

## 320.06 Travel Demand Forecasting

Designers, planners, and analysts need to be aware of the practical limitations of the selected method of multimodal traffic demand forecasting and should consider the impact of demand uncertainty when conducting analyses and drawing conclusions from those analyses. Special attention should be given to any post-processing efforts. For guidance in the selection of analysis methodology, refer to the [Traffic Analysis Procedures Manual](#). Following are brief descriptions of the four main methods for demand forecasting.

### 320.06(1) Travel Demand Models

For the vast majority of projects, this will be the proper approach for developing future year demand volumes. However, caution should be taken when using this approach to draw conclusions from operational model Measures of Effectiveness (MOEs) that are based on such forecasts, because specific and accurate turning movement volumes are needed to produce credible MOEs. Forecast models are most commonly used to produce general volumes that can help traffic planners evaluate and compare the relative merits of potential solutions against each other.

### 320.06(2) Trend Line Projections

Where travel demand models are not established or are otherwise considered inadequate, trend data can be used but must be constrained by system flow limitations. Trend line growth cannot account for peak spreading when traffic demand exceeds system supply. Use with caution and consult the [HQ Transportation Data & GIS Office](#) (TDGO) for further details about this method and any inherent limitations.

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<sup>2</sup> Metropolitan Planning Organization/Regional Transportation Planning Organization

### 320.06(3) *Cumulative Impacts*

This method is typically used to forecast volumes in areas that demonstrate uniform growth and exhibit only minor changes and marginal impacts to the region. It is also useful for analyzing growth in suburban areas that are experiencing rapid development, as other methods may not be as reliable. The basic concept is to add volumes for developments to the trending background traffic growth. The comprehensive plan for such areas should be consistent with the expected growth predicted by a project (and include other anticipated projects) in order to result in a reasonable estimate of cumulative impacts. Use with caution due to an inability to fully account for secondary impacts like future environmental issues, local network connectivity, public services, and multimodal demands.

### 320.06(4) *Limitations of the Surrounding Network*

For projects that contain infrastructure of particular importance, extraordinary expense, life span expectancy beyond 20 years, or where travel demand will likely always exceed transportation system capacity constraints, give consideration to the concept of facility capacity balancing within the context of the larger transportation system.

This approach needs to demonstrate that the maximum amount of upstream traffic flowing into a project, as well as all project-area traffic flowing into downstream sections, can be handled acceptably. This does not require traditional travel demand forecasting, which has a limitation of about 20 years. Instead, it requires a sensitivity approach where maximum up- and downstream flows are used to right-size the project area's proposed improvements. The simplest example is the SR 520 Floating Bridge: constraints on either end of the bridge limit the usefulness of adding more lanes on the bridge.

TIAs and IJR (see [Chapter 550](#)) shall clearly describe the methodology and process used to develop forecasts in support of a proposed project's analysis. For example, include only those projects that:

- Are on the six-year Transportation Improvement Plan.
- Are fully funded.
- Have entered the environmental review process.

## 320.07 **Traffic Impact Analysis (TIA)**

TIA is a term used for all analyses that are not structured IJR (see [Chapter 550](#)) or planning-level efforts like corridor studies. The quality and level of service<sup>3</sup> for state-owned and state-interest facilities shall be based upon MOEs that support the project purpose and need. They shall also be developed and presented in accordance with the latest versions of the *Highway Capacity Manual* (HCM), *FHWA Traffic Analysis Toolbox*, *Traffic Analysis Procedures Manual*, and WSDOT Vissim Protocol.

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<sup>3</sup> WSDOT sets level of service (LOS) standards for state highways and ferry routes of statewide significance (HSS) based on [RCW 47.06.140\(2\)](#). Regional transportation planning organizations (RTPOs) and WSDOT jointly develop and RTPOs establish LOS standards for regionally significant state highways and ferry routes (non-HSS) based on [RCW 47.80.030\(1\)\(c\)](#).

For some example MOEs, see the [FHWA MOE List](#), which describes measures typically used for analyzing state and local agency facilities such as freeway segments, signalized intersections, ramp terminals/junctions, sidewalks, and transit services.

Depending on the facility and when HCM Level of Service MOE is used, WSDOT thresholds are “C” for rural and “D” for urban non-NHS facilities, unless a WSDOT region specifies otherwise for specific route segments. (See each WSDOT region for details.) Refer to the [WSDOT State Highway Log](#) for a determination of existing route segment definitions for urban or rural status.

Depending on the project type and purpose, multimodal MOEs may be employed.

### **320.07(1) Updating an Existing TIA**

TIAs require either updating or a sensitivity analysis if they become more than 3 years old; however, a TIA will require updating sooner in rapidly developing areas. TIAs can avoid such update efforts in slowly developing areas. To determine if an update is required, an assessment of critical infrastructure functionality must be documented.

If the amount or character of traffic in the study area is significantly different from an earlier analysis, an update will be required. The definition of significant is 10% (volume, flow rate, travel time, delay, density, or other key MOEs) where existing operations are currently acceptable. If they are not currently acceptable, the threshold is reduced to 5%. In cases where greater than 10% change or failed MOEs have been found, consultation and concurrence with WSDOT Traffic Office of purview is required to avoid a full IJR or TIA update.

Developer-initiated TIAs are typically valid for 5 or 6 years, as that is the window provided under the Growth Management Act for concurrency. The Development Services Office should be consulted regarding the need for updates to TIAs for developer, tribal, and local agency projects.

## **320.08 TIA Scope**

To establish the appropriate scope, consultation between the lead agency, WSDOT, and those preparing the TIA is encouraged before beginning work. TIA-required elements can be found in the [Traffic Analysis Procedures Manual](#) (an abbreviated list is provided below). **Note:** For developer-initiated TIAs, the local agency may prescribe the scope of the TIA per the local agency’s adopted standards.

### **320.08(1) TIA Boundaries**

The traffic impacts of local streets and roads can impact intersections on state highway facilities. In these cases, include in the TIA an analysis of adjacent local facilities (driveways, intersections, main lines, and interchanges) upstream and downstream of the intersection with the state highway. A “lesser analysis” may include obtaining traffic counts, preparing signal warrants, or a focused TIA. For developer projects, the boundaries of the analysis (such as the city limits) may be determined in consultation with local agencies and WSDOT. For further guidance, consult the [Traffic Analysis Procedures Manual](#) and [Development Services Manual](#).

### 320.08(2) Traffic Analysis Scenarios

WSDOT must understand the effects of plan updates and amendments, as well as the effects of specific project elements (including site plans, conditional use permits, subdivisions, and rezoning) that have the potential to impact state facilities. Consultation between the lead agency, WSDOT, and those preparing the TIA is essential early in the process to help determine appropriate scenario analyses and goals. For further guidance, consult the [Traffic Analysis Procedures Manual](#) and [Development Services Manual](#).

Depending on the type of work being analyzed, required TIA scenarios can range from simple “existing conditions with and without project,” to more complex analyses where TIA scenarios could include: existing; opening year with and without project; interim years with and without project; and design year with and without project. If developed with WSDOT, and if following IJR guidance, pre-IJR work such as Area Study TIAs can be used in future IJRs.

The appropriate and necessary scenarios shall be agreed upon by the TIA study team and documented in the TIA Methods and Assumptions (M&A) Document.

For existing networks, calibrate models to existing conditions.

If a near-term baseline network is required, only funding-secured projects should be added to the existing network. This is typical of opening year models that are a few years beyond existing year.

For interim scenario networks, include only projects or developments within the forecasting process that have the highest probability within the 10-year horizon. For example, include projects that are fully funded or have a construction phase in the six-year Transportation Improvement Plan.

For scenarios with phases beyond 10 years, TIA or IJR teams should discuss and document the merits of including other potential projects. For example:

- Projects on current long-range regional transportation plans (or the locally-adopted transportation plan, if the TIA is not on a regionally-significant facility)
- Projects on the HSP or MTP

All other potential influences with lower probability should not be allowed to affect travel or trip demand forecast results—with one exception: TIAs and IJRs may include multiple scenarios for the design year. For example, if a major assumption for unfunded additional lanes “feeding traffic into” or “allowing traffic from” the project is desired for the design year to allow for a better understanding of expensive infrastructure sizing (such as ultimate bridge widths), ensure a constrained design year scenario is included so that proper funding-based phasing solutions are communicated.

## 320.09 TIA Methods and Assumptions Document

The TIA M&A is similar to an IJR M&A in that it documents the “who, what, where, when, how, and why” items associated with the traffic analysis portion of a project.

Prior to any substantial fieldwork or traffic/facility data collection, consultation between the lead agency, WSDOT, and those preparing the TIA is encouraged to help reach and document consensus on study data needs and assumptions. These and other items should be documented and the M&A signed by all lead staff that conduct work in association with the TIA M&A document. For further guidance, consult the [Traffic Analysis Procedures Manual](#) and [Development Services Manual](#).

## 320.10 TIA Methodologies

The [FHWA Traffic Analysis Toolbox](#), Volume 2, provides a methodology for selecting traffic analysis tools. However, in general, traffic analysis methodologies for those facility types indicated below are used by WSDOT and will be accepted if agreed upon by those who sign TIA or IJR Analysis M&A Documents.

- **Freeway Segments:** *Highway Capacity Manual/Software (HCM/S)*; operational and design analysis; macroscopic, mesoscopic, and microsimulation
- **Weaving Areas:** *Design Manual (DM)*; HCM/S; operational and design analysis; microsimulation
- **Ramps and Ramp Terminals:** HCM/S; operational and design analysis; DM; microsimulation
- **Multilane Highways:** HCM/S; operational and design analysis; macroscopic, mesoscopic, and microsimulation
- **Two-Lane Highways:** HCM/S; operational and design analysis
- **Intersection, Signalized:** Sidra; Synchro; SimTraffic; HCM/S; Vissim,
- **Intersection, Roundabout:** Sidra; Rodel; HCM; Vissim
- **Corridors:** Sidra; Synchro; SimTraffic; HCM; Vissim
- **Stop-Controlled Intersections:** HCM/S for capacity; DM [Chapter 1330](#) and the [MUTCD](#) for signal warrants (if a signal is being considered)
- **Transit:** HCM/S; operational and design analysis; [Traffic Manual](#)
- **Pedestrians:** HCM/S
- **Bicycles:** HCM/S
- **WSDOT Criteria/Warrants:** [MUTCD](#) (signals, stop signs); [Traffic Manual](#) (school crossings); DM [Chapter 1040](#) (freeway lighting, conventional highway lighting)
- **Channelization:** DM

The procedures in the *Highway Capacity Manual* do not explicitly address operations of closely spaced signalized intersections, nor does WSDOT currently endorse microsimulation or roundabout guidance as noted in the HCM/S. Under such conditions, several unique characteristics must be considered, including spill-back potential from the downstream intersection to the upstream intersection; effects of downstream queues on upstream saturation flow rates; and unusual platoon dispersion or compression between intersections. An example of such closely spaced operations is signalized ramp terminals at urban interchanges. Queue interactions between closely spaced intersections can seriously distort the results of analyses that follow the procedures in the HCM.

Other analysis methods may be accepted; however, consultation between the lead agency, region or HQ Traffic, and those preparing the TIA is encouraged to reach consensus on the data necessary for the analysis if meso- or microsimulation is employed. When a state highway has saturated flows, the use of a meso- or microsimulation models can provide additional understanding. Note, however, that the simulation model must be calibrated and validated for reliable results and is intended for near-term operational analyses (see the [Traffic Analysis Procedures Manual](#) for guidance on calibration and validation).

Operational MOEs for simulation models based on long-term forecasts should be used primarily to determine which scenarios are better than others. The models can only do so if the resultant MOEs demonstrate significant differentiation between scenarios. TIA or IJR teams will determine what is considered significant and will document those findings in the study. However, at a minimum, significant must be greater than the expected error band of the models used. For example, if Vissim is considered to be calibrated to a given MOE within 15% of existing conditions (a very wide band), the scenarios need to show greater than 15% differentiation between each other to be significant.

### 320.11 TIA Mitigation Measures

Consultation between the lead agency, WSDOT, and the responsible parties preparing the TIA is recommended in order to reach consensus on the project mitigation measures. Mitigation measures, if applicable, need to be included in the TIA to determine whether a project's impacts can be eliminated or reduced to a level of insignificance. Eliminating or reducing impacts to a level of insignificance is the standard pursuant to the State Environmental Policy Act (SEPA) and National Environmental Policy Act (NEPA). The lead agency is responsible for administering the SEPA and/or NEPA review process. WSDOT is responsible for reviewing the TIA for impacts that pertain to state highway facilities. However, the authority vested in the lead agency under SEPA/NEPA does not take precedence over other authorities in law.

Development work in the state highway right of way requires a WSDOT permit or agreement. Normally, this work is coordinated by the region Development Services Office.

Mitigation measures may take the following forms:

- Channelization such as turn lanes or raised islands
- Installation of a roundabout or, if necessary, a traffic signal (signal warrant analysis per [MUTCD](#) is required)
- Frontage improvements
- Donation of right of way

- Addressing any design or operational deficiencies created by the proposal
- Possible restrictions of turning movements
- Sight distance enhancements
- Traffic mitigation payment (pro rata share contribution) to a programmed WSDOT project (see Chapter 4 of the *Development Services Manual*)
- Satisfaction of local agency guidelines and interlocal agreements

## 320.12 TIA Report

### 320.12(1) TIA Minimum Contents

The minimum contents of a TIA report are listed in the *Traffic Analysis Procedures Manual* and *Development Services Manual*. Listed below is a summary; however, the depth and detail of content under each element varies in relation to the scale and complexity of the project.

#### (a) Executive Summary

#### (b) Table of Contents

1. List of Exhibits (Maps)
2. List of Tables

#### (c) Introduction

1. Description of the proposed project with purpose and need.
2. Traffic Impact Analysis Methods and Assumptions summary.
3. Map of project location.
4. Site plan, including all access to state highways (site plan, map).
5. Circulation network, including all access to state highways (vicinity map).
6. Land use and zoning.
7. Phasing plan, including proposed dates of project (phase) completion.
8. Project sponsor and contact person(s).
9. References to other traffic impact studies.
10. Other mitigation measures considered.

#### (d) Traffic Analysis

1. TIA M&A (see the *Traffic Analysis Procedures Manual* for a template or the *Development Services Manual*).
2. Existing and projected conditions of the site: posted speed; traffic counts (to include turning movements); sight distance; channelization; design deviations; pedestrian and bicycle facilities; design vehicle; and traffic controls, including signal phasing and multi-signal progression where appropriate (exhibit(s)).

3. DHV and ADT; project trip generation and distribution map, including references and a detailed description of the process involved in forecasting the projected trips, including tables.
4. Project-related transportation mode split, with a detailed description of the process involved in determining transportation mode split.
5. Project-generated trip distribution and assignment with a detailed description of the process involved in distributing and assigning the generated traffic, including exhibit(s).
6. If intersection control additions are employed and traffic signals are assumed, include functionality and warrant analyses. With roundabouts or signals, include existing conditions, cumulative conditions, and full-build of plan conditions with and without project.
7. Safety performance analysis (see [Chapter 321](#) and the [Traffic Analysis Procedures Manual](#)).

**(e) Conclusions and Recommendations**

1. Quantified or qualified LOS, QOS, and other appropriate MOEs of impacted facilities with and without mitigation measures.
2. Predicted safety performance with and without mitigation measures.
3. Mitigation phasing plan with dates of proposed mitigation measures.
4. Defined responsibilities for implementing mitigation measures.
5. Cost estimates for mitigation measures and financing plan.

**(f) Appendices**

1. Description of traffic data and how data was collected and manipulated.
2. Description of methodologies and assumptions used in analyses.
3. Worksheets used in analyses; for example, signal warrants, LOS, QOS, and traffic count information.
4. If microsimulation is used, provide a copy of the Confidence and Calibration Report.

- 321.01 General
- 321.02 Sustainable Safety for I-2 Projects
- 321.03 Sustainable Safety for Other Projects
- 321.04 Safety Analysis Process & Tools
- 321.05 References
- 321.06 Documentation

## 321.01 General

WSDOT has a transportation safety goal titled Target Zero as part of the Washington State Strategic Highway Safety Plan. In pursuit of that goal, WSDOT recognizes that risk exists in all modes of transportation. The universal objective is to reduce the number and severity of crashes within the limits of available resources, science, technology, and legislatively mandated priorities.

The Secretary's [Executive Order 1085](#), Sustainable Highway Safety Program, sets the overarching policy for the Washington State Department of Transportation (WSDOT) to embark on a more targeted and scientifically-based approach for identifying and addressing collision risks. This policy relies on quantification of safety modifications using various tools and assessment techniques to determine appropriate safety countermeasures.

The policy directs engineers to base project-level decisions on the safety analysis of specific locations and corridors. Proven low-cost countermeasures should be considered. Focusing on proven lower-cost targeted countermeasures at specific locations optimizes the return on investment of safety dollars. These lower-cost investments allow for additional identified locations to be addressed.

Implementing Sustainable Safety improves WSDOT's effectiveness in reducing the risk of fatal and serious injury collisions statewide. It focuses on site-specific crash contributing factors and types of collisions through the use of state-of-the-art principles and analytical methods to diagnose, quantify, and predict potential collision risks. The Sustainable Safety approach relies on peer review of projects presented to region and Headquarters (HQ) experts to critically review and offer potential options to project scope and approaches.

The Sustainable Highway Safety Policy directs WSDOT to use the most effective and efficient resources to achieve the goals of the Washington State Strategic Highway Safety Plan: Target Zero. This approach:

1. Maximizes the reduction in the risk of fatal and serious injury collisions on Washington's highways.
2. Provides the most accurate assessment of collision risk.
3. Identifies the most critical risk locations.
4. Provides the most accurate assessment of potential collision reduction benefits.
5. Identifies and deploys solutions with the greatest benefit/cost.
6. Reduces waste by removing design elements that provide marginal or no reduction in collision risk.

7. Addresses the greatest number of crucial risk locations for a given investment level.
8. Provides a more accurate assessment of project and program performance.
9. Provides scientific and engineering tools to continually improve and refine safety analyses.

Practical Design is an approach to making project decisions that focus on the need and purpose for the project using the most cost-effective solutions. Practical Design that integrates Sustainable Safety supports Washington in reaching its Target Zero goal. Sustainable Safety is an essential part of successful Practical Design implementation. It provides the process and methods to incorporate safety performance assessment and peer review into Performance-Based Practical Design. Sustainable Safety allows the planner, engineer, and decision maker, to identify and quantify the safety performance of design alternatives. Sustainable Safety is a critical and complementary element of Practical Design.

### 321.02 Sustainable Safety for I-2 Projects

The Highway Safety Executive Committee (HSEC) formally adopted the *Highway Safety Manual* (HSM) for statewide implementation in 2011. The HSM introduced a science-based technical approach to identifying sites with the most potential for reducing crash severity or frequency, and potential countermeasures for addressing factors contributing to those crashes. For a brief introduction of the *Highway Safety Manual*, see: [www.highwaysafetymanual.org/about.aspx](http://www.highwaysafetymanual.org/about.aspx)

As part of the endorsement of HSM, WSDOT implemented SafetyAnalyst as the new tool for screening and initial ranking of sites within the state system. SafetyAnalyst is used to analyze the entire roadway network and identify sites with potential for safety improvements. These sites are identified as collision analysis segments and the statewide locations with the highest potential for reducing the number and/or severity of fatal and serious injury collisions. The formal process for evaluating and scoping safety projects is illustrated in the [Safety Scoping Process](#) flowchart. The safety scoping process identifies a Safety Review Panel where the regions present their proposed projects for approval.

#### 321.02(1) Safety Management Process

The safety management process is a methodology used to reduce crashes on existing roadway networks statewide. These steps are a set of tools available for use in conjunction with sound engineering judgment. The typically responsible groups are mentioned below; however, depending on how a region is organized, the responsible groups may vary. The seven steps are:

1. **Network Screening is initiated** by HQ Capital Program Development & Management (CPDM), approved by HSEC, then refined by the region Planning, Traffic, or Programming Office. In this step, the whole or a subset of the transportation network is screened to identify and rank sites from *most likely* to *least likely* to realize reductions in collision frequency and/or severity by implementing countermeasures.
2. **Diagnosis** is usually done through preparation of the Collision Data Analysis Report by the region Program Management or Traffic Office. This step provides an understanding of safety performance using observed collision history and physical characteristics to determine the contributing factors and potential sites with higher-than-normal safety opportunities for that type of site using HSM methodologies.

3. **Selecting Countermeasures** is usually done by the region Program Management or Traffic Office with region Design Office input. In this step, the higher-than-normal collision sites are further evaluated to identify factors that may be contributing to observed collisions. Countermeasures are then selected to address the factors contributing to the number and/or severity of collisions.
4. **Economic Appraisals** is usually done by the region Program Management Office in coordination with the region Traffic Office. In this step, economic appraisals are performed to compare the benefits of potential collision countermeasures (calculated using crash modification factors) versus countermeasure costs and their effects on overall project costs.
5. **Prioritize Projects** is usually done in coordination with the region Program Management office, region Traffic Office and CPDM. In this step, potential safety projects are reviewed and prioritized based on their benefits and costs.
6. **Design decision documentation** is performed by the Region Office preparing the design using safety analyses for design decisions and documentation of those decisions. Specific uses include:
  - Design of I-2 Safety Projects
  - Safety analysis of alternatives
  - Safety analysis for design deviations/project analyses/corridor analyses (see [Chapter 300](#))
  - Work zone design
7. **Safety Effectiveness Evaluation** is a post-project step, usually performed by HQ CPDM, HQ Design Office, or the region or HQ Traffic Office, that analyzes the effectiveness of countermeasures used in past projects. Countermeasures are evaluated for their effectiveness in reducing the number and/or severity of collisions in order to determine if predicted collision reductions were realized. Safety effectiveness evaluations play an important role in assessing how well funds have been invested in safety improvements. Each of these aspects of safety effectiveness evaluation may influence future decision-making activities related to allocation of funds and revisions to highway agency policies. CPDM and HQ Design evaluate the overall effectiveness of the I-2 safety program.

### 321.03 Sustainable Safety for Other Projects

The *Highway Safety Manual* and its safety analysis tools have been developed to aid design decision making and documentation. It does so by helping to quantify the safety performance implications of design decisions and by providing a basis for predicting and documenting the future safety performance of those decisions. Safety analysis tools may be appropriate for the following activities:

- Design Decisions:
  - To analyze and document the safety performance of any alternatives and design decisions.
- Design Deviations/Corridor Analyses/Project Analyses (see [Chapter 300](#)):
  - To predict the safety performance of each design alternative, and to help weigh the safety risk of each alternative as part of the information needed to apply engineering judgment.

- Most of the alternatives discussed in deviations have safety aspects that should be analyzed to compare them to the other alternatives. If a deviation has no safety aspects, a safety analysis would not provide benefit.
- Interchange Justification Reports (IJRs) Collision Analysis. (See [Chapter 550](#) about collision analysis in IJRs.)
  - Identify and document the existing safety performance of the freeway section and the adjacent affected local surface system.
  - Predict the safety performance from traffic flow and geometric conditions imposed by the access point revision alternatives.
  - The scope of a collision analysis in an IJR is the decision of the IJR support team and the approving authority(ies), the Assistant State Design Engineer for your region, and the Federal Highway Administration (FHWA) Safety/Design Engineer.

Whether or not a deviation needs a safety analysis of its alternatives is ultimately the decision of the approving authority (see [Exhibit 300-2](#)).

### 321.04 Safety Analysis Process & Tools

Perform a safety analysis to: identify sites with the most potential for crash frequency or severity reduction; identify factors contributing to crashes and the associated potential countermeasures to address these issues; conduct economic appraisals of improvements and prioritize projects; evaluate the crash reduction benefits of implemented treatments; and calculate the effect of various design alternatives on crash frequency and severity. Calculate these effects for planning, design, operations, and policy decisions.

The safety analysis process is intended to be scalable. In every safety analysis, determine the correct level needed. The approving authority for the design or planning document in question is always the final authority on whether a safety analysis is needed and how extensive it is. (See Exhibits [300-2](#) and [300-3](#) for a list of approving authorities.)

#### 321.04(1) Collision Data Analysis Report

The primary tool used to document the results of a safety analysis is the Collision Data Analysis Report. A report template with instructions is available here:

<http://wwwi.wsdot.wa.gov/riskmanagement/shs/safetytools.htm>

Conduct a collision data analysis to determine the contributing factors associated with the collisions. Once the contributing factors are known, identify countermeasures that range from low cost to high cost. Complete a benefit/cost analysis to determine what countermeasure to select. Based on the selected countermeasure, determine and document those design elements and levels to be included in the project (see the [Safety Scoping Process](#) flowchart). Complete the following documentation:

- Include an analysis of the collision history to identify contributing factors.
- Identify which of the 4 E's (Engineering, Enforcement, Education, and Emergency Services) best address the contributing factors. If you select engineering solutions, then consider countermeasures that include operational, low-cost, and high-cost solutions.

- Select the recommended countermeasure based on a benefit/cost analysis. Tools available for use in selecting recommended countermeasures include HSM, SafetyAnalyst, Road Safety Assessments (RSAs), Interactive Highway Safety Design Model (IHSDM), and the Crash Modification Clearinghouse. New and other tools will be assessed for use as they become available. WSDOT's "Short List" of approved countermeasures can be found here:

🔗 <http://wwwi.wsdot.wa.gov/riskmanagement/shs/safetycountermeasures.htm>

### 321.04(2) **Safety Analysis Resources and Tools**

Various tools are available to support a safety analysis. All of the safety performance tools mentioned below can be found through the Sustainable Highway Safety website:

🔗 <http://wwwi.wsdot.wa.gov/riskmanagement/shs/>

- **SafetyAnalyst:** This application is used by and CPDM for network screening. It is also used during scoping and design for gathering collision data for analysis. SafetyAnalyst has collision data broken down into highway segments and intersections that can be displayed in tables, graphs, and charts. The collision data in SafetyAnalyst is updated once every year when the last year's data has been input in the Collision Data Mart.
- **The Collision Data Mart:** This database application is another way to obtain collision data. Access to this application is granted by your supervisor and the Transportation Data Office. The data is updated as it comes in.
- **Collision Analysis Data Report:** This template is the basis for all collision analyses for all types of design documentation that need collision analyses (see [321.04\(1\)](#)).
- **Interchange Safety Analysis Tool enhanced (ISATe):** This tool analyzes the safety performance of freeway segments, speed change lanes, interchange ramps, ramp terminal intersections, and collector-distributor (CD) lanes.
- **Highway Safety Manual Spreadsheets:** There are different spreadsheet options for *Highway Safety Manual* safety performance predictions. Each of these spreadsheet tools can predict the safety performance of highway segments and intersections for three types of highways: Rural Two-lane Two-way, Rural Multilane, and Urban-Suburban Arterial.

Following are the spreadsheet options, with their benefits and limitations:

1. **AASHTO Highway Spreadsheets:** These spreadsheets are the simplest of the three, but they can only handle a maximum of two segments and two intersections of the same type of highway at a time.
2. **Extended Highway Spreadsheets:** These spreadsheets are a little more complicated, but they can handle an unlimited number of highway segments and intersections of the same highway type. In other words, you can analyze an unlimited number of highway segments and intersections as long as you don't change highway types.

3. **Collision Analysis Tool (CAT):** This is an application with an accessible spreadsheet behind it. It can handle an unlimited number of segments and intersections for any of the highway types. In other words, you can analyze an unlimited number of highway segments and intersections and can mix and match highway types. This tool also calculates Benefit Cost ratio of alternatives.
4. **WSDOT Crash Modification Factor (CMF) Short List:** This is a spreadsheet displaying the latest pre-approved CMFs that can be readily used if the context of the listed CMF matches the context of the alternative being analyzed. To back up the CMFs on this spreadsheet, there are detailed investigation reports for each CMF type.
  - **Crash Modification Factor Clearinghouse:** For needed CMFs not yet on the short list, this online AASHTO database holds all of the advertised CMFs. Consult this database when no suitable CMF can be found on the short list:  
🔗 <http://wwwi.wsdot.wa.gov/riskmanagement/shs/safetycountermeasures.htm>

## 321.05 References

### 321.05(1) Federal/State Directives, Laws, and Codes

[23 United States Code \(USC\) 148](#) – Federal requirements for the Highway Safety Improvement Program (HSIP)

[Revised Code of Washington \(RCW\) 47.05.010](#) – The statement of purpose for priority programming of transportation projects

[Secretary's Executive Order 1085](#) – Sustainable Highway Safety Program

### 321.05(2) Design Guidance

*Highway Safety Manual (HSM)*, AASHTO, 2010

*A Policy on Geometric Design of Highways and Streets (Green Book)*, AASHTO, 2011

### 321.05(3) Supporting Information

Safety Scoping Process for State Routes flowchart Internal Web Page:

🔗 <http://wwwi.wsdot.wa.gov/ppsc/pgmmgt/wwwi/planprog/scoping/safetyscopingprocessflowchart.pdf>

Strategic Highway Safety Plan: Target Zero – Washington State's strategic traffic safety plan developed by the Washington Traffic Safety Commission: 🔗 <http://www.targetzero.com/>

Sustainable Highway Safety Internal Web Page – Contains all of the procedures and tools to implement highway safety: 🔗 <http://wwwi.wsdot.wa.gov/riskmanagement/shs/>

Washington Transportation Plan – Washington State Transportation Commission's recommended strategic transportation plan; includes a highway safety element:

🔗 [http://www.wstc.wa.gov/wtp/documents/wtp2030\\_201012.pdf](http://www.wstc.wa.gov/wtp/documents/wtp2030_201012.pdf)

## 321.06 Documentation

Refer to [Chapter 300](#) for documentation requirements.

- 400.01 General
- 400.02 References
- 400.03 Procedures
- 400.04 Datums
- 400.05 Global Positioning System
- 400.06 WSDOT Survey Monument Database
- 400.07 Geographic Information System
- 400.08 Photogrammetric Surveys
- 400.09 Documentation

## 400.01 General

The Washington State Department of Transportation (WSDOT) is permitted, by an agreement with the Board of Registration for Professional Engineers and Land Surveyors, to practice land surveying “under the direct supervision of a licensed professional land surveyor OR a licensed professional engineer” (see [Exhibit 400-1](#), Interagency Agreement).

## 400.02 References

### 400.02(1) *Federal/State Laws and Codes*

[Revised Code of Washington \(RCW\) 58.09](#), Surveys – Recording

[RCW 58.20.120](#), System designation – Permitted uses

[RCW 58.24.040\(8\)](#), “. . . temporary removal of boundary marks or monuments”

[Washington Administrative Code \(WAC\) 332-120](#), Survey monuments – Removal or destruction

[WAC 332-130](#), Minimum standards for land boundary surveys and geodetic control surveys and guidelines for the preparation of land descriptions

Interagency Agreement Between the Washington State Department of Transportation and the Board of Registration for Professional Engineers and Land Surveyors (1990)

### 400.02(2) *Design Guidance*

[Construction Manual](#), M 41-01, WSDOT

[Highway Surveying Manual](#), M 22-97, WSDOT

[Plans Preparation Manual](#), M 22-31, WSDOT

WSDOT Survey Monument Database

[www.wsdot.wa.gov/monument/](http://www.wsdot.wa.gov/monument/)

### 400.03 Procedures

For WSDOT projects, it is recommended that surveying activities include (if appropriate) but not be limited to the following items.

#### 400.03(1) *Project Definition Phase*

During the Project Definition phase, perform the following:

- (a) Record any pertinent surveying information as detailed in the Design Documentation Checklist: [www.wsdot.wa.gov/design/projectdev/](http://www.wsdot.wa.gov/design/projectdev/)
- (b) Conduct research to find recorded survey monuments existing within the project area.
- (c) Determine and prioritize project survey needs and tasks to be completed. Needs and tasks may include the following issues:
  - Cadastral
  - Right of way
  - Geodetic
  - Photogrammetry
  - Other issues as needed
- (d) Contact city, county, state, and federal agencies, the Region Survey Office, and the GeoMetrix Geodetic Survey section for potential impact to existing monuments.

#### 400.03(2) *Design and Development of the Plans, Specifications, and Estimates*

During the design and development of the Plans, Specifications, and Estimates (PS&E), perform the following:

- (a) The project manager and project surveyor hold a preliminary survey meeting, regarding:
  - Project schedule.
  - Anticipated survey requests.

For preliminary survey meeting specifics and roles and responsibilities of the project manager and project surveyor, see the *Highway Surveying Manual*.

- (b) Perform field reconnaissance, mark existing recorded survey monuments, and determine the location of possible new survey monuments. Also, mark found unrecorded monuments for preservation if practical.
- (c) Contact the GeoMetrix Geodetic Survey section by email, memo, or other written notification for assistance in determining the impact to state and federal geodetic monuments.
- (d) Refer to the *Highway Surveying Manual* to:
  - Convert Washington State Plane Coordinates to project datum.
  - Document the procedure and combined factor used for converting between datums.
  - Determine survey collection methods.
  - Collect primary, secondary, and tertiary survey data.
  - Process and import secondary, tertiary, or other survey data into design software for use by designers.

- (e) Apply to the Department of Natural Resources (DNR) for permits for monuments that will be disturbed or removed (see [Chapter 410](#)).
- (f) The GeoMetrix Geodetic Survey section will archive new primary survey control data in the WSDOT Monument Database for future retrieval.
- (g) Ensure that all survey monuments within the project right of way are shown on the contract plans in order to avoid accidental damage.
- (h) Develop a Record of Survey ([RCW 58.09](#)) or a Monumentation Map as required (see [Chapter 410](#)).

### **400.03(3) After Construction is Completed**

- (a) Complete a post construction survey as described in the [Highway Surveying Manual](#).
- (b) Have the DNR Completion Report signed and stamped by the appropriate professional in direct charge of the surveying work, then file with DNR as described in [Chapter 410](#).

## **400.04 Datums**

A datum is a geometrical quantity (or set of quantities) that serves as a reference, forming the basis for computation of horizontal and vertical control surveys in which the curvature of the earth is considered. Adjusted positions of the datum, described in terms of latitude and longitude, may be transformed into State Plane Coordinates.

All engineering work (mapping, planning, design, right of way, and construction) for WSDOT projects is based on a common datum.

### **400.04(1) Horizontal**

[WAC 332-130-060](#) states, "The datum for the horizontal control network in Washington shall be NAD83 (1991) [the North American Datum of 1983] as officially adjusted and published by the National Geodetic Survey of the United States Department of Commerce and as established in accordance with [Chapter 58.20 RCW](#). The datum adjustment shall be identified on all documents prepared; i.e., NAD83 (1991)." (See the [Highway Surveying Manual](#) for further information.)

### **400.04(2) Vertical**

The North American Vertical Datum of 1988 (NAVD88) as defined by the National Geodetic Survey (NGS) is the official civilian datum for surveying and mapping activities in the United States. WSDOT has adopted this datum. (See the [Highway Surveying Manual](#) for further information.)

## **400.05 Global Positioning System**

A Global Positioning System (GPS) uses a constellation of satellites and earth stationed receivers to determine geodetic positions (latitude and longitude) on the surface of the earth. WSDOT personnel use this survey technology. (See the [Highway Surveying Manual](#) for more detailed discussions.)

GPS technology is changing rapidly. The key point is for the designer and surveyor to select the best tool (GPS or conventional applications) for doing the survey fieldwork. Often, a combination of GPS and conventional (Total Station) surveying is appropriate.

## 400.06 WSDOT Survey Monument Database

The WSDOT Survey Monument Database provides storage and retrieval capabilities for data associated with survey control monuments set by WSDOT. This database supports and tracks the Report of Survey Mark and aids in fulfilling WSDOT's obligation to contribute to the body of public record, thereby minimizing the duplication of survey work. The Report of Survey Mark provides data on specific GPS stations. (See [Exhibit 400-2](#) for an example of a Report of Survey Mark.)

To access the WSDOT Survey Monument Database, see the following website:

[www.wsdot.wa.gov/monument/](http://www.wsdot.wa.gov/monument/)

## 400.07 Geographic Information System

The Geographic Information System (GIS) is a compilation of information from many sources. Its purpose is to assemble data into a central database for the common good. The data is stored on many levels so the desired information can be selected and combined to achieve the desired product. Surveying and photogrammetric data are vital elements of this system.

## 400.08 Photogrammetric Surveys

Photogrammetric surveys are performed to furnish topographic or planimetric maps and cross sections for use in the reconnaissance, location, and preliminary design phases of highway work. To use photogrammetric surveys for final design and construction requires that the ground be nearly bare to obtain the necessary accuracy. By using well-planned aerial photography in stereoscopic plotters, contours and other physical features are delineated on map sheets to a scale consistent with the accuracies or detail required.

The usefulness of aerial photography is not limited to mapping. Taking the form of enlargements, mosaics, and digital images, it can be used as a visual communication tool (displays and exhibits) for planning, design, property acquisition, engineering, construction, litigation, and public relations.

To obtain information on preparation, procedure, and programming of aerial photography and photogrammetric mapping and applications, contact the HQ [GeoMetrix](#) Office. When requesting a photogrammetric survey, specify the desired units and check the units of the product. Allow for the time required to communicate the complex and detailed work request, develop the service, and accomplish the product.

## 400.09 Documentation

For documentation related to monuments, see [Chapter 410](#).

Primary and secondary survey control data are archived in the WSDOT Survey Monument Database and GIS when available.

For the list of documents required to be preserved in the Design Documentation Package and the Project File, see the Design Documentation Checklist:

[www.wsdot.wa.gov/design/projectdev/](http://www.wsdot.wa.gov/design/projectdev/)

## Exhibit 400-1 Interagency Agreement

INTERAGENCY AGREEMENT BETWEEN  
THE WASHINGTON STATE DEPARTMENT OF TRANSPORTATION  
AND THE BOARD OF REGISTRATION FOR PROFESSIONAL  
ENGINEERS AND LAND SURVEYORS

THE FOLLOWING Interagency Agreement is hereby entered into between the Washington State Department of Transportation (hereafter referred to as "WSDOT") and the Washington State Board of Registration for Professional Engineers and Land Surveyors (hereafter referred to as "BOARD").

I

DECLARATIONS OF THE PARTIES

- A. WHEREAS the BOARD has the exclusive authority to regulate the practice of engineering and land surveying in Washington; and
- B. WHEREAS WSDOT employees are required to practice land surveying as defined by [RCW 18.43.020](#) in carrying out the program of said agency; and
- C. WHEREAS WSDOT is exempted from necessarily using a licensed land surveyor to perform said surveys in accordance with the provisions of the Survey Recording Act, [RCW 58.09.090](#); and
- D. WHEREAS both the BOARD'S and WSDOT'S goals include the performance of land surveys in conformance with recognized standards of practice and relevant laws and administrative codes in order to safeguard life, health and property; and
- E. WHEREAS the parties to this Agreement agree to the following Principles of Agreement.

II

PRINCIPLES OF AGREEMENT

- A. The practice of land surveying performed by WSDOT employees shall be under the direct supervision of a licensed professional land surveyor OR licensed professional engineer. Said licensee shall hold a valid Washington license issued in conformance with [RCW 18.43](#).
- B. All surveys performed by WSDOT employees shall be performed in accordance with the Survey Standards promulgated under Chapter [332-130 WAC](#).
- C. When a survey has been performed by WSDOT employees a survey map shall be prepared and filed with the county engineer in compliance with [RCW 58.09.090\(1\)\(a\)](#). Said map's contents shall be in conformance with the requirements of [RCW 58.09.060](#) and [WAC 332-130](#). Furthermore, said map shall contain the stamp and signature of the licensee who was in direct responsible charge of the work.

Exhibit 400-1 Interagency Agreement (continued)

- D. A record of corner information shall be filed in accordance with RCW 58.09.040(2) and 58.09.090(2) where WSDOT employees replace or restore an existing or obliterated general land office corner. Said record of corner information shall be signed and stamped by the professional land surveyor or professional engineer responsible for said work.
- E. The temporary removal or destruction of any section corner or any other land boundary mark or monument shall be permitted if performed in compliance with RCW 58.24.040(7)(8).
- F. Whether performed by a licensed professional engineer or a licensed professional land surveyor, any surveys performed by WSDOT shall be in accordance with the standards generally expected of those practicing professional land surveying.

IN WITNESS WHEREOF: The Washington State Department of Transportation and the Board of Registration have signed this Agreement.

\_\_\_\_\_/S/\_\_\_\_\_  
 Ed W. Ferguson, PE  
 DEPUTY SECRETARY  
 Department of Transportation

\_\_\_\_\_/1/5/90\_\_\_\_\_  
 Date

This Agreement approved by motion of the Board dated January 19, 1990.

\_\_\_\_\_/S/\_\_\_\_\_  
 Wesley E. Taft, PE  
 CHAIRMAN, Board of Registration

\_\_\_\_\_/1/19/90\_\_\_\_\_  
 Date

Exhibit 400-2 Report of Survey Mark Example



**Geographic Services**

**Report of Survey Mark**

SURVEY INFORMATION SYSTEM

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GENERAL MONUMENT INFORMATION

<b>Designation:</b> GP29530-21 <b>Monument ID:</b> 8 <b>State:</b> WASHINGTON <b>County:</b> SNOHOMISH <b>Region:</b> NW <b>Nearest Town:</b> ARLINGTON <b>Usgs Quad:</b> ARLINGTON WEST	<b>T.R.S:</b> 31N, 5E, 2 <b>Corner Code:</b> <b>State Route:</b> 530 <b>Mile Post:</b> 20.590 <b>Station:</b> <b>Offset:</b> <b>Owner:</b> GS <b>Bearing:</b> M	<b><u>ACCOUNTS INFORMATION</u></b> <b>BOOK PROJECT INVOICE</b> 49 0L2030 23-94042
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**Description**  
 TO REACH THE STATION FROM THE INTERSECTION OF SR 530 AND SR 009 AT ARLINGTON, GO WEST 0.2 MILES ALONG SR 530 TO THE STATION ON THE RIGHT. IT IS LOCATED 1.1 METERS SOUTH OF A WITNESS POST, 33.5 METERS WEST OF THE APPROXIMATE CENTERLINE OF DIKE ROAD AND 1.2 METERS NORTH OF A GUARD RAIL. THE STATION IS A STANDARD WSDOT BRASS DISK SET IN A ROUND CONCRETE MONUMENT PROJECTING 0.2 FEET ABOVE THE GROUND. NOTE: 'POSITION UP-DATE BY OCCUPYING WITH G.P.S.' NOTE: TIED TO HPN 4/94. THIS IS A NAVD88 UPDATE.



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CURRENT SURVEY CONTROL

<u>DATUM</u>	<u>LATITUDE</u>	<u>UNIT</u>	<u>LONGITUDE</u>	<u>UNIT</u>	<u>NETWORK</u>	<u>METHOD</u>	<u>ACCURACY</u>
NAD 83/91	48 11 54.567381	N	122 08 03.530464	W	PRIMARY	GPS	2 CM

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550.01	General
550.02	References
550.03	Procedures
550.04	Interchange Justification Report and Supporting Analyses
550.05	Report Organization and Appendices
550.06	IJR Review and Approval
550.07	Updating an IJR
550.08	Documentation

### 550.01 General

The primary function of limited access freeways and highways is to provide safe and reliable travel for people, goods, and services from state to state and region to region within a state. They should not be used for local trips as an extension of the local street network. Adding or revising access can adversely impact the safety and operations of these facilities; therefore, access revisions must be done with caution. For this reason, new and/or modified access must be justified, and this chapter contains the process for seeking access approval.

An Interchange Justification Report (IJR) is the document used to justify a new access point or access point revision on existing limited access freeways and highways in Washington State. This chapter provides policy and guidance on developing the required documentation for an IJR, and the sequence of an IJR presentation, for both Interstate and non-Interstate limited access routes.

Federal law requires Federal Highway Administration (FHWA) approval of all revisions to the Interstate system, including changes to limited access. Both FHWA and Washington State Department of Transportation (WSDOT) policy require the formal submission of a request to either break or revise the existing limited access on Interstate routes. This policy also facilitates decision-making regarding proposed changes in access to the Interstate system in a manner that considers and is consistent with the vision, goals, and long-range transportation plans of a metropolitan area, region, and state. Breaking or revising existing limited access on state routes must be approved in accordance with [Chapter 530](#), Limited Access Control. An IJR is a document that includes all of the necessary supporting information needed for a request. It documents the IJR team's assumptions and the design of the preferred alternative, the planning process, the evaluation of the alternatives considered, and the coordination that supports and justifies the request for an access revision. FHWA cannot give final approval to the IJR unless environmental analysis/documentation has been approved for the project. Therefore, the IJR process and the environmental analysis (EA/EIS) should be conducted concurrently.

Engineers at the WSDOT Headquarters (HQ) Design Office Access and Hearings Section specialize in providing support for meeting the guidance provided in this chapter. To ensure project success, consult with them before any of the IJR work is started. They can help during the development of the study, Methods and Assumptions Document, and the Interchange Justification Report.

An IJR support team, including HQ Access and Hearings, agrees upon what an IJR will include. IJR on the Interstate require that all eight policy points contained in the [FHWA Policy on Adding Additional Interchanges](#) be addressed. The scale and complexity of the report varies considerably with the scope of the proposal. [Exhibit 550-1](#) lists typical projects for Interstates and the required policy points to address. The level of effort is set by the support team and documented in the Methods and Assumptions Document. For non-Interstate IJR, [Exhibit 550-2](#) lists project types and required policy points to address.

When a local agency or developer is proposing an access point revision, WSDOT requires that a support team be formed.

The IJR will contain a signature page that will be stamped by the Engineer of Record responsible for the report's preparation and the Traffic Analysis Engineer responsible for the traffic analysis included in [Policy Point 3](#). (See [Exhibit 550-6](#) for an example.)

## 550.02 References

### 550.02(1) *Federal/State Laws and Codes*

[23 Code of Federal Regulations \(CFR\) Part 450](#) (implementing 23 United States Code [USC] Section 135)

[40 CFR Parts 51 and 93](#) (regarding federal conformity with state and federal air quality implementation plans)

[23 USC Sections 111](#) (requires the U.S. Secretary of Transportation to approve access revisions to the Interstate System), [134](#) (metropolitan transportation planning), and [135](#) (statewide transportation planning)

FHWA "Interstate System Access Information Guide"

<http://www.fhwa.dot.gov/design/interstate/pubs/access/access.pdf>

Notice of policy statement: "Additional Interchanges to the Interstate System," FHWA notice published in the Federal Register, February 11, 1998 (Vol. 63, No. 28)

[www.access.gpo.gov/su\\_docs/fedreg/a980211c.html](http://www.access.gpo.gov/su_docs/fedreg/a980211c.html)

[Revised Code of Washington \(RCW\) 36.70A](#), Growth management – Planning by selected counties and cities

### 550.02(2) *Design Guidance and Supporting Information*

*Design Manual*, [Chapter 320](#), Traffic Analysis

*Design Manual*, [Chapter 321](#), Sustainable Safety

*Design Manual Glossary* – Defines many of the terms encountered in this chapter

FHWA Traffic Analysis Toolbox (tools used in support of traffic operations analyses)

[www.ops.fhwa.dot.gov/trafficanalysistools/index.htm](http://www.ops.fhwa.dot.gov/trafficanalysistools/index.htm)

*Highway Capacity Manual*, (HCM) 2010, Transportation Research Council

*Highway Safety Manual*

[Local Agency Guidelines](#) (LAG), M 36-63, WSDOT

State Highway System Plan

[www.wsdot.wa.gov/planning/HSP](http://www.wsdot.wa.gov/planning/HSP)

**WSDOT GeoPortal** – Tool for viewing WSDOT spatial data (like Functional Class, Interchange Drawings, City Limits, and State Routes) via a web browser. Users can check a box to select from a variety of base maps and data layers.

[http://wwwi.wsdot.wa.gov/gis/roadwaydata/geoportal\\_int.htm](http://wwwi.wsdot.wa.gov/gis/roadwaydata/geoportal_int.htm)

WSDOT HQ Access and Hearings web page (provides guidance and timelines for preparing IJR and example Methods and Assumptions Documents):

[www.wsdot.wa.gov/design/accessandhearings](http://www.wsdot.wa.gov/design/accessandhearings)

### 550.03 Procedures

An access point revision is a multistep process. It begins with assembling a support team to conduct a feasibility or planning-level study. The purpose of this study is to determine whether there are improvements that can be made to the local roadway network to meet the purpose and need of the proposed access modification. If the study shows that the purpose and need of the proposal cannot be achieved with the local infrastructure only, the next step would normally be to prepare an IJR (see the Interstate IJR: Process Flow Chart, [Exhibit 550-3](#)).

The IJR is typically initiated early in the environmental process. Traffic analyses help define the area of impact and the range of alternatives. Since the traffic data required for the National Environmental Policy Act (NEPA) or the State Environmental Policy Act (SEPA) and the operational/safety analyses of the IJR are the same, these documents need to be coordinated and developed together, using the same data sources and procedures.

The required steps in the IJR process are described in detail in this chapter, and include:

- Assemble the support team to engage subject experts and decision makers.
- Define purpose and need of the proposal (team).
- Determine whether a feasibility study needs to be conducted or already exists (team).
- Prepare Methods and Assumptions Document to lay the groundwork for the IJR, including scope of IJR and team roles and responsibilities (team).
- Endorse Methods and Assumptions Document to prepare the IJR (team).
- Prepare draft IJR (team or consultant).
- Review draft IJR (team).
- Finalize IJR by addressing comments and issues.
- Review and approve IJR (or conceptual approval).

#### 550.03(1) *Organize Support Team and Conduct Study*

##### 550.03(1)(a) **Support Team**

Establish a support team before beginning the feasibility study. This same support team is also involved with the IJR process if the study shows that either a revision or a new access point is needed to meet the proposal purpose and need.

The support team normally consists of the following:

- FHWA Area Engineer and FHWA Safety and Geometric Design Engineer (for Interstate projects)
- Region Planning, Design, or Project Development Engineer (or designee)
- HQ Assistant State Design Engineer
- HQ Development Services & Access Manager
- HQ Traffic Office Representative
- Representative from local agencies (city, county, port, or tribal government)
- Recorder (records and prepares meeting minutes for documentation purposes)

The support team enlists specialists, including but not limited to:

- Metropolitan Planning Organization (MPO)
- Regional Transportation Planning Organization (RTPO)
- WSDOT region (planning, design, environmental, maintenance, and traffic)
- WSDOT Headquarters (design, bridge, traffic, and geotechnical)
- Project proponent specialists (region, local agency, developer)
- Transit agencies
- Other identified stakeholders/partners

The support team's role is to:

- Develop processes for reaching agreement, resolving disputes, and assigning responsibility for final decisions. This is especially important for complex proposals.
- Review regional and state transportation plans to see if the request is consistent with the needs and solutions shown in those plans.
- Develop purpose and need statements for the proposal, consistent with the project environmental document.
- Expedite the study steps (and, if needed, the IJR development and review process) through early communication and agreement.
- Establish the agreed-upon study area (including baseline transportation improvements) and future travel demand forecasts for each of the alternatives being considered.
- Develop and endorse the Methods and Assumptions Document.
- Provide guidance and support.
- Evaluate data and identify possible alternatives for the proposal during the study and, if needed, for an IJR.
- Contribute material for the report that documents the discussions and decisions.
- Review results and determine whether an IJR is warranted.
- Ensure the compatibility of data used in adjacent or overlapping studies.
- Ensure integration of the following as required: Project Definition process, value engineering studies, public involvement efforts, environmental analyses, operational analyses, safety analyses, and other analyses for the study. This encourages the use of consistent data.
- Address design elements. Status of known deviations must be noted in Policy Point 4. Deviations are discouraged on new accesses.

The support team works together, from the corridor study through preparation of the assumptions document and completion of the IJR.

### 550.03(1)(b) Methods and Assumptions Document

This document is developed to record assumptions used in the IJR, along with analysis methodologies, criteria, and support team decisions. The document presents the proposed traffic analysis tool and approach, safety analysis methodology, study area, peak hour(s) for analysis, traffic data, design year, opening year, travel demand forecasts, baseline conditions, and design year conditions. It also documents the team's decisions on how much detail will be included in each policy point. The signed Methods and Assumptions Document represents endorsement by the support team on the IJR approach, tools, data, and criteria used throughout the IJR process. This document is used on both interstate & non-interstate IJRs.

The Methods and Assumptions Document is dynamic, and is updated and re-endorsed when changed conditions warrant. The document also serves as a historical record of the processes, dates, and decisions made by the team. WSDOT and FHWA require the development and acceptance of the document, because early agreement on details results in the highest level of success for the IJR process.

Example Methods and Assumptions Documents and an outline of this process are provided online at: [www.wsdot.wa.gov/design/accessandhearings](http://www.wsdot.wa.gov/design/accessandhearings)

Refer to [Exhibit 550-5](#) for an example form for support team's concurrence to Methods and Assumptions Document.

### 550.03(1)(c) Feasibility Study

Study the transportation network in the area. This study must identify the segments of both the local and regional network that are currently experiencing congestion or safety deficiencies, or where planned land use changes will prompt the need to evaluate the demands on and the capacity of the transportation system. The study area includes the affected existing and proposed interchanges/ intersections upstream and downstream from the proposed access point revision. Extend the study area far enough that the proposal creates no significant impacts to the adjacent interchanges/intersections, then analyze only through the area of influence. When the area of influence extends beyond one interchange/intersection upstream and downstream, extend the analysis to include the extent of the traffic impacts.

Segments of the local and regional network within the study area will be evaluated for system improvements. Part of the study process is to identify local infrastructure needs and develop a proposal. The study must investigate investments in local infrastructure improvements to meet the purpose and need of the proposal. It must be shown that the local infrastructure alone cannot be improved to address the purpose and need. The limited access facility should not be used to solve congestion problems on the local network.

During the feasibility study process and while developing a proposal, it is important to use the data and analysis methods required for an IJR. If the study indicates that an IJR is warranted, the study data can then be utilized in the IJR. The feasibility study and the IJR can also be used to support the transportation analysis requirements in the project's environmental documentation (DCE, EA, or EIS).

### **550.03(2) Conduct Analysis and Prepare IJR**

Prepare a detailed IJR using the guidance in [550.04](#), Interchange Justification Report and Supporting Analyses, and [Exhibit 550-3](#).

#### **550.03(2)(a) IJR Policy Points**

The IJR addresses the following eight specific policy points, which are described in detail in [540.04](#):

1. Need for the Access Point Revision
2. Reasonable Alternatives
3. Operational and Collision Analyses
4. Access Connections and Design
5. Land Use and Transportation Plans
6. Future Interchanges
7. Coordination
8. Environmental Processes

### **550.04 Interchange Justification Report and Supporting Analyses**

The eight policy points are presented below. Factors that affect the scope include location (rural or urban), access points (new or revised), ramps (new or existing), and ramp terminals (freeway or local road).

#### **550.04(1) Policy Point 1: Need for the Access Point Revision**

*What are the current and projected needs? Why are the existing access points and the existing or improved local system unable to meet the proposal needs? Is the anticipated demand short or long trip?*

Describe the need for the access point revision and why the existing access points and the existing or improved local system cannot address the need. How does the proposal meet the design year travel demand? Provide the analysis and data to support the need for the access request.

##### **550.04(1)(a) Project Description**

Describe the needs being addressed, and define the current problem or deficiency that the project is looking to address or overcome. Using specific performance measures can be helpful; for example, state the average speed or throughput during the A.M. or P.M. peak. The need for improvement should be established using factors such as existing conditions and the conditions anticipated to occur in the analysis years under the “no-build” alternative, or other factors such as the need for system linkage.

Demonstrate that improvements to the local transportation system and the existing interchanges cannot be improved to satisfactorily accommodate the design year travel demands. Describe traffic mitigation measures considered at locations where the level of service (LOS) is (or will be) below agreed-upon service standards in the design year. (See the [State Highway System Plan](#) for further information on LOS standards.) Additional measures of effectiveness (such as density, speed changes, delay, and travel times) should be discussed and documented in the Methods and Assumptions Document.

The access point revision should meet regional, not local, travel demands. Describe the local and regional traffic (trip link and/or route choice) benefiting from the proposal.

#### **550.04(1)(b) Analysis and Data to Support Proposal**

The proposal analysis tools, data, and study area must be agreed upon by the support team. Use the Methods and Assumptions Document to detail the specific items and record the team's agreement to them. Establishing assumptions upfront ensures the project will have the highest rate of success. For further guidance and examples on assumptions documents, see:

 [www.wsdot.wa.gov/design/accessandhearings](http://www.wsdot.wa.gov/design/accessandhearings)

Show that a preliminary (planning level) analysis, comparing build to no-build data, was conducted for the current year, year of opening, and design year, comparing baseline, no-build condition, and build alternatives. Include the following steps:

1. Define the study area. The study area is a minimum of one interchange upstream and downstream from the proposal. The study area should be expanded as necessary to capture operational impacts of adjacent interchanges in the vicinity that are, or will be, bottlenecks or chokepoints that influence the operations of the study interchange.
2. Establish baseline transportation networks and future land use projections for the study area. The baseline transportation network typically includes local, regional, and state transportation improvement projects that are funded. The land use projection includes population and employment forecasts consistent with the regional (MPO or RTPO) and local jurisdiction forecasts.
3. Collect and analyze current traffic volumes to develop current year, year of opening, and design year peak hour traffic estimates for the regional and local systems in the area of the proposal. Use regional transportation planning organization-based forecasts, refined by accepted travel demand estimating procedures. Forecasts for specific ramp traffic may require other methods of estimation procedures and must be consistent with the projections of the travel demand models. Modeling must include increased demand caused by anticipated development.
4. Identify the origins and destinations of trips on the local systems, the existing interchange/intersections, and the proposed access using existing information.
5. Develop travel demand forecasts corresponding to assumed improvements that might be made to the following:
  - The local system: widen, add new surface routes, coordinate the signal system, control access, improve local circulation, or improve parallel roads or streets.
  - The existing interchanges: lengthen or widen ramps, add park & ride lots, or add frontage roads.

- The freeway lanes: add collector-distributor roads or auxiliary lanes.
  - Transportation system management and travel demand management measures.
6. Describe the current year, year of opening, and design year level of service at all affected locations within the study area, including local systems, existing ramps, and freeway lanes.

### **550.04(2) Policy Point 2: Reasonable Alternatives**

*Describe the reasonable alternatives that have been evaluated.*

Describe all reasonable alternatives that have been considered. These include the design options, locations, project phasing, and transportation system management-type improvements such as ramp metering, public transportation, and HOV facilities that have been assessed and that meet the proposal's design year needs. The alternatives analysis must be the same as that used in the environmental documentation.

After describing each of the alternatives that were proposed, explain why reasonable alternatives were omitted or dismissed from further consideration. Where operational and safety concerns are some of the reasons that alternatives are rejected, the support group may need operational and/or safety analyses for those alternatives (see [Policy Point 3](#) below).

Future projects must be coordinated as described in [Policy Point 7](#), Coordination.

### **550.04(3) Policy Point 3: Operational and Collision Analyses**

*How will the proposal affect safety and traffic operations at year of opening and design year?*

Policy Point 3 documents the operational and safety effects of the proposal(s) and the results that support the final proposal, including any mitigation measures that compensate for operational and/or safety tradeoffs. Policy Point 3 shall also include a conceptual plan of the type and location of the signs proposed to support the design alternative.

The preferred operational alternative is selected, in part, by showing that it will meet the access needs without causing a significant adverse impact on the operation and safety of the freeway and the affected local network, or that the proposal impacts will be mitigated.

Document the results of the following analyses in the report:

- Operational Analysis – “No-Build” Alternative: An operational analysis of the current year, year of opening, and design year for the existing limited access freeway and the affected local roadway system. This is the baseline plus state transportation plan and comprehensive plan improvements expected to exist at the year of opening or design year. All of the alternatives will be compared to the no-build condition. The report should document the calibration process and results that show the current year operations closely match actual field conditions.
- Operational Analysis – “Build” Alternative: An operational analysis of the year of opening and design year for the proposed future freeway and the affected local roadway system.
- Collision Analysis – “Observed collision history”: Document the observed collision history, for the most current data years, of the existing limited access freeway and the affected local roadway system. The support team will determine the number of years as well as the scope and detail of this section.

- Collision Analysis – “Proposal(s)”: A collision analysis should be performed for the year of opening and design year of the existing limited access freeway and the affected local roadway system for the “no-build,” “build,” and possibly other scenarios as determined by the support team. The support team will also determine the year of opening and design year as well as the scope and detail of this section.

The data used for the operational and safety analyses must be the same as the data used in the environmental documentation. If not, describe and justify the discrepancies in the Methods and Assumptions Document as well as in this section of the IJR. The transportation section of the environmental document should include a similar discussion, and the Methods and Assumption Document should be included in the appendix of the environmental document.

#### **550.04(3)(a) Operational Analyses**

Demonstrate that the proposal does not have a significant adverse impact on the operation of the freeway and the affected local roadway system. If there are proposal impacts, explain how the impacts will be mitigated.

To understand the proposal’s positive and negative impacts to main line, crossroad, and local system operations, the selection of the appropriate analysis tool(s) is critical. This is a major piece of the assumptions process. Record the support team’s tool selection agreement in the Methods and Assumptions Document. FHWA’s [Traffic Analysis Toolbox](#) provides an overview and details for making the best tool category selection.

Document the selected operational analysis procedures. For complex urban projects, a refined model might be necessary. WSDOT supports the traffic analysis and traffic simulation software listed on the HQ Traffic Operations website: [www.wsdot.wa.gov/design/traffic/analysis/](http://www.wsdot.wa.gov/design/traffic/analysis/)

All operational analyses shall be of sufficient detail, and include sufficient data and procedure documentation, to allow independent analysis during FHWA and Headquarters evaluation of the proposal. For Interstate proposals, Headquarters must provide concurrence before it transmits the proposal to FHWA with its recommendation.

Prepare a layout displaying adjacent interchanges/intersections and the data noted below, based on support team determination, which should show:

- Distances between intersections or ramps of a proposed interchange, and those of adjacent existing and known proposed interchanges.
- Design speeds.
- Grades.
- Truck volume percentages on the freeway, ramps, and affected roadways.
- Adjustment factors (such as peak hour factors).
- Affected freeway, ramp, and local roadway system traffic volumes for the “no-build” and each “build” option. This will include: A.M. and P.M. peaks (noon peaks, if applicable); turning volumes; average daily traffic (ADT) for the current year; and forecast ADT for year of opening and design year.
- Affected main line, ramp, and local roadway system lane configurations.

The study area of the operational analysis on the local roadway system includes documenting that the local network is able to safely and adequately collect and distribute any new traffic loads resulting from the access point revision. Expand the limits of the study area, if necessary, to analyze the coordination required with an in-place or proposed traffic signal system. Record the limits of the analysis as well as how the limits were established in the project Methods and Assumptions Document.

Document the results of analyzing the existing access and the proposed access point revision at all affected locations within the limits of the study area, such as weave, merge, diverge, ramp terminals, collision sites, and HOV lanes; along the affected section of freeway main line and ramps; and on the affected local roadway system. In the report, highlight the following:

- Any location for which there is a significant adverse impact on the operation or safety of the freeway facility, such as causing a reduction of the operational efficiency of a merge condition at an existing ramp; introducing a weave; or significantly reducing the level of service on the main line due to additional travel demand. Note what will be done to mitigate this adverse impact.
- Any location where a congestion point will be improved or eliminated by the proposal, such as proposed auxiliary lanes or collector-distributor roads for weave sections.
- Any local roadway network conditions that will affect traffic entering or exiting the freeway. If entering traffic is to be metered, explain the effect on the connecting local system (for example, vehicle storage).
- When the existing local and freeway network does not meet agreed-upon level of service standards, show how the proposal will improve the level of service or keep it from becoming worse than the no-build condition in the year of opening and the design year. Level of service should not be the only performance measure evaluated. There are other measures of effectiveness that can be used to illustrate a broader traffic operation perspective.

#### **550.04(3)(b) Collision Analysis**

This section describes the two parts of an IJR collision analysis: the *existing* (observed) condition as well as the *proposed* “no-build,” “build,” and possibly other scenarios as determined by the support team. It is the intent of this section that future readers will fully understand the existing condition and all of the presented scenarios without the need for other documents. The study limits (area and years) are the same as the study limits of the operational analyses. If the support team determines that some limits are different from the operational analysis, document them by describing and justifying the differences in the Methods and Assumptions Document as well as in Policy Point 3 of the IJR. Document all the tools used and all assumptions made and agreed to as well as the basis and reason(s) for using those tools and assumptions. The data used for the collision analysis must be the same as the data used in the operational analysis and the environmental documentation. If not, describe and justify the differences. ([Chapter 321](#), Sustainable Safety, gives collision analysis guidance.)

Collision analysis data needs to include a disclaimer: “Under Section 409 of Title 23 of the United States Code, collision data is prohibited from use in any litigation against state, tribal, or local government that involves the location(s) mentioned in the collision data.”

**550.04(3)(b)(1) Existing (Observed) Portion of Collision Analysis**

Identify and document the collision histories, severities, and types for the existing freeway section and the adjacent affected local surface system within the study area as determined by the support team. A five-year collision history is a good default; however, the support team will determine the number of years.

Document all the tools used and all assumptions made and agreed to as well as the basis and reason(s) for using those tools and assumptions.

***Detailed list of the existing (observed) portion of the collision analysis:***

Document the existing safety performance of the freeway section and the adjacent affected local surface system within the study area.

- Produce a diagram of the collision history of the freeway section and the adjacent affected local surface system within the study limits.
- Analyze the existing performance of the freeway section and the adjacent affected local surface system within the study area for over dispersions of collision types, contributing circumstances, and/or severities.
  - What types of collisions are occurring (overtakes, rear-ends, enter-at-angle, hitting fixed object)?
  - What types of collisions are most prevalent?
  - Are there any patterns of collision type or cause?
  - Use ISATe (Enhanced Interchange Safety Analysis Tool) to determine if there are any over dispersions of collision types or causes.
- Determine severity (fatalities, serious injuries, evident injuries, possible injuries, and/or property damage only).
  - What collision severities are most prevalent?
  - Are there any collision severity patterns?
  - Use ISATe to determine if there are any over dispersions of severities.
- Use ISATe to perform an expected safety performance analysis using the observed collisions to determine if the existing safety performance is normal for the existing configuration as compared to others like it (see [Chapter 321](#) for guidance).

**550.04(3)(b)(2) Proposed Portion of Collision Analysis**

Identify and document the predicted safety performance of the proposed access point revision proposal(s), including the freeway section, speed change lanes, ramps, collector-distributor (c-d) lanes, ramp terminal intersections, and the adjacent affected local surface system, including segments and intersections.

Demonstrate that (1) the final proposal does not have a significant adverse impact on the safety of the freeway or the adjacent affected local surface system, or (2) a list of the mitigation measures mitigate each adverse impact.

Document all the tools used and all assumptions made and agreed to as well as the basis and reason(s) for using those tools and assumptions.

**Detailed list of the predicted safety performance portion of the collision analysis.**

- Document the predicted safety performance of the freeway section using the *Highway Safety Manual* (to access ISATe), speed change lanes, ramps, c-d lines, ramp terminal intersections, and the adjacent affected local surface system, including segments and intersections within the study limits for each of the proposed “no-build,” “build,” and possibly other scenarios and alternatives as determined by the support team.
- Document the design elements that contribute to the predicted safety performance, including types and severities of crashes, especially design elements that contribute to significant adverse safety impacts of the freeway or the adjacent affected local surface system.
- Compare the safety performances of the “no-build” scenario(s) with the safety performance of the proposed scenario(s) to demonstrate that the final proposal(s) do not have a significant adverse impact on the safety of the freeway or the adjacent affected local surface system.
  - Break out fatal and serious injuries in this analysis.

**550.04(4) Policy Point 4: Access Connections and Design**

*Will the proposal provide fully directional interchanges connected to public streets or roads, spaced appropriately, and designed to full design level geometric control criteria?*

Provide for all directions of traffic movement on Interstate system-to-system type interchanges, unless justified. The intent is to provide full movement at all interchanges, whenever feasible. Partial interchanges are discouraged and will not likely be approved for Interstate access. Less than fully directional interchanges for special-purpose access for transit vehicles, for HOVs, or to or from park & ride lots will be considered on a case-by-case basis.

A proposed new or revised interchange access must connect to a public freeway, road, or street and be endorsed by the local governmental agency or tribal government having jurisdiction over said public freeway, road, or street.

Explain how the proposed access point relates to present and future proposed interchange configurations and the *Design Manual* spacing criteria. Note that urban and rural interchange spacing for crossroads also includes additional spacing requirements between adjacent ramps, as noted in [Chapter 1360](#).

Develop the proposal in sufficient detail to conduct a design and operational analysis. Include the number of lanes, horizontal and vertical curvature, lateral clearance, lane width, shoulder width, weaving distance, ramp taper, interchange spacing, and all traffic movements. This information is presented as a sketch or a more complex layout, depending on the complexity of the proposal.

The status of all known or anticipated project deviations must be noted in this policy point, as described in [Chapter 300](#).

**550.04(5) Policy Point 5: Land Use and Transportation Plans**

*Is the proposed access point revision compatible with all land use and transportation plans for the area?*

Show that the proposal is consistent with local and regional land use and transportation plans. Before final approval, all requests for access point revisions must be consistent with the regional or statewide transportation plan, as appropriate (see [Chapter 120](#)). The proposed access point revision may affect adjacent land use and, conversely, land use may affect the travel demand generated. Therefore, reference and show compatibility with the land use plans, zoning controls, and transportation ordinances in the affected area.

Explain the consistency of the proposed access point revision with the plans and studies, the applicable provisions of [23 CFR Part 450](#), the applicable transportation conformity requirements of [40 CFR Parts 51 and 93](#), and [Chapter 36.70A RCW](#).

The support team reviews regional and state transportation plans to determine whether the need and proposed solution are already identified. Proposals to request new or reconstructed interchanges must be consistent with those plans.

If the proposed access is not specifically referenced in the transportation plans, define its consistency with the plans and indicate the process for the responsible planning agency to incorporate the project. In urbanized areas, the plan refinement must be adopted by the metropolitan planning organization (MPO) before the project is designed. The action must also be consistent with the multimodal State Transportation Plan.

**550.04(6) Policy Point 6: Future Interchanges**

*Is the proposed access point revision compatible with a comprehensive network plan? Is the proposal compatible with other known new access points and known revisions to existing points?*

The report must demonstrate that the proposed access point revision is compatible with other planned access points and revisions to existing points.

Reference and summarize any comprehensive freeway network study, plan refinement study, or traffic circulation study.

Explain the consistency of the proposed access point revision with those studies.

**550.04(7) Policy Point 7: Coordination**

*Are all coordinating projects and actions programmed and funded?*

When the request for an access point revision is generated by new or expanded development, demonstrate appropriate coordination between the development and the changes to the transportation system.

Show that the proposal includes a commitment to complete the other non-interchange/non-intersection improvements that are necessary for the interchange/intersection to function as proposed. For example, if improvements to the local circulation system are necessary for the proposal to operate, they must be in place before new ramps are opened to traffic. If future reconstruction is part of the mitigation for design year level of service, the reconstruction projects must be in the State Highway System Plan and Regional Transportation Plan.

All elements for improvements are encouraged to include known fiscal commitments and an anticipated time for completion. If the project is to be constructed in phases, it must be demonstrated in Policy Point 3 that each phase can function independently and does not affect the safety and operational efficiency of the freeway. Identify the funding sources, both existing and projected, and the estimated time of completion for each project phase.

#### **550.04(8) Policy Point 8: Environmental Processes**

*What is the status of the proposal's environmental processes? This section should be something more than just a status report of the environmental process; it should be a brief summary of the environmental process.*

All requests for access point revisions on freeways must contain information on the status of the environmental approval and permitting processes.

The following are just a few examples of environmental status information that may apply:

- Have the environmental documents been approved? If not, when is the anticipated approval date?
- What applicable permits and approvals have been obtained and/or are pending?
- Are there hearings still to be held?
- Is the environmental process waiting for an engineering and operational acceptability decision?
- Are the assumptions, methodology, study area, and traffic analysis used in the transportation element of the environmental document consistent with the IJR? If no, explain why not and provide justification.

#### **550.05 Report Organization and Appendices**

Begin the IJR with an executive summary. Briefly describe the access point revision being submitted for a decision and why the revision is needed. Include a brief summary of the proposal.

The IJR must be assembled in the policy point order noted in [550.03\(2\)](#).

Formatting for the IJR includes providing numbered tabs in the report for each policy point section and each appendix and numbering all pages, including references and appendices. A suggestion for page numbering is to number each individual section, such as "Policy Point 3, PP3-4" and "Appendix 2, A2-25." This allows for changes without renumbering the entire report.

On the bottom of each page, place the revision date for each version of the IJR. As an individual page is updated, this revision date will help track the most current version of that page. Also, include the title of the report on the bottom of each page.

Use a three-ring binder for ease of page replacement. Do not use comb or spiral binding.

Appendix A is reserved for the Methods and Assumptions Document. Include meeting notes where subsequent decisions are made as additional appendices to the original signed document.

Additional appendices may include documents such as technical memorandums, memos, and traffic analysis operations output.

## 550.06 IJR Review and Approval

Concurrence and approval of a new or revised access point is based on the IJR. The IJR must contain sufficient information about and evaluation/analysis of the proposal to provide assurance that the safety and operations of the freeway and local systems are not significantly impacted.

The region, or proponents, with the help of the support team, prepares the IJR and submits four draft copies, including backup traffic data, to the HQ Access and Hearings Section for review.

For a final IJR submittal, contact the HQ Access and Hearing Section for the necessary number of copies.

### 550.06(1) Interstate IJR Approval

On Interstate projects, a submittal letter is sent by the region through the HQ Access and Hearings Section, requesting final FHWA approval of the IJR. Interstate IJR's are submitted by Headquarters to FHWA for approval.

Interstate access point revisions are reviewed by both WSDOT Headquarters and FHWA. This can be a two-step process:

- If environmental documentation has not yet been approved, a finding of engineering and operational acceptability can be given.
- If the environmental documentation is complete, final approval can be given.

Some Interstate IJR's are reviewed and approved by the Washington FHWA Division Office. Other Interstate IJR's are reviewed and approved by the FHWA Headquarters Office in Washington DC. Additional review time is necessary for reports that have to be submitted to Washington DC (see [Exhibit 550-1](#)).

Final IJR approval by FHWA is provided when the appropriate final environmental decision is complete: ECS, FONSI, or ROD (see the [Glossary](#)).

### 550.06(2) Non-Interstate IJR Approval

On non-Interstate projects, concurrence from the support team is required on the Methods and Assumptions to document the acceptance of the scope and complexity of the IJR or the acceptance of the decision that an IJR is not required. If an IJR is prepared, the appropriate WSDOT HQ Assistant State Design Engineer grants the final approval (see Exhibits [550-2](#) and [550-4](#)).

### **550.07 Updating an IJR**

Recognizing that the time period between the approval of the IJR and the construction contract commonly spans several years, the approved IJR will be reviewed and updated to identify changes that may have occurred during this time period. If no work has begun in accordance with the environmental documentation, and several years have passed, a re-evaluation of the EA/EIS/DCE may be required. Submit a summary assessment to the HQ Design Office for evaluation to determine whether the IJR needs to be updated. The HQ Design Office will forward the assessment to FHWA if necessary. The assessment is a document summarizing the significant changes since it was approved. Contact the HQ Access and Hearings Section to coordinate this summary assessment.

### **550.08 Documentation**

Refer to [Chapter 300](#) for design documentation requirements.

Exhibit 550-1 Interstate Routes: IJR Content and Review Levels

Project Type	Support Team	Policy Point								Concurrence	Approval
		1	2	3	4	5	6	7	8		
<b>Interstate Routes</b>											
New freeway-to-crossroad interchange in a Transportation Management Area <sup>[1]</sup>	Yes	✓	✓	✓	✓	✓	✓	✓	✓	FHWA and HQ	FHWA DC
New partial interchange	Yes	✓	✓	✓	✓	✓	✓	✓	✓	FHWA and HQ	FHWA DC
New HOV direct access	Yes	✓	✓	✓	✓	✓	✓	✓	✓	FHWA and HQ	FHWA DC
New freeway-to-freeway interchange	Yes	✓	✓	✓	✓	✓	✓	✓	✓	FHWA and HQ	FHWA DC
Revision to freeway-to-freeway interchange in a Transportation Management Area <sup>[1][2]</sup>	Yes	✓	✓	✓	✓	✓	✓	✓	✓	FHWA and HQ	FHWA
New freeway-to-crossroad interchange not in a Transportation Management Area <sup>[1]</sup>	Yes	✓	✓	✓	✓	✓	✓	✓	✓	HQ	FHWA
Revision to freeway-to-freeway interchange not in a Transportation Management Area <sup>[1][2]</sup>	Yes	✓	✓	✓	✓	✓	✓	✓	✓	HQ	FHWA
Revision to interchange <sup>[2][3]</sup>	Yes	✓	✓	✓	✓	✓	✓	✓	✓	HQ	FHWA
Transit flyer stop on main line	Yes	✓	✓	✓	✓	✓	✓	✓	✓	HQ	FHWA
Transit flyer stop on an on-ramp	No	✓		✓	✓					HQ	FHWA
Addition of entrance or exit ramps that complete basic movements at an existing interchange	Yes	✓	✓	✓	✓	✓	✓	✓	✓	HQ	FHWA
Abandonment of a ramp <sup>[4]</sup>	Yes	✓	✓	✓	✓	✓	✓	✓	✓	HQ	FHWA
Locked gate <sup>[6]</sup>	No	✓			[5]					HQ	FHWA
Access breaks that do not allow any type of access to main line or ramps	No	✓	✓		[5]					HQ	FHWA
Pedestrian structure	No	✓			[5]					HQ	FHWA
Construction/emergency access break	No	✓	✓	✓	✓					Region	FHWA

**Notes:**

All policy points must be addressed on all studies. The scale and scope of the project dictate the level of effort needed to address each policy point. Blank cells in the table above indicate that the policy point will need to be addressed briefly in the IJR. Consult the HQ Access and Hearings Section for direction.

- [1] In Washington, designated Transportation Management Areas include Clark, King, Kitsap, Pierce, Snohomish, and Spokane counties.
- [2] "Revision" includes changes in interchange configuration, even though the number of access points does not change. Changing from a cloverleaf to a directional interchange is an example of a "revision."
- [3] Revisions that might adversely affect the level of service of the through lanes. Examples include: doubling lanes for an on-ramp with double entry to the freeway; adding a loop ramp to an existing diamond interchange; and replacing a diamond ramp with a loop ramp. Revisions to the ramp terminal intersections may not require an IJR unless the traffic analysis shows an impact to the main line traffic.
- [4] Unless it is a condition of the original approval.
- [5] Update the right of way/limited access plan as necessary.
- [6] As part of [Policy Point 1](#), include a narrative stating that all other alternatives are not feasible.

## Exhibit 550-2 Non-Interstate Routes: IJR Content and Review Levels

Project Type	Support Team	Policy Point								Concurrence	Approval
		1	2	3	4	5	6	7	8		
<b>Non-Interstate Routes</b>											
New freeway-to-crossroad interchange on a predominately grade-separated corridor	Yes	✓	✓	✓	✓	✓	✓	✓	✓	Region	HQ
New freeway-to-freeway interchange	Yes	✓	✓	✓	✓	✓	✓	✓	✓	Region	HQ
Revision to freeway-to-freeway interchange	Yes	✓	✓	✓	✓	✓	✓	✓	✓	Region	HQ
New freeway-to-crossroad interchange on a predominately at-grade corridor <sup>[5]</sup>	No	✓		✓	✓					Region	HQ
Revision to interchange <sup>[1]</sup>	No	✓		✓	✓					Region	HQ
Addition of entrance or exit ramps that complete basic movements at an existing interchange	No	✓		✓	✓					Region	HQ
Abandonment of a ramp <sup>[2]</sup>	No	✓		✓						Region	HQ
Transit flyer stop on main line	Yes	✓	✓	✓	✓	✓	✓	✓	✓	Region	HQ
Transit flyer stop on an on-ramp	No	✓		✓	✓					Region	HQ
Locked gate <sup>[4]</sup>	No	✓			[3]					Region	HQ
Pedestrian structure	No	✓			[3]					Region	HQ
Construction/emergency access break	No	✓	✓	✓						Region	HQ

**Notes:**

Policy points to be addressed will be determined by the IJR support team. The scale and scope of the project dictate the level of effort needed to address each policy point. Blank cells in the table above indicate that the policy point will need to be addressed briefly in the IJR as determined by the support team. Consult the HQ Access and Hearings Section for direction.

- [1] Revisions that might adversely affect the level of service of the through lanes. Examples include: doubling lanes for an on-ramp with double entry to the freeway; adding a loop ramp to an existing diamond interchange; and replacing a diamond ramp with a loop ramp.
- [2] Unless it is a condition of the original approval.
- [3] Update the right of way/limited access plan as necessary.
- [4] As part of [Policy Point 1](#), include a narrative stating that all other alternatives are not feasible.
- [5] Example: Revising an existing at-grade intersection into an access controlled grade-separated interchange.

Exhibit 550-3 Interstate IJR: Process Flow Chart

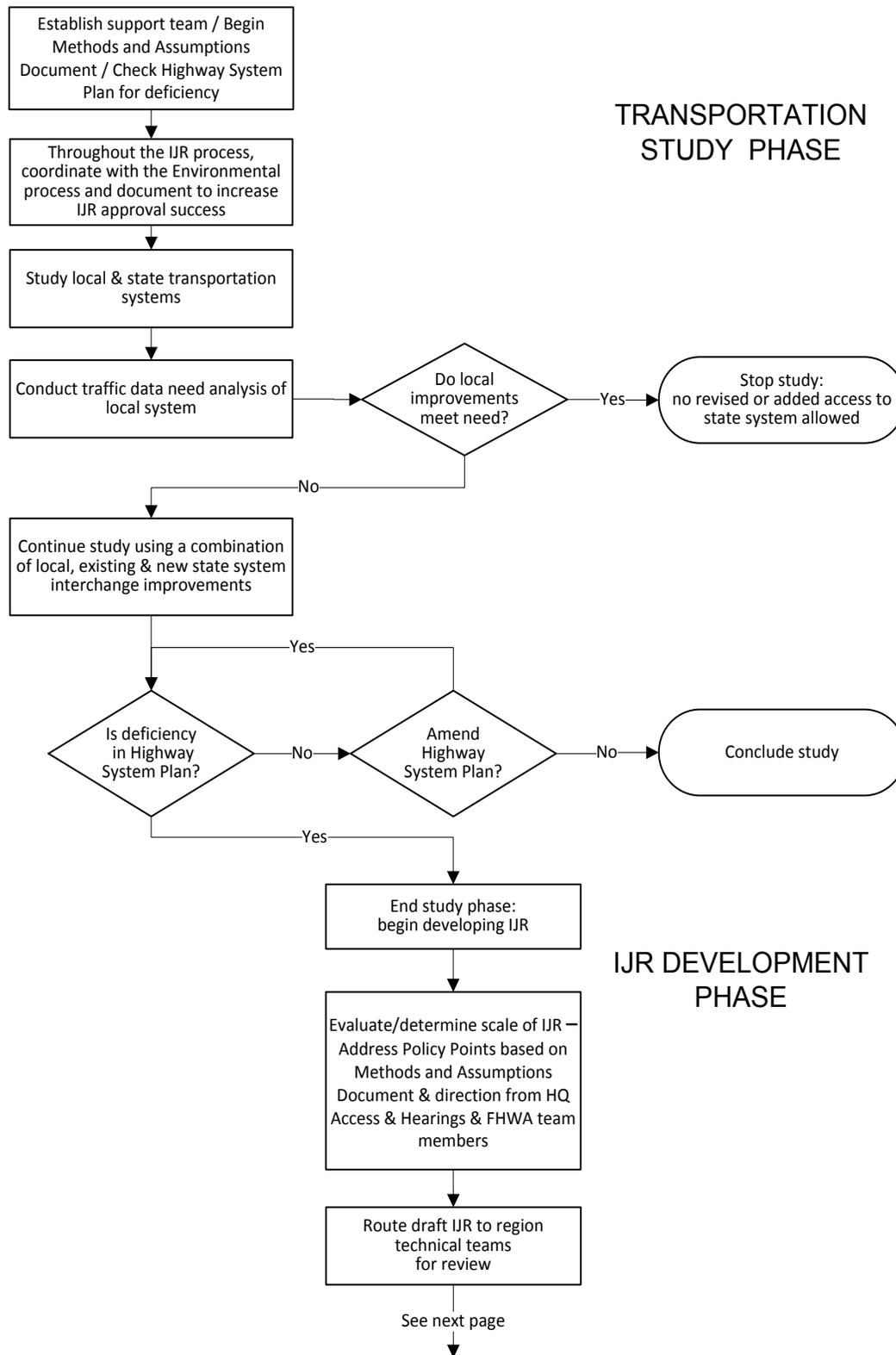


Exhibit 550-3 Interstate IJR: Process Flow Chart (continued)

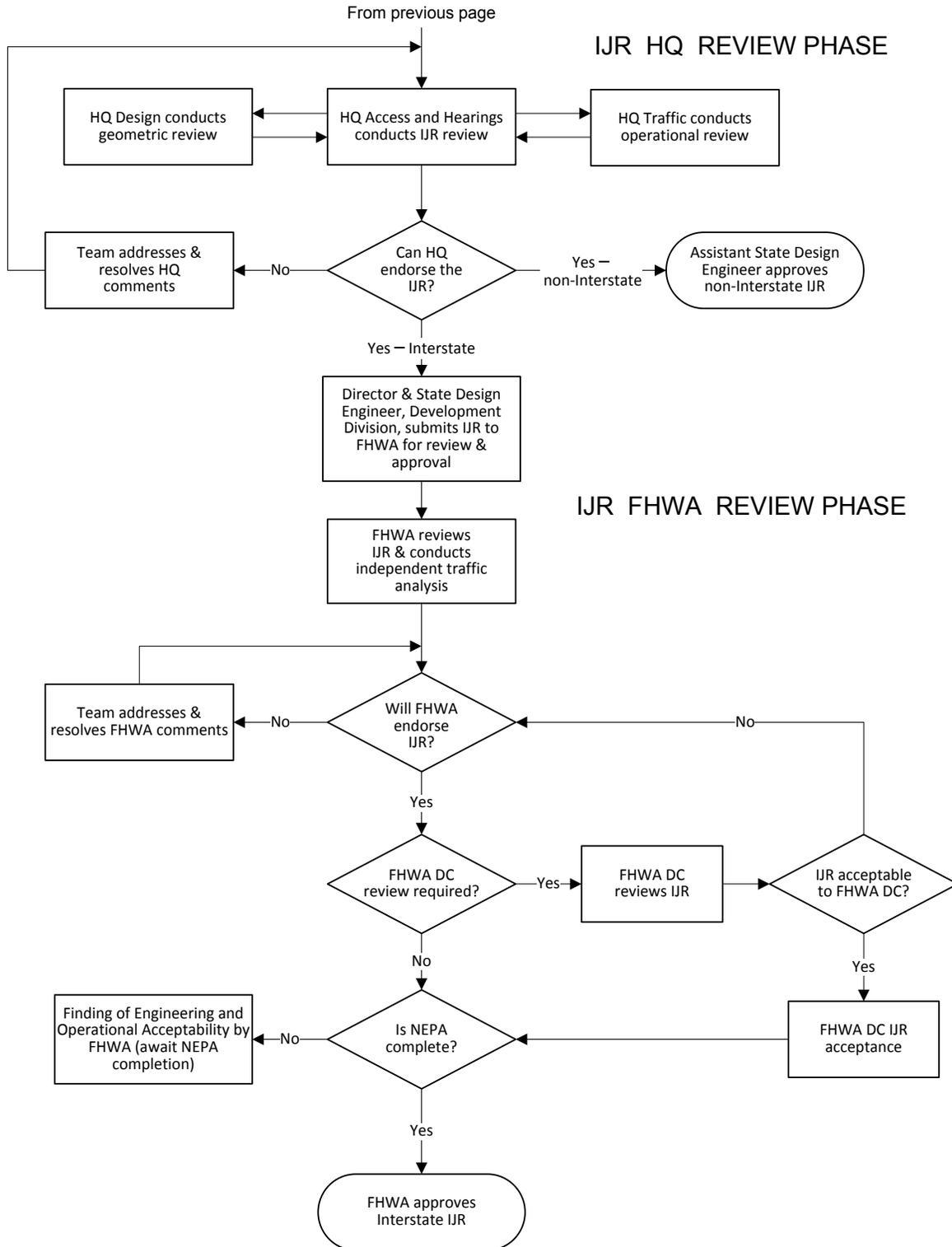


Exhibit 550-4 Non-Interstate IJR: Process Flow Chart

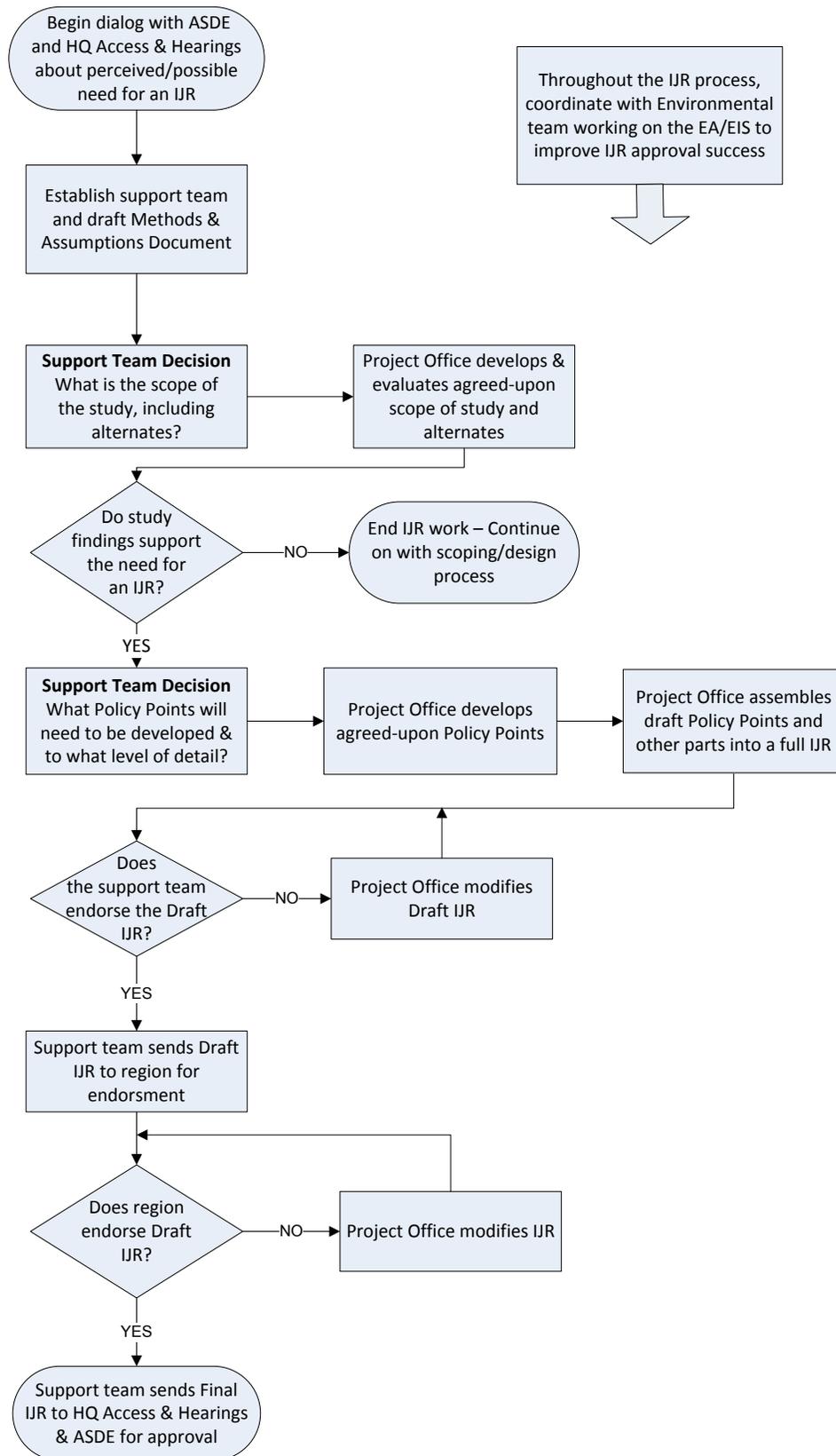


Exhibit 550-5 Methods and Assumptions Document for IJR: Concurrence Form Example

**Methods and Assumptions Document Concurrence Form  
for Interchange Justification Report  
"Project Title" "MP to MP"**

<b>We the undersigned hereby concur with the methods and assumptions used for the (INSERT PROJECT NAME) Interchange Justification Report.</b>	
<b>IJR Engineer of Record:</b>	<b>By:</b> _____ <b>Date:</b> _____
<b>Traffic Analysis Engineer</b>	<b>By:</b> _____ <b>Date:</b> _____
<b>Region Traffic Engineer</b>	<b>By:</b> _____ <b>Date:</b> _____
<b>Project Development Engineer</b>	<b>By:</b> _____ <b>Date:</b> _____
<b>Development Services and Access Manager</b>	<b>By:</b> _____ <b>Date:</b> _____
<b>Assistant State Design Engineer</b>	<b>By:</b> _____ <b>Date:</b> _____
<b>FHWA Area Engineer</b>	<b>By:</b> _____ <b>Date:</b> _____
<b>FHWA Safety and Design Engineer</b>	<b>By:</b> _____ <b>Date:</b> _____
<b>City Representative</b>	<b>By:</b> _____ <b>Date:</b> _____
<b>County Representative</b>	<b>By:</b> _____ <b>Date:</b> _____

Exhibit 550-6 IJR: Stamped Cover Sheet Example

**Interchange Justification Report**  
**“Project Title”**  
**“MP to MP”**

This **Interchange Justification Report** has been prepared under my direct supervision, in accordance with Chapter 18.43 RCW and appropriate Washington State Department of Transportation manuals.

**IJR Engineer of Record**

By: \_\_\_\_\_ P.E.  
 Project Engineer

Date: \_\_\_\_\_

**Traffic Analysis Engineer**

By: \_\_\_\_\_ P.E.  
 Traffic Analysis Engineer

Date: \_\_\_\_\_

**Concurrence –  
 Region Traffic Engineer**

By: \_\_\_\_\_ P.E.

Date: \_\_\_\_\_

**Concurrence –  
 Project Development Engineer**

By: \_\_\_\_\_ P.E.

Date: \_\_\_\_\_

**WSDOT Approval –  
 Development Services and  
 Access Manager**

By: \_\_\_\_\_ P.E.

Date: \_\_\_\_\_

**WSDOT Approval –  
 Assistant State Design Engineer**

By: \_\_\_\_\_ P.E.

Date: \_\_\_\_\_

**FHWA Approval –  
 FHWA Safety and Design  
 Engineer**

By: \_\_\_\_\_

Date: \_\_\_\_\_



# **Project Development Roles and Responsibilities for Projects With Structures**

## **Chapter 700**

---

- 700.01 General
- 700.02 Procedures

### **700.01 General**

This chapter presents the project development process used by the Washington State Department of Transportation (WSDOT) in the regions and the Headquarters (HQ) Bridge and Structures Office to determine the roles and responsibilities for projects with structures during the project development phase of a project. This chapter complements WSDOT's *Project Management Online Guide*:

🔗 <http://www.wsdot.wa.gov/projects/projectmgmt/pmog.htm>

For design procedures, see Division 7 chapters and the *Bridge Design Manual*.

The primary objective of this process is to provide a consistent means of selecting a bridge design team to perform the structural design work, whether it is by a consultant or the HQ Bridge and Structures Office.

If the local agency will be requesting any services from WSDOT, the local agency will contact WSDOT's Local Programs Engineer, who will help define the level of WSDOT's involvement in design and construction.

### **700.02 Procedures**

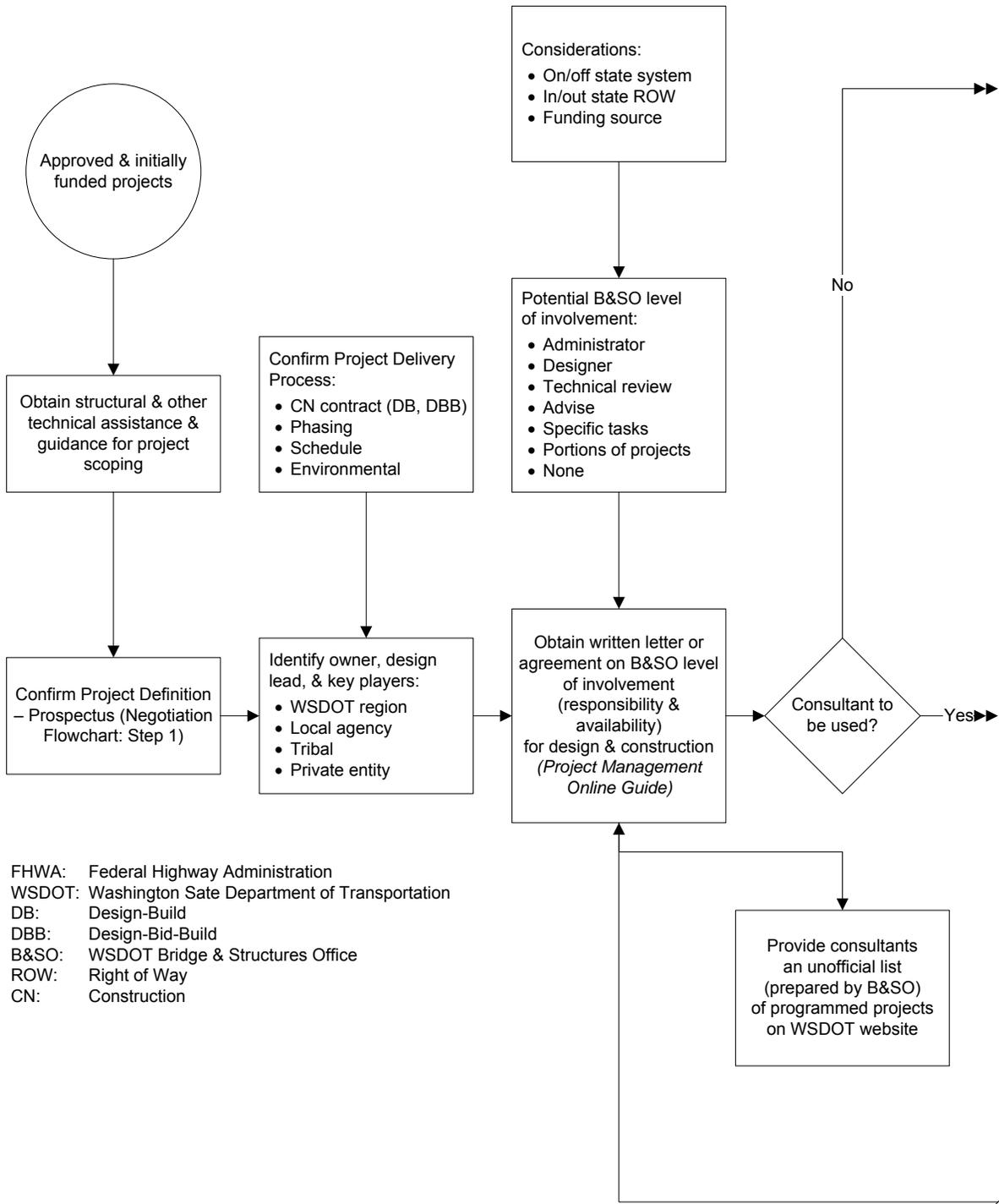
The flow diagram (see [Exhibit 700-1](#)) begins at the left with the initial approval and funding of the project and ends at the right with the start of the project delivery process.

After a project is programmed, WSDOT is tasked with confirming the project scope and defining the structural team's level of involvement in design and construction. If a consultant is not used, the bridge design work will be performed by the HQ Bridge and Structures Office. If a consultant is used, the region and the HQ Bridge and Structures Office will determine the level of involvement and responsibility for the design.

Agreements defining the level of involvement and responsibility will be developed and executed between the region office responsible for project development and the HQ Bridge and Structures Office, and the appropriate project delivery process will be implemented.

More information on this process and the desired outcomes is available on the HQ Bridge and Structures Office's home page:

🔗 <http://www.wsdot.wa.gov/bridge/structures>



FHWA: Federal Highway Administration  
 WSDOT: Washington State Department of Transportation  
 DB: Design-Build  
 DBB: Design-Bid-Build  
 B&SO: WSDOT Bridge & Structures Office  
 ROW: Right of Way  
 CN: Construction

**Determination of the Roles and Responsibilities for Projects With Structures:  
 Project Development Phase**  
*Exhibit 700-1*

The HQ Geotechnical Office has overall approval authority for the wall design. Once the wall design has been completed, the HQ Geotechnical Office, and in some cases the HQ Bridge and Structures Office, provides geotechnical and structural plan details to be included in the region plan sheets and special provisions for the PS&E. The region then completes the PS&E package.

For soil nail walls, once the HQ Geotechnical Office has performed the geotechnical design, the HQ Bridge and Structures Office, in cooperation with the HQ Geotechnical Office, coordinates the design effort and completes the PS&E package.

### **(3) Guidelines for Wall/Slope Data Submission for Design**

#### **(a) Standard Walls, Proprietary Walls, Geosynthetic Walls/Slopes, and Soil Nail Walls**

Where Headquarters involvement in retaining wall/slope design is required (as it is for standard walls and preapproved proprietary walls over 10 feet in height, gabions over 6 feet in height, rockeries over 5 feet in height, all nonpreapproved proprietary walls, geosynthetic walls/slopes, and all soil nail walls), the region submits the following information to the HQ Geotechnical Office or HQ Bridge and Structures Office as appropriate:

- Wall/slope plans.
- Profiles showing the existing and final grades in front of and behind the wall.
- Wall/slope cross sections (typically every 50 feet) or InRoads files that define the existing and new ground line above and below the wall/slope and show stations and offsets.
- Location of right of way lines and other constraints to wall/slope construction.
- Location of adjacent existing and/or proposed structures, utilities, and obstructions.
- Desired aesthetics.
- Date design must be completed.
- Key region contacts for the project.

Note that for the purpose of defining the final wall geometry, it is best to base existing ground measurements on physical survey data rather than solely on photogrammetry. In addition, the region is to complete a Retaining Wall/Reinforced Slope Site Data Check List, DOT Form 351-009 EF, for each wall or group of walls submitted.

#### **(b) Nonstandard Walls, Except Geosynthetic Walls/Slopes and Soil Nail Walls**

In this case, the region is to submit site data in accordance with [Chapter 710](#). Additionally, the region is to complete a Retaining Wall/Reinforced Slope Site Data Check List, DOT Form 351-009 EF, for each wall or group of walls.

## **730.07 Documentation**

Refer to [Chapter 300](#) for design documentation requirements.

Specific Wall Type	Advantages	Disadvantages	Limitations
Steel soil reinforcement with full height precast concrete panels	Relatively low cost.	Can tolerate little settlement; generally requires high-quality backfill; wide base width required (70% of wall height).	Applicable primarily to fill situations; maximum feasible height is approximately 20 feet.
Steel soil reinforcement with modular precast concrete panels	Relatively low cost; flexible enough to handle significant settlement.	Generally requires high-quality backfill; wide base width required (70% of wall height).	Applicable primarily to fill situations; maximum height of 33 feet; heights over 33 feet require a special design.
Steel soil reinforcement with welded wire and cast-in-place concrete face	Can tolerate large short-term settlements.	Relatively high cost; cannot tolerate long-term settlement; generally requires high-quality wall backfill soil; wide base width required (70% of wall height); typically requires a settlement delay during construction.	Applicable primarily to fill situations; maximum height of 33 feet for routine designs; heights over 33 feet require a special design.
Steel soil reinforcement with welded wire face only	Can tolerate large short-term settlements; low cost.	Aesthetics, unless face plantings can be established; generally requires high-quality backfill; wide base width required (70% of wall height).	Applicable primarily to fill situations; maximum height of 33 feet for routine designs; heights over 33 feet require a special design.
Segmental masonry concrete block-faced walls, generally with geosynthetic soil reinforcement	Low cost; flexible enough to handle significant settlement.	Internal wall deformations may be greater for steel reinforced systems, but are acceptable for most applications; generally requires high-quality backfill; wide base required (70% of wall height).	Applicable primarily to fill situations; in general, limited to a wall height of 20 feet or less; greater wall heights may be feasible by special design in areas of low seismic activity and when geosynthetic products are used in which long-term product durability is well defined. (See <i>Qualified Products List</i> .)
Geosynthetic walls with a shotcrete or cast-in-place concrete face	Very low cost, especially with shotcrete face; can tolerate large short-term settlements.	Internal wall deformations may be greater than for steel reinforced systems, but are still acceptable for most applications; generally requires high-quality backfill; wide base width required (70% of wall height).	Applicable primarily to fill situations; in general, limited to wall height of 20 feet or less unless using geosynthetic products in which long-term product durability is well defined. (See <i>Qualified Products List</i> .) For qualified products, heights of 33 feet or more are possible.

**Summary of Mechanically Stabilized Earth (MSE) Gravity  
Wall/Slope Options Available**  
*Exhibit 730-1*

- 900.01 General
- 900.02 References
- 900.03 Project Development
- 900.04 Documentation

## 900.01 General

The Washington State Department of Transportation (WSDOT) recognizes roadsides as an asset. WSDOT manages roadsides, balancing operational and environmental functions and lowest life cycle costs consistent with a reliable, safe, and sustainable transportation system.

The roadside is the primary place used to blend transportation facilities into the context of the natural and built environments. The roadside is the [green infrastructure](#) that contributes to the transportation system. It integrates natural processes into the built environment and includes the concepts of [low-impact development \(LID\)](#). Good roadside design coordinates many elements, including, but not limited to: structures; vegetation; signs; pedestrian and bicycle movement; stormwater treatment facilities; and other right of way functions. All the elements work together to provide visual continuity in the highway corridor.

WSDOT is committed to ensuring designs meet the needs and functions of the project and the community in a way that is safe, cost-effective, attractive, and maintainable. WSDOT is also committed to building transportation facilities in context with the surrounding environment, which is reflected in the Context Sensitive Solutions Executive Order ([E 1028](#)) and the Washington Transportation Plan (WTP).

The WSDOT [Roadside Manual](#) is the “how-to” manual for roadside design. It shows the links and coordination necessary between all WSDOT partners responsible for roadside activities. It also provides in-depth information on how to restore the roadside, including chapters on law and policy, soil bioengineering, contour grading, vegetation, irrigation, and many more.

In the fall of 2013, WSDOT published the new [Roadside Policy Manual](#) (RPM). In conformance with current WSDOT policies, the roadside policy team developed the RPM into a comprehensive roadside policy that promotes our state’s healthy economy, environment, and communities. It contains vital policy information needed to design roadsides in conjunction with the [Roadside Manual](#). WSDOT’s policy is to preserve and restore roadside functions through the preservation and use of soils, vegetation, and other roadside elements. Chapter 2 of the RPM defines these important project requirements. The RPM is intended for use in all phases of transportation asset management: Planning, Program Management, Project Development, Construction, and Maintenance. For further information, see: [www.wsdot.wa.gov/design/roadside/](http://www.wsdot.wa.gov/design/roadside/)

## 900.02 References

*Maintenance Manual*, M 51-01, WSDOT

*Roadside Manual*, M 25-30, WSDOT

*Roadside Policy Manual*, M 3110, WSDOT

*Understanding Flexibility in Transportation Design – Washington*, WSDOT, 2004

*Utilities Accommodation Policy*, M 22-86, WSDOT

For utility-related roadside issues, see the *Utilities Manual*, and for Scenic Classification ratings, see the *Utilities Accommodation Policy*

For WSDOT Project Management web resources, start here:

 [www.wsdot.wa.gov/projects/projectmgmt/](http://www.wsdot.wa.gov/projects/projectmgmt/)

*Roadside Design Guide*, AASHTO, 2011

Roadside development concepts covered elsewhere in the *Design Manual* include the following:

- Fencing ([Chapter 560](#))
- Jurisdiction (Chapters [300](#), [1100](#), [1600](#))
- Noise barriers ([Chapter 740](#))
- Pedestrian facilities ([Chapter 1510](#))
- Public art ([Chapter 950](#))
- Retaining walls ([Chapter 730](#))
- Roadside safety, traffic barriers, and energy attenuators (Chapters [1600](#), [1610](#), [1620](#))
- Safety rest areas, parks, viewpoints, and historical markers ([Chapter 1710](#))
- Signs ([Chapter 1020](#))

## 900.03 Project Development

### 900.03(1) *Region Landscape Architect*

The region Landscape Architect is responsible for the following:

- Designs, supervises, has approval authority over, and stamps plans for wetland mitigation, roadside restoration, and revegetation.
- Coordinates the visual elements within highway corridors, in conjunction with the State Bridge and Structures Architect.
- Designs and supervises other roadside work, such as site design for park & ride lots or safety rest areas, to ensure roadside restoration is designed and constructed to WSDOT guidelines and standards.
- Provides visual discipline reports for environmental documentation.
- Assists the region in completing the plant establishment phase of projects.

The Headquarters (HQ) Roadside and Site Development Section will provide roadside and mitigation design, visual impact assessment, and construction inspection work for the project offices in regions without a Landscape Architect. Refer to the [Project Management Online Guide](#) for further descriptions of the roles and responsibilities of project teams.

### **900.03(2) Roadside Restoration Projects**

There are typically two types of roadside restoration projects pertaining to vegetation-related roadway construction projects: regulatory and restoration.

#### **900.03(2)(a) Regulatory**

The first type of project is work related to regulatory or permit requirements. Examples are wetland mitigation work or Hydraulic Permit Approvals (HPAs). This work typically must occur by the time the impacting project is complete.

#### **900.03(2)(b) Restoration**

The second type of project is the restoration of construction impacts to roadside functions to meet the WSDOT policy requirements outlined in the [Roadside Policy Manual](#).

### **900.03(3) Stand-Alone Project or Part of Roadway Construction?**

Roadside restoration work should be evaluated by the design team to determine whether it will be most efficient as part of the roadway construction contract or as a separate stage contract.

#### **900.03(3)(a) Roadway Construction Contract**

The benefits of roadside restoration during roadway construction include the following:

- All work can be done under one contract.
- The restoration can be completed without waiting for a new contract to be let and administered.
- Plant establishment can often begin sooner.

#### **900.03(3)(b) Separate Stage Project**

A separate stage contract provides the following opportunities because it would be done when road construction is completed:

- If construction impacts are different than originally anticipated, the restoration contract can be changed. For example, if disturbance is minimized, fewer plants and soil amendments may be needed.
- The site can be watched to see how the grading and hydrology interact before plants are planted.
- The prime contractor can be someone who specializes in roadside work.

### **900.03(4) Plant Establishment**

Plant establishment periods are included as part of roadside restoration and on all environmental mitigation projects.

- A minimum of three years of plant establishment work is required for all planted areas in western Washington, and planted and/or seeded areas in eastern Washington.
- In situations where it is important to provide a full cover of vegetation to achieve the environmental or operational functions, five years of plant establishment may be needed.
- If the plant establishment period will last longer than three years on a roadside restoration contract, discussion should occur with Program Management to request and justify additional funding.
- In an environment that uses woody plants, plant establishment may take up to 10 years for the woody vegetation to exclude weeds and reach a condition with the lowest life cycle cost.
- Regulatory aspects of projects can require 10 years of plant establishment to ensure the standards of success outlined in the permit, although aggressive weed control and favorable weather can allow sites to close out early.

The goal is to give WSDOT Maintenance a site that is nearly self-sustaining after the plant establishment period is complete.

### **900.04 Documentation**

Refer to [Chapter 300](#) for design documentation requirements.

- 950.01 General
- 950.02 References
- 950.03 Standard Architectural Design
- 950.04 Criteria for Public Art
- 950.05 Process and Project Delivery Timing
- 950.06 Approvals
- 950.07 Documentation

## 950.01 General

There has been a growing interest on the part of communities to use art within the transportation facilities of the Washington State Department of Transportation (WSDOT). It can be used to provide visual interest along roadsides, make unique statements about community character, and create a positive public response that will last over time.

Proponents for public art might be local agencies or engaged citizens' groups with interest in the outcome of a WSDOT project. The environmental and public involvement processes offer opportunities for community partnership on the visual and aesthetic qualities of a corridor.

The public art policy in this chapter is intended to: provide guidance for managing public art on WSDOT facilities and within its rights of way; reinforce the existing policy in the [Roadside Policy Manual](#); designate appropriate locations for the incorporation of public art features; and provide for the consistent use of statewide development, review, and approval processes on new and existing features.

The appropriateness of public art is frequently dependent upon its location and composition. For example, an art piece or feature chosen for the back side of a noise wall, at a safety rest area, or along a bike path may not be suitable at the end of a freeway ramp or along the main line of a highway. In addition to appropriate placement, WSDOT must balance the requests for proposed public art projects with the need to provide corridor continuity, improve the unity of highway elements, and provide roadsides that do not divert motorists' attention from driving.

While some local jurisdictions dedicate a percentage of their project budgets for art, WSDOT has no such dedicated funding. Section 40 of the State Constitution specifies that gas tax money must be used for a "highway purpose." Therefore, public art beyond WSDOT standard design is typically funded by communities or other entities outside of WSDOT.

When city or community entrance markers are proposed, this policy should be used in conjunction with the guidance contained in [Chapter 1600](#), Roadside Safety, the [Traffic Manual](#), and the [Roadside Policy Manual](#).

### **What is public art?**

*For the purposes of WSDOT policy, public art is an enhancement to a functional element, feature, or place within a transportation corridor to provide visual interest. The enhancement could be an addition to a functional element, integrated into a design, or for purely aesthetic purposes.*

*An element is considered "public art" if it is beyond WSDOT standard practice for architectural treatment.*

## 950.02 References

### 950.02(1) Federal/State Laws and Codes

[Chapter 47.42 Revised Code of Washington \(RCW\)](#), Highway advertising control act – Scenic vistas act

### 950.02(2) Design Guidance

[Bridge Design Manual](#), M 23-50, WSDOT

[Roadside Policy Manual](#), M 25-31, WSDOT

### 950.02(3) Supporting Information

[A Guide for Achieving Flexibility in Highway Design](#), AASHTO, 2004

[Flexibility in Highway Design](#), FHWA, 1997

[Roadside Manual](#), M 25-30, WSDOT

[Traffic Manual](#), M 51-02, WSDOT

[Understanding Flexibility in Transportation Design – Washington](#), WSDOT, 2005

[www.wsdot.wa.gov/research/reports/600/638.1.htm](http://www.wsdot.wa.gov/research/reports/600/638.1.htm)

## 950.03 Standard Architectural Design

WSDOT's public art policy does not apply to the standard design of transportation architectural elements such as simple geometric patterns; combinations of WSDOT [standard concrete formliners](#); contrasting pavement patterns or colors in crosswalks or roundabouts; or earth-tone colors on structures or barriers.

To discuss the details of proposed public art projects, contact the State Bridge and Structures Architect, and the region or Headquarters (HQ) Landscape Architect for regions without a Landscape Architect. They are key members of the Public Art Specialty Services Team (described in [950.05](#)) and can answer questions and assist in determining an appropriate course of action.

## 950.04 Criteria for Public Art

Placement and composition of public art is unique and is to be evaluated on a case-by-case basis. Prior to approval of public art, a public art plan is to be developed in coordination with the Public Art Specialty Services Team. The team will review the concept, guide the local agency or design team through the process, and approve the plan in accordance with [950.06](#).

The following criteria are to be addressed and documented in the public art plan:

- The public art proponent, the funding source, and those responsible for the installation and maintenance of the proposed art.
- Safe maintenance access.
- Maintenance Agreement with local agencies for maintenance where appropriate. If there is a potential for vandalism, address this issue in the associated maintenance agreement.

- Whether public art resulted from the specific recommendation(s) of a planning-level study.
- Subject of the recommended art.
- Visibility:
  - Art visible from the main line must contribute to corridor continuity and the view from the road.
  - Art visible to the community or adjacent to the neighborhood side of a structure may have more flexibility in design than that visible from the main line.
- Safety and security: Public art must not negatively impact safety nor create an attractive nuisance.
- Potential for traffic distraction: Proposed art must not distract motorists. It must be appropriate for the speed and angle at which it will be viewed.
- Scale and context: The public art plan should address the scale of the proposed work and its fit within the surrounding landscape and land use.
- Contribution of the art to community character.
- Impact of the proposed art on social, cultural, and environmental features:
  - In general, WSDOT would not approve the addition of art on a historic structure or within an ecologically sensitive area.
- Compliance with applicable laws, such as the [Scenic Vistas Act](#) and [23 CFR 752](#), Landscape and Roadside Development.
- Compliance with the [Traffic Manual](#) and the [Roadside Policy Manual](#):
  - Lettering that can be construed as advertisement is not allowed.
  - “Welcome to [insert city name]” lettering is permissible at the end of ramps if it complies with the [Traffic Manual](#) section on Sign Design.
  - Locations for community gateway signs are described in the [Roadside Policy Manual](#).
- Demonstrated responsible use of tax dollars and enhanced public trust in WSDOT judgment.

For further information on these criteria, see the [Roadside Manual](#).

#### **950.04(1) Acceptable Public Art Features**

Public art must be in compliance with WSDOT corridor guidelines, such as the Mountains to Sound Greenway Implementation Plan or the I-90 Architectural Design Standards, and existing policies such as the [Roadside Policy Manual](#) and the [Bridge Design Manual](#).

The following are examples of types and locations of acceptable public art features:

- Concrete surface treatments (beyond WSDOT standard)
- Colored paving/colored pavers/scoring patterns (beyond WSDOT standard)
- Specially designed benches, trash cans, planters, or other street furnishings
- Soft lighting and lighting fixtures
- Small-scale sculptures or art pieces (when not viewed from the main line)
- Attachments to decorative railings, light poles, or fences
- Decorative bus shelters

#### **950.04(2) Unacceptable Public Art Features**

The following are examples of unacceptable public art features:

- Kinetic sculptures
- Brightly lit or flashing art
- Art that poses a safety risk or liability
- Large sculptures (the size is relative to its context and location in the landscape)
- Art with highly reflective qualities or adverse colors
- Art that is a distraction to drivers or out of context with the surroundings
- Art with a topic/theme that could cause negative public reaction
- Art that resembles a traffic control device
- Art that contains advertising

### **950.05 Process and Project Delivery Timing**

Begin the development and review of public art early in the design process, and conduct subsequent reviews during the course of its development. Do not include public art as a change order or addendum to a project without first having gone through the process described in this policy. Project Ad and Award dates will not be delayed due to an incomplete public art process.

A public art plan is developed to incorporate public art into projects on state highways. Include the review of the public art plan by the [Public Art Specialty Services Team](#) in project reviews.

#### **950.05(1) Public Art Plan**

The public art plan is developed by the Project Engineer's Office or by the local artist or community sponsoring the proposal. The plan provides enough detail and description to convey the intent of the proposed art project. The plan documents how the proposed art meets the criteria listed in [950.04](#) and includes the following elements:

- Cover sheet with appropriate approval signatures (see [950.06](#)).
- Project overview.

- Location of the proposed art.
- Scale drawings of the proposed art, including proposed materials, attachments, and finishes. Any attachments to fencing or structures, or proposed new structures, will require structural engineering calculations.
- All criteria from 950.04, Criteria for Public Art, addressed and documented.
- Justification and recommendations for public art.
- Documentation showing support by the local community.

Without an approved public art plan, a Maintenance Agreement (as appropriate), and funding, the “art” will not be constructed or installed.

### **950.05(2) Public Art Specialty Services Team**

Include the Public Art Specialty Services Team in the development of public art and the public art plan. The Team includes the following:

- Project Engineer or a designee (if the art is included in a project)
- State Bridge and Structures Architect
- Region or HQ Landscape Architect
- Region Traffic Engineer
- Region Local Programs Engineer (if the proponent is a local community)

For public art proposed within Interstate Limited Access, the following team members are also required:

- Assistant State Design Engineer
- Federal Highway Administration (FHWA) Safety/Geometric Engineer or a designee

Consider team membership from the following functional areas when their expertise is applicable:

- Maintenance
- Planning
- Environmental
- Real Estate Services

## **950.06 Approvals**

### **950.06(1) Intermediate Approvals**

The Public Art Specialty Services Team is responsible for approving the public art; therefore, be sure to involve them in the development of art during the earliest possible phase of project development. This will ensure approvals happen smoothly and WSDOT and FHWA are aware of the public art as soon as possible.

Project development phases include the following:

- Initial Art Concept review: input and approval.
- Selected Art Concept review: input and approval.
- Final Proposed Art review: input and approval.

### **950.06(2) Final Approval**

Approval of the public art plan is considered approval for the public art. The public art plan cover letter needs to include the following approval signatures as appropriate.

#### **950.06(2)(a) Within Limited Access**

Public art within Limited Access on the Interstate is approved by:

- Project Engineer or a designee (if the art is included in a project)
- State Bridge and Structures Architect
- Region or HQ Landscape Architect
- Region Traffic Engineer
- Region Local Programs Engineer (if the proponent is a local community)
- Assistant State Design Engineer
- Region Administrator or designee
- FHWA Safety/Geometric Design Engineer or designee

#### **950.06(2)(b) All Other Projects**

Public art for all other projects is approved by:

- Project Engineer or a designee (if the art is included in a project)
- Region or HQ Landscape Architect
- State Bridge and Structures Architect
- Region Traffic Engineer
- Region Local Programs Engineer (if the proponent is a local community)
- Region Administrator or designee

## **950.07 Documentation**

The public art plan, complete with approval signatures, is retained in the Design Documentation Package (DDP).

Refer to [Chapter 300](#) for design documentation requirements.

- 1010.01 General
- 1010.02 References
- 1010.03 Definitions
- 1010.04 Work Zone Safety and Mobility
- 1010.05 Transportation Management Plans and Significant Projects
- 1010.06 Developing TMP Strategies
- 1010.07 Capacity Analysis
- 1010.08 Work Zone Design Standards
- 1010.09 Temporary Traffic Control Devices
- 1010.10 Positive Protection Devices
- 1010.11 Other Traffic Control Devices or Features
- 1010.12 Traffic Control Plan Development and PS&E
- 1010.13 Training and Resources
- 1010.14 Documentation

## 1010.01 General

Addressing work zone impacts to road users is an important component in the design of a project and needs to be given adequate consideration early in the design process. Most work zones create some level of traffic impacts and require additional safety features; therefore, all work areas and operations needed for construction must be identified and addressed during the project design. It is not acceptable to allow a project to move forward to advertisement without appropriately addressing work zone impacts, as the costs can account for up to 30% of the project cost. Planners, designers, construction engineers, maintenance personnel, and others all play a role in developing a comprehensive work zone design.

This chapter provides the designer with guidance to develop comprehensive work zone strategies and plans to address a project's safety, mobility, and constructability issues. A systematic process for addressing work zone impacts is required by federal regulations and state policy.

## 1010.02 References

### 1010.02(1) Federal/State Laws and Codes

[23 Code of Federal Regulations \(CFR\) Part 630 Subpart J](#) – Work Zone Safety and Mobility

Americans with Disabilities Act of 1990 (ADA) (28 CFR Part 36, Appendix A, as revised July 1, 1994)

“Final Rule on Work Zone Safety and Mobility,” Federal Highway Administration (FHWA), Effective Date October 12, 2007

[www.ops.fhwa.dot.gov/wz/resources/final\\_rule.htm](http://www.ops.fhwa.dot.gov/wz/resources/final_rule.htm)

*Manual on Uniform Traffic Control Devices for Streets and Highways*, USDOT, FHWA; as adopted and modified by [Chapter 468-95 WAC](#) “Manual on uniform traffic control devices for streets and highways” (MUTCD)

### 1010.02(2) Design Guidance

*A Policy on Geometric Design of Highways and Streets* (Green Book), AASHTO

*Accessible Rights-of-Way: A Design Guide*, U.S. Access Board, Washington DC

🔗 <http://www.access-board.gov/guidelines-and-standards>

Americans with Disabilities Act and Architectural Barriers Act Accessibility Guidelines (ADAAG), July 23, 2004, U.S. Access Board

🔗 [www.wbdg.org/ccb/astand/ada\\_aba.pdf](http://www.wbdg.org/ccb/astand/ada_aba.pdf)

Executive Order E 1001, Work Zone Safety and Mobility

🔗 <http://wwwi.wsdot.wa.gov/publications/policies/fulltext/1001.pdf>

Executive Order E 1033, WSDOT Employee Safety

🔗 <http://wwwi.wsdot.wa.gov/publications/policies/fulltext/1033.pdf>

*Plans Preparation Manual*, M 22-31, WSDOT

*Standard Plans for Road, Bridge, and Municipal Construction* (Standard Plans), M 21-10, WSDOT

*Standard Specifications for Road, Bridge, and Municipal Construction* (Standard Specifications), M 41-10, WSDOT

*Traffic Manual*, M 51-02, WSDOT

*Work Zone Traffic Control Guidelines*, M 54-44, WSDOT

### 1010.02(3) Supporting Information

*Construction Manual*, M 41-01, WSDOT

*“Crashworthy Work Zone Traffic Control Devices,” Report 553*, NCHRP, 2006

*Environmental Manual*, M 31-11, WSDOT

*Highway Capacity Manual*, 2010, TRB

*ITE Temporary Traffic Control Device Handbook*, 2001

*ITS in Work Zones*

🔗 [www.ops.fhwa.dot.gov/wz/its/](http://www.ops.fhwa.dot.gov/wz/its/)

*“Recommended Procedures for the Safety Evaluation of Highway Features,” Report 350*, NCHRP, 1993

*Roadside Design Guide*, AASHTO, 2011

*Manual for Assessing Safety Hardware*, AASHTO, 2009

Work Zone & Traffic Analysis, FHWA

🔗 [www.ops.fhwa.dot.gov/wz/traffic\\_analysis.htm](http://www.ops.fhwa.dot.gov/wz/traffic_analysis.htm)

*Work Zone Operations Best Practices Guidebook*, FHWA, 2007

🔗 [www.ops.fhwa.dot.gov/wz/practices/practices.htm](http://www.ops.fhwa.dot.gov/wz/practices/practices.htm)

Work Zone Safety and Mobility, FHWA

🔗 [www.ops.fhwa.dot.gov/wz/index.asp](http://www.ops.fhwa.dot.gov/wz/index.asp)

Work Zone Safety Web Page, WSDOT

🔗 [www.wsdot.wa.gov/safety/workzones/](http://www.wsdot.wa.gov/safety/workzones/)

### 1010.03 Definitions

The following terms are defined in the *Design Manual Glossary*: **transportation management area (TMA)**; **transportation management plan (TMP)**; **work zone**; **work zone impact**; **work zone traffic control**; **traveling public**.

### 1010.04 Work Zone Safety and Mobility

Washington State Department of Transportation (WSDOT) policy per [Executive Order E 1001, Work Zone Safety and Mobility](#), is intended to support systematic consideration and management of work zone impacts across all stages of project development.

The policy states:

*All WSDOT employees are directed to make the safety of workers and the traveling public our highest priority during roadway design, construction, maintenance, and related activities.*

Designers should be familiar with this document. The policy defines how WSDOT programs address work zone safety and mobility issues during project planning, design, and construction.

### 1010.05 Transportation Management Plans and Significant Projects

#### 1010.05(1) Transportation Management Plan (TMP)

A transportation management plan is a set of strategies for managing the corridor-wide work zone impacts of a project. A TMP is required for all projects and is the key element in addressing all work zone safety and mobility impacts. The TMP development begins in the scoping phase of a project by assessing impacts known at the time and then selecting mitigating strategies and design solutions to manage those impacts. It is very important to continue the development of the TMP throughout the project development process.

Not all work zone impacts have to be addressed with traffic control plans only. Many work zone impacts can be reduced or eliminated through project design elements like alignment choice, materials selection, structure types, overbuilding, and phased construction. Work zone impacts related to work duration may be resolved or reduced through innovative bidding and contract administration.

The three major components of a TMP are described below.

#### 1010.05(1)(a) Temporary Traffic Control (TTC)

The TTC components are those strategies for directing traffic through the work zone and minimizing the duration of the impacts. These components are to be included in the Plans, Specifications, and Estimates (PS&E) as traffic control plans (TCPs) and contract provisions. The TTC components may include but are not limited to the following strategies:

- TTC strategies such as lane closures or shifts, one-lane two-way operations (flagging and or pilot car), staged construction, or full road closures and detours.
- Traffic Control Devices such as temporary signing, channelizing devices (cones, drums), changeable message signs, arrow boards, temporary signals, and temporary pavement markings.

- Corridor Project Coordination, Contracting Strategies, and Innovative Construction Strategies such as A+B bidding, incentives/disincentives, and precast members or rapid cure materials.

#### **1010.05(1)(b) Transportation Operations (TO)**

The TO components are those strategies for improving traffic flow and safety through the work zone. Some of these strategies may be included in the PS&E, but could also be WSDOT-managed elements outside the contract. The TO components may include but are not limited to the following strategies:

- Demand Management Strategies such as Transit service improvements, transit incentives, and park & ride promotion.
- Corridor/Network Management (traffic operations) Strategies such as Signal timing/coordination improvements, temporary signals, bus pullouts, reversible lanes, and truck/heavy-vehicle restrictions.
- Work Zone Safety Management Strategies such as Positive protective device use, speed limit reductions, and automated flagger assistance devices.
- Traffic/Incident Management and Enforcement Strategies such as Work Zone Intelligent Transportation Systems (ITS), Washington State Patrol, tow service, WSDOT Incident Management vehicle(s), and traffic screens.

#### **1010.05(1)(c) Public Information (PI)**

The PI components are those strategies for raising awareness of the upcoming project impacts or current restrictions. Public awareness strategies may be developed and implemented by WSDOT through the region or Headquarters (HQ) Communications offices and implemented before and during construction. Motorist information strategies may be WSDOT-managed elements with state equipment outside the contract or identified on plans in the PS&E. The PI components may include, but are not limited to, the following strategies:

- Public Awareness Strategies such as Brochures or mailers, press releases, paid advertisements, and project website (consider providing information in other languages if appropriate).
- Motorist Information Strategies such as Highway advisory radio (HAR), changeable message signs, and transportation management center (TMC).

It is very important to continue the development of the TMP throughout the project development process. Not all work zone impacts have to be addressed with traffic control plans only. Many work zone impacts can be reduced or eliminated through project design elements like alignment choice, materials selection, structure types, overbuilding, and phased construction. Work zone impacts related to work duration may be resolved or reduced through innovative bidding and contract administration.

The TMP Checklist in [Exhibit 1010-3](#) will help identify and organize TMP components. Include the completed checklist in the Project File. For significant projects, develop this checklist and the supporting plans, data, impacts assessment, strategies, capacity/delay analysis and endorsements into a formal TMP document to be included in the Project File. For TMP examples, see:

🔗 [http://www.ops.fhwa.dot.gov/wz/resources/final\\_rule/tmp\\_examples/sample\\_tmpls.htm](http://www.ops.fhwa.dot.gov/wz/resources/final_rule/tmp_examples/sample_tmpls.htm)

🔗 [http://www.ops.fhwa.dot.gov/wz/resources/publications/trans\\_mgmt\\_plans/trans\\_mgmt\\_plans.pdf](http://www.ops.fhwa.dot.gov/wz/resources/publications/trans_mgmt_plans/trans_mgmt_plans.pdf)

### 1010.05(2) Significant Projects

The FHWA definition of a “significant project” is as follows:

*A significant project is one that, alone or in combination with other concurrent projects nearby, is anticipated to cause sustained work zone impacts that are greater than what is considered tolerable based on state policy and/or engineering judgment.*

*All Interstate system projects within the boundaries of a designated Transportation Management Area (TMA) that occupy a location for more than three days with either intermittent or continuous lane closures shall be considered as significant projects.*

**Note: Significant projects require a TMP document addressing safety and mobility impacts with strategies or elements from all three TMP components.**

For projects not identified as significant, a TMP is the TTC components included in the PS&E. Transportation Operations and Public Information components may also be required to properly address the impacts as many projects can have significant work zone safety and mobility impacts, but are not necessarily a significant project as defined under the federal requirements stated above. Consider developing a TMP document for these types of projects as well.

The Project Summary must include a Work Zone Strategy Statement and indicate whether the project is significant in regard to work zone impacts.

Significant projects may require a Value Engineering (VE) study (see [Chapter 310](#)) and a Cost Risk Assessment (CRA) or Cost Estimate Validation Process (CEVP) that could help define strategies or identify risks: 🔗 [www.wsdot.wa.gov/projects/projectmgmt/riskassessment/](http://www.wsdot.wa.gov/projects/projectmgmt/riskassessment/)

## 1010.06 Developing TMP Strategies

### 1010.06(1) Key Considerations

The following list is intended to alert the designer to actions and issues that need to be addressed as part of a TMP. Addressing these items is required per WSDOT’s work zone policy and federal regulations, and they are key to the successful development of a project’s TMP.

- Determine work zone impacts through an impact assessment process.
- Minimize, mitigate, and manage work zone impacts.
- Integrate work zone impacts strategies early, during planning, programming, and design.
- Develop an accurate scoping estimate based on the work zone strategies.

- Hold a Work Zone Design Strategy Conference early in the design process. (Include bridge, construction, traffic, maintenance, local agency, and law enforcement personnel.)
- Utilize the Work Zone TMP Checklist/TMP document (required for significant projects).
- Emphasize flagger safety.
- Assess work zone mobility through a capacity analysis.
- Integrate project constructability, work efficiency and cost containment into the work zone strategy.
- Attend work zone training.
- Address Washington State traffic and safety regulations as provided for by state law.
- Use the legally adopted [Manual on Uniform Traffic Control Devices](#) (MUTCD), with Washington State modifications as the minimum standard.
- Provide an appropriate level of traffic control plans (TCPs).
- Consider work zone ITS elements.
- Use established design criteria in work zone roadway and roadside design.
- Accommodate pedestrian access (including ADA requirements) and maintenance of existing transit stops and bicycle traffic.
- Consider maintenance issues and needs through the duration of the project.
- Consider school, hospital, emergency services, and postal delivery, impacts.
- Consider economic impacts (business access) due to traffic delay or restricted access.
- Consider freight mobility; total roadway widths to less than 16 feet should be avoided if possible.
- Address traffic impacts extending beyond the project limits and impacting other roads.
- Identify seasonal or special event impacts that affect recreation or business due to work zone impacts.
- Consider risk management and tort liability exposure.
- Approach the work zone design from the road user's perspective.
- Incorporate worker safety needs (positive protection) in your work zone designs.
- Account for all needed work areas, operations and possible staging areas.
- Address work vehicle ingress and egress to each work area.
- Use of law enforcement

### **1010.06(2) Impacts Assessment**

One of the most important tasks in developing a TMP is assessing all of the project impacts to mobility and safety. Impacts that are not identified and addressed in the TMP will undoubtedly become issues during the construction phase of the project. A designer needs to possess a clear understanding of how project features will be constructed, including work methods, equipment, materials, and duration, to complete the work. Involve the construction PE when making decisions on assessing and addressing impacts.

A complete and accurate impacts assessment will allow for the development of an effective TMP that should only need minor modifications to address construction issues.

An early and ongoing impacts assessment allows time to:

- Develop TTC, TO, and PI strategies to address identified impacts as needed to effectively manage the project.
- Resolve potential work zone impacts within the design features of the project. Decisions that consider work zone impacts during bridge type selection, materials selection, advertisement dates, and others have the potential to resolve or minimize work zone impacts.
- Consider innovative mitigation strategies that may involve many stakeholders.

Some impacts may be difficult to completely solve and may ultimately need a management decision to determine the level of mitigation or impact that is acceptable. These types of impacts need to be clearly addressed in the TMP with documentation supporting and explaining the decision.

The following are some examples of impacts that need to be managed during the design of a project:

1. Bridge construction sequence or falsework opening plans need to match the TCC staging or channelization plans. Coordination with the HQ Bridge and Structures Office is essential as the bridge design schedule may differ than the project schedule. Maintain the legal height of 16 feet 6 inches as the minimum falsework opening whenever possible; anything less than this must consider overheight vehicle impacts and possible additional signing needs. Impacts to shoulder widths due to barrier or bridge staging may impact bicycle or pedestrian access and must be addressed in TCC plans. Refer to [Chapter 720](#) for additional requirements and approvals. Coordination with the Permits Office may be needed.
2. If existing signal and illumination systems are not able to be maintained during the construction phases, plans for temporary systems or connections need to be included in the project.
3. Temporary relocation of existing signing (including overhead signing) may be required and should be detailed in the plans.
4. Permanent traffic loop installation (such as advance loops, turn pockets, and stop bars, and ITS loops) and pavement marking installations (crosswalks, arrows, and so on) may require specific TTC plans.
5. What type of temporary marking is most appropriate for the installation, work duration, and the pavement surface? Will the final pavement surface have a “ghost stripe” potential?
6. Lane shifts onto existing shoulders:
  - Is the depth of the existing shoulder adequate to carry the extra traffic and are there rumble stripe that need to be removed?
  - Are there any existing catch basins or junction boxes located in the shoulder that cannot accept traffic loads over them?
  - What is the existing side slope rate? If steeper than 4H:1V, does it need mitigation? Are there existing roadside objects that, when the roadway is shifted, are now within the clear zone limits?

- Shifting of more than one lane in a direction is only allowed with temporary pavement markings. Shifting lanes by using channelizing devices is not allowed due to the high probability that devices used to separate the traffic will be displaced.
  - Signal head alignment: When the lane is shifted approaching the intersection, is the signal head alignment within appropriate limits?
7. Roundabout construction at an existing intersection requires site-specific staging plans. Roundabouts create many unique construction challenges and each roundabout has very site-specific design features.

### **1010.06(3) Work Duration**

The duration of work is a major factor in determining a strategy and the amount and types of devices to use in traffic control work zones. A project may have work operations with durations that meet several or all of the following conditions:

#### **1010.06(3)(a) Long-Term Stationary Work Zone**

This is work that occupies a location continuously for more than three days. Construction signs should be post-mounted and larger; more stable channelizing devices should be used for increased visibility. Temporary barriers, pavement markings, illumination, and other considerations may be required for long-term stationary work. Staged construction or temporary alignment/channelization plans are required with this type of work.

#### **1010.06(3)(b) Intermediate-Term Stationary Work Zone**

This is work that occupies a location for up to three days. Signs may still be post-mounted if in place continuously. Temporary pavement markings, in addition to channelization devices, may be required for lane shifts. Barrier and temporary illumination would normally not be used in this work zone duration.

#### **1010.06(3)(c) Short-Term Stationary Work Zone**

This is work that occupies a location for more than one hour within a single day. At these locations, all devices are placed and removed during the single period.

#### **1010.06(3)(d) Short-Duration Work Zone**

This is work that occupies a location for up to one hour. Because the work time is short, the impact to motorists is usually not significant. Simplified traffic control set-ups are allowed, to reduce worker exposure to traffic. The time it may take to set up a full complement of signs and devices could approach or exceed the amount of time required to perform the work. Short-duration work zones usually apply to maintenance work and are not used on construction projects. (See [Work Zone Traffic Control Guidelines](#) for more information.)

### **1010.06(3)(e) Mobile Work Zone**

This is work that moves intermittently or continuously. These operations often involve frequent stops for activities such as sweeping, paint striping, litter cleanup, pothole patching, or utility operations, and they are similar to short-duration work zones. Truck-mounted attenuators, warning signs, flashing vehicle lights, flags, and channelizing devices are used, and they move along with the work. When the operation moves along the road at low speeds without stopping, the advance warning devices are often attached to mobile units and move with the operation.

Pavement milling and paving activities are similar to mobile operations in that they can progress along a roadway several miles in a day. These operations, however, are not considered mobile work zones, and work zone traffic control consistent with construction operations is required.

### **1010.06(4) TMP Strategies**

With a completed impacts assessment, strategy development can begin. There are often several strategies to address a work zone impact, and engineering judgment will be needed in selecting the best option. Constructability, along with addressing safety and mobility, is the goal. Selecting a strategy is often a compromise and involves many engineering and non-engineering factors. Work closely with bridge, construction, maintenance and traffic office personnel when selecting and developing strategies for the TMP and PS&E.

Do not assume that strategies chosen for past projects will adequately address the impacts for similar current projects. There may be similarities with the type of work, but each project is unique and is to be approached in that manner. Always look for other options or innovative approaches; many projects have unique features that can be turned to an advantage if carefully considered. Even a basic paving project on a rural two-lane highway may have opportunities for detours, shifting traffic, or other strategies.

For a list of work zone analysis tools, see:

 [http://ops.fhwa.dot.gov/wz/traffic\\_analysis/index.htm#tools](http://ops.fhwa.dot.gov/wz/traffic_analysis/index.htm#tools)

### **1010.06(5) Temporary Traffic Control (TTC) Strategies**

#### **1010.06(5)(a) Lane Closure**

One or more traffic lanes are closed. A capacity analysis is necessary to determine the extent of congestion that may result. Night work or peak hour restrictions may be required. Use traffic safety drums and truck-mounted attenuators for freeway or expressway lane closures. Channelization devices should not encroach on the open freeway lanes; an additional lane should be closed if encroachment is necessary. Consider closing additional lanes to increase the lateral buffer space for worker safety.

#### **1010.06(5)(b) Shoulder Closure**

A shoulder closure is used for work areas off the traveled way. On high-volume freeways or expressways, they should not be allowed during peak traffic hours. Channelization devices should not encroach on the open lanes of high-speed roadways.

### 1010.06(5)(c) Alternating One-Lane Two-Way Traffic

This strategy involves using one lane for both directions of traffic. Flaggers are used to alternate the traffic movements.

If flaggers are used at an intersection, a flagger is required for each leg of the intersection. Only law enforcement personnel are allowed to flag from the center of an intersection. Close lanes and turn pockets so only one lane of traffic approaches a flagger station. When a signal is present, it shall be turned off or set to red flash mode when flagging.

Law enforcement personnel may be considered for some flagging operations and can be very effective where additional driver compliance is desired. The *Traffic Manual* contains information on the use of law enforcement personnel at work zones.

Flagger safety is a high emphasis area. Do not include alternating traffic with flaggers as a traffic control strategy until all other reasonable means of traffic control have been considered. Flagging stations need to be illuminated at night. Flaggers need escape routes in case of errant vehicles. Provide a method of alerting them to vehicles approaching from behind. Two-way radios or cellular phones are required to allow flaggers to communicate with one another. The flagger's location, escape route, protection, signing, and any other safety-related issues all need to be incorporated into the traffic control plan for the flagging operation. Flaggers are not to be used on freeways or expressways. Using flaggers solely to instruct motorists to proceed slowly is an unacceptable practice.

Removing flaggers from the roadway during alternating traffic operations can be done with portable temporary traffic control signals or automated flagging assistance devices (AFAD). Portable signals work best when the length between signals will be 1,500 feet maximum and no accesses lie between the temporary signals. Each AFAD unit will need a flagger operating the device from a safe location off the roadway. A traffic control plan should show the advance signing and the AFAD or signal locations. Temporary stop bars, and lighting at the stop bars is required for signal use. For assistance on using these devices, contact the region Traffic Office.

Refer to [WAC 296-155-305](#) for flagging requirements.

### 1010.06(5)(d) Temporary Alignment and Channelization

Temporary alignments and/or channelization may be an option for long-term work zones or staged traffic control. The following are guiding principles for the design of temporary alignment and channelization plans:

- Use site-specific base data to develop site-specific traffic control plans.
- Use permanent geometric design criteria.
- Provide beginning and ending station ties and curve data.
- Include lane and shoulder widths.
- Provide temporary roadway sections.
- To avoid confusion, do not show existing conflicting or unnecessary details on the plan.
- Do not use straight line tapers through curves; use circular alignment.
- Be aware of existing crown points, lane/shoulder cross slope breaks, and super-elevation transitions that may affect a driver's ability to maintain control of a vehicle.

- If the project has multiple stages, from one stage to the next, show newly constructed features as existing elements. For example, if an edge line is removed in one stage, the following stage would show the change by indicating where the new edge line is located.
- Consider the time needed for removal of existing markings and placement of the new markings and possibly placement of barriers and attenuators. In urban areas where work hours for lane closures are limited, special consideration may be necessary to allow time to implement the plan, or an interim stage may be necessary.
- Use shoulder closure signing and channelizing devices to close a shoulder prior to a temporary impact attenuator and run of temporary concrete barrier.
- Existing signing may need to be covered or revised, and additional construction warning signs may be needed for the new alignment.
- Temporary pavement marking types and colors should be specified. Long-duration temporary markings should be installed per the [Standard Plans](#) for permanent markings.
- For better guidance through shifting or taper areas, consider solid lane lines. Return to broken lane lines between shift areas.
- Provide a list of the approved temporary impact attenuators that may be used for the plan if applicable.
- The plans must provide all the layout information for all the temporary features just as a permanent pavement marking plan would.

#### **1010.06(5)(d)(1) Staged Construction**

Staged construction entails combining multiple work areas into a logical order to provide large protected work areas for long durations, which maximizes work operations and minimizes daily impacts to traffic. Temporary alignment and channelization plans must be designed to place traffic in these semi-permanent locations. Minimum geometric design criteria are to be used when developing these plans. Design strategies such as overbuilding for future stages or the use of temporary structures are often part of staged construction on significant impact projects or mega projects. Develop detailed capacity analysis and traffic modeling for each stage.

#### **1010.06(5)(d)(2) Lane Shift/Reduced Lane Width**

Traffic lanes may be shifted and/or width-reduced in order to accommodate a long-duration work area when it is not practicable, for capacity reasons, to reduce the number of available lanes. Shifting more than one lane of traffic requires the removal of conflicting pavement markings and the installation of temporary markings; the use of channelization devices to delineate multiple lanes of traffic is not allowed. Use advanced warning signs to show the changed alignment when the lateral shifting distance is greater than one-half of a lane width, and consider the use of solid lane lines through the shift areas.

Utilizing the existing shoulder may be necessary to accommodate the shifting movement. First, determine the structural capacity of the shoulder to ensure its ability to carry the proposed traffic. Remove and inlay existing shoulder rumble strips prior to routing traffic onto the shoulder.

**1010.06(5)(d)(3) Traffic Split or Island Work Zone**

This strategy separates lanes of traffic traveling in one direction around a work area. On higher-speed roadways, temporary barriers are provided to prevent errant vehicles from entering the work area. Some drivers have difficulty understanding "lane split" configurations, which sometimes results in poor driving decisions such as unnecessary or late lane changes. Braking and erratic lane changes decrease the traffic capacity through the work zone, which results in an unstable traffic flow approaching the lane split. Evaluate other strategies, such as overbuilding, to keep traffic on one side of the work area to avoid a traffic split if possible.

Consider the following guidance for traffic split operations:

- Define the work operation and develop the traffic control strategy around the specific operation.
- Limit the duration the traffic split can be in place. Consider incentives and disincentives to encourage the contractor to be as efficient as possible. A higher level of traffic impacts may be acceptable if offset with fewer impacted days.
- Advance warning signs advising drivers of the approaching roadway condition are required. Consider the use of Portable Changeable Message Signs (PCMS), portable Highway Advisory Radio (HAR), and other dynamic devices. Overhead signing and in-lane pavement markings also may be necessary to give additional driver notice of the traffic split.
- Consider how the operation will impact truck traffic. If the truck volumes are high, additional consideration may be prudent to control in which lane the trucks drive. If the trucks are controlled, it eliminates much of the potential for truck/car conflicts and sorts out undesirable truck lane changes through the work zone. For questions concerning truck operations, contact the HQ Freight Systems Division.
- To discourage lane changing, consider the use of solid lane line markings to delineate traffic approaching the split or island. Refer to the [MUTCD](#) for additional details.
- Consider the use of STAY IN LANE (black on white) signs, or set up a "no pass" zone approaching the lane split and coordinate with the Washington State Patrol (WSP).
- Supplement the existing roadway lighting with additional temporary lighting to improve the visibility of the island work area (see [Exhibit 1040-23](#)).
- Coordinate with the region Traffic Office for signing and pavement marking details when designing island work zones.

**1010.06(5)(d)(4) Temporary Bypass**

This strategy involves total closure of one or both directions of travel on the roadway. Traffic is routed to a temporary bypass usually constructed within the highway right of way. An example of this is the replacement of an existing bridge by building an adjacent temporary structure and shifting traffic onto the temporary structure. A temporary channelization plan will show pavement markings, barrier and attenuators, sign and device placement.

**1010.06(5)(d)(5) Median Crossover**

This strategy involves placing all multilane highway traffic on one side of the median. Lanes are usually reduced in both directions and one direction is routed across the median. The design for elements of temporary crossovers needs to follow the same guidance as permanent design for alignment, barriers, delineation, and illumination.

- Design crossovers for operating speeds not less than 10 mph below the posted speed limit unless unusual site conditions require a lower design speed.
- Median paving may be required to create crossover locations (consider drainage for the added pavement).
- Use temporary barrier to separate the two directions of traffic normally separated by a median barrier,
- Temporary illumination at the crossover locations (see [Exhibit 1040-24](#))
- Straight line crossover tapers work best for highways with narrow paved medians.
- Temporary pavement markings, removal of conflicting existing markings, and construction signs are also required.
- A good array of channelizing devices and properly placed pavement markings is essential in providing clear, positive guidance to drivers.
- Provide a clear roadside recovery area adjacent to the crossover. Consider how the roadway safety hardware (guardrail, crash cushions, and so on) may be impacted by the traffic using the crossover if the traffic is going against the normal traffic flow direction. Avoid or mitigate possible snagging potential. Avoid placing crossover detours near structures.

**1010.06(5)(e) Total Closures and Detours**

Total closures may be for the project duration or for a critical work operation that has major constructability or safety issues. The main requirement for total closures is the availability of a detour route and if the route can accommodate the increased traffic volumes and trucks turning movements. Local roads may have lower geometric criteria than state facilities. Placing additional and new types of traffic on a local road may create new safety concerns, especially when drivers are accustomed to the geometrics associated with state highways. Pavement integrity and rehabilitation may need to be addressed when traffic is detoured to specific local roadways.

For the traveling public, closing the road for a short time might be less of an inconvenience than driving through a work zone for an extended period of time (see the [Traffic Manual](#) and [RCW 47.48](#)). Advance notification of the closure is required, and a signed detour route may be required.

Consider the following road closure issues:

- Communication with all stakeholders, including road users, adjoining property owners, local agencies, transit agencies, the freight industry, emergency services, schools, and others, is required when considering a total closure strategy. This helps determine the level of support for a closure and development of an acceptable closure duration (see [Commercial Vehicle Services](#)).

- Analyze a closure strategy and compare it to other strategies, such as staged work zones, to determine which is overall more beneficial. This information helps stakeholders understand the impacts if a closure is not selected.
- A closure decision (other than short-term, minor-impact closures) will require stakeholder acceptance and management approval once impacts and benefits have been analyzed.
- Closures that reopen to a new, completed roadway or other noticeable improvements are generally more accepted by the public.
- Route-to-route connections and other strategic access points may have to be maintained or a reasonable alternative provided.
- Material selection, production rates, and work operation efficiencies have a direct tie to the feasibility of the closure strategy. A strong emphasis has been placed on this area and several successful strategies have been implemented, such as weekend-long closures or extended-duration single-shift closures. These strategies use specific materials such as quick-curing concrete, accelerated work schedules, prefabricated structure components, on-site mix plants, and so on, and are based on actual production rates. The WSDOT Materials Laboratory and the HQ Construction Office are good resources for more information on constructability as a component of an effective work zone strategy.
- Interstate or interstate ramp closures (including interstate closures with interchange ramps as detours) lasting more than 7 days require FHWA 60-day advance notice. (See the [Stewardship and Oversight Agreement](#) for closure notification requirements.)
- Short-duration closures of ramps or intersecting streets during off-peak hours do not require extensive approval if advance notice is provided and reasonable alternate routes are available.
- Detailed, project-specific traffic control plans, traffic operation plans, and public information plans are required.
- Depending on the duration of the closure/detour and the anticipated amount and type of traffic that will use the route, consider upgrades to the route such as signal timing, intersection turning radius for large vehicle, structural pavement enhancements, or shoulder widening.
- An approved detour agreement with the appropriate local agency is required for detour routes using local roadways and must be completed prior to project advertisement.
- Document road closure decisions and agreements in the Project File.

#### **1010.06(5)(f) Intermittent Closure**

This involves stopping all traffic for a short time to allow the work to proceed. Traffic volumes will determine the allowed duration of the closures. Typically, the closure would be limited to a ten-minute maximum and would occur in the lowest traffic volume hours. Equipment crossing and material delivery are where this type of closure may work well. Traffic is reduced to a single lane on a multilane highway, and a flagger or law enforcement is used to stop traffic.

### 1010.06(5)(g) Rolling Slowdown

Rolling slowdowns are commonly practiced by the Washington State Patrol (WSP) for emergency closures. They are a legitimate form of traffic control for contractors or utility and highway maintenance crews for very specific short-duration closures (to move large equipment across the highway, to pull power lines across the roadway, to switch traffic onto a new alignment, and so on). They are not to be used for routine work that can be addressed by lane closures or other formal traffic control strategies. Traffic control vehicles, during off-peak hours, form a moving blockade, which reduces traffic speeds and creates a large gap (or clear area) in traffic, allowing very short-term work to be accomplished without completely stopping the traffic.

Consider other forms of traffic control as the primary choice before the rolling slowdown. A project-specific traffic control plan (TCP) must be developed for this operation. The TCP or contract provisions should list the work operations in which a rolling slowdown is allowed. The gap required for the work and the location where the rolling slowdown begins needs to be addressed on the TCP. Use of the WSP is encouraged whenever possible. Refer to the *Standard Specifications* and *Work Zone Traffic Control Guidelines* for additional information on rolling slowdown operations.

### 1010.06(5)(h) Pedestrian and Bike Detour Route

When existing pedestrian access routes and bike routes are disrupted due to construction activities, address detour routes with a traffic control plan. The plan must show enough detail and be specific enough to address the conflicts and ensure the temporary route is reasonably safe and adequate to meet the needs of the user. Also, consider the impacts to transit stops for pedestrians: Will the bus stops be able to remain in use during construction or will adjustments be necessary? (See [Chapter 1510](#) for pedestrian work zone design requirements.)

### 1010.06(5)(i) Alternative Project Delivery

To reduce construction times and minimize impacts to the traveling public, consider alternative delivery techniques to accomplish this. For more information, see:

<http://www.wsdot.wa.gov/projects/delivery/alternative/>

### 1010.06(5)(j) Innovative Design/Construction Methods

- Overbuild beyond normal project needs to maintain additional traffic or facilitate staged construction.
- Replace bridges using new alignments so they can be built with minimal impacts.
- Bring adjacent lifts of hot mix asphalt (HMA) to match the latest lifts (lag up), and require a tapered wedge joint to eliminate drop-off and abrupt lane edges to improve motorist safety.
- Require permanent pavement markings at intervals during multi-season projects to limit the duration temporary markings are needed and to avoid temporary marking issues during winter shut-down.

## **1010.06(6) Transportation Operations (TO) Strategies**

### **1010.06(6)(a) Demand Management**

- Provide transit service improvements and possible incentives to help reduce demand.
- For long-term freeway projects, consider ramp metering.
- Provide a shuttle service for pedestrians and bicyclists.
- Provide local road improvements (signals modifications, widening, and so on) to improve capacity for use as alternate routes.
- Provide traffic screens to reduce driver distraction.

### **1010.06(6)(b) Corridor/Network Management**

- Provide a temporary express lane with no access through the project.
- Consider signal timing or coordination modifications.
- Provide emergency pullouts for disabled vehicles on projects with long stretches of narrow shoulders and no other access points.
- Use heavy-vehicle restrictions and provide alternate routes or lane use restrictions.

### **1010.06(6)(c) Work Zone Safety Management**

- Provide temporary access road approaches for work zone access.
- Use positive protective devices (barrier) for long-term work zones to improve the environment for workers and motorists.
- Install intrusion alarms or vehicle arresting devices.
- Use speed limit reductions when temporary conditions create a need for motorist slow-downs. Refer to the [Traffic Manual](#) for additional information, guidance and approval requirements for speed limit reductions in work zones.

### **1010.06(6)(d) Traffic/Incident Management and Enforcement**

- Provide law enforcement patrols to reduce speeding and aggressive drivers.
- Provide incident response patrols during construction to reduce delays due to collisions in the work zone.
- Include work zone ITS elements in the project or coordinate with TMC to use existing equipment.
- Provide a dedicated tow service to clear incidents.

## **1010.06(7) Public Information (PI) Strategies**

### **1010.06(7)(a) Public Awareness**

One PI strategy is a public awareness campaign using the media, project websites, public meetings, e-mail updates, and mailed brochures. This gives regular road users advance notice of impacts they can expect and time to plan for alternate routes or other options to avoid project impacts. Involve the region or HQ Communications Office in developing and implementing these strategies.

### 1010.06(7)(b) Driver Information

In addition to work zone signs, provide driver information using highway advisory radio (HAR) and changeable message signs (existing or portable). Provide additional work zone ITS features that could include traffic cameras or queue detection along with changeable message signs to provide drivers with real time information on delays and traffic incidents. Involve the region TMC in the development and implementation of these strategies. Coordinate freight travel information and restrictions through the Freight Systems Office. Additional information on work zone ITS can be found on the Work Zone Safety web page:

[www.wsdot.wa.gov/safety/workzones/](http://www.wsdot.wa.gov/safety/workzones/)

Work zone strategy development is a fluid process and may be ongoing as project information and design features are developed during the design process. There may be many factors involved with strategy development, and it is necessary to be well organized to make sure all the relative factors are identified and evaluated.

### 1010.06(7)(c) Pedestrian and Bicycle Information

Include pedestrian and bicycle access information and alternate routes in the public awareness plans. Pedestrian and bicyclist information signing, including alternate route maps specifically for these road users, could be considered.

## 1010.07 Capacity Analysis

Work zone congestion and delay is a significant issue for many highway projects. At high-volume locations with existing capacity problems, even shoulder closures will increase congestion.

All work zone traffic restrictions need to be analyzed to determine the level of impacts. Short-term lane closures may only require work hour restrictions to address delays; long-term temporary channelization, realignments, lane shifts, and more will require a detailed capacity analysis to determine the level of impact. Demand management and public information strategies may be required to address delays. Traffic capacity mitigation measures are important since many projects cannot effectively design out all the work zone impacts. Include a [Work Zone & Traffic Analysis](#) in the TMP.

Work zone mobility impacts can have the following effects:

- **Crashes:** Most work zone crashes are congestion-related, usually in the form of rear-end collisions due to traffic queues. Traffic queues beyond the advance warning signs increase the risk of crashes.
- **Driver Frustration:** Drivers expect to travel to their destinations in a timely manner. If delays occur, driver frustration can lead to aggressive or inappropriate driving actions.
- **Constructability:** Constructing a project efficiently relies on the ability to pursue work operations while maintaining traffic flow. Delays in material delivery, work hour restrictions, and constant installation and removal of traffic control devices all detract from constructability.
- **Local Road Impacts:** Projects with capacity deficiencies can sometimes cause traffic to divert to local roadways, which may impact the surrounding local roadway system and community.

- **Public Credibility:** Work zone congestion and delay can create poor credibility for WSDOT with drivers and the surrounding community in general.
- **Restricted Access:** Severe congestion can effectively gridlock a road system, preventing access to important route connections, businesses, schools, hospitals, and so on.
- **User Cost Impacts:** Traffic delays have an economic impact on road users and the surrounding community. Calculated user costs are part of a work zone capacity analysis and may be used to determine liquidated damages specifications.

WSDOT has a responsibility to maintain traffic mobility through and around its projects. The goal is to keep a project's work zone traffic capacity compatible with existing traffic demands. Maintaining the optimum carrying capacity of an existing facility during construction may not be possible, but an effort must be made to maintain existing traffic mobility through and/or around the work zone.

Maintaining mobility does not rule out innovative strategies such as roadway closures. Planned closures can accelerate work operations, reducing the duration of impacts to road users. These types of traffic control strategies must include demand management and public information plans to notify road users and mitigate and manage the impacts as much as possible.

A capacity analysis helps determine whether a work zone strategy is feasible. Mitigation measures that provide the right combination of good public information, advance signing and notification, alternate routes, detours, and work hour restrictions, as well as innovations such as strategic closures, accelerated construction schedules, or parallel roadway system capacity improvements, can be very effective in reducing mobility impacts.

Some of the impact issues and mitigating measures commonly addressed by traffic analyses include:

- Work hour time restrictions
- Hourly liquidated damage assessment
- Use of staged construction
- Working day assessment
- Public information campaign
- User cost assessment
- Local roadway impacts
- Special event and holiday time restrictions
- Closure and detour options
- Mitigation cost justification
- Level of service
- Queue lengths
- Delay time
- Running speed
- Coordination with adjoining projects (internal and local agency)

Many projects will have several potential work zone strategies, while other projects may only have one obvious work zone strategy. It is possible that a significant mobility impact strategy may be the only option. TMP strategies still need to be considered. An analysis will help show the results of these mitigating measures.

There is no absolute answer for how much congestion and delay are acceptable on a project; it may ultimately become a management decision.

Reductions in traffic capacity are to be mitigated and managed as part of the TMP. The traffic analysis process helps shape the TMP as the work zone strategies are evaluated and refined into traffic control plans and specifications. Maintain analysis documents in the Project File.

### 1010.07(1) **Collecting Traffic Volume Data**

Current volume data in the project vicinity is required for accurate traffic analysis results. Seasonal adjustment factors may be needed depending on when the data was collected and when the proposed traffic restrictions may be in place. Assess existing data as early as possible to determine whether additional data collection may be required. The region Traffic Office and the HQ Transportation Data & GIS Office can assist with collecting traffic volume data. Coordination with local agencies may be needed to obtain data on affected local roads.

### 1010.07(2) **Short-Term Lane Closure Work Zone Capacity**

For short-term lane closures on multilane highways or alternating one-way traffic on two-lane highways, see [Exhibit 1010-1](#). It provides information for a quick analysis when compared to current hourly volumes on the highway. The basic traffic analysis programs QUEWZ 98, along with hourly volume input, the number of lanes to be closed, the hours of closure, and other default information, will output queue length, delay time, user costs, and running speed.

**Exhibit 1010-1 General Lane Closure Work Zone Capacity**

Roadway Type	Work Zone Capacity
Multilane Freeways/Highways	1300 VPHPL*
Multilane Urban/Suburban	600 VPHPL*
Two-Lane Rural Highway	400 VPHPL/ 800 VPH total*
*These are average capacity values. The actual values would be dependent on several factors, which include the existing number of lanes, number of lanes closed, traffic speed, truck percentage, interchanges/intersections, type of work, type of traffic control, and seasonal factors (among others). For further information, consult the <i>Highway Capacity Manual</i> .	

### 1010.07(3) Long-Term Work Zone Capacity

For complex strategies that change traffic patterns, a more detailed analysis is required using advanced traffic modeling software. These strategies could include reducing lane and shoulder widths for extended lengths, reducing the number of lanes for extended durations, moving all lanes of traffic onto a temporary alignment, changing access locations to and from the highway, or closures with detours (including public information and traffic operation plans with anticipated reduction in demand). Work with the region Traffic Office for assistance with this level of analysis.

The following resources are also available to assist with the actual analysis and mitigation strategy development upon request:

- HQ Transportation Data & GIS Office
- HQ Traffic Offices
- Region Work Zone Specialist
- Region Public Information Office

Training is also available to obtain further knowledge and expertise in traffic analysis (see [1010.12](#)).

## 1010.08 Work Zone Design Standards

Part 6 of the [MUTCD](#) mostly addresses short-duration temporary traffic control standards. Some long-duration work zones may require temporary alignments and channelization, including barrier and attenuator use, temporary illumination and signals, and temporary pedestrian and bicycle routes. Refer to the *Design Manual's* chapters for permanent features for design guidance.

### 1010.08(1) Lane Widths

Maintain existing lane widths during work zone operations whenever possible. For projects that require lane shifts or narrowed lanes due to work area limits and staging, consider the following before determining the final lane width to be implemented:

- Overall roadway width available
- Posted speed limit
- Traffic volumes through the project limits
- Number of lanes
- Existing lane and shoulder widths
- Length and duration of lane width reduction (if in place)
- Roadway geometry (cross slope, vertical and horizontal curves)
- Truck percentage
- Over-sized loads

Work zone geometric transitions should be minimized or avoided if possible. When necessary, such transitions should be made as smoothly as the space available allows. Maintain approach lane width, if possible, throughout the connection. Design lane width reductions prior to any lane shifts within the transition area. Do not reduce curve radii and lane widths simultaneously.

The minimum allowable striped lane width is 11 feet to a maximum allowable lane width of 14 feet when the radius is greater than 500 feet. Consider additional advance warning signs stating no shoulders for any wide loads. Follow existing lane widths when delineating temporary lanes with channelizing devices. For low-speed low-volume roadways 10 foot lanes are allowed with approval from the region Traffic Engineer.

When determining lane widths, the objective is to use lane geometrics that will be clear to the driver and keep the vehicle in the intended lane. Lane lines and construction joints are treated to provide a smooth flow through the transition area. In order to maintain the minimum lane widths and shy distances, temporary widening may need to be considered.

### **1010.08(2) Buffer Space and Shy Distance**

Buffer spaces separate road user flow from the work space or other areas off limits to motorists, and it might provide some recovery space for an errant vehicle.

- A lateral buffer provides space between the vehicles and adjacent work space, traffic control device, or a condition such as an abrupt lane edge or drop-off. As a minimum, a 2-foot lateral buffer space is recommended. Positive Protective Devices may be required if workers are within one lane width of traffic.
- A longitudinal buffer space is used immediately downstream of closed or shifted traffic lane or shoulder. This space provides a recovery area for errant vehicles before they approach the work space.
- Shy distance is the distance from the edge of the traveled way beyond which a roadside object will not be perceived as an immediate concern by the typical driver to the extent that the driver will change the vehicle's placement or speed. A minimum 2-foot shy distance is required to barriers. An edge line should be used in front of barrier.

Devices used to separate the driver from the work space should not encroach into adjacent lanes. If encroachment is necessary, it is recommended to close the adjacent lane to maintain the lateral buffer space.

In order to achieve the minimum lateral clearances, there may be instances where temporary pavement widening or a revision to a stage may be necessary. In the case of short-term lane closure operations, the adjacent lane may need to be closed or traffic may need to be temporarily shifted onto a shoulder to maintain a lateral buffer space. During the design of the traffic control plan, the lateral clearance needs to be identified on the plan to ensure additional width is available; use temporary roadway cross sections to show the space in relation to the traffic and work area.

### 1010.08(3) Work Zone Clear Zone

The contractor's operations present opportunities for errant vehicles to impact the clear area adjacent to the traveled way. A work zone clear zone (WZCZ) is established for each project to ensure the contractor's operations provide an appropriate clear area. The WZCZ addresses items such as storage of the contractor's equipment and employee's private vehicles and storage or stockpiling of project materials. The WZCZ applies during working and nonworking hours and applies only to roadside objects introduced by the contractor's operations. It is not intended to resolve preexisting deficiencies in the Design Clear Zone or clear zone values established at the completion of the project. Those work operations or objects that are actively in progress and delineated by approved traffic control measures are not subject to the WZCZ requirements.

Minimum WZCZ values are presented in [Exhibit 1010-2](#). WZCZ values may be less than Design Clear Zone values due to the temporary nature of the construction and limitations on horizontal clearance. To establish an appropriate project-specific WZCZ, it may be necessary to exceed the minimum values. The following conditions warrant closer scrutiny of the WZCZ values, with consideration of a wider clear zone:

- Outside of horizontal curves or other locations where the alignment presents an increased potential for vehicles to leave the traveled way.
- The lower portion of long downgrades or other locations where gradient presents an increased potential for vehicles to exceed the posted speed.
- Steep fill slopes and high traffic volumes. (Although it is not presented as absolute guidance, the Design Clear Zone exhibit in [Chapter 1600](#) may be used as a tool to assess increases in WZCZ values.)

**Exhibit 1010-2** Minimum Work Zone Clear Zone Distance

Posted Speed	Distance From Traveled Way (ft)
35 mph or less	10
40 mph	15
45 to 55 mph	20
60 mph or greater	30

### 1010.08(4) Abrupt Lane Edges and Drop-offs

Minimize, mitigate, or eliminate abrupt lane edges adjacent to the traveled lane whenever possible. There are work operations where drop-offs are unavoidable in order to perform the work, but in these instances, the drop-off can generally be anticipated and addressed in the work zone traffic control plan design. Contract provisions should be included limiting the duration of edges from planing and paving operations and requiring a step wedge on new pavement edges or a lag up requirement to minimize the instances of abrupt lane edges. Use the following guidance examples for drop-off protection measures. **Note:** This is also discussed in Standard Specification 1-07.23(1):

[www.wsdot.wa.gov/publications/manuals/fulltext/m41-10/division1.pdf](http://www.wsdot.wa.gov/publications/manuals/fulltext/m41-10/division1.pdf)

- Drop-offs up to 0.20 foot may remain exposed with appropriate warning signs alerting motorists of the condition.
- Drop-offs more than 0.20 foot are not allowed in the traveled way or auxiliary lane unless protected with appropriate warning signs and further protected as described below with channelization devices or barrier.
- Drop-offs more than 0.20 foot, but no more than 0.50 foot, that will not be within the traveled way shall be protected with appropriate warning signs and further protected by one of the following:
  - A wedge of compacted stable material at a slope of 4:1 or flatter.
  - Channelization devices 36 inches or more in height, placed along the traffic side of the drop-off, and a new edge line placed a minimum of 3 feet from the drop-off.
  - Barrier placed on the traffic side of the drop-off with 2 feet between the drop-off and the back of the barrier and a new edge line on the traffic side of the barrier with a 2-foot shy distance minimum. End treatment and delineation of the barrier will be required.
- Drop-offs more than 0.50 foot, but less than 2 feet, not within the traveled way or auxiliary lane shall be protected with appropriate warning signs and further protected with one of the three methods above if all of the following conditions will be met:
  - The total length throughout the projects will be less than 1 mile;
  - Will not remain for more than 3-working days;
  - Will not be present on holidays listed in Standard Specification 1-08.5;
  - Will only be on one side of the roadway.
- Drop-offs more than 0.50 foot that will not be within the traveled way or auxiliary lane and are not otherwise covered by the above shall be protected with appropriate warning signs and further protected by the wedge of compacted stable material at a slope of 4H:1V or flatter or the barrier and pavement-marking option. (See [Chapter 1610](#) for information on flare rates and deflection if using barrier.)
- Open trenches within the traveled way or auxiliary lane shall have a steel-plate cover placed and anchored over them. A wedge of suitable material, if required, shall be placed for a smooth transition between the pavement and the steel plate. Warning signs shall be used to alert motorists of the presence of the steel plates.

Abrupt lane edges and drop-offs require additional warning and considerations for motorcyclists, bicyclists, and pedestrians, including pedestrians with disabilities. Adequate signing to warn the motorcycle rider of these conditions is required. (See [RCW 47.36.200](#) and [WAC 468-95-305](#).)

### **1010.08(5) Vertical Clearance**

In accordance with [Chapter 720](#), the minimum vertical clearance over new highways is 16.5 feet. Anything less than the minimum must follow the reduced clearance criteria discussed in Chapter 720 and be included in the temporary traffic control plans. Maintain legal height on temporary falsework for bridge construction projects. Anything less than this must consider over-height vehicle impacts and possible additional signing needs and coordination with permit offices. Widening of existing structures can prove challenging when the existing height is at or less than legal height, so extra care is required in the consideration of over-height vehicles when temporary falsework is necessary. Coordination with the HQ Bridge and Structures Office is essential to ensure traffic needs have been accommodated. Vertical clearance requirements associated with local road networks may be different than what is shown in Chapter 720. Coordinate with the local agency.

### **1010.08(6) Reduced Speeds in Work Zones**

Drivers tend to reduce their speed only if they perceive a need to do so. Reduced speed limits should only be used to address an altered geometry when not able to meet design standards for the existing speed, when the roadway will be narrowed with minimal shy distance to barriers, when roadway conditions warrant a reduction like BST operations, and when there will be workers on foot within a lane width of high-speed high-volume traffic without positive protection devices in place. Speed reductions are not applied as a means for selecting lower work zone design criteria (tapers, temporary alignment, device spacing, and so on).

Speed limit reductions are categorized as follows:

- Continuous Regulatory Speed Limit Reduction: A speed reduction in place 24 hours a day for the duration of the project, stage, or roadway condition.
- Variable Regulatory Speed Limit Reduction: A speed reduction in place only during active work hours (Class B construction signs may be used). This is a good option when positive protection devices are not used.
- Advisory Speed Reduction: In combination with a warning sign, an advisory speed plaque may be used to indicate a recommended safe speed through a work zone or work zone condition. Refer to the [MUTCD](#) for additional guidance.

Refer to the [Traffic Manual](#) for additional information, guidance and approval requirements for speed limit reductions in work zones. Include approval documents in the Project File.

### **1010.08(7) Accommodation for Pedestrians and Bicyclists**

Many public highways and streets accommodate pedestrians and bicyclists, predominately in urban areas. During construction, access must be maintained through or around the work zones. When existing pedestrian routes that are accessible to pedestrians with disabilities are closed, the alternate routes must be designed and constructed to meet or exceed the existing level of accessibility. Temporary pedestrian facilities within the work zone must meet accessibility criteria to the maximum extent feasible. (See [1510.06](#) and [1510.07](#) for pedestrian circulation path and pedestrian access route accessibility criteria.) Covered walkways are to be provided where there is a potential for falling objects.

In work areas where the speeds are low (25 mph), or the ADT is 2,000 or less, bicyclists can use the same route as motorized vehicles. For work zones on higher-speed facilities, bicyclists will need a minimum 4-foot shoulder or detour route to provide passage through or around a work zone. Bicyclists may be required to dismount and walk their bikes through a work zone on the route provided for pedestrians (see [Exhibit 1520-1](#)).

It may be possible to make other provisions to transport pedestrians and bicyclists through a work zone or with a walking escort around the active work area. Roadway surfaces are an important consideration for pedestrian and bicycle use. Unacceptable conditions such as loose gravel, uneven surfaces, milled pavement, and asphalt tack coats endanger the bicyclist and restrict access to pedestrians with disabilities.

Information can be gathered on bike issues by contacting local bike clubs. Coordination with local bike clubs goes a long way to ensuring their members are notified of work zone impacts, and it helps maintain good public relations. (See [Chapter 1520](#) for more bicycle design requirements and [Chapter 1510](#) and [MUTCD Chapter 6D](#) for pedestrian work zone design requirements.)

### **1010.08(8) Motorcycles**

The same road surfaces that are a concern for bicyclists are also a concern for motorcyclists. Stability at high speed is a far greater concern for motorcycles than cars on grooved pavement, milled asphalt, and transitions from existing pavement to milled surfaces. Contractors must provide adequate warning signs for these conditions to alert the motorcycle rider. For regulations on providing warnings to motorcyclists, see [RCW 47.26.200](#).

### **1010.08(9) Oversized Vehicles**

The region Maintenance offices and the HQ Commercial Vehicle Services Office issue permits to allow vehicles that exceed the legal width, height, or weight limits to use certain routes. If a proposed work zone will reduce roadway width or vertical clearance, or have weight restrictions, adequate warning signs and notification to the HQ Commercial Vehicle Services Office and the appropriate region Maintenance Office is required as a minimum. When the total width of a roadway is to be reduced to less than 16 feet for more than three days, communication with these offices and any other stakeholders is required; include documentation in the Project File. The contract documents shall include provisions requiring the contractor to provide a 30-calendar-day notice prior to placing the restriction.

In the permit notification, identify the type of restriction (height, weight, or width) and specify the maximum size that can be accommodated. On some projects, it may be necessary to designate a detour route for oversized vehicles. An important safety issue associated with oversized loads is that they can sometimes be unexpected in work zones, even though warning and restriction or prohibition signs may be in place. Some oversized loads can overhang the temporary barrier or channelization devices and endanger workers. Consider the potential risk to those within the work zone. Routes with high volumes of oversized loads or routes that are already strategic oversized load routes may not be able to rely only on warning or prohibition signs. Protective features or active early warning devices may be needed. If the risk is so great that one oversized load could potentially cause significant damage or injury to workers, failsafe protection measures may be needed to protect structures and workers. The structure design, staging, and falsework openings may need to be reconsidered to safely accommodate oversized loads.

## 1010.09 Temporary Traffic Control Devices

FHWA regulations require that devices such as portable sign stands, barricades, traffic barriers, barrier terminals, crash cushions, and work zone hardware be compliant with the National Cooperative Highway Research Program (NCHRP) Report 350 or the *Manual for Assessing Safety Hardware* (MASH) crash test requirements.

### 1010.09(1) Channelizing Devices

Channelizing devices are used to alert and guide road users through the work zone. They are used to channelize traffic away from the work space, pavement drop-offs, or opposing directions of traffic. Traffic Safety Drums are the preferred devices on freeways and expressways as they are highly visible and are less likely to be displaced by traffic wind. 28-inch cones are also used on WSDOT projects. They are a good choice for flagging operations. Tall channelization devices are 42-inch cone-type devices and should be used in place of tubular markers to separate opposing traffic. Tubular markers are not a recommended device unless they are being used to separate traffic on low-volume low-speed roadways. Longitudinal channelizing devices are interconnected devices that provide channelization with no gaps. These devices look like a temporary barrier, but are not approved as a positive protective device. Barricades are a channelization device mostly used to supplement other channelization devices in traffic control operations involving road, ramp, or sidewalk closures.

### 1010.09(2) Construction Signs

Portable and temporary signs (Class B Construction Signs) are generally used in short-term work zones. They are set up and removed daily or frequently repositioned as the work moves along the highway. These signs are mounted on crashworthy, collapsible sign supports. The minimum mount height is 1 foot above the roadway, but there are temporary sign supports that will provide 5- to 7-foot mounting heights. This may be useful when temporary signs are mounted behind channelizing device or in urban areas with roadside parking that may obstruct sign visibility and multilane facilities. Temporary signs need to be placed such that they do not obstruct pedestrian facilities. Warning signs in place longer than three days at one location must be post-mounted.

Fixed signing (Class A Construction Signs) are the signs mounted on conventional sign supports along or over the roadway. This signing is used for long-term stationary work zones. Details for their design are in [Chapter 1020](#) and the *Standard Plans*. Sign messages, color, configuration, and usage are shown in the [MUTCD](#) and the *Sign Fabrication Manual*. Existing signs may need to be covered, removed, or modified during construction.

### 1010.09(3) Warning Lights

Warning lights are either flashing or steady burn and can be mounted on channelizing devices, barriers, and signs. Secure crashworthy mounting of warning lights is required.

- **Type A:** Low-intensity flashing warning light used on a sign or barricade to warn road users during nighttime hours that they are approaching a work zone.
- **Type B:** High-intensity flashing warning light used on a sign or barricade to warn road users during both daytime and nighttime hours.
- **Type C and Type D 360 degree:** Steady-burn warning lights designed to operate 24 hours a day to delineate the edge of the roadway.

### **1010.09(4) Arrow Board**

The arrow board (Sequential Arrow Sign) displays either an arrow or a chevron pointing in the direction of the intended route of travel. Arrow board displays are required for lane closures on multilane roadways. When closing more than one lane, use an arrow board display for each lane reduction. Place the arrow board at the beginning of the transition taper and out of the traveled way. The caution display (four corner lights) is only used for shoulder work. Arrow boards are not used on two-lane two-way roadways.

### **1010.09(5) Portable Changeable Message Signs (PCMS)**

PCMS have electronic displays that can be modified and programmed with specific messages and may be used to supplement other warning signs. These signs are usually trailer mounted with solar power and batteries to energize the electronic displays. A two-second display of two messages is the recommended method to ensure motorists have time to read the sign's message twice. These devices are not crashworthy and should be removed when not in use, or placed behind barrier or guardrail. PCMS are best used to provide notice of unexpected situations like the potential for traffic delays or queuing and to provide a notice of future closures or restrictions. They should not be used in place of required signs or to provide redundant information.

### **1010.09(6) Portable Temporary Traffic Control Signals**

These versatile trailer-mounted portable signals are battery powered, with the ability to be connected to AC power. They can operate on fixed timing or be traffic actuated. They are typically used on two-lane two-way highways to alternate traffic in a single lane for extended durations.

### **1010.09(7) Portable Highway Advisory Radio (HAR)**

HAR can be used to broadcast AM radio messages about work zone traffic and travel-related information. The system may be a permanently located transmitter or a portable trailer-mounted system that can be moved from location to location as necessary. Contact the region Traffic Office for specific guidance and advice on the use of these systems.

### **1010.09(8) Automated Flagger Assistance Device (AFAD)**

An AFAD is a flagging machine that is operated remotely by a flagger located off the roadway and away from traffic. This device could be used to enhance safety for flaggers on highways with reduced sight distance or limited escape routes. A traffic control plan is required for use of the AFAD. A flagger is required to operate each device.

Refer to the [MUTCD](#) for additional guidance on temporary traffic control zone devices.

## **1010.10 Positive Protection Devices**

Channelizing devices will not provide adequate worker and road user protection in some work zones. Positive protective devices are required for the following conditions unless an engineering study determines otherwise:

- To separate opposing high-speed traffic normally separated by a median or existing median barrier.

- Where existing traffic barriers or bridge railings are to be removed.
- For drop-off protection during widening or excavations (see [Standard Specification 1-07.23\(1\)](#)).
- When temporary slopes change clear zone requirements.
- For bridge falsework protection.
- When equipment or materials must remain in the work zone clear zone.
- When newly constructed features in the clear zone will not have permanent protection until later in the project.
- Where temporary signs or light standards are not crashworthy.
- To separate workers from motorized traffic when work zone offers no means of escape for the worker, such as tunnels, bridges, and retaining walls, or for long-duration worker exposure within one lane-width of high-speed high-volume traffic.

### **1010.10(1) Temporary Barriers**

Providing temporary barrier protection may become the key component of the work zone strategy. Barrier use usually requires long-term stationary work zones with pavement marking revisions, and will increase the traffic control costs of a project. The safety benefit versus the cost of using barrier requires careful consideration, and cost should not be the only or primary factor determining the use of barrier. (See [Chapter 1610](#) for guidance on barriers.)

#### **1010.10(1)(a) Temporary Concrete Barriers**

These are the safety-shape barriers shown in the [Standard Plans](#). Lateral displacement from impacts is usually in the range of 2 to 4 feet. (See [Chapter 1610](#) for detailed information on deflection.) When any barrier displacement is unacceptable, these barriers are anchored to the roadway or bridge deck. Some deflection with anchored systems is still expected.) Anchoring systems are also shown in the [Standard Plans](#).

#### **1010.10(1)(b) Movable Barriers**

Movable barriers are specially designed segmental barriers that can be moved laterally one lane width or more as a unit with specialized equipment. This allows strategies with frequent or daily relocation of a barrier. The ends of the barrier must be located out of the clear zone or fitted with an impact attenuator. Storage sites at both ends of the barrier will be needed for the barrier-moving machine.

#### **1010.10(1)(c) Portable Steel Barriers**

Portable steel barriers have a lightweight stackable design. They have options for gate-type openings and relocation without heavy equipment. Lateral displacement from impacts is in the range of 6 to 8 feet. Steel barriers can be anchored according to the manufacturer's specifications. Some deflection with anchored systems is still expected.

### **1010.10(2) Impact Attenuators**

Within the Design Clear Zone, the approach ends of temporary barriers shall be fitted with impact attenuators. The information in [Chapter 1620](#) provides all the needed impact attenuator performance information, but the actual work zone location may require careful consideration by the designer to ensure the correct application is used. Consider the dynamic nature of work operations where work zone ingress and egress, work area protection, worker protection, and traffic protection all factor into the final selection as well as the placement surface available. Contract plans showing temporary impact attenuator placement need to include a list of the approved attenuators that a contractor may use for that installation.

### **1010.10(3) Transportable Attenuators**

A transportable attenuator (TA) is a positive protection device that will provide protection for the work area only a short distance in front of the device. An impact attenuator device is attached to the rear of a large truck that weighs 15,000 lbs. total weight or more to minimize the roll-ahead distance when impacted by an errant vehicle. A TA should be used on all high-speed roadway operations.

## **1010.11 Other Traffic Control Devices or Features**

### **1010.11(1) Delineation**

Temporary pavement markings will be required when permanent markings are eliminated because of construction operations or when lane shifts or temporary alignments are needed for long-term work zone strategies. Temporary pavement markings can be made using paint, tape, or raised pavement markers. Short-duration temporary pavement markings are made with materials intended to last only until permanent markings can be installed on paving and BST projects, or for short durations between construction stages. Broken line patterns consist of a 4-foot line with a 36-foot gap. Temporary edge lines are usually not required on paving/BST projects and must be specified in the plans if desired. Long-duration temporary pavement markings are made with materials intended to last for staged construction on high-volume highways, for use between construction seasons, or for long-duration lane shifts. Existing contradictory pavement markings must be removed. These markings are installed in accordance with the Standard Plans for permanent markings. Long-duration markings need to be detailed in the contract plans for installation and material type. Removable tapes work well for broken lines and can be removed by hand, leaving no scar on the pavement surface. Complex projects will most likely require both long- and short-duration temporary markings.

Lateral clearance markers are used at the angle points of barriers where they encroach on or otherwise restrict the adjacent shoulder. Barrier delineation is necessary where the barrier is less than 4 feet from the edge of traveled way.

Guideposts may be considered to aid nighttime driving through temporary alignments or diversions. (See [Chapter 1030](#) for delineation requirements.)

### 1010.11(2) Screening

Screening devices can be used to reduce motorists' distraction due to construction activities adjacent to the traveled way. Consider screening when a highway operates near capacity during most of the day. Screening should be positioned behind traffic barriers to prevent impacts by errant vehicles and should be anchored or braced to resist overturning when buffeted by wind. Commercially available screening or contractor-built screening can be used, provided the device meets crashworthy criteria if exposed to traffic and is approved by the Engineer prior to installation.

Glare screening may be required on concrete barriers separating two-way traffic to reduce headlight glare from oncoming traffic. Woven wire and vertical blade-type screens are commonly used in this installation. This screening also reduces the potential for motorist confusion at nighttime by shielding construction equipment and the headlights of other vehicles on adjacent roadways. Make sure that motorists' sight distance is not impaired by these glare screens. Contact the HQ Design Office and refer to AASHTO's *Roadside Design Guide* for additional information on screening.

### 1010.11(3) Illumination

Illumination might be justified if construction activities take place on the roadway at night for an extended period of time. Illumination might also be justified for long-term construction projects at the following locations:

- Road closures with detours or diversions.
- Median crossovers on freeways.
- Complex or temporary alignment or channelization.
- Haul road crossings (if operational at night).
- Temporary traffic signals.
- Temporary ramp connections.
- Projects with lane shifts and restricted geometrics.
- Projects with existing illumination that needs to be removed as part of the construction process.

Illumination is required when:

- Traffic flow is split around or near an obstruction.
- Flaggers are necessary for nighttime construction activities (supplemental lighting of the flagger stations by use of portable light plants or other approved methods). Refer to [Standard Specification 1-10.3\(1\)A](#).

For information on light levels and other electrical design requirements, see [Chapter 1040](#).

### 1010.11(4) Signals

A permanent signal system can be modified for a temporary configuration such as temporary pole locations during intersection construction, span wire systems, and adjustment of signal heads and alternative detection systems to accommodate a construction stage (see [Chapter 1330](#)).

### **1010.11(5) Work Zone Intelligent Transportation Systems (ITS)**

Intelligent Transportation Systems apply advanced technologies to optimize the safety and efficiency of the existing transportation network. Many permanent systems already exist throughout Washington State and provide the opportunity to greatly enhance construction projects that fall within the limits of the ITS network. Temporary portable ITS applications in work zones can be used to provide traffic monitoring and management, data collection, and traveler information.

ITS can provide real-time work zone information and associated traffic conditions such as queue detection for “slowed or stopped traffic ahead” before motorists see brake lights, or they can advise of alternate routes, giving motorists options to avoid delays and warn drivers of haul vehicles entering or leaving a work area.

Work zone ITS technology is an emerging area that can provide the means to better monitor and manage traffic flow through and around work zones. Equipment used in work zones, such as portable camera systems, highway advisory radios, variable speed limits, ramp metering systems, and queue detection sensors, helps ensure a more efficient traffic flow with a positive impact on safety, mobility, access, and productivity.

Identify work zone ITS elements early in the strategy development process and include them in the preliminary estimate so they can be designed along with the other traffic control elements. For large mobility projects that have existing freeway cameras already in place, temporary ITS features (such as temporary poles and portable systems) may be necessary to ensure the network can be maintained during construction, especially if existing camera locations are in conflict with construction activities. In locations that do not have existing camera locations, but have significant construction projects planned, work zone ITS may be a good opportunity to bring ITS technology to the route.

Refer to [Chapter 1050](#) and the work zone safety web page for additional ITS information and guidance.

### **1010.12 Traffic Control Plan Development and PS&E**

WSDOT projects need to include plans and payment items for controlling traffic based on a strategy that is consistent with the project construction elements, even though there may be more than one workable strategy. A constructable and biddable method of temporary traffic control is the goal. The contractor has the option of adopting the contract plans or proposing an alternative method.

#### **1010.12(1) Traffic Control Plans (TCPs)**

“Typical” traffic control plans are generic in nature and are not intended to address all site conditions. They are intended for use at multiple work locations and roadways with little or no field modifications necessary. Typical plans may be all that are needed for basic paving projects. Some typical plans are located at: [www.wsdot.wa.gov/design/standards/plansheet.htm](http://www.wsdot.wa.gov/design/standards/plansheet.htm)

“Project-specific” traffic control plans are typical-type plans that have been modified to fit a specific project or roadway condition. Dimension lines for signs and device placement have the distances based on the project highway speed limit, and spacing charts have been removed; the lane and roadway configuration may also be modified to match the project conditions.

“Site-specific” traffic control plans are drawn for a specific location. Scaled base data drawn plans will be the most accurate as device placement and layout issues can be resolved by the designer. These types of plans should be used for temporary alignment and channelization for long-duration traffic control. Making a “project-specific” plan applicable for a site-specific location is another option, but the designer must ensure the device layout will match the site-specific location since it will not be a scaled plan.

The following plans, in addition to the TCP types above addressing the TTC strategies, may be included in the PS&E.

#### **1010.12(1)(a) Construction Sign Plan**

Show Class A Construction Signs that will remain in place for the duration of the project located by either station or milepost. Verify the locations to avoid conflicts with existing signing or other roadway features. These locations may still be subject to movement in the field to fit specific conditions. For simple projects these sign are often shown on the vicinity map sheet.

#### **1010.12(1)(b) Construction Sign Specification Sheet**

Provide a Class A Construction Sign Specifications sheet on complex or staged projects. Include location, post information, and notes for [Standard Plans](#) or other specific sign information and sign details.

#### **1010.12(1)(c) Quantity Tabulation Sheets**

Quantity Tabulation sheets are a good idea for barrier and attenuator items and temporary pavement markings on projects with large quantities of these items or for staged construction projects.

#### **1010.12(1)(d) Traffic Control Plan Index**

An Index sheet is a useful tool for projects that contain a large quantity of traffic control plans and multiple work operations at various locations throughout the project. The Index sheet provides the contractor a quick referencing tool indicating the applicable traffic control plan for the specific work operation.

#### **1010.12(1)(e) Construction Sequence Plans**

Sequence plans are placed early in the plan set and are intended to show the proposed construction stages and the work required for each stage. They should refer to the corresponding TCPs for the traffic control details of each stage.

#### **1010.12(1)(f) Temporary Signal Plan**

The temporary signal plan will follow conventions used to develop permanent signals (as described in [Chapter 1330](#)), but will be designed to accommodate temporary needs and work operations to ensure there will be no conflicts with construction operations. Ensure opposing left-turn clearances are maintained as described in [Chapter 1310](#) if channelization has been temporarily revised, or adjust signal timing to accommodate. Some existing systems can be maintained using temporary span wires for signal heads and video, microwave actuation, or timed control.

### 1010.12(1)(g) Temporary Illumination Plan

Full lighting is normally provided through traffic control areas where power is available. The temporary illumination plan will follow conventions used to develop permanent illumination (as described in [Chapter 1040](#)), but will be designed to accommodate temporary needs and work operations to ensure there will be no conflicts with construction operations.

### 1010.12(2) Contract Specifications

Work hour restrictions for lane closure operations are to be specifically identified for each project where traffic impacts are expected and liquidated damages need to be applied to the contract. Refer to the [Plans Preparation Manual](#) for additional information on writing traffic control specifications.

### 1010.12(3) Cost Estimating

Temporary traffic control devices and traffic control labor can be difficult to estimate. There is no way of knowing how many operations a contractor may implement at the same time. The best method is to follow the working day estimate schedule and the TCPs that will be used for each operation. Temporary signs and devices will be used on many plans, but the estimated quantity reflects the most used at any one time. To use the lump sum item to pay for all temporary traffic control, be certain how the contractor's work operations will progress and that the traffic control plans fully define the work zone expectations.

## 1010.13 Training and Resources

Temporary traffic control-related training is an important component in an effective work zone safety and mobility program. Federal regulations require that those involved in the development, design, implementation, operation, inspection, and enforcement be trained at a level consistent with their responsibilities.

### 1010.13(1) Training Courses

The following work zone related courses are available through the Talent Development office and the State Work Zone Training Specialist can assist with the availability and scheduling of classes:

- **Work Zone Traffic Control Plan Design Course:** This course, taught by the HQ Traffic Office, focuses on work zone safety and mobility through transportation management plan and temporary traffic control PS&E development.
- **Traffic Control Supervisor (TCS) Course:** The same course taught by the Evergreen Safety Council, NW Laborers Union, and ATSSA, for contractors is also taught by the HQ Traffic Office for WSDOT employees. Field personnel who have TCS related responsibilities or designers wanting basic temporary traffic control design and implementation training should attend this course. This course may be taken without the intention of becoming a certified TCS.
- **Flagger Certification Course:** This course is for employees who may have flagging duties or want to become a certified Traffic Control Supervisor. The safety offices can assist with class scheduling.

Traffic analysis, traffic engineering, pedestrian facilities design and other courses may also be available and apply to work zone safety and mobility.

The American Traffic Safety Services Association (ATSSA) offers free or low-cost training through an FHWA [work zone safety grant](#).

### **1010.13(2) Resources**

The responsibility of the designer to fully address all work zone traffic control impacts is very important because the level of traffic safety and mobility will be directly affected by the effectiveness of the transportation management plan (TMP). The following resources are available to assist the designer with various aspects of the work zone design effort.

#### **1010.13(2)(a) Region Work Zone Resources**

Each region has individuals and offices with various resources that provide work zone guidance and direction beyond what may be available at the project Design Office level. They include:

- Region Traffic Office
- Region Work Zone Specialist
- Region Construction and Design Offices

#### **1010.13(2)(b) Headquarters (HQ) Work Zone Resources**

The HQ Traffic Office has a work zone team available to answer questions, provide information, or otherwise assist. The HQ Design and Construction offices may also be able to assist with some work zone issues. They include:

- State Assistant Traffic Design Engineer
- State Work Zone Engineer
- State Work Zone Training Specialist
- WSDOT Work Zone Web Page

#### **1010.13(2)(c) FHWA Work Zone Resources**

The FHWA Washington Division Office and Headquarters (HQ) Office may be able to provide some additional information through the WSDOT HQ Traffic Office. The FHWA also has a work zone web page: [www.ops.fhwa.dot.gov/wz/](http://www.ops.fhwa.dot.gov/wz/)

## **1010.14 Documentation**

Refer to [Chapter 300](#) for design documentation requirements.

## Exhibit 1010-3 Transportation Management Plan Components Checklist

Use the following checklist to develop a formal TMP document on significant projects.

TMP Component	✓
<b>1. Introductory Material</b>	
Cover page	
Licensed Engineer stamp page (if necessary)	
Table of contents	
List of figures	
List of tables	
List of abbreviations and symbols	
Terminology	
<b>2. Executive Summary</b>	
<b>3. TMP Roles and Responsibilities</b>	
TMP manager	
Stakeholders/review committee	
Approval contact(s)	
TMP implementation task leaders (public information liaison, incident management coordinator)	
TMP monitors	
Emergency contacts	
<b>4. Project Description</b>	
Project background	
Project type	
Project area/corridor	
Project goals and constraints	
Proposed construction phasing/staging	
General schedule and timeline	
Adjacent projects	
<b>5. Existing and Future Conditions</b>	
Data collection and modeling approach	
Existing roadway characteristics (history, roadway classification, number of lanes, geometrics, urban/suburban/rural)	
Existing and historical traffic data (volumes, speed, capacity, volume-to-capacity ratio, percent trucks, queue length, peak traffic hours)	
Existing traffic operations (signal timing, traffic controls)	
Incident and crash data	
Local community and business concerns/issues	
Traffic growth rates (for future construction dates)	
Traffic predictions during construction (volume, delay, queue)	
<b>6. Work Zone Impacts Assessment Report</b>	
Qualitative summary of anticipated work zone impacts	
Impacts assessment of alternative project design and management strategies (in conjunction with each other)	
<ul style="list-style-type: none"> <li>• Construction approach/phasing/staging strategies</li> <li>• Work zone impacts management strategies</li> </ul>	

(Continued on the next page)

Exhibit 1010-3 Transportation Management Plan Components Checklist (continued)

TMP Component	✓
Traffic analysis results (if applicable)	
• Traffic analysis strategies	
• Measures of effectiveness	
• Analysis tool selection methodology and justification	
• Analysis results	
Traffic (volume, capacity, delay, queue, noise)	
Safety	
Adequacy of detour routes	
Business/community impact	
Seasonal impacts	
Cost-effectiveness/evaluation of alternatives	
Selected alternative	
• Construction approach/phasing/staging strategy	
• Work zone impacts management strategies	
<b>7. Selected Work Zone Impacts Management Strategies</b>	
Temporary Traffic Control (TTC) strategies	
• Control strategies	
• Traffic control devices	
• Corridor Project coordination, contracting, and innovative construction strategies	
Public Information (PI)	
• Public awareness strategies	
• Motorist information strategies	
Transportation Operations (TO)	
• Demand management strategies	
• Corridor/network management strategies	
• Work zone safety management strategies	
• Traffic/incident management and enforcement strategies	
<b>8. TMP Monitoring</b>	
Monitoring requirements	
Evaluation report of successes and failures of TMP	
<b>9. Contingency Plans</b>	
Trigger points	
Decision tree	
Contractor's contingency plan	
Standby equipment or personnel	
<b>10. TMP Implementation Costs</b>	
Itemized costs	
Cost responsibilities/sharing opportunities	
Funding source(s)	
<b>11. Special Considerations (as needed)</b>	
<b>12. Attachments (as needed)</b>	

1020.01	General
1020.02	References
1020.03	Design Components
1020.04	Overhead Installation
1020.05	State Highway Route Numbers
1020.06	Mileposts
1020.07	Guide Sign Plan
1020.08	Documentation

### 1020.01 General

The Washington State Department of Transportation (WSDOT) uses signing as the primary mechanism for regulating, warning, and guiding traffic. Signing must be in place when any section of highway is open to the motoring public. Each highway project has unique and specific signing requirements. For statewide signing uniformity and continuity, it is sometimes necessary to provide signing beyond the project limits. Design characteristics of the facility determine the size and legend for a sign. As the design speed increases, larger sign sizes are necessary to provide adequate message comprehension time. The MUTCD, the *Traffic Manual*, and the *Sign Fabrication Manual* contain standard sign dimensions, specific legends, and reflective sheeting types for all new signs.

Guide signing provides the motorist with directional information to destinations. This information is always presented in a consistent manner. In some cases, there are specific laws, regulations, and policies governing the content of the messages on these signs. All proposed guide signs for a project require the approval of the region Traffic Engineer. The use of nonstandard signs is strongly discouraged and their use requires the approval of the State Traffic Engineer.

The design matrices in [Chapter 1100](#) identify the design levels for signing on all Preservation and Improvement projects. These levels are indicated in the column “Signing” for Interstate main line and the column “Signing, Delineation, and Illumination” for all other routes.

Review and update existing signing within the limits of all Preservation and Improvement projects as indicated in the matrices. Apply the following criteria when determining whether to replace or modify existing signs:

- Lack of nighttime retroreflectivity
- Substantial damage, vandalism, or deterioration
- Age of signs (seven to ten years old)
- Change in sign use policy
- Improper location
- Message or destination changes necessary to satisfy commitments to public or local agencies
- Substandard mounting height
- Change in jurisdiction (for example, a county road becomes a state route)

Address sign support breakaway features when identified in the “Clear Zone” columns of the matrices. When the “F” (full design level) matrix designation is present, the preceding criteria are still applicable and all existing signing is required to conform to the current policy for reflective sign sheeting requirements. Remove or replace signing not conforming to this policy.

## 1020.02 References

### (1) Federal/State Laws and Codes

23 Code of Federal Regulations (CFR) 655, Traffic Operations

WSDOT [Executive Order E 1064](#), “State Route Mileposts,” WSDOT

[Revised Code of Washington \(RCW\) 47.36](#), Traffic control devices

### (2) Design Guidance

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

*Plans Preparation Manual*, M 22-31, WSDOT

*Sign Fabrication Manual*, M 55-05, WSDOT

*Standard Plans for Road, Bridge, and Municipal Construction (Standard Plans)*, M 21-01, WSDOT

*Standard Specifications for Road, Bridge, and Municipal Construction (Standard Specifications)*, M 41-10, WSDOT

*Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals*, 4th Edition, Washington DC, AASHTO, 2001

*Traffic Manual*, M 51-02, WSDOT

## 1020.03 Design Components

### (1) Location

The [MUTCD](#) contains the guidelines for positioning signs. Check sign locations to ensure the motorist’s view of the sign is not obscured by other roadside appurtenances. Also, determine whether the proposed sign will obstruct the view of other signs or limit the motorist’s sight distance of the roadway. Reposition existing signs, when necessary, to satisfy these visibility requirements. Where possible, locate signs behind existing traffic barriers, on grade separation structures, or where terrain features will minimize their exposure to errant vehicles.

### (2) Longitudinal Placement

The [MUTCD](#) and the [Traffic Manual](#) provide guidelines for the longitudinal placement of signs that are dependent on the type of sign. Select a location to fit the existing conditions to provide for visibility and adequate response time. In most cases, signs can be shifted longitudinally to enhance safety without compromising their intended purpose.

The HQ Bridge and Structures Office designs structure-mounted sign mountings, monotube sign bridges, and monotube cantilever sign supports. For overhead sign installation designs, provide sign dimensions, horizontal location in relation to the roadway, and location of the lighting fixtures to facilitate design of the mounting components by the HQ Bridge and Structures Office.

### (1) Illumination

The retroreflectivity of currently approved sign sheeting removes the need to provide illumination for most sign installations. Ground-mounted signing, regardless of sign type or message content, does not require sign lighting for nighttime legibility. Only overhead-mounted signs with “EXIT ONLY” panels in noncontinuous illumination areas or overhead-mounted guide signs for left side exits in all areas are illuminated.

The sign lights for existing illuminated overhead and ground-mounted signs can only be de-energized and removed if the retroreflective sheeting is adequate for nighttime legibility. A nighttime assessment of all nonilluminated overhead signs within the project limits is required. Replace all signs that have inadequate retroreflectivity (contact the region Traffic Office). In situations where a nonhighway light source interferes with a sign’s legibility, consider relocating the sign or providing sign lights.

Flashing beacon signs are used to alert motorists of unusual or unexpected driving conditions ahead. Sign lights are unnecessary on flashing beacon signs when appropriate sign sheeting, full circle or tunnel signal head visors, and automatic dimmer devices are used.

Overhead Sign Type	Continuous or Noncontinuous Illumination	Sign Lighting Required	Sheeting Type (Background)	Sheeting Type (Legend & Border)
EXIT ONLY guide sign	Continuous	No	IV*	VIII or IX
EXIT ONLY guide sign	Noncontinuous	Yes	II	III or IV
Guide signs for left side exits	Both	Yes	II	III or IV
Other guide signs	Both	No	III or IV	VIII or IX
Regulatory signs	Both	No	IV	n/a
Warning signs	Both	No	VIII or IX	n/a
<p>*For Yellow Background Sheeting, use Type VIII or IX Fluorescent Sheeting.</p> <p><b>Note:</b> Continuous (Full) Illumination is when light standards (luminaires) exist between interchanges.</p>				

### Reflective Sheeting Requirements for Overhead Signs

*Exhibit 1020-1*

All other overhead signs are illuminated only when one of the following conditions is present:

- Sign visibility is less than 800 feet due to intervening sight obstructions such as highway structures or roadside features.
- Signs directly adjacent to other overhead signs have sign lights.

### **(2) Vertical Clearance**

The minimum vertical clearance from the roadway surface to the lowest point of an overhead sign assembly is 17 feet 6 inches. The minimum vertical clearance from the roadway surface to the lowest point of an overhead sign assembly without sign light(s) is 19 feet 6 inches. The maximum clearance is 21 feet. Contact the HQ Traffic Office regarding signs under bridges and in tunnels.

### **(3) Horizontal Placement**

Consider roadway geometrics and anticipated traffic characteristics when locating signs above the lane(s) to which they apply. Install advance guide signs and exit direction signs that require an EXIT ONLY and “down arrow” panel directly above the drop lanes. To reduce driver confusion about which lane is being dropped, avoid locating a sign with an EXIT ONLY panel on a horizontal curve.

### **(4) Service Walkways**

Walkways are provided on structure-mounted signs, truss-type sign bridges, and truss-type cantilever sign supports where roadway and traffic conditions prohibit normal sign maintenance activities. Monotube sign bridges and cantilever sign supports normally do not have service walkways.

Vandalism of signs, particularly in the form of graffiti, can be a major problem in some areas. Vandals sometimes use the service walkways and vandalize the signs. Maintenance costs for cleaning or replacing the vandalized signs at these locations can exceed the benefit of providing the service walkway.

## **1020.05 State Highway Route Numbers**

For state routes, [RCW 47.36.095](#) authorizes WSDOT to sign state highways using a system of state route numbers assigned to eliminate duplication of numbers. This numbering system follows the system employed by the federal government in the assignment of Interstate and U.S. routes: odd numbers indicate general north-south routes and even numbers indicate general east-west routes.

## **1020.06 Mileposts**

Milepost markers are a part of a statewide system for all state highways and are installed in accordance with [Executive Order E 1064](#), “State Route Mileposts,” and Chapter 2 of the [Traffic Manual](#).

- 1040.01 General
- 1040.02 References
- 1040.03 Definitions
- 1040.04 Design Considerations
- 1040.05 Required Illumination
- 1040.06 Additional Illumination
- 1040.07 Design Criteria
- 1040.08 Documentation

## 1040.01 General

Illumination is provided along highways, in parking lots, and at other facilities to enhance the visual perception of conditions or features that require additional motorist, cyclist, or pedestrian alertness during the hours of darkness.

The Washington State Department of Transportation (WSDOT) is responsible for illumination on state highways and crossroads ([WAC 468-18-040](#) and [WAC 468-18-050](#)) with partial limited access control, modified limited access control, or full limited access control, regardless of the location. WSDOT is responsible ([WAC 468-18-050](#)) for illumination on state highways and crossroads with managed access control located outside the corporate limits of cities. Cities are responsible for illumination on managed access state highways within their corporate limits.

For the definitions of limited access control and managed access control, see [Chapter 520](#). For a listing (by milepost) of the limited access or managed access status of all state highways, refer to the Access Control Tracking System Limited Access and Managed Access Master Plan, under the “More Information” heading: [www.wsdot.wa.gov/design/accessandhearings](http://www.wsdot.wa.gov/design/accessandhearings). For further information, refer to the WSDOT/Association of Washington Cities agreement “City Streets as Part of State Highways”: [www.wsdot.wa.gov/localprograms/lag/construction.htm](http://www.wsdot.wa.gov/localprograms/lag/construction.htm)

## 1040.02 References

### 1040.02(1) Federal/State Laws and Codes

National Electrical Code (NEC), NFPA, Quincy, MA

[Revised Code of Washington \(RCW\) 47.24.020](#), Jurisdiction, control

[Washington Administrative Code \(WAC\) 296-24-960](#), Working on or near exposed energized parts

[WAC 468-18-040](#), Design standards for rearranged county roads, frontage roads, access roads, intersections, ramps and crossings

[WAC 468-18-050](#), Policy on the construction, improvement and maintenance of intersections of state highways and city streets

### 1040.02(2) Design Guidance

*American National Standard Practice for Roadway Lighting*, IES RP-8-00, New York, NY 2000

*Manual on Uniform Traffic Control Devices for Streets and Highways*, USDOT, FHWA; as adopted and modified by Chapter 468-95 WAC “Manual on uniform traffic control devices for streets and highways” (MUTCD)

NFPA 502: Standard for Road Tunnels, Bridges, and Other Limited Access Highways, NFPA, Quincy, MA 2011

*Recommended Practice for Tunnel Lighting*, IESNA RP-22-05, New York, NY 2011

*Roadway Lighting Design Guide*, AASHTO, October 2005

*Roadway Lighting Handbook, Addendum to Chapter Six: Designing the Lighting System Using Pavement Luminance*, Federal Highway Administration, Addendum to Implementation Package 78-15, Washington, DC 1983

*Roadway Lighting Handbook*, Federal Highway Administration, Implementation Package 78-15, Washington, DC 1978 (Reprinted April 1984)

*Standard Plans for Road, Bridge, and Municipal Construction (Standard Plans)*, M 21-01, WSDOT

### 1040.02(3) Supporting Information

*A Policy on Geometric Design of Highways and Streets (Green Book)*, AASHTO, Current Edition

*An Informational Guide for Roadway Lighting*, AASHTO, Washington, DC 1984

*City Streets as Part of State Highways Guidelines Reached by the Washington State Department of Transportation and the Association of Washington Cities on Interpretation of Selected Topics of RCW 47.24 and Figures of WAC 468-18-050 for the Construction, Operations and Maintenance Responsibilities of WSDOT and Cities for such Streets, 4-30-1997 amended 4-2-2013*

*Light Trespass: Research Results and Recommendations*, IES TM-11-00, New York, NY 2000

### 1040.03 Definitions

The following terms are defined in the [Glossary](#): *adaptive lighting system, average light level, complex ramp alignment and grade, continuous load, footcandle (fc), lamp lumens, light emitting diode(LED), long tunnel, lumen, luminaire, luminance, luminous flux, maximum uniformity ratio, maximum veiling luminance ratio, minimum average light level, minimum light level, mounting height – luminaire, multimodal connection, negative illumination, nighttime, pedestrian crossing, pole height (H1), positive illumination, roadway luminance, security lighting, short tunnel, Signal Maintenance Management System (SIMMS), slip base, spacing, transit flyer stop, transit stop, uniformity ratio, and veiling luminance.*

### 1040.04 Design Considerations

An illumination system is built from many separate components. The simplest illumination system contains the following:

- A power feed from the local utility company.
- An electrical service cabinet containing a photocell and circuit breaker for each illumination circuit.

- Runs of conduit with associated junction boxes leading to each luminaire.
- Conductors routed from the service cabinet breaker to each luminaire.
- A concrete light standard foundation.
- A light standard with a slip base or a fixed base.
- A luminaire (light) over or near the roadway edge line.

There are design considerations that need to be addressed when performing even the most minimal work on an existing illumination system. An existing electrical system is acceptable for use under the design requirements and National Electric Code (NEC) rules that were in effect at the time of installation. When modifying an existing electrical service or transformer, the designer is responsible for bringing the whole system up to current NEC design standards. Retrofitting an existing fixed base light standard with a slip base feature requires the installation of quick disconnect fittings and fuses in the circuit, at the luminaire only. The existing conductor configuration for a fixed base luminaire is not acceptable for use on a breakaway (slip base) installation. Existing conductors and components that no longer meet current NEC requirements are to be replaced and the whole circuit is to be designed to current standards. This may mean replacing the whole circuit back to the nearest overcurrent protection device (circuit breaker). Address the following when modifying an existing illumination system:

- Whether the existing circuit is in compliance with current NEC standards (deficient electrical component).
- Whether existing luminaire system components, such as conductors, conduit, junction boxes, foundation, and pole comply with current standards.
- Whether conductors meet NEC requirements for temperature rating (deficient electrical component).
- Conductor material: aluminum conductors or copper conductors (deficient electrical component).
- Whether the existing bonding and grounding system is adequate: cabinets, poles, junction boxes, including lids, and other appurtenances are bonded and grounded per NEC requirements.
- The condition and adequacy of the existing conduit running between the luminaire and the nearest junction box (deficient electrical component).
- The condition of the junction box next to the luminaire (deficient electrical component).
- The suitability of the existing foundation to meet current design requirements.
- The suitability of the location to meet current design standards for illumination.
- The location and bolt pattern of the existing foundation to meet current design standards.
- The design life remaining for the existing light standard (deficient electrical component).
- The condition of the existing light standard (deficient electrical component).
- Maintenance personnel assessment of the electrical safety of the installation.

Involve appropriate Headquarters (HQ) and region Traffic Office design personnel early in the process. Ensure potential system deficiencies are reflected in the estimate of work.

Maintain required illumination during all construction activities, except when shutdown is permitted to allow for alterations or final removal of the system per the Engineer. Site preparation, widening, drainage, guardrail installation, or other work can easily impact existing conduit runs or luminaire locations. Also, changed conditions such as merging, weaving, or unusual alignment due to traffic control often require additional temporary illumination.

**Note:** The same lighting requirements apply whether a condition is temporary or permanent.

Illumination is not required for minor operational enhancement projects, unless that is the specific reasoning for the project. (See [Chapter 1110](#), Minor Operational Enhancement Projects.)

## 1040.05 Required Illumination

The following items are to be considered for each project:

- Replace standard duty junction boxes that are located in paved areas with heavy-duty junction boxes, and bring electrical components to current standards. Relocate/remove junction boxes that are located in the travel way when practical.
- Review the age of the equipment as listed in SIMMS and consider replacing components that have reached the end of their design life. Replace poles, foundations, heads, and other equipment, that have reached their design life.
- Locate components so that they can be safely accessed from the right of way.
- Ensure existing slip base features are in accordance with current design standards.
- Consider additional illumination in accordance with [1040.06](#), if warranted, or design additional illumination if it is called for in the Project Definition.
- When it is necessary to relocate existing light standard foundations, evaluate the entire conduit run serving those light standards and replace deficient components to current (NEC) standards.

Exhibits [1040-1a](#) through [1040-24](#) show examples of illumination for roadway, transit flyer stops, parking lots, truck weigh stations, tunnels, bridges, work zones, and detour applications.

A minimum of two light standards of standard pole height are required at all design areas, with the exception of ramp terminals and entrance/exit points at minor parking lots.

### 1040.05(1) Freeway Off-Ramps and On-Ramps

Provide the necessary illumination for the design area of all freeway off-ramp gore areas and on-ramp acceleration tapers (see [1040.07\(2\)](#) and Exhibits [1040-1a](#), [1b](#), and [1c](#)).

### 1040.05(2) Freeway Ramp Terminals

Provide the necessary illumination for the design area (see [Exhibit 1040-2](#)).

### 1040.05(3) Freeway On-Ramps With Ramp Meter Signals

Provide the necessary number of light standards to illuminate freeway on-ramps with ramp meters, from 150' before the ramp meter stop bar to 50' past the ramp meter stop bar. When there is an HOV bypass lane or a two-lane merge beyond the ramp meter, then also provide illumination from the point where the merging lane width is 10' to 200' downstream of that point (see [Exhibit 1040-3](#)). Illumination for the ramp merge with mainline is to be done per [Exhibit 1040-1b](#).

**1040.05(4) Vacant****1040.05(5) HOT (High-Occupancy Toll) Lane Enter/Exit Zones**

Provide the necessary number of luminaires to illuminate the design area of the enter/exit zones of the HOT lane (see [Exhibit 1040-5](#)).

**1040.05(6) Lane Reduction**

Provide the necessary number of light standards to illuminate the design area of all highway lane reduction areas within the urban boundary (see [Exhibit 1040-6](#)). This requirement does not apply to:

- The end of slow-moving vehicle turnouts.
- The end of the area where driving on shoulders is allowed.

**1040.05(7) Vacant****1040.05(8) Intersections With Left-Turn Lane Channelization**

Illumination of the intersection area is required for intersections with painted or other low-profile pavement markings such as raised pavement markings. When the channelization is delineated with curbs, raised medians, or islands, illuminate the raised channelization from the beginning of the left-turn approach taper (see Exhibits [1040-8a](#) and [8b](#)).

**1040.05(9) Vacant****1040.05(10) Intersections With Traffic Signals**

Illuminate intersections with traffic signals on state highways (see [Exhibit 1040-10](#)). In cities with a population under 25,000, the state may assume responsibility for illumination installed on signal standards.

**1040.05(11) Roundabouts**

Provide the necessary number of light standards to illuminate the design areas of roundabouts (see [Chapter 1320](#) and [Exhibit 1040-12](#)).

**1040.05(12) Railroad Crossings With Gates or Signals**

Railroad crossings with automated gates or signals on state highways are illuminated if there is nighttime train traffic. Within the corporate limits of a city, and outside limited access control, illumination is the responsibility of the city. Install luminaires beyond the railroad crossing, on the side of the roadway opposite the approaching traffic, to backlight the train (see [Exhibit 1040-13](#)).

**1040.05(13) Midblock Pedestrian Crossings**

Illuminate the entire midblock pedestrian crossing, including the crosswalks, the refuge area in the roadway, and the sidewalks or shoulders adjacent to the crosswalk. When a raised median pedestrian refuge design is used, illuminate the raised channelization (see [Exhibit 1040-14](#)).

**1040.05(14) Transit Flyer Stops**

Illuminate the pedestrian-loading areas of transit flyer stops located within the limited access boundaries (see [Exhibit 1040-15](#)).

**1040.05(15) Major Parking Lots**

All parking lots with usage exceeding 50 vehicles during the nighttime peak hour are considered major parking lots. Provide an illumination design that will produce the light levels shown in [Exhibit 1040-25](#). (See [Exhibit 1040-16](#) for the parking design area and bus loading zone design area.) During periods of low usage at night, security lighting is required only in the parking area and bus loading zone. Provide an electrical circuitry design that allows the illumination system to be reduced to approximately 25% of the required light level.

**1040.05(16) Minor Parking Lots**

Minor parking lots have a nighttime peak hour usage of 50 or fewer vehicles. Provide security-level lighting for those lots owned and maintained by the state. Security lighting for a minor parking lot consists of lighting the entrance and exit to the lot (see [Exhibit 1040-17](#)).

**1040.05(17) Truck Weigh Sites**

Provide illumination of the roadway diverge and merge sections, scale platforms, parking areas, and inspection areas of weigh sites (see [Exhibit 1040-18](#)).

**1040.05(18) Safety Rest Areas**

Provide illumination within rest areas at the roadway diverge and merge sections, the walkways between parking areas and rest room buildings, and the parking areas the same as for a major parking lot (see [Exhibit 1040-19](#)).

**1040.05(19) Chain-Up/Chain-Off Parking Areas**

Provide the necessary number of luminaires to illuminate the design area of the chain-up/chain-off parking area (see [Exhibit 1040-20](#)). The illumination is to be installed in the median and on the shoulder to provide lighting on both sides of the stopped vehicles.

**1040.05(20) Tunnels, Lids, and Underpasses**

For the purposes of this chapter, a tunnel is a structure over a roadway, which restricts the normal daytime illumination of a roadway section such that the driver's visibility is substantially diminished. Tunnels cover roadways and produce a shadow that limits the ability of the driver to see objects or obstructions within the tunnel. In most locations, no supplemental daytime lighting is required for underpasses or structures less than 80 feet in length. Provide both nighttime and daytime lighting for long tunnels. (See ANSI/IES publication RP-22-11 for tunnel lighting design criteria.) Provide vandal-resistant daytime and nighttime security lighting in pedestrian tunnels. Short tunnels and underpasses where the exit portal is not visible from the entrance portal due to curvature of the roadway are to be considered long tunnels.

**1040.05(21) Bridge Inspection Lighting**

Provide the necessary number of light fixtures and electrical outlets to illuminate the interior inspection areas of floating bridges, steel box girder bridges and concrete box girder bridges where access is provided (see [Exhibit 1040-22](#)). Separate circuits are to be used for lighting and electrical outlets. Each electrical outlet is to be powered by 2 Duplex receptacles on two separate circuits. All electrical outlets are to be labeled with circuit identifications. Coordinate bridge illumination requirements with the HQ Bridge and Structures Office.

**1040.05(22) Same Direction Traffic Split Around an Obstruction**

Provide the necessary number of light standards to illuminate the design area where traffic is split around an obstruction. This requirement applies to permanent and temporary same-direction split channelization. For temporary work zones, illuminate the obstruction for the duration of the traffic split (see [Exhibit 1040-23](#)).

**1040.05(23) Vacant****1040.06 Additional Illumination**

At certain locations, additional illumination is desirable to provide better definition of nighttime driving conditions or to provide consistency with local agency goals and enhancement projects. For Improvement projects on state highways, additional illumination could be reviewed as a crash countermeasure under certain circumstances, which are listed in this section. Justify the additional illumination in the Design Documentation Package (DDP).

**1040.06(1) Conditions for Additional Illumination**

Following are some conditions used in making the decision to provide additional illumination:

**1040.06(1)(a) Crash Analysis**

The following conditions have to be met when making the decision to provide additional illumination:

- During the last full five calendar years, the site has experienced nighttime crashes that are correctable with illumination, AND
- The benefit-cost analysis for the proposed illumination exceeds 1, AND
- Alternative lower-cost countermeasures have been evaluated and did not address the particular nighttime crash history.

Nighttime crashes are defined as crashes occurring between half an hour after sunset and half an hour before sunrise. Correctable nighttime crashes are crashes that (a) meet the nighttime definition in this chapter, (b) have contributing factors related to a lack of lighting, and (c) where lighting, if installed, would directly address the contributing factor(s) to the crashes.

Collision reporting forms and the crash data are not adequate means to distinguish between day and nighttime conditions: the crash location, the reported crash times, and seasonal variations should be used to determine which crashes qualify as nighttime crashes. Also:

- For sites where the number of nighttime crashes equals or exceeds the number of daytime crashes, the above-mentioned crash and benefit-cost analysis should be performed.
- For sites where these nighttime crashes involve pedestrians, refer to [1040.06\(12\)](#).

**1040.06(1)(b) Locations With Nighttime Pedestrian Crashes**

The mitigation of nighttime pedestrian crashes requires different lighting strategies than vehicular crash locations. Provide light levels to emphasize crosswalks and adjacent sidewalks by using positive lighting of the pedestrians.

Multilane highways with two-way left-turn lanes, in areas transitioning from rural land use to urban land use, or areas experiencing commercial growth or commercial redevelopment, are typically high-speed facilities with numerous road approaches and driveways. These approaches allow numerous vehicle entry and exit points and provide few crossing opportunities for pedestrians; consider additional illumination.

**1040.06(2) *Highways***

Proposals to provide full (continuous) illumination require the approval of the Region and State Traffic Engineers. Regions may choose to develop (regional or corridor-specific) system plans for providing full (continuous) illumination. The State Traffic Engineer's approval of a system plan will eliminate the need for a project-specific approval from the State Traffic Engineer.

The decision whether to provide full (continuous) illumination is to be made during the scoping stage and communicated to the designers as soon as possible.

Continuous illumination should be considered when the crash analysis requirements in 1040.6(1) are met and a benefit/cost analysis between the required and full (continuous) illumination exceeds 1.

On the main line of highways without full limited access control, consider full (continuous) illumination if the segment of highway is in a commercial area and the crash analysis requirements in 1040.6(1) are met, has raised channelization, has medium or high pedestrian activity during night time hours, and an engineering study indicates that nighttime driving conditions will be improved.

**1040.06(3) *Ramps***

Consider additional illumination at ramps where the alignment or grade is complex.

**1040.06(4) *Vacant*****1040.06(5) *Crossroads***

Consider additional illumination if the crossroad is in a short tunnel, an underpass, or a lid.

**1040.06(6) *Intersections Without Turn-Lane Channelization***

Refer to [Exhibit 1040-11](#).

**1040.06(7) *Short Tunnels, Underpasses, or Lids***

Consider illumination of the sidewalk, walkway, or shared-use path if it is included as part of the short tunnels, underpasses, or lids.

### **1040.06(8) Work Zones and Detours**

Consider temporary illumination of the highway through work zones and detours when changes to the highway alignment or grade remain in place during nighttime hours and when the following conditions may be present (see [Exhibit 1040-24](#)):

- Nonstandard roadway features such as narrow lanes, narrow shoulders, or substandard shy distance to barriers or structures.
- The temporary alignment includes abrupt changes in highway direction or lane shifts with substandard lane shift tapers.
- Other unusual highway features such as abrupt lane edge drop-offs, sudden changes in pavement conditions, or temporary excavation or trenching covers.
- There is an anticipation of heavy construction truck traffic, possibly requiring flaggers, entering and exiting the highway during nighttime hours.

For further information on work zones, see [Chapter 1010](#).

### **1040.06(9) Transit Stops**

The responsibility for lighting at transit stops is shared with the transit agency. Consider illuminating transit stops with shelters as they usually indicate greater passenger usage. Negotiation with the transit agencies is required for the funding and maintenance of this illumination. Negotiating a memorandum of understanding (MOU) with each transit agency is preferred over spot negotiations. If the transit agency is unable or unwilling to participate in the funding and maintenance of the illumination, consider a single light standard positioned to illuminate both the transit pullout area and the loading area.

### **1040.06(10) Bridges**

Justification for illuminating the roadway/sidewalk portion of bridges is the same as that for highways on either end of the bridge with or without full limited access control, as applicable. Justification for illuminating the architectural features of a bridge structure requires the approval of the State Traffic Engineer. For justification for illuminating pedestrian walkways or bicycle trails under a bridge, see [1040.06\(12\)](#).

### **1040.06(11) Railroad Crossing Without Gates or Signals**

Consider the illumination of railroad crossings without gates or signals when:

- The crash history indicates that motorists experience difficulty in seeing trains or control devices.
- There are a substantial number of rail operations conducted during nighttime hours.
- The crossing is blocked for long periods due to low train speeds.
- The crossing is blocked for long periods during the nighttime.

For further information, see the [MUTCD](#).

### **1040.06(12) Sidewalks, Walkways, and Shared-Use Paths**

Consider illumination of a pedestrian walkway if the walkway is a connection between two highway facilities. This could be between parking areas and rest room buildings at rest areas; between drop-off/pick-up points and bus loading areas at flyer stops; or between parking areas and bus loading areas or ferry loading zones. Consider illuminating existing sidewalks, walkways, and shared-use paths if security problems have been reported or are anticipated. Under these conditions, these facilities are illuminated to the level shown in [Exhibit 1040-25](#).

## **1040.07 Design Criteria**

### **1040.07(1) Light Levels**

Light levels vary with the functional classification of the highway, the development of the adjacent area, and the level of nighttime activity. Light level requirements for highways and other facilities are shown in [Exhibit 1040-25](#). These levels are the minimum average light levels required for a design area at the end of rated lamp life for applications requiring a spacing calculation. Light level requirements are not applicable for single light standards or security lighting installations where:

- The light level is reduced to approximately 25% of the required light level in parking lots and parking lot loading areas during periods of low usage at night.
- Walkway or path illumination is installed only at areas where shadows and horizontal and vertical geometry obstruct a pedestrian's view.

Light level requirements are applicable when:

- The complete walkway or path is to be illuminated for public safety.

The access areas used for interior inspection of floating bridges or steel box/concrete box girder bridges are exempt from lighting level and lighting ratio design requirements.

For design-level classifications of highways, see Chapters [1100](#), [1120](#), [1130](#), and [1140](#).

### **1040.07(1)(a) Activity Areas**

The types of activity areas (shown below) are related to the number of pedestrian crossings through the design area. These crossings need not occur within a single crosswalk and can be at several locations along the roadway in an area with pedestrian generators. Land use and activity classifications are as follows:

#### **1040.07(1)(a)(1) High Activity**

Areas with over 100 pedestrian crossings during nighttime peak hour pedestrian usage. Examples include downtown retail areas; near outdoor stage theaters, concert halls, stadiums, and transit terminals; and parking areas adjacent to these facilities.

#### **1040.07(1)(a)(2) Medium Activity**

Areas with pedestrian crossings that number between 11 and 100 during nighttime peak hour pedestrian usage. Examples include downtown office areas; blocks with libraries, movie theaters, apartments, neighborhood shopping, industrial buildings, and older city areas; and streets with transit lines.

**1040.07(1)(a)(3) Low Activity**

Areas with pedestrian crossings that number less than 11 during the nighttime peak hour pedestrian usage. Examples include suburban single-family areas, low-density residential developments, and rural or semirural areas.

**1040.07(2) Design Areas**

The design area is that portion of the roadway, parking lot, or other facility subject to the minimum light level, minimum average light level, uniformity ratio, and maximum veiling luminance ratio design requirements. This encompasses the area between the edges of the traveled way along the roadway; the outer edges of the stopping points at intersections; and, when present, a bike lane adjacent to the traveled way. When the roadway has adjacent sidewalks, the design area includes these features; however, sidewalks adjacent to the traveled way are exempt from maximum veiling luminance ratio requirements.

**1040.07(2)(a) Design Area Requirements**

Design area requirements for various applications are shown in Exhibits [1040-1a](#) through [1040-24](#) and are described in the following:

**1040.07(2)(a)(1) Single-Lane Off-Ramp**

Two main line through lanes and the ramp lane, including gore area, from the gore point (beginning of wide line) to a point 200 feet (minimum) downstream of the gore point. A 100-foot longitudinal tolerance either way from the gore point is allowed.

**1040.07(2)(a)(2) Two-Lane Off-Ramp**

Two main line through lanes and both ramp lanes, including gore area, from a point 200 feet upstream of the gore point (beginning of wide line) to a point 200 feet downstream of the gore point. A 100-foot longitudinal tolerance either way from the gore point is allowed.

**1040.07(2)(a)(3) Single-Lane On-Ramp**

Two main line through lanes and the ramp lane, from a point where the ramp lane is 10 feet wide to a point 200 feet downstream. A 100-foot longitudinal tolerance either way is allowed; this includes auxiliary lane on-connections and lane reductions.

**1040.07(2)(a)(4) Two-Lane On-Ramp**

Two main line through lanes and the ramp lanes from a point where the ramp width is 22 feet wide to a point 200 feet upstream and 200 feet downstream. A 100-foot longitudinal tolerance either way is allowed.

**1040.07(2)(a)(5) Intersections Channelized With Pavement Markings**

When the leg of an intersection is two lanes wide or less, the design area starts at the stop bar and encompasses the intersection area. When the leg of an intersection is three or more lanes wide, the design area starts 25' before the stop bar and encompasses the intersection area.

**1040.07(2)(a)(6) Intersections With Raised Channelization**

The design area has two components: the intersection area and the approach areas. The intersection area is the area between the stopping points on both the main road and the minor road, including marked or unmarked crosswalks. The approach areas are the areas on the main roadway between the stopping point and where the left-turn taper begins.

**1040.07(2)(a)(7) Unchannelized Intersection**

The area between the stopping points on both the main road and the minor road, including marked or unmarked crosswalks.

**1040.07(2)(a)(8) Railroad Crossing**

The roadway width from a point 50 feet on either side of the track (the approach side only for one-way roadways).

**1040.07(2)(a)(9) Transit Loading Area**

The lane width and length designated for loading.

**1040.07(2)(a)(10) Major Parking Lot**

The entire area designated for parking, including internal access lanes.

**1040.07(2)(a)(11) Scale Platform at Weigh Site**

The approach width from the beginning of the scale platform to the end of the platform.

**1040.07(2)(a)(12) Inspection Area at Weigh Site**

The area dedicated to inspection as agreed upon with the Washington State Patrol.

**1040.07(2)(a)(13) Bridge Inspection Lighting System**

Fixtures are to be ceiling mounted. For steel box girders bridges, the spacing shall not be greater than the smaller of 4 times the web depth or 25 ft. For concrete box girder bridges, the spacing shall not be greater than the smaller of 8 times the web depth or 50 ft. Illumination is to consist of a 100 watt incandescent (or fluorescent equivalent) fixture. The bulb should have a minimum of 1600 lumens. Each fixture is to be designed with a 20 amp rated ground fault circuit interrupt (GFCI) receptacle. A light switch is needed at each entrance to any common inspection area. For inspection areas with two or more entrances, three-way or four-way switches are required.

**1040.07(3) Daytime Light Levels for Tunnels, Lids, and Underpasses**

It is important to provide sufficient illumination inside a tunnel. When driving into and through a tunnel during the day, a driver's eyes have to adjust from a high light level (daylight) to a lower lighting level inside the tunnel. Motorists require sufficient time for their eyes to adapt to the lower light level of the tunnel itself. When sufficient lighting is not provided in the threshold, transition, or interior zones of a tunnel, a motorist's eyes may not have enough time to adapt and may experience a "black hole" or "blackout" effect. This "black hole" effect may cause a motorist to slow down, reducing the efficiency of the roadway. When leaving the tunnel, the driver's eyes have to adjust from a low lighting level back to daytime conditions. The full design considerations for tunnel lighting are covered in [1040.02\(2\)](#) in the Design Guidance section.

- All designs for illuminating tunnels are to be reviewed and approved by the State Traffic Engineer.
- Long tunnels are divided into zones for the determination of daytime light levels. The zones are Threshold Zone, Transition Zone(s), and Interior Zone. Each zone length is calculated using the method described in ANSI/IES RP-22-11.
- The designer of a long tunnel shall perform a Lseq (Equivalent Veiling Luminance) calculation. Lseq values obtained from this calculation shall be used to reduce (or increase) the Suggested Daytime Maintained Average Pavement Luminance Levels where indicated.
- Tunnel wall illumination is required.
- The approach and exit roadways shall have a nighttime luminance level of no less than one third of the tunnel interior level for one safe stopping sight distance (SSSD).
- Provide illumination of fire protection equipment, alarm pull boxes, phones, and emergency exits in long tunnels. (See NFPA 502 for additional information.)
- Short tunnels and underpasses in rural areas or with low pedestrian usage normally do not have daytime illumination. Short tunnels and underpasses in urban areas with high pedestrian usage may require daytime and nighttime illumination. Consultation with the affected local agency is recommended. Short tunnels and underpasses are treated the same as an entrance zone on a long tunnel to establish daytime light levels.
- Nighttime light level requirements for short tunnels on continuously illuminated roadways are the same as the light level required on the roadway outside the tunnel.

#### **1040.07(4) Light Standards**

##### **1040.07(4)(a) Light Standards on State Highway Facilities**

Light standards are the most common supports used to provide illumination for highway facilities. The 40-foot and 50-foot light standards with slip bases and Type 1 mast arms are predominantly used on state highways. The angular Type 2 mast arms are allowed only to match existing systems. Use Type 1 mast arms on all new systems. Cities and counties may elect to use different mounting heights to address factors unique to their environments. On state highways, alternative light standards may be considered if requested by the city or county, provided they agree to pay any additional costs associated with this change.

The typical location for a light standard is on the right shoulder. When considering designs for light standards mounted on concrete barrier in the median, consider the total life cycle cost of the system, including the user costs resulting from lane closures required for relamping and repair operations. Light standards located in the vicinity of overhead power lines require a minimum 10 foot circumferential clearance from the power line (including the neutral conductor) to any portion of the light standard or luminaire. Depending on the line voltage, a distance greater than 10 feet may be required ([WAC 296-24-960](#)). Consult the HQ Bridge and Structures Office when mounting light standards on structures such as retaining walls and bridge railings.

It is preferable to locate a light standard as far from the traveled way as possible to reduce the potential for impacts from errant vehicles. The typical luminaire position is mounted directly over the edge line plus or minus 4 feet. However, some flexibility is acceptable with the luminaire position to allow for placement of the light standard provided light levels, uniformity, and maintenance considerations are also addressed and with the Region Traffic Engineer's approval. On Type III signal standards, luminaires may be placed more than 4 feet from the edge line.

Standard mast arm lengths are available in 2-foot increments between 6 and 16 feet. The preferred design for a single-arm light standard is a 16-foot mast arm installed on a 40-foot or 50-foot standard. The maximum allowable mast arm length for a single-arm light standard is 16 feet. The preferred design for a double mast arm light standard has mast arms between 6 feet and 12 feet in length, installed on a 40-foot or 50-foot standard. The maximum allowable mast arm length for a double luminaire light standard is 12 feet.

When light standards are located within the Design Clear Zone, breakaway and slip base features are used to reduce the severity of an impact. (See [Chapter 1600](#) for additional guidance on clear zone issues.)

In curb and sidewalk sections, locate the light standard behind the sidewalk. Slip bases on light standards are a safety requirement for roadways where the posted speed is 35 mph or higher. They are not always desirable at other locations. Fixed bases are installed in the following locations:

- Parking lots.
- Medians where the light standard is mounted on median barrier.
- Behind traffic barrier, beyond the barrier's deflection design value (see [Chapter 1610](#)).
- Along pedestrian walkways, bike paths, and shared-use paths.

#### **1040.07(4)(b) Light Standard Heights**

Standard pole heights (20-foot, 30-foot, 40-foot, or 50-foot) are readily available from local distributors and manufacturers. Light standards can also be supplied with other lengths. However, WSDOT Maintenance offices cannot stock poles with nonstandard lengths for use as replacements in the event of a knockdown. Nonstandard lengths in 5-foot increments (25-foot, 35-foot, or 45-foot) will require a longer delivery time. Other nonstandard lengths (for example, 27-foot, 33-foot, 43-foot, or 47-foot) will not only require a longer delivery time, they will also be more expensive.

In almost all cases, use standard pole heights of 40 feet and 50 feet for roadway illumination. Structure-mounted light standards may need to be shorter than the standard 40-foot or 50-foot grade-mounted pole. It is acceptable to use 20-foot or 30-foot light standards on bridges, retaining walls, or other structures to compensate for top-of-structure elevation above the roadway surface. Use of these standard pole heights will result in variable mounting heights for the luminaires. Luminaire mounting height is defined as the actual distance from the roadway surface directly under the luminaire to the luminaire itself. Use the actual mounting height at each location when calculating light standard spacing. Luminaires with a mounting height over 50 feet require lowering devices.

High mast light supports may be considered for complex interchanges where continuous lighting is justified. High mast lighting may be considered for temporary illumination areas during construction. Initial construction costs, long-term maintenance, clear zone mitigation, spillover light onto adjacent properties, and negative visual impacts are important factors when considering high mast illumination.

Shorter light standards of 30 feet or less may be used for minor parking lots, trails, pedestrian walkways, and locations with restricted vertical clearance.

#### **1040.07(4)(c) Standard Luminaire**

The cobra head-style, high-pressure sodium vapor luminaire with Type III, medium distribution full cut off fixture is the normal light source used for state highway lighting. A Type III distribution projects an oval pattern of light on the roadway, and a Type V distribution projects a circular pattern. Post top-mounted luminaires and other decorative light fixtures with Type V patterns are more effective for area lighting in parking lots and other locations where more symmetrical light distribution patterns are used. The standard wattages for High Pressure Sodium Luminaires are 200W, 250W, and 400W.

There is currently a transition from HPS luminaires to LED luminaires for Cobra head-style fixtures. LED luminaires can be installed on a project with HQ Traffic approval. The HQ Traffic Office will then direct the designer on which LED fixtures they can use on a project.

#### **1040.07(4)(d) Electrical Design**

For an example of circuit layout, conductor sizing, conduit sizing, overcurrent protection device sizing, and other electrical design calculations, see the Power Supply Design material located at: <http://www.wsdot.wa.gov/design/traffic/electrical/training.htm>

An example of illumination design grid layouts and calculations is located in the Illumination Design for Transportation Applications material located in the link above.

The illumination circuitry is to be laid out so that if four or more luminaires are installed, it should have a minimum of two circuits. The intent is to make sure that if a circuit fails, there will still be partial lighting from the other circuits.

The maximum allowable junction box spacing is as follows:

1. 360 feet allowed between in grade junction boxes with a straight pull.
2. 180 feet when conduit run is along a curve or when the conduit makes a 30 degree or greater change in direction.
3. 180 feet between NEMA junction boxes in traffic barrier, retaining wall, or structure.
4. A junction box is required within 5 feet minimum (preferred) & 10 feet maximum of the luminaire base, regardless of the luminaire spacing.
5. 360 feet between NEMA junction boxes when fiber optic cable is run through conduit in traffic barrier, retaining wall, or structure.
6. Pull Box interconnect to Traffic Signal – spacing is 500 feet maximum. Disclaimer: This would only apply to a single fiber optic cable.
7. 1,000 feet between cable vaults or pull boxes – main line fiber optic cable.

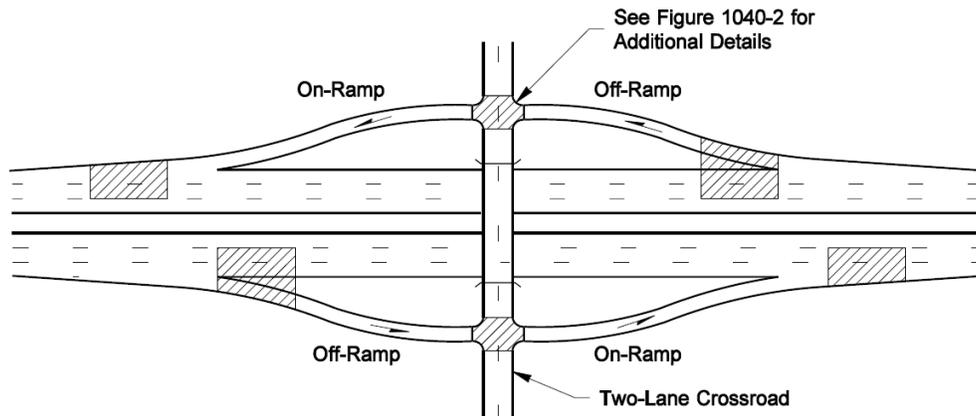
**1040.07(5) Adaptive Lighting**

Adaptive Lighting Systems may be used at select locations where changing traffic conditions allow for lowering of light levels or the changing of a required design area. Some examples would be: the Pedestrian/Area Classification changes requiring different levels; traffic volumes drop sharply; or chain up/chain off areas. Region and State Traffic Engineers' approval is required for adaptive lighting systems.

**1040.08 Documentation**

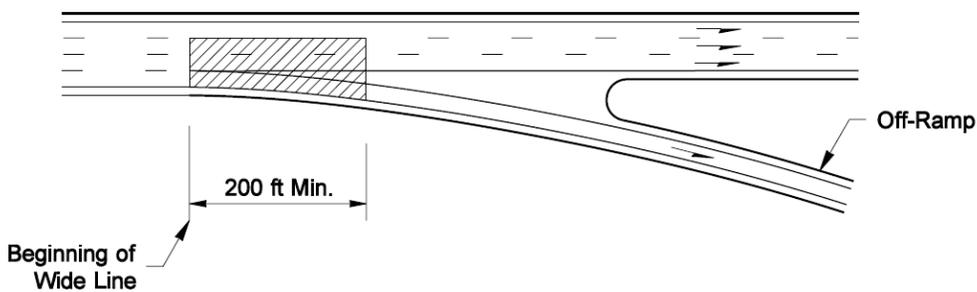
Refer to [Chapter 300](#) for design documentation requirements.

Exhibit 1040-1a Freeway Lighting Applications



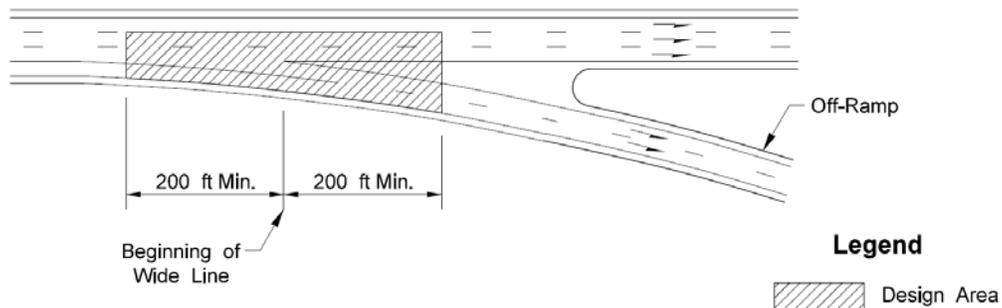
**Required Illumination for a Typical Diamond Interchange**

Shown for single-lane ramp connection and a two-lane crossroad without channelization.



**Single-Lane Off-Connection**

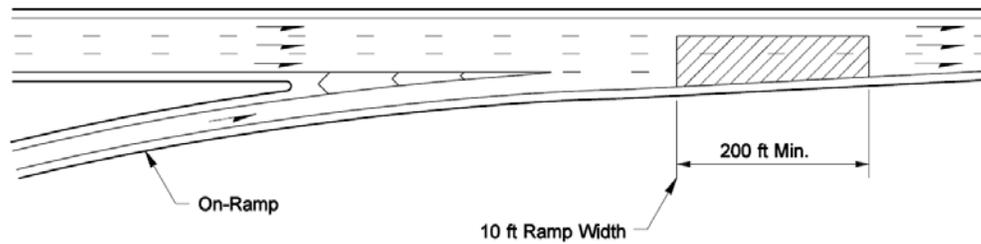
The design area may be shifted up to 100 ft from the beginning of the wide line; a minimum of two light standards of standard pole height required for design area.



**Two-Lane Off-Connection: One Exit Only Lane; One Optional Lane**

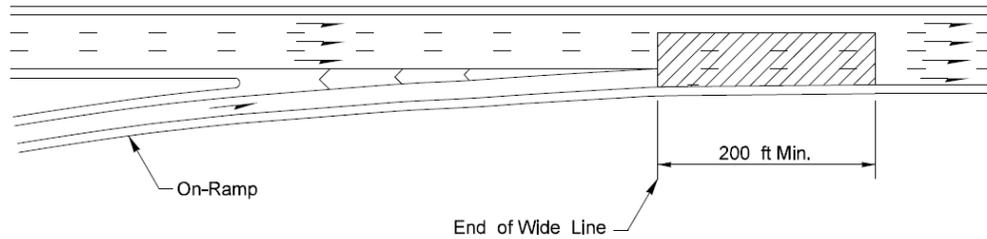
The design area may be shifted up to 100 ft from the beginning of the wide line; a minimum of three light standards of standard pole height required for design area.

Exhibit 1040-1b Freeway Lighting Applications



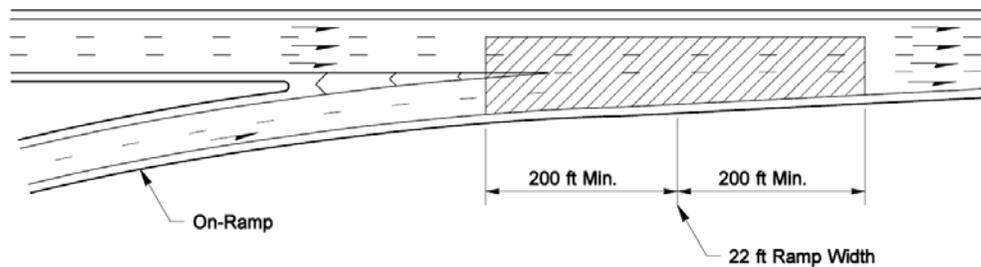
**Single-Lane On-Connection**

The design area may be shifted up to 100 ft from the 10-ft-wide ramp point; a minimum of two light standards of standard pole height required for design area.



**Auxiliary Lane at On-Connection**

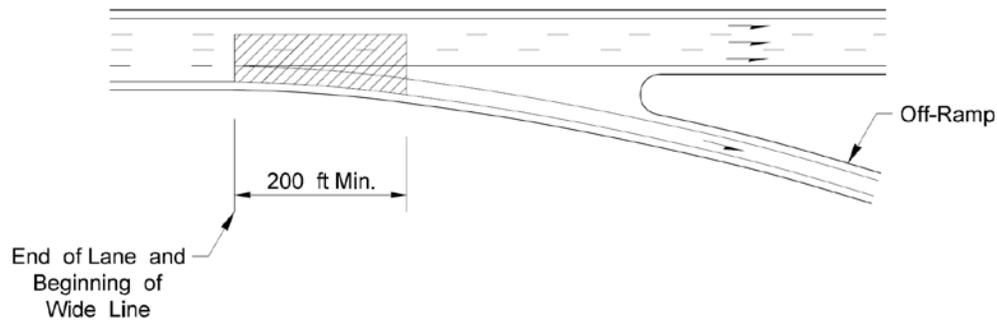
The design area may be shifted up to 100 ft from the end of wide line; a minimum of three light standards of standard pole height required for design area.



**Two-Lane On-Connection: One Auxiliary Lane; One Merge Lane**

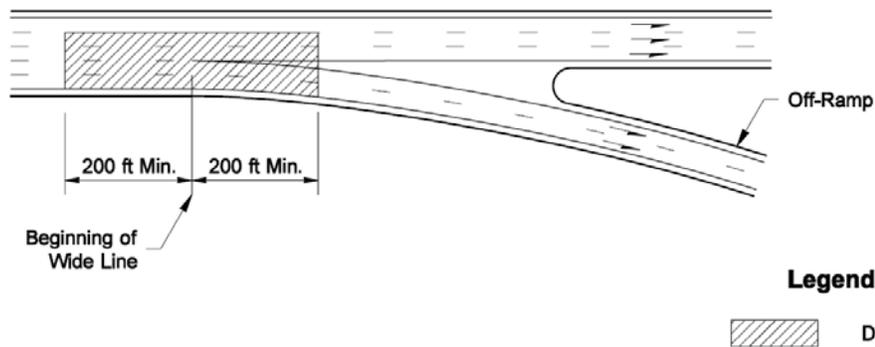
The design area may be shifted up to 100 ft from the 22-ft-wide ramp point; a minimum of three light standards of standard pole height required for design area.

Exhibit 1040-1c Freeway Lighting Applications



**Single Exit-Only Lane**

The design area may be shifted up to 100 ft from the end of lane and the beginning of wide line; a minimum of two light standards of standard pole height required for design area.



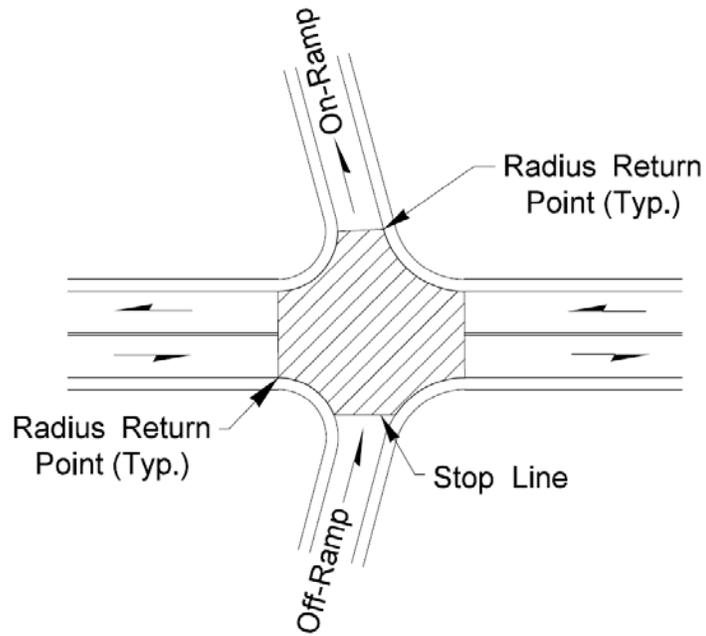
**Legend**

 Design Area

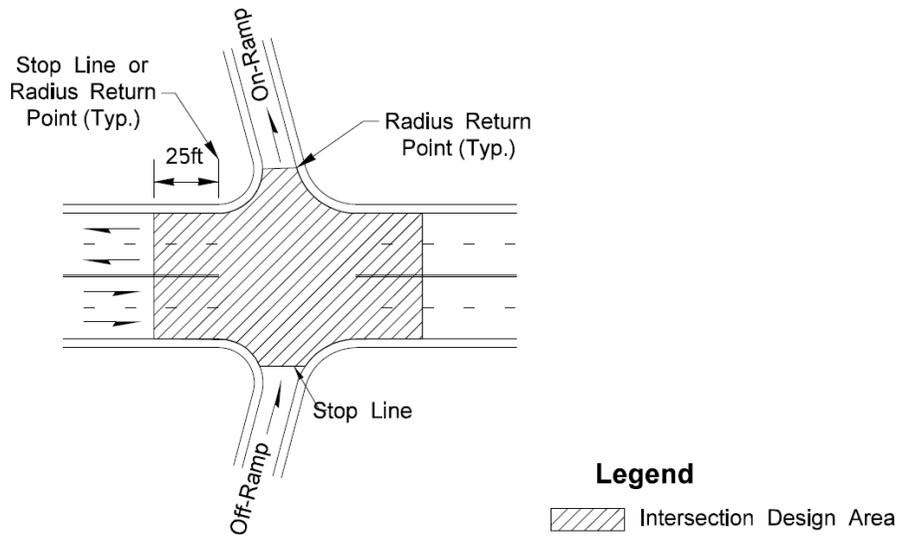
**Two Exit-Only Lanes**

The design area may be shifted up to 100 ft from the end of lane and the beginning of wide line; a minimum of three light standards of standard pole height required for design area.

Exhibit 1040-2 Freeway Ramp Terminals

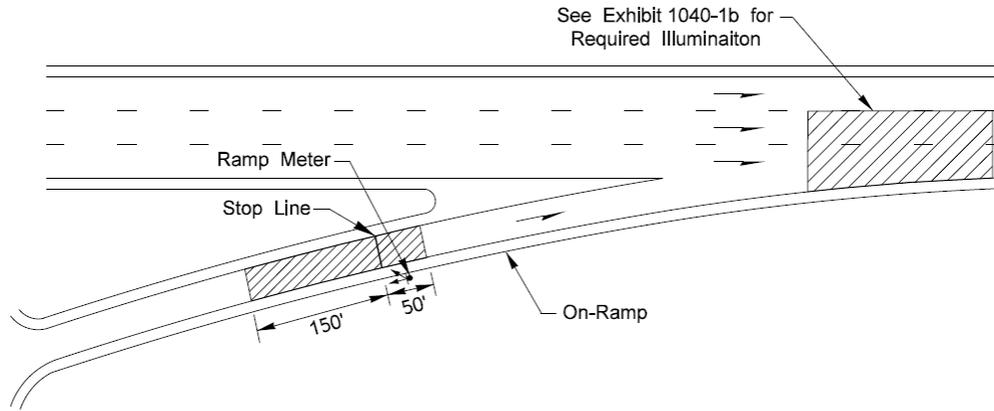


Off Ramp With Single-Lane Crossroad

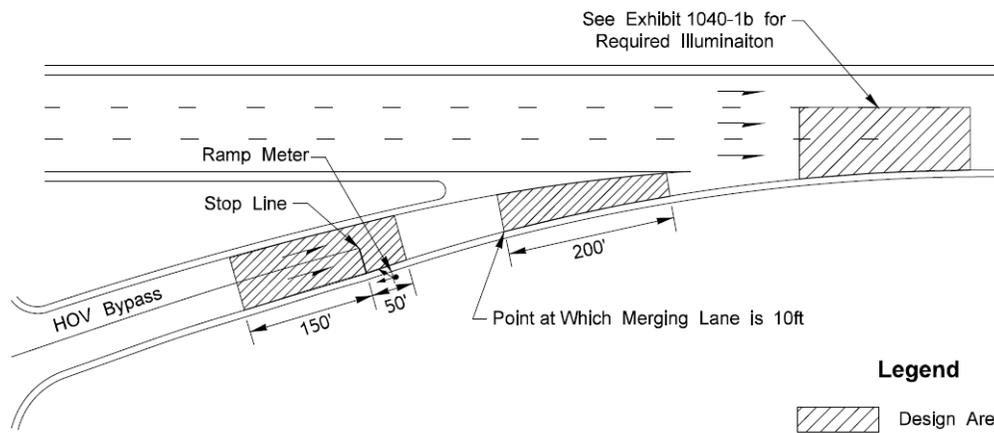


Off-Ramp With Multilane Crossroad

Exhibit 1040-3 Ramp With Meter



Single-Lane On-Ramp



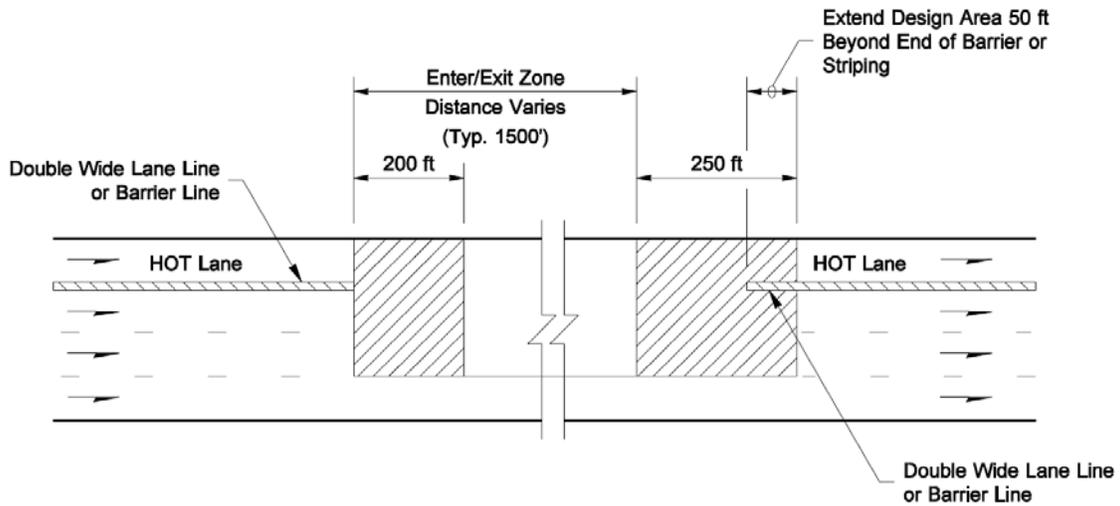
Legend

 Design Area

Multilane On-Ramp With HOV Bypass Lane

Exhibit 1040-4 Vacant

Exhibit 1040-5 HOT (High-Occupancy Toll) Lane Enter/Exit Zone

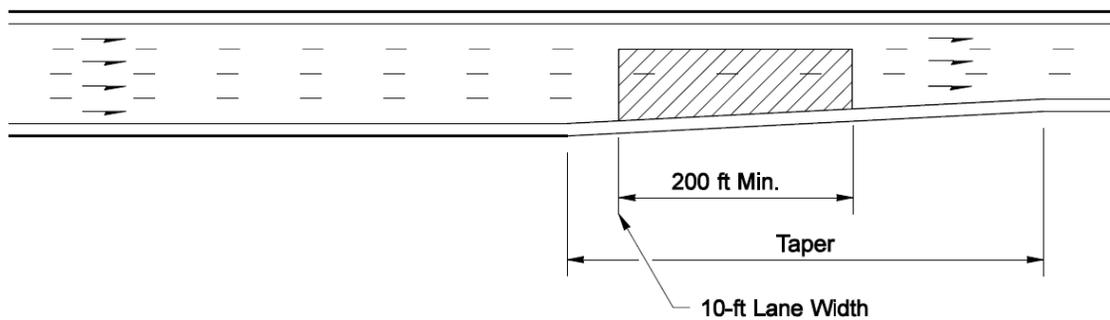


**Legend**

 Design Area

A minimum of two light standards of standard pole height required for each design area.

Exhibit 1040-6 Lane Reduction



A minimum of two light standards of standard pole height required for design area; design area may be shifted 100 ft.

Exhibit 1040-7 Vacant

Exhibit 1040-8a Intersection With Left-Turn Channelization: Divided Highway

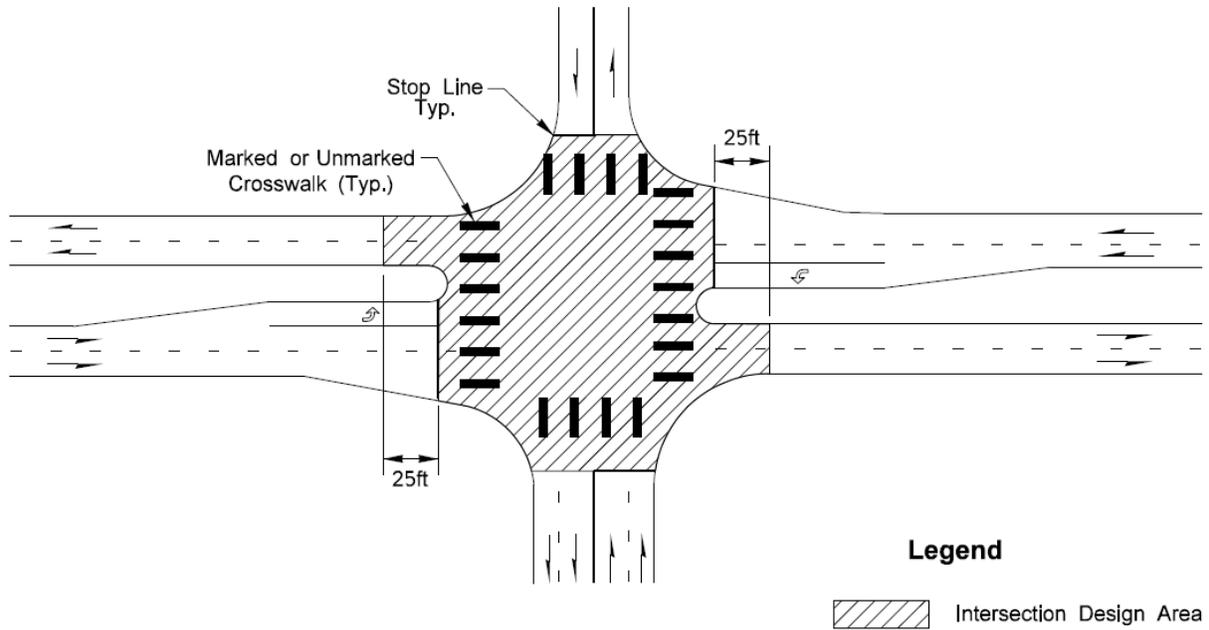
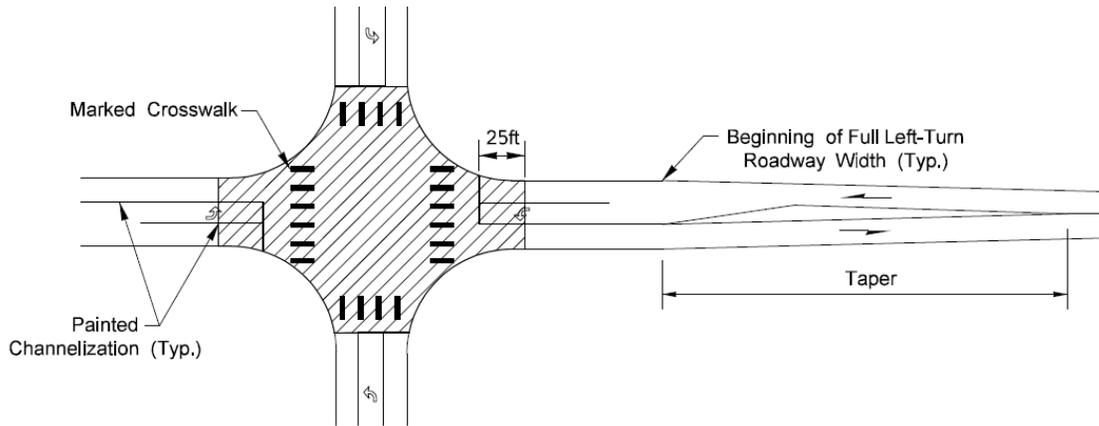
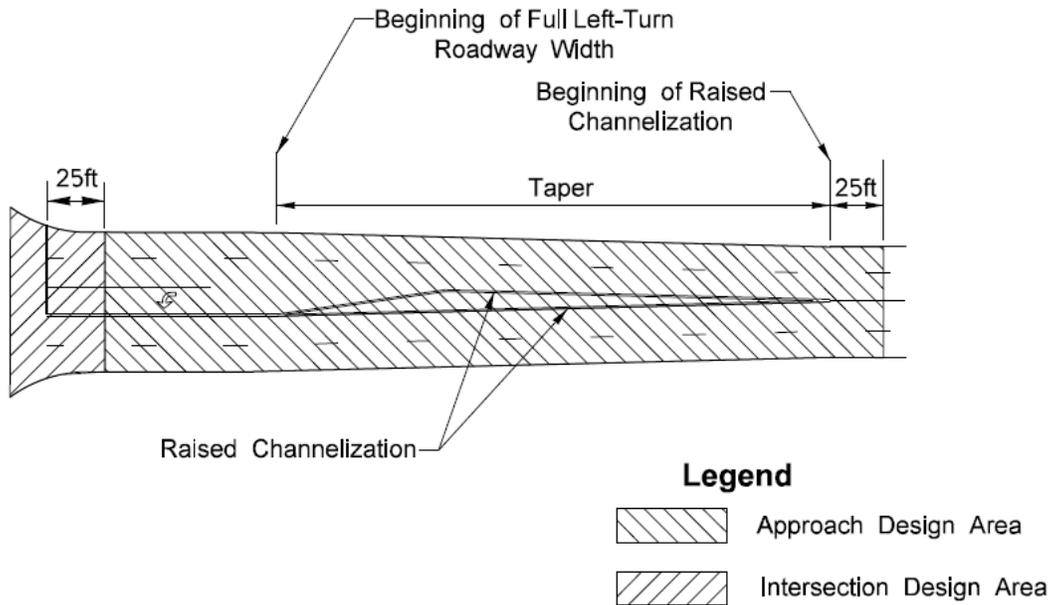


Exhibit 1040-8b Intersections With Left-Turn Channelization



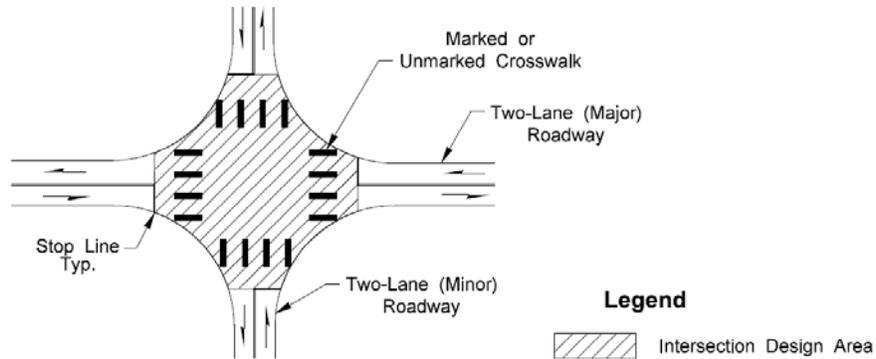
Intersection With Low-Profile Left-Turn Channelization Pavement Markings



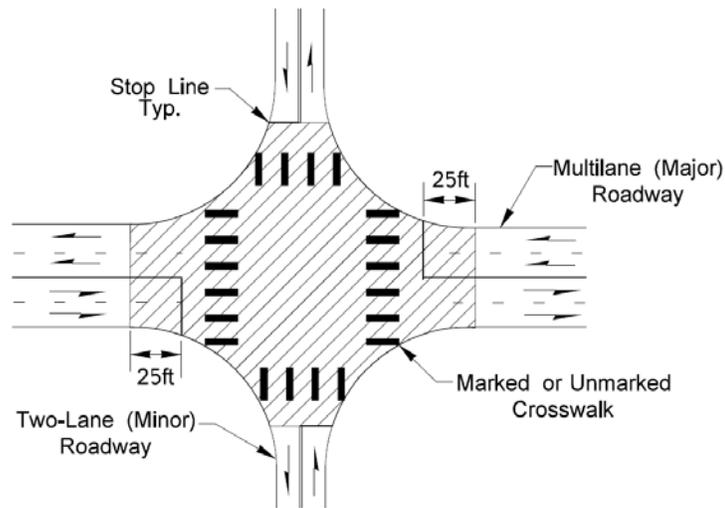
Intersection With Raised Left-Turn Channelization

Exhibit 1040-9 Vacant

Exhibit 1040-10 Intersections With Traffic Signals

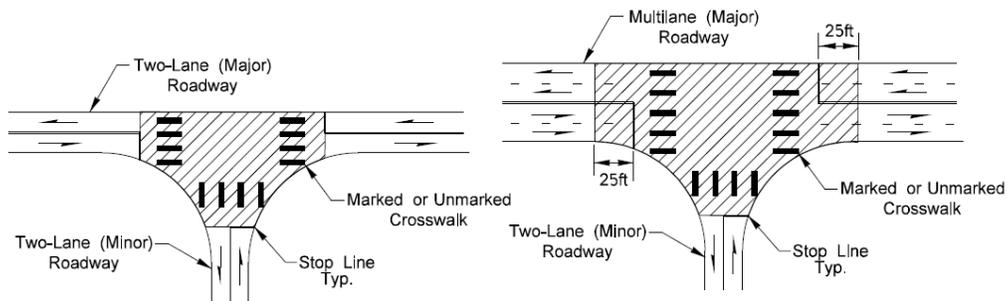


**Four-Way Intersection With Single-Lane Approaches**



**Four-Way Intersection With Multilane Major Approaches**

A minimum of two light standards required for design area.



**Minor Tee Intersection**

**Major Tee Intersection**

A minimum of two light standards is required for design area.

Exhibit 1040-11 Intersection Without Channelization

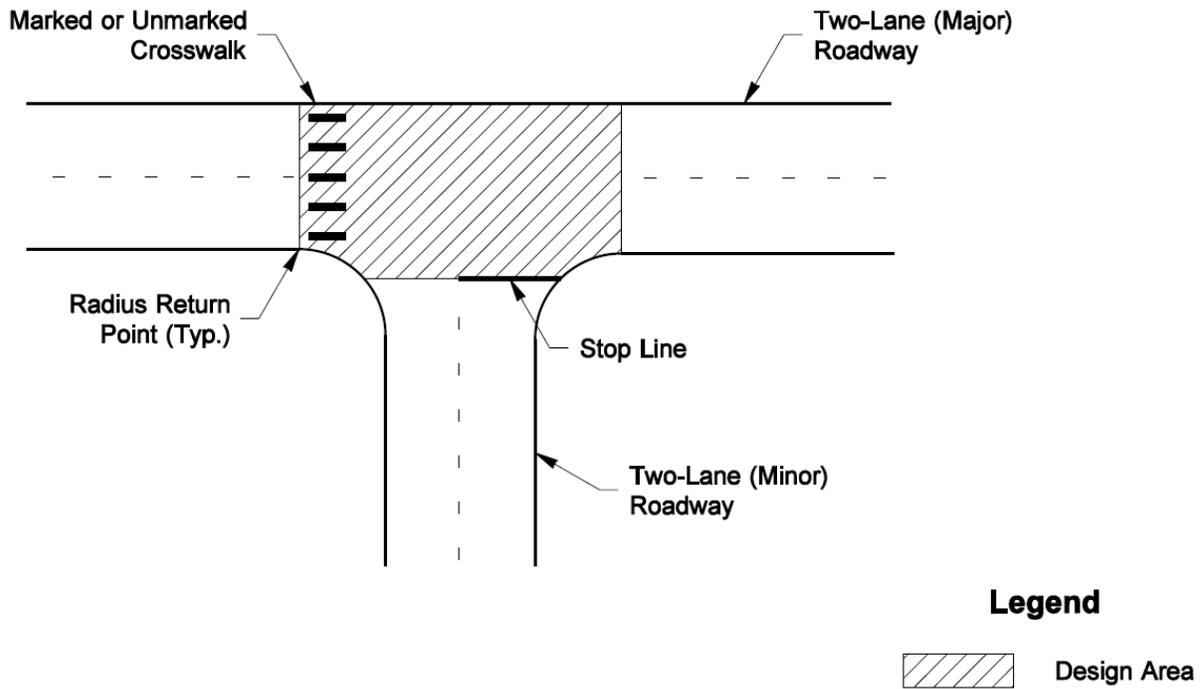
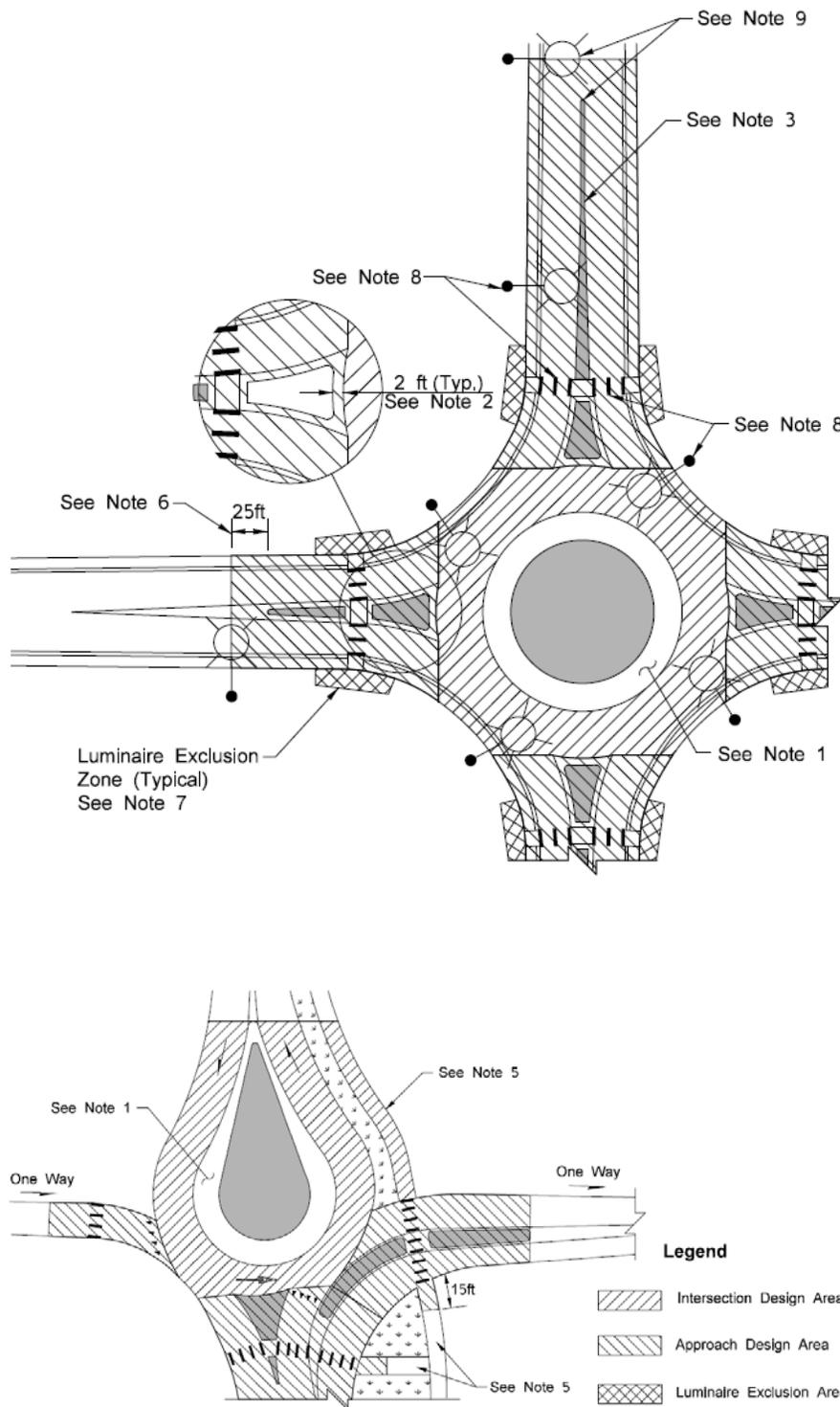


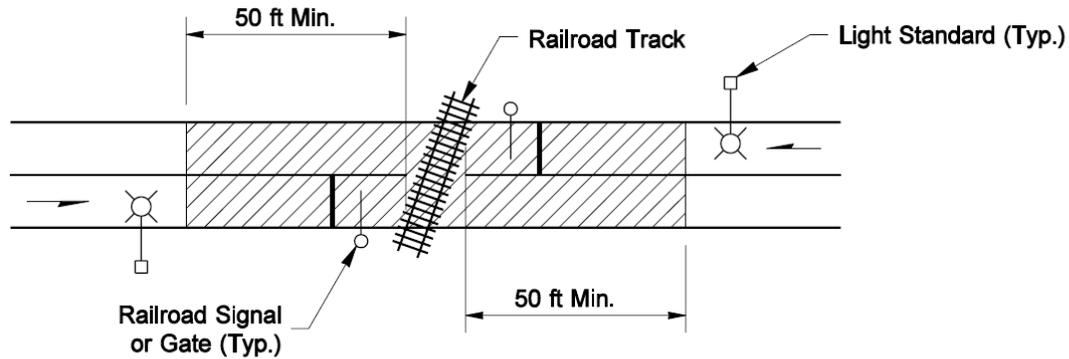
Exhibit 1040-12 Roundabout



**Notes**

1. Exclude Truck Apron from lighting calculations.
2. Exclude the portion inside the 2ft offset areas of the raised channelization islands from calculation.
3. All channelization 2ft wide or less is included in the Approach Design Area calculation.
4. When a leg of the roundabout is a one-way roadway, the Approach Design Area starts at the beginning of the raised channelization, or 50ft from the outside edge of the circulating roadway, or 50ft beyond a sidewalk, whichever is further.
5. A sidewalk is included in the Intersection Design Area calculation when a planting strip is less than 15ft wide.
6. Install luminaire to provide positive illumination of raised channelization. The preferred luminaire location would be from 20' to one mounting height's distance in front of the raised channelization.
7. Do not install luminaire in the area from 20' in front of the crosswalk to 20' past the crosswalk.
8. Install luminaire to provide positive illumination of the crosswalk for approaching vehicles. The preferred luminaire location would be one mounting height's distance in front of the crosswalk.
9. If approach intersection area requires more than one luminaire, the last luminaire on that approach chain can be replaced with a ground-mounted, internally illuminated bollard with sign in place of 2<sup>nd</sup> luminaire.

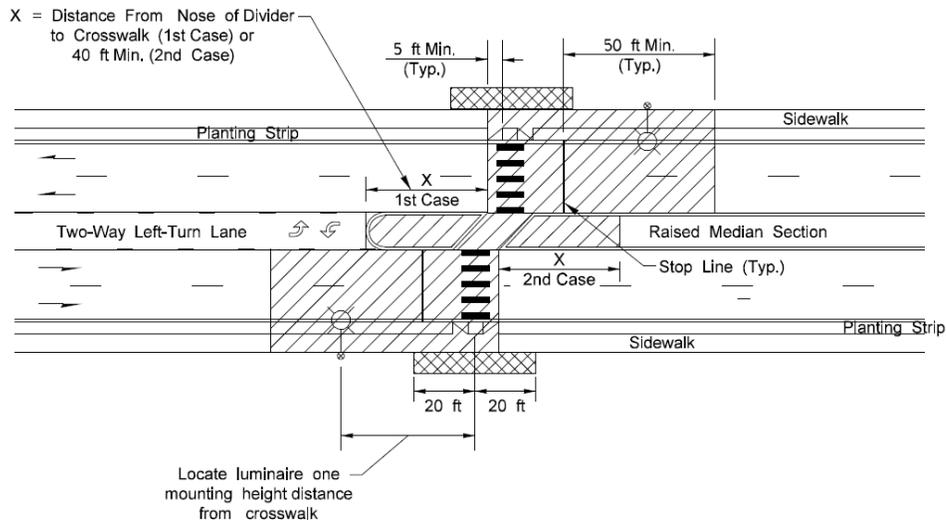
Exhibit 1040-13 Railroad Crossing With Gates or Signals



**Legend**

 Design Area

Exhibit 1040-14 Midblock Pedestrian Crossing



**Legend**

 Design Area  
 Luminaire Exclusion Zone

A minimum of two light standards of standard height is required for the design area.

Exhibit 1040-15 Transit Flyer Stop

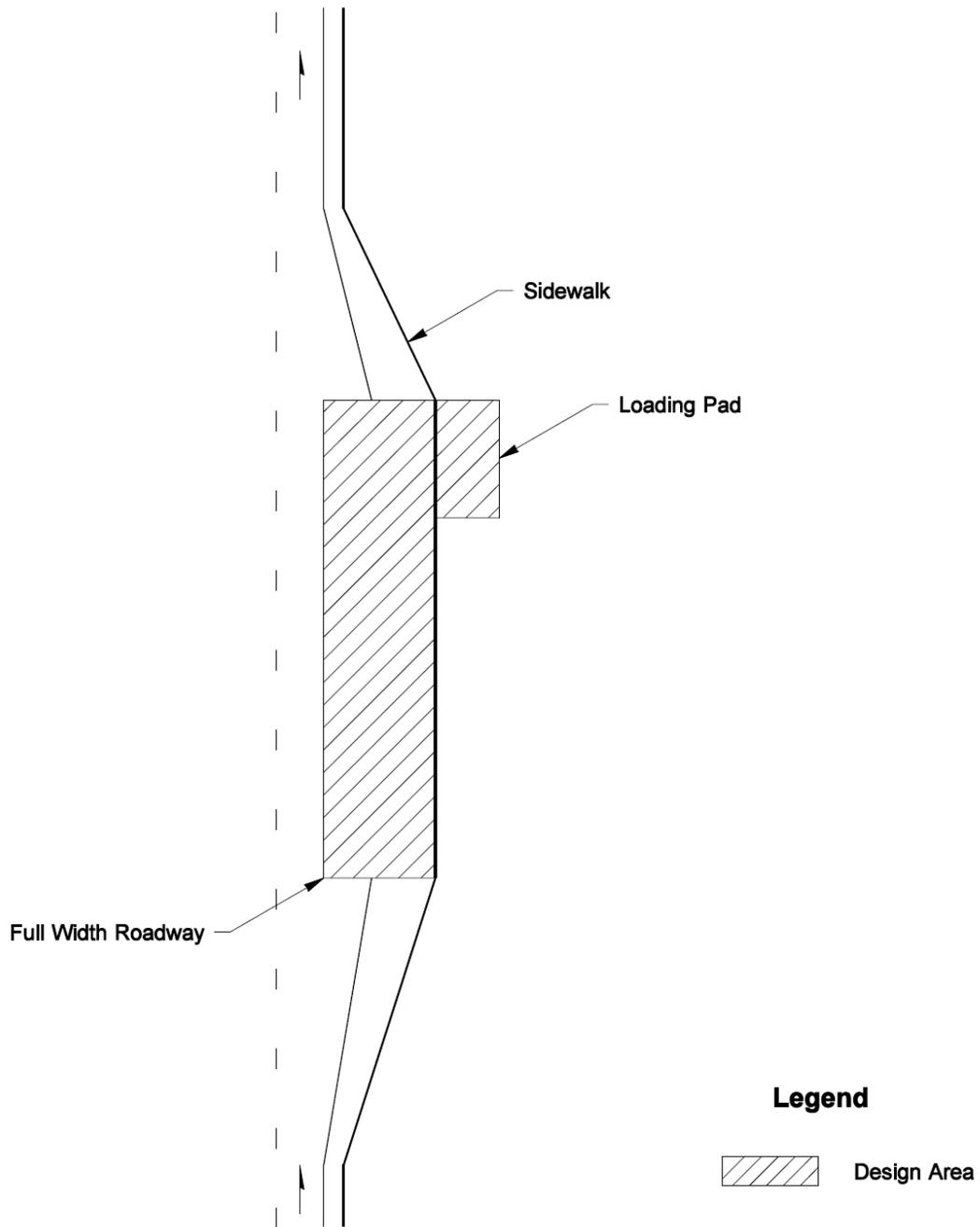


Exhibit 1040-16 Major Parking Lot

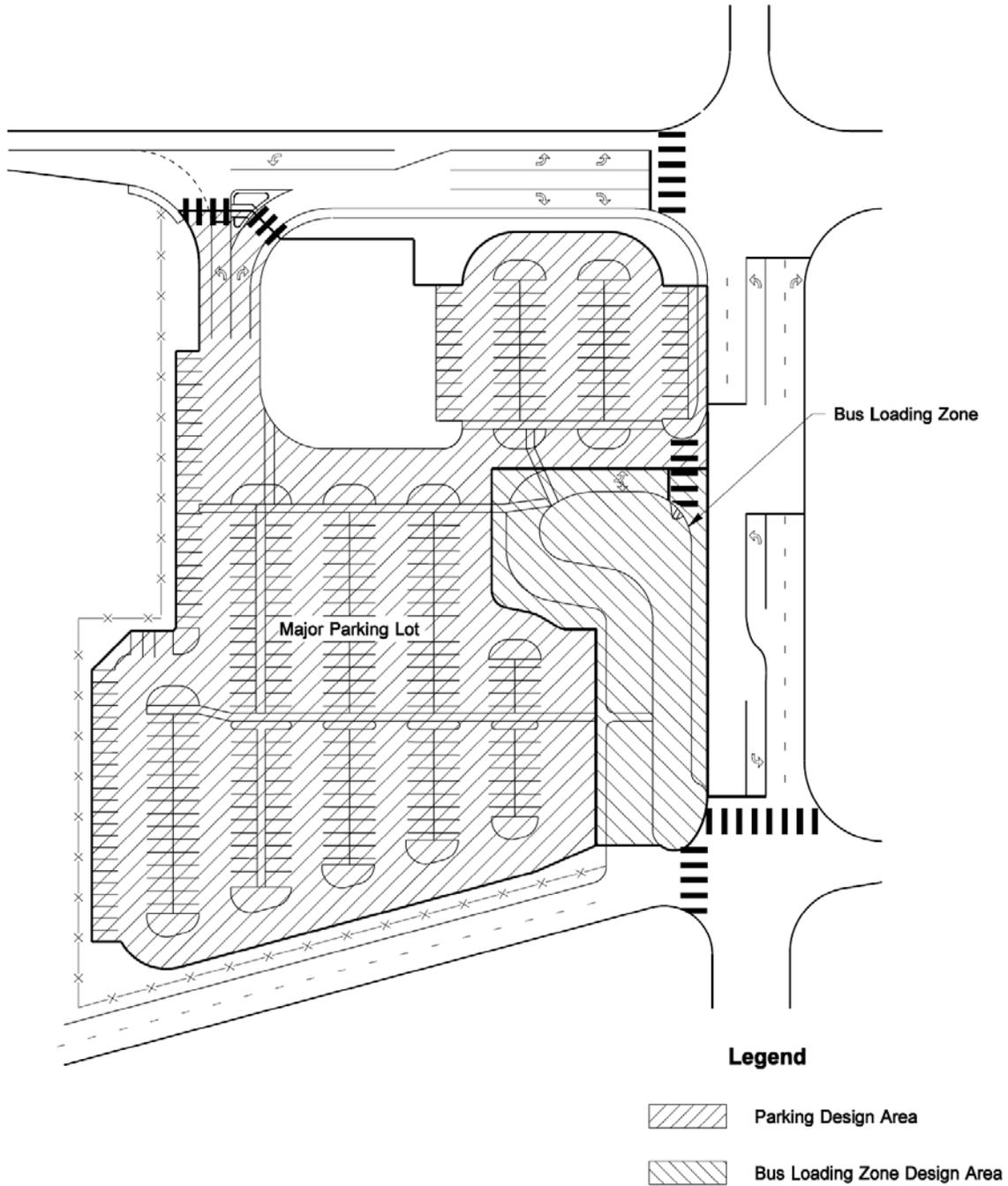


Exhibit 1040-17 Minor Parking Lot

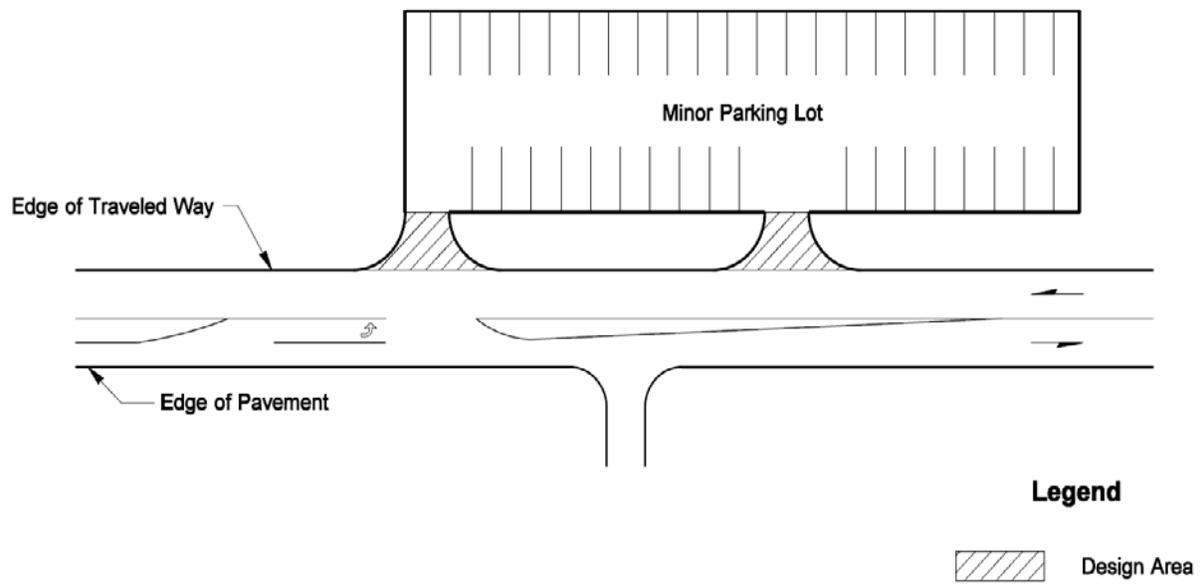


Exhibit 1040-18 Truck Weigh Site

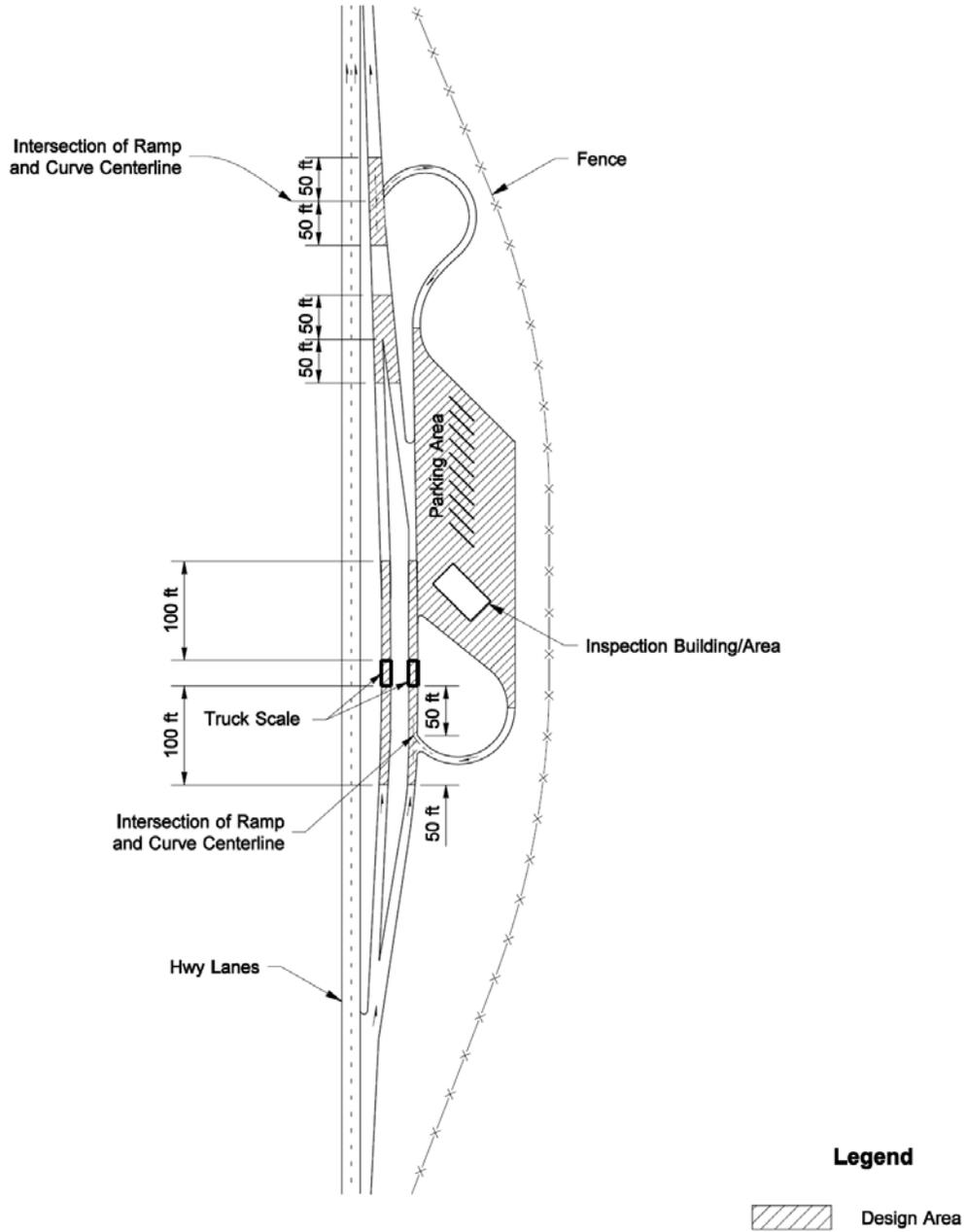
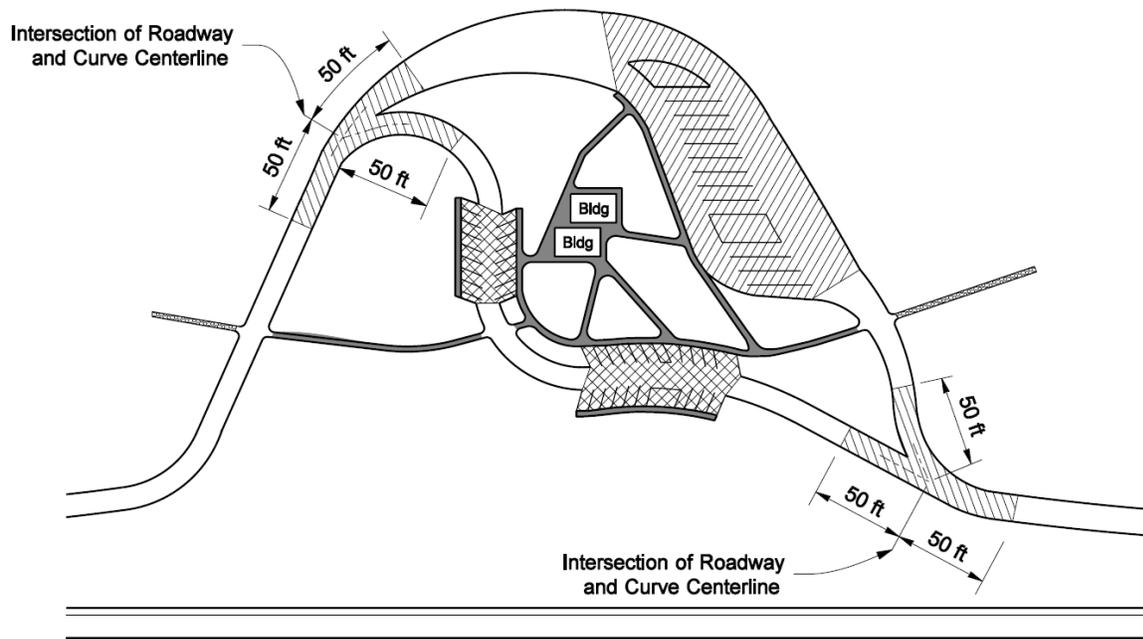


Exhibit 1040-19 Safety Rest Area



**Legend**

-  Diverge/Merge Design Area
-  Truck Parking Design Area
-  Passenger Vehicle Parking Design Area
-  Pedestrian Walkway Design Area
-  Walkway/Bicycle Trail

Exhibit 1040-20 Chain-Up/Chain-Off Parking Area

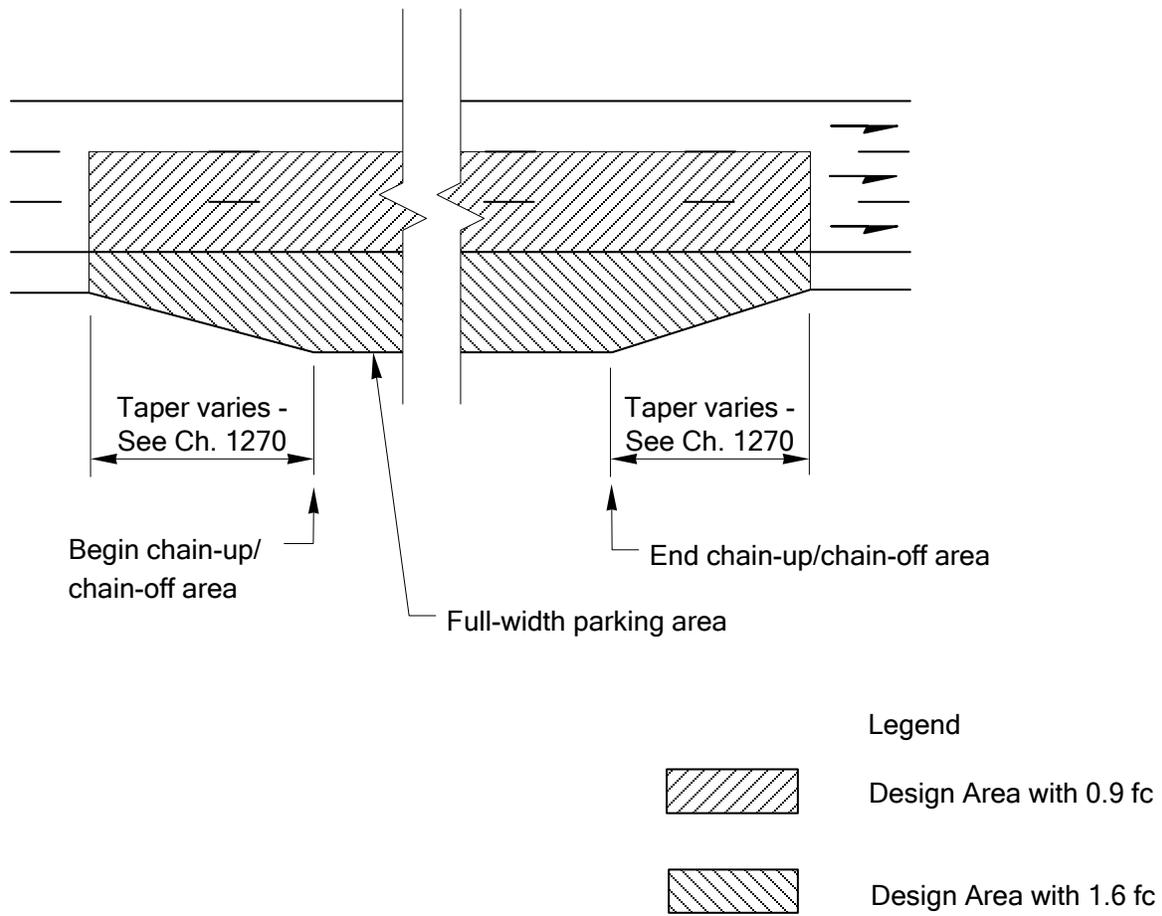
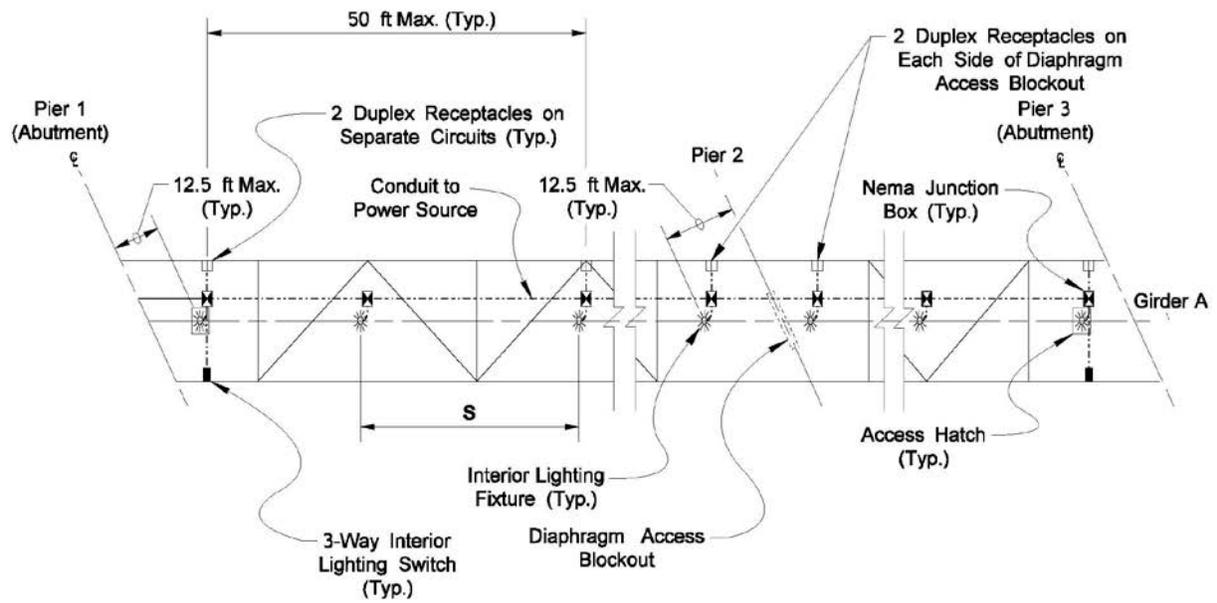


Exhibit 1040-21 Vacant

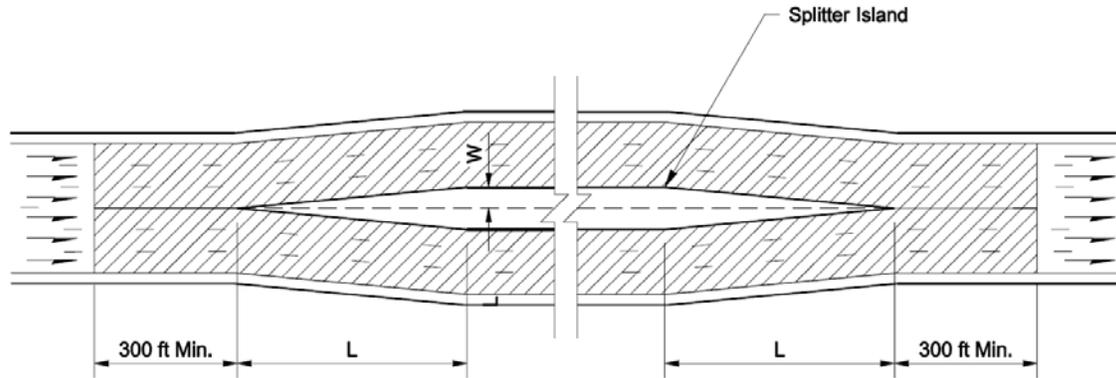
Exhibit 1040-22 Bridge Inspection Lighting System



**Maximum Lighting Fixture Spacing (S):**

**Steel Box Girder Bridge  $S = 4 \times (\text{WEB DEPTH}) \leq 25 \text{ FT}$**   
**Concrete Box Girder Bridge  $S = 8 \times (\text{WEB DEPTH}) \leq 50 \text{ FT}$**

Exhibit 1040-23 Traffic Split Around an Obstruction



**Legend**

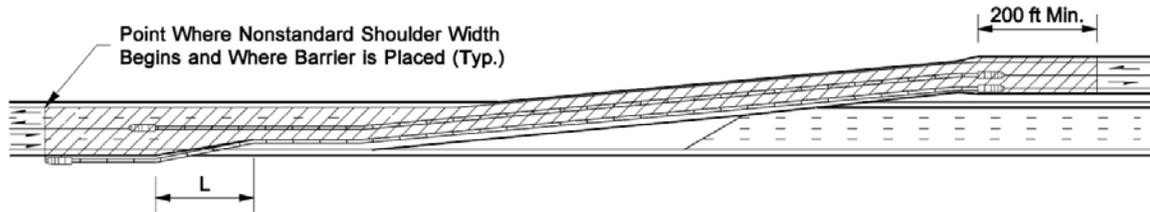
 Design Area

For speeds 45 mph or more:  $L = WS$   
 For speeds less than 45 mph:  $L = WS^2/60$   
 L = Taper in feet  
 W = Width of offset in feet  
 S = Posted speed

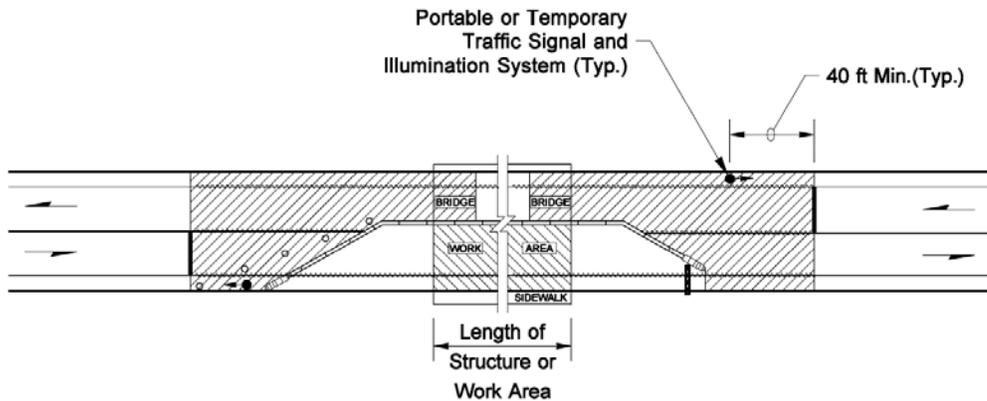
**Note:**

For temporary work zone plan applications, a site-specific traffic control plan is required. Refer to Chapters 1610 and 1620 for traffic barrier and attenuator information, Chapter 1010 for work zone information, and Chapter 1020 for signing information.

Exhibit 1040-24 Construction Work Zone and Detour



Detour Traffic



Legend

 Design Area

**Lane Closure With Barrier and Signals Without Flaggers or Spotters**

One-direction closure shown/other direction closure typical.

**Note:**

For temporary work zone plan applications, a site-specific traffic control plan is required. Refer to Chapters 1610 and 1620 for traffic barrier and attenuator information, Chapter 1010 for work zone information, and Chapter 1020 for signing information. Refer to the MUTCD Typical Application 12 for additional details.

Exhibit 1040-25 Light Levels and Uniformity Ratios

Light Level and Uniformity Ratio Chart					
Highway Design Class	Minimum Average Maintained Horizontal Light Level <sup>[2]</sup>			Maximum Uniformity Ratio <sup>[5]</sup>	Maximum Veiling Luminance Ratio <sup>[6]</sup>
	Pedestrian/Area Classification				
	High (footcandles)	Medium (footcandles)	Low (footcandles)		
<b>Highways With Full Access Control<sup>[1][8]</sup></b>					
Main Line	0.6	0.6	0.6	4:1	0.3:1
Ramps	0.6	0.6	0.6	4:1	0.3:1
Crossroads	0.6	0.6	0.6	<u>4</u> :1	0.3:1
Ramp Intersections	0.9	0.9	0.9	<u>4</u> :1	0.3:1
<b>Highways Without Full Access Control<sup>[3][8]</sup></b>					
Main Line	<u>1.2</u>	<u>0.9</u>	0.6	<u>4</u> :1	0.3:1
Intersections	<u>1.2</u>	<u>0.9</u>	0.9	<u>4</u> :1	0.3:1
<b>Other Illuminated Features</b>					
Construction Lanes and Detours	1.0	1.0	1.0	<u>4</u> :1	0.3:1
Major Parking Lots/Rest Areas	0.8	0.8	0.8	<u>4</u> :1	0.3:1
Vehicle Inspection Areas	2.0	2.0	2.0	<u>4</u> :1	0.3:1
Sidewalks, Walkways & Shared Use Paths	0.8	0.8	0.8	<u>4</u> :1	0.3:1
Weigh Scales	0.8	0.8	0.8	<u>4</u> :1	0.3:1
Transit Stops <sup>[4]</sup>	2.0	2.0	2.0	NA <sup>[7]</sup>	0.3:1
Midblock Ped X-ing	2.0	2.0	2.0	<u>4</u> :1	0.3:1

Notes:

- [1] The minimum light level is 0.2 footcandle (fc) for any application with a minimum average maintained horizontal light level of 0.6 fc. The minimum light levels for all other applications are controlled by the uniformity ratio.
- [2] Light level and uniformity ratio apply only when installation of more than one light standard is justified.
- [3] Light levels shown also apply to modified and partial limited access control.
- [4] For single light standard installations, provide the light level at the location where the bus stops for riders (see 1040.06(6)).
- [5] Minimum Average Maintained Light Level/Minimum Light Level = Maximum Uniformity Ratio.
- [6] Maximum Veiling Luminance/Average Luminance = Maximum Veiling Luminance Ratio.
- [7] The Maximum Uniformity Ratio is 4:1 when more than one light standard is justified.
- [8] Roundabout illumination shall meet intersection lighting requirements for the associated roadway classification.

- 1050.01 General
- 1050.02 References
- 1050.03 Systems Engineering
- 1050.04 FHWA Washington Division ITS Project Contracting Guidance
- 1050.05 Documentation

## 1050.01 General

Intelligent Transportation Systems (ITS) have the potential to reduce crashes and increase mobility of transportation facilities. They also enhance productivity through the use of advanced communications technologies and their integration into vehicles and the transportation infrastructure. These systems involve a broad range of wireless and wire line communications-based information, electronics, or information processing technologies. Some of these technologies include cameras, variable message signs, ramp meters, road weather information systems, highway advisory radios, traffic management centers, and adaptive signal control technology (ASCT). ASCT is a traffic signal system that detects traffic conditions and adjusts signal timing remotely in response. More information on ASCT can be found at:

 [www.fhwa.dot.gov/everydaycounts/technology/adsc](http://www.fhwa.dot.gov/everydaycounts/technology/adsc)

The purpose and direction of ITS for the Washington State Department of Transportation (WSDOT) can be found in the Statewide Intelligent Transportation Systems Plan, which is available upon request from the Headquarters (HQ) Traffic Operations Office. The plan identifies the current and long-term ITS needs to meet the objectives identified in Moving Washington, WSDOT's program to fight traffic congestion.

The Statewide ITS Plan is a comprehensive document that discusses:

- The history of ITS deployment in Washington.
- How ITS meets WSDOT's transportation vision and goals.
- The current state of ITS deployment.
- WSDOT's near-term ITS plans.
- How projects are prioritized.
- What long-term ITS issues WSDOT needs to begin planning for.

Due to the dynamic nature of ITS, printed guidance is soon outdated. Detailed design guidance and current practices are located on the following websites. For additional information and direction, contact the region Traffic Engineer or the HQ Traffic Operations Office:

 [www.wsdot.wa.gov/design/traffic/](http://www.wsdot.wa.gov/design/traffic/)

## 1050.02 References

23 Code of Federal Regulations (CFR), Part 940, Intelligent Transportation System Architecture and Standards

<http://www.ecfr.gov>

USDOT, *Systems Engineering for Intelligent Transportation Systems*, FHWA-HOP-07 069, January 2007

<http://ops.fhwa.dot.gov/publications/seitsguide/index.htm>

USDOT/CalTrans, *Systems Engineering Guidebook for Intelligent Transportation Systems*, Version 3, November 2009

<http://www.fhwa.dot.gov/cadiv/segb/>

USDOT, *Model Systems Engineering Documents for Adaptive Signal Control Technology (ASCT) Systems*, FHWA HOP-11-027, August 2012

<http://www.ops.fhwa.dot.gov/publications/fhwahop11027/index.htm>

*Manual on Uniform Traffic Control Devices for Streets and Highways*, USDOT, FHWA; as adopted and modified by [Chapter 468-95 WAC](#) “Manual on uniform traffic control devices for streets and highways” (MUTCD)

[www.wsdot.wa.gov/publications/manuals/mutcd.htm](http://www.wsdot.wa.gov/publications/manuals/mutcd.htm)

SAFETEA-LU (Safe Accountable Flexible Efficient Transportation Equity Act: A Legacy for Users)

<http://www.fhwa.dot.gov/safetealu/index.htm>

MAP-21 (Moving Ahead for Progress in the 21st Century Act)

<http://www.fhwa.dot.gov/map21/>

WSDOT Northwest Region Traffic Design

<http://www.wsdot.wa.gov/northwest/trafficdesign>

WSDOT Traffic Design

<http://www.wsdot.wa.gov/design/traffic/>

## 1050.03 Systems Engineering

Systems engineering is a typical part of any ITS project development process. It is required on any federal-aid project that has an ITS work element, per [23 CFR 940.11](#). Systems engineering is an interdisciplinary step-by-step process for complex projects (such as ITS projects) to:

- Assess a system’s needs and its relationship to the regional architecture.
- Plan a project that meets those needs as well as stakeholder needs and expectations.
- Define other specific requirements for the project/system.
- Develop and implement the project/system.
- Define the operations and maintenance requirements for the system.
- Plan for the refinement or replacement of the system.

Using systems engineering on ITS projects has been shown to increase the likelihood of a project’s success. A successful project is one that meets the project scope and stakeholder/project sponsor expectations, is completed on time and within budget, and is efficient and cost-effective to operate and maintain.

The level of systems engineering used for a project should be on a scale commensurate with the scope, cost, and risk of the project. Complete the Intelligent Transportation Systems (ITS) Systems Engineering Analysis Worksheet in [Exhibit 1050-2](#), or a document with the same information, for all federal-aid projects that include ITS elements. Completing the Worksheet will meet the minimum requirements in [23 CFR 940.11](#) for systems engineering, determine the project's risk, and determine if a more in-depth systems engineering analysis is required. The Worksheet and the four systems engineering documents outlined below are to be completed with coordination between the project engineer and region Traffic Engineer.

As shown in the Worksheet, a more in-depth analysis requires that the following four documents be completed and used to implement the project. These documents are produced as the result of the steps in the systems engineering process.

1. **Concept of Operations:** This document defines the problem, the project's goals, stakeholder needs and expectations, constraints, and the way the ITS system is required to operate and be maintained.
2. **System Requirements:** This document contains specifications of what the system is required to do, how well it is required to do it, and under what conditions. These requirements are based on the goals, stakeholder needs and expectations, constraints, and operation and maintenance requirements documented in the Concept of Operations.
3. **System Verification Plan:** This document describes how the agency will verify that the system being built meets the requirements in the System Requirements document. The agency will implement the System Verification Plan to ensure all system requirements are verified before it accepts the system.
4. **System Validation Plan:** This document describes how the agency will assess the system's performance against the goals, stakeholder needs and expectations, constraints, and operation and maintenance requirements documented in the Concept of Operations. The goal is for the agency to understand and review the strengths and weaknesses of the system and identify any new opportunities and needs if appropriate. The agency will implement the System Validation Plan after it accepts the system. This evaluation sets the stage for the next time the system/project is changed or expanded.

For specific guidance on developing the four systems engineering plans listed above, see the plan templates in the USDOT/CalTrans document, [Systems Engineering Guidebook for Intelligent Transportation Systems](#), Version 3, November 2009. Pertinent page numbers include:

- Concept of Operations Template: Page 254
- System Requirements Template: Page 257
- Verification Documents Plan Template: Page 269
- Validation Documents Plan Template: Page 278

For Adaptive Signal Control Technology Projects (ASCT) using the latest edition of the USDOT [Model Systems Engineering Documents for Adaptive Signal Control Technology \(ASCT\) Systems](#), FHWA-HOP-11-027, August 2012, is required.

As each phase of an ITS project is completed, a report is to be submitted by the Project Engineer to the region Traffic Engineer describing how the project is meeting the requirements outlined in the above systems engineering plans. Approvals for ITS projects are dependent upon project complexity and cost. (See Chapter 300 for ITS project approval requirements.)

Systems engineering costs are to be estimated and incorporated into the construction engineering (CE) and project engineering (PE) portions of the construction estimate.

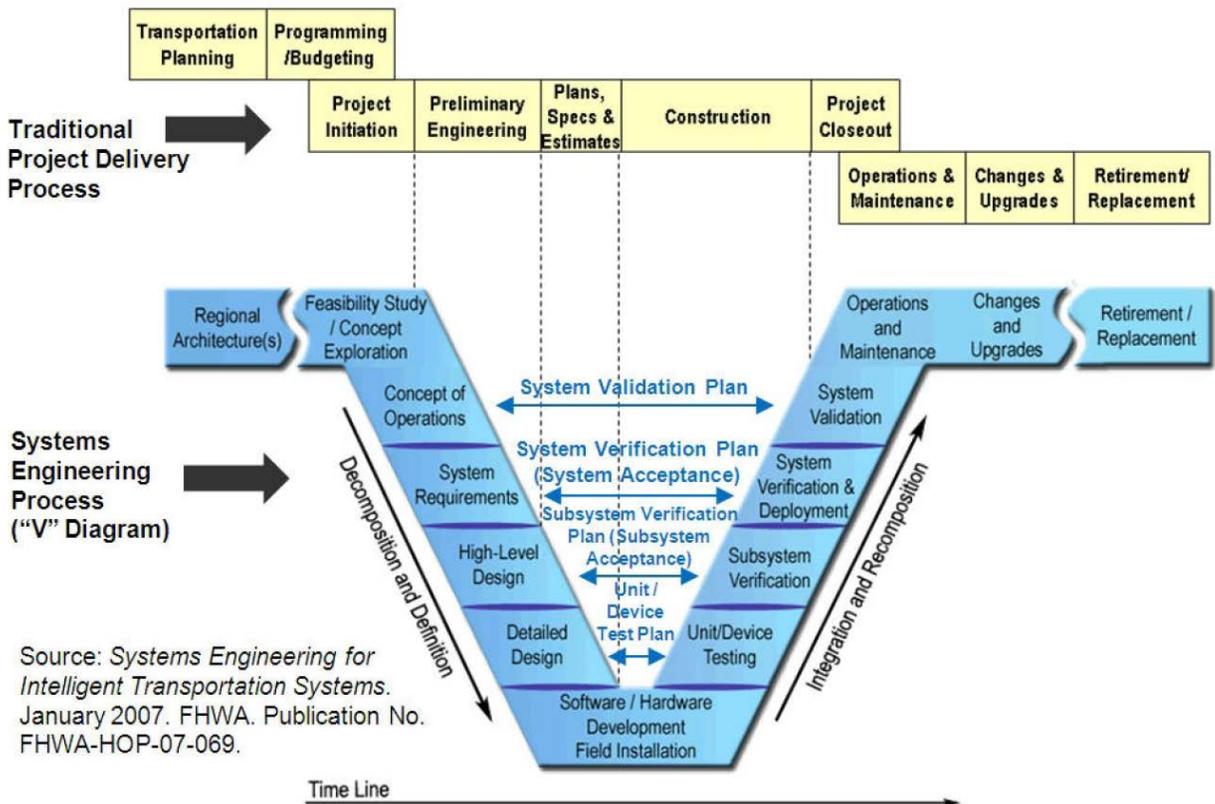
For further project development guidance related to procurement and administration of Federal-Aid Intelligent Transportation System (ITS) contracts, see 1050.04.

**1050.03(1) Systems Engineering Process “V” Diagram**

The systems engineering process contains a number of steps that are not included in a traditional project delivery process. The systems engineering process is often referred to as the “V” diagram (see Exhibit 1050-1). An ITS project begins on the left side of the “V” and progresses down the left side and then up the right side. Then the project is evaluated by validating and verifying the elements on the right side of the “V” with the elements on the left side.

The Federal Highway Administration (FHWA) and WSDOT are in agreement that, for project development and delivery, the most critical portions of the systems engineering process are the Concept of Operations; System Requirements; System Verification; and System Validation. As a result, the Intelligent Transportation Systems (ITS) Systems Engineering Analysis Worksheet in Exhibit 1050-2 is focused on these core areas.

Exhibit 1050-1 Systems Engineering Process “V” Diagram



Source: *Systems Engineering for Intelligent Transportation Systems*. January 2007. FHWA. Publication No. FHWA-HOP-07-069.

## 1050.04 FHWA Washington Division ITS Project Contracting Guidance

### 1050.04(1) Purpose

The purpose of this document is to provide basic guidance related to the procurement and administration of Federal-Aid ITS contracts.

### 1050.04(2) Scope

This document is intended to be used by the FHWA Washington Division Office, WSDOT, and local agencies as a guide on the proper types of procurement methods for various types of ITS projects. This guidance is not all-encompassing, as ITS projects can vary significantly in scope. However, it should provide adequate information to address a majority of situations. Specific questions about an individual ITS project should be directed to the Washington Division Office.

### 1050.04(3) Construction versus Non-Construction

ITS improvements may be incorporated as part of a traditional federal-aid construction contract, or the contracting agency may elect to procure ITS services under a separate contract (i.e., stand-alone ITS projects). When procured as a separate contract, the scope of an ITS contract will determine the applicability of federal procurement requirements. [Title 23 United States Code 101\(a\)\(4\)](#) provides a broad definition for construction for federal-aid eligibility purposes. FHWA generally interprets the definition broadly, resulting in many types of projects being classified as construction. Very simply, a contract that incurs costs incidental to the construction or reconstruction of a highway, including improvements that directly facilitate and control traffic flow (e.g., traffic control systems) are by definition construction contracts. This includes rehabilitation of an existing physical ITS infrastructure. Construction contracts must follow the regulatory requirements of [23 CFR 635](#) or [23 CFR 636](#) in the case of Design-Build.

Non-construction-type ITS contracts will be either Engineering Contracts or Service Contracts. Engineering is defined as professional services of an engineering nature as defined by state law. If the ITS contract primarily involves engineering, then qualifications-based selection (QBS) procedures, in compliance with the Brooks Act, must be followed. Service contracts (non-construction, non-engineering in nature) are to be procured in accordance with the Common Rule for Grants and Cooperative Agreements to States and Local Governments found at [49 CFR 18.36](#).

### 1050.04(4) Types of ITS Projects

Stand-alone ITS projects can generally be categorized into one of the following types of ITS projects: (1) planning/research, (2) preliminary engineering/project development, (3) software development/system integration, (4) system deployments, (5) traditional construction, and (6) operations and maintenance. All Federal-Aid ITS projects, regardless of the type, are directed in [23 CFR 940](#) to follow a systems engineering process.

[Exhibit 1050-3](#) provides further information about each of these ITS project types.

## 1050.05 Documentation

Include all ITS systems engineering documentation in the Design Documentation Package (DDP). All systems engineering documentation requires region Traffic Engineer approval.

## Exhibit 1050-2 Intelligent Transportation Systems (ITS) Systems Engineering Analysis Worksheet

**Intelligent Transportation Systems  
Systems Engineering Analysis Worksheet**

This worksheet, or a document with the same information, must be completed for all federal-aid projects that include Intelligent Transportation Systems (ITS) elements. This worksheet must be completed prior to submitting a construction authorization request and must be kept in the project file for the entire document retention period of the project. If Concept of Operations, System Requirements, Verification Plan, and Validation Plan documents are required for the project, as determined by this spreadsheet, these documents must be submitted for review prior to submitting a construction authorization request and must be kept in the project file for the entire document retention period.

1. **Project Name:** Click here to enter text.
  
2. **Contract Number:** Click here to enter text.
  
3. **Total project cost (includes preliminary engineering/design, right of way, and construction phases):** Click here to enter text.
  
4. **Amount of total project cost for ITS elements:** Click here to enter text.
  
5. Will this project implement a new or expand an existing adaptive signal control technology (ASCT) system?
  - Yes FHWA and WSDOT consider the project to be high risk. Four additional systems engineering documents (Concept of Operations, System Requirements, Verification Plan, and Validation Plan) are required. (See definitions in [1050.03 Systems Engineering](#).) These documents must be produced using the latest edition of the USDOT [Model Systems Engineering Documents for Adaptive Signal Control Technology \(ASCT\) Systems](#), FHWA-HOP-11-027, August 2012. *Please skip questions 6 and 7.*
  - No

## Exhibit 1050-2 Intelligent Transportation Systems (ITS) Systems Engineering Analysis Worksheet (continued)

6. Select which of the following items, if any, apply to this project:

- The project includes new and unproven hardware and/or communications technology that is considered “cutting edge” or not in common use. This could include custom-developed or unproven commercial-off-the-shelf (COTS) technology that has not been used by the agency previously. *Please explain why you selected or did not select this item.*

Click here to enter text.

- The project will add new software that will be custom developed for this project or will make major modifications to existing custom-developed software. *Please explain why you selected or did not select this item.*

Click here to enter text.

- The project will add new interfaces to systems operated or maintained by other agencies. *Please explain why you selected or did not select this item.*

Click here to enter text.

- The project will develop new system requirements or require revisions to existing system requirements that are not well understood within the agency and/or well documented at this time. These system requirements will be included in a request for proposal, or plans, specifications, and estimate bid document package. Therefore, it will require significant stakeholder involvement and/or technical expertise to develop these items during the project delivery process. *Please explain why you selected or did not select this item.*

Click here to enter text.

- Multiple agencies will be responsible for one or more aspects of the project design, construction, deployment, and/or the ongoing operations and maintenance of the system. *Please explain why you selected or did not select this item.*

Click here to enter text.

Exhibit 1050-2 Intelligent Transportation Systems (ITS) Systems Engineering Analysis Worksheet (continued)

7. If you answered yes to any of the items in question 6, FHWA and WSDOT consider the project to be high risk. See the following table for additional requirements.

Project Risk Level	Total Project Cost for ITS Elements	
	Less than \$1,000,000 <sup>[3]</sup>	Equal or Greater than \$1,000,000 <sup>[3]</sup>
High-Risk ITS	Additional systems engineering documents (Concept of Operations, System Requirements, Verification Plan, and Validation Plan) <sup>[2]</sup> are recommended. <sup>[1]</sup>	Additional systems engineering documents (Concept of Operations, System Requirements, Verification Plan, and Validation Plan) <sup>[2]</sup> are required.

**Notes:**

- [1] A decision not to complete the additional systems engineering documents for high-risk projects that have less than \$1,000,000 of ITS elements requires FHWA concurrence prior to submitting a construction authorization request.
- [2] See definitions in 1050.03, Systems Engineering.
- [3] Use the amount from question 4.

8. What is the name of the regional ITS architecture and which portions of the architecture will be implemented? Is the project consistent with the architecture? Are revisions to the architecture required? Also, which user services, physical subsystem elements, information flows, and market/service packages will be completed, and how will these pieces be part of the architecture?

[Click here to enter text.](#)

9. Identify the participating agencies, their roles and responsibilities, and the concept of operations. For the elements and market/service packages to be implemented, define the high-level operations of the system. This includes where the system will be used, its performance parameters, its life cycle, and who will operate and maintain it. Discuss the established requirements or agreements on information sharing and traffic device control responsibilities. The regional ITS architecture operational concept is a good starting point for discussion.

If this is a high-risk project and a more extensive Concept of Operations document is being prepared for this project (see question 7), this answer can be a simple reference to that document.

[Click here to enter text.](#)

## Exhibit 1050-2 Intelligent Transportation Systems (ITS) Systems Engineering Analysis Worksheet (continued)

10. Define the system requirements. Based on the concept of operations, define the “what” and not the “how” of the system. Define the detailed requirements for eventual detailed design. The applicable high-level functional requirements from the regional architecture are a good starting point for discussion. A review of the requirements by the project stakeholders is recommended.

If this is a high-risk project, and a more extensive System Requirements document is being prepared for this project (see question 7), this answer can be a simple reference to that document.

[Click here to enter text.](#)

11. Provide an analysis of alternative system configurations and technology options to meet requirements. This analysis should outline the strengths and weaknesses, technical feasibility, institutional compatibility, and life cycle costs of each alternative. The project stakeholders should have had input in choosing the preferred solution.

[Click here to enter text.](#)

12. Identify procurement/contracting options. Since there are different procurement methods for different types of projects, the decision regarding the best procurement option should consider the level of agency participation, compatibility with existing procurement methods, the role of the system integrator, and life cycle costs. Some options to consider include: consultant design/low-bid contractor, systems manager, systems integrator, task order, and design/build.

If the ITS portions of the project significantly meet the definition of construction, then construction by low-bid contract would be used. Non-construction ITS portions of the project, such as services for software development, systems integration, systems deployment, systems management, or design, will be either engineering or service contracts. In these cases, a qualifications-based selection (QBS) or best value procurement may be more appropriate. For guidance on procurement options for ASCT systems, refer to Pages 15-20 of USDOT’s *Model Systems Engineering Documents for Adaptive Signal Control Technology (ASCT) Systems*, FHWA-HOP-11-027, August 2012.

[Click here to enter text.](#)

## Exhibit 1050-2 Intelligent Transportation Systems (ITS) Systems Engineering Analysis Worksheet (continued)

13. Identify the applicable ITS standards and testing procedures. Include documentation on which standards will be incorporated into the system design. Also, include justification for any applicable standards not incorporated. The standards discussion in the regional architecture is a good starting point for discussion.

[Click here to enter text.](#)

14. Outline the procedures and resources necessary for operations and management of the system. In addition to the concept of operations, document any internal policies or procedures necessary to recognize and incorporate the new system into the current operations and decision-making processes. Also, resources necessary to support continued operations, including staffing and training, must be recognized early and be provided for. Such resources must also be provided to support necessary maintenance and upkeep to ensure continued system viability.

[Click here to enter text.](#)

Exhibit 1050-3 FHWA Washington Division – ITS Project Contracting Guidance

ITS Project Type	Description	Examples
Planning/Research	Generally, involves studies that research new concepts or develop plans or procedures at a broader agency- or region-wide level. These are generally not construction and are often done by agency personnel.	<ul style="list-style-type: none"> <li>• Regional ITS architecture development and maintenance</li> <li>• Regional Concept of Operation</li> <li>• Traffic incident management planning</li> <li>• Standards testing and specification development</li> <li>• Public outreach and communication</li> </ul>
Preliminary Engineering/Project Development	Generally, a project, or phase of a larger project, that leads to some type of ITS deployment/construction. Typically involve some type of service or engineering contact, or work done by agency personnel, and are generally not considered construction.	<ul style="list-style-type: none"> <li>• Scoping/field surveys</li> <li>• Project-level Concept of Operation</li> <li>• Environmental Review</li> <li>• Development of RFPs</li> <li>• Development of PS&amp;Es</li> <li>• Evaluation of technology, networking, systems architecture alternatives</li> </ul>
Software Development/System Integration	Generally, involves projects that develop new or upgraded ITS-related software or involve integrating ITS services and equipment. These are typically not construction and often fall under a service contract.	<ul style="list-style-type: none"> <li>• Traffic Management Center (TMC) central software design, development, installation</li> <li>• Modifying existing central system software to communicate with new field equipment</li> <li>• Incorporation of device control software into central systems</li> <li>• Acceptance testing and configuration management</li> </ul>
System Deployments	Generally, includes total system implementation involving design, equipment, computer systems, telecommunications, and integration. Contracts are often non-construction in nature, depending on the amount and type of field work relative to the overall project. These types of projects will often be the least cut-and-dried in terms of the appropriate contracting method.	<ul style="list-style-type: none"> <li>• Road-weather information systems (RWIS)</li> <li>• Surveillance camera procurement and installation on existing poles (non-construction when limited in scope)</li> <li>• Non-intrusive sensor procurement and installation on existing poles (non-construction when limited in scope)</li> <li>• Adaptive Signal Control Systems</li> </ul>
Traditional Construction	Typical construction projects involving considerable installation of equipment or work in the field. Design-Bid-Build (low bid) or Design-Build contracting are appropriate for this type of work.	<ul style="list-style-type: none"> <li>• Installation of variable message signs</li> <li>• Installation of poles, controller cabinets, foundations, guardrail, gantries</li> <li>• Installation of radio towers and civil infrastructure for wireless systems</li> <li>• Installation of tolling field equipment (tag readers, video cameras, etc.)</li> <li>• Installation of underground infrastructure (trenching, cable installation, etc.)</li> </ul>
Operations/Maintenance	Ongoing operations and/or maintenance of ITS services, software, and equipment. Typically is a service contract (non-construction).	<ul style="list-style-type: none"> <li>• Operating costs for traffic monitoring, management, control systems (e.g., rent, communications, labor, utilities)</li> <li>• Preventative maintenance</li> </ul>





Washington State  
Department of Transportation

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# Design Manual

## Volume 2 – Design Criteria

M 22-01.11

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Division 12 – Geometrics

Division 13 – Intersections and Interchanges

Division 14 – HOV and Transit

Division 15 – Pedestrian and Bicycle Facilities

Division 16 – Roadside Safety Elements

Division 17 – Roadside Facilities

**Engineering and Regional Operations**

Development Division, Design Office

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## 1100.01 General

The *Design Manual* provides guidance for three levels of design for highway projects: basic, modified, and full design levels. The design matrices in this chapter are used to identify the design level(s) for a project and the associated processes for allowing design variances. The matrices address the majority of Preservation and Improvement projects and focus on those design elements that are of greatest concern in project development.

The design matrices are five tables that are identified by route type. Two of the matrices apply to Interstate highways; the other three apply to non-Interstate highways.

A design matrix is used to determine the design level for the design elements of a project. Apply the appropriate design levels and document the design decisions as required by this chapter and [Chapter 300](#).

## 1100.02 Selecting a Design Matrix

Selection of a design matrix (see [Exhibit 1100-1](#)) is based on highway system (Interstate, NHS excluding Interstate, and non-NHS) and location (main line and interchange).

**Exhibit 1100-1** Design Matrix Selection Guide

Highway System	Location	
	Main Line	Interchange Area
Interstate	Matrix 1	Matrix 2
NHS*	Matrix 3	Matrix 4
Non-NHS	Matrix 5	Matrix 4
* Except Interstate.		

### 1100.02(1) Interstate System

The Interstate System (Matrices 1 and 2) is a network of routes selected by the state and the FHWA under terms of the federal-aid acts. These routes are the principal arterials that are the most important to the economic welfare and defense of the United States. They connect, as directly as practicable, the following:

- Principal metropolitan areas and cities
- Industrial centers
- International border crossings

The Interstate System includes important routes into, through, and around urban areas; serves the national defense; and (where possible) connects with routes of continental importance. It also serves international and interstate travel.

The Interstate System is represented on the list of NHS highways with the letter “I” before the route number (see [www.wsdot.wa.gov/mapsdata/tdgo\\_home.htm](http://www.wsdot.wa.gov/mapsdata/tdgo_home.htm)).

### **1100.02(2) National Highway System (NHS)**

The National Highway System (Matrices 3 and 4) is an interconnected system of principal arterial routes and highways that serves the following:

- Major population centers
- International border crossings
- Industrial centers
- Ports
- Airports
- Public transportation facilities
- Other intermodal transportation facilities
- Other major travel destinations

The NHS includes the Interstate System and the Strategic Highway Corridor Network (STRAHNET) and its highway connectors to major military installations (Interstate and non-Interstate).

The NHS meets national defense requirements and serves international, interstate, and interregional travel (see [www.wsdot.wa.gov/mapsdata/tdgo\\_home.htm](http://www.wsdot.wa.gov/mapsdata/tdgo_home.htm)).

### **1100.02(3) Non-NHS Highways**

The non-NHS highways (Matrices 4 and 5) are state routes that form a highway network that supplements the NHS system by providing for freight mobility and regional and interregional travel. Highways not included on the list of NHS routes are non-NHS highways.

## **1100.03 Using a Design Matrix**

The design matrices and associated notes are shown in Exhibits [1100-2](#) through [1100-7](#). Follow *Design Manual* guidance for all projects except as noted in the design matrices (and elsewhere as applicable). The definitions presented in this chapter are meant to provide clarification of terminology used in the *Design Manual*. There is no assurance that these terms are used consistently in references outside the *Design Manual*.

### **1100.03(1) Project Type**

For project types (such as unstable slopes) not listed in the design matrices, see [300.04](#) and consult the Headquarters (HQ) Design Office for guidance.

In the design matrices, row selection is based on Project Type. The Project Summary (see [Chapter 300](#)) defines the purpose and needs for the project and describes the project.

For NHS and non-NHS routes (Matrices 3, 4, and 5), the project’s program/subprogram might provide sufficient information to identify the Project Type.

The various sources of funds for these subprograms carry eligibility requirements that the designers and project developers must identify and monitor throughout project development.

This is especially important to ensure accuracy when writing agreements and to avoid delaying advertisement for bids if the Project Type changes.

Some projects involve work from several subprograms. In such cases, identify the various limits of the project that apply to each subprogram. Where the project limits overlap, apply the higher design level to the overlapping portion.

**Project Types** (in alphabetical order) are:

**At Grade:** Safety Improvement projects on NHS and non-NHS highways (45 mph or higher) to build grade-separation facilities that replace the existing intersections.

**Bike Routes (Shldr):** Main line economic development Improvement projects to provide a statewide network of rural bicycle touring routes with shoulders a minimum of 4 feet wide.

**Bike/Ped. Connectivity:** Improvement projects to provide bicycle/pedestrian connections, along or across state highways within urban growth areas, to complete local networks.

**Bridge Deck Rehab:** Structures Preservation projects that repair delaminated bridge decks and add protective overlays to provide a sound, smooth surface, prevent further corrosion of the reinforcing steel, and preserve operational and structural integrity.

**Bridge Rail Upgrades:** Safety Improvement projects to update older bridge rails to improve strength and redirection capabilities.

**Bridge Repl. (Multilane):** Non-NHS main line structures Preservation projects that replace bridges on multilane highways to improve operational and structural capacity.

**Bridge Replacement:** NHS and two-lane non-NHS (main line and interchange) structures Preservation projects that replace bridges to improve operational and structural capacity.

**Bridge Restrictions:** Main line economic development Improvement projects that remove vertical or load capacity restrictions to benefit the movement of commerce.

**BST:** Roadway Preservation projects that resurface highways at regular intervals.

**Collision Analysis Locations (CALs), Collision Analysis Corridors (CACs), Intersection Analysis Locations (IALs):** Sites identified through a system-wide analysis that have a high-severity collision history. These sites are created with the intent to modify, where appropriate, specific highway elements that are focused on addressing the contributing factors of the identified high-severity collisions. (See WSDOT's [Risk Management](http://wwwi.wsdot.wa.gov/riskmanagement/shs/) website for additional information: [http://wwwi.wsdot.wa.gov/riskmanagement/shs/.](http://wwwi.wsdot.wa.gov/riskmanagement/shs/))

**Corridor:** Main line Improvement projects to reduce and prevent vehicular, nonmotorized, and pedestrian collisions (within available resources).

**Diamond Grinding:** Grinding a concrete pavement, using gang-mounted diamond saw blades, to remove surface wear or joint faulting.

**Dowel Bar Retrofit:** Reestablishing the load transfer efficiencies of the existing concrete joints and transverse cracks by cutting slots, placing epoxy-coated dowel bars, and placing high-early strength nonshrink concrete.

**Four-Lane Trunk System:** NHS economic development Improvement projects to complete contiguous four-lane limited access facilities on a trunk system consisting of all Freight and Goods Transportation Routes (FGTS) with a classification of 10,000,000 tons/year.

**Freight & Goods (Frost Free):** Main line economic development Improvement projects to reduce delay from weather-related closures on high-priority freight and goods highways.

**Guardrail Upgrades:** Safety Improvement projects limited to the specified roadside design elements. These projects focus on W-beam with 12-foot-6-inch spacing and on guardrail systems with concrete posts. The length of need is examined and minor adjustments are made. Removal is an option if guardrail is no longer needed. For non-Interstate routes, additional length of more than 5% of the existing length is beyond the intent of this program. In these instances, consider funding in accordance with priority programming instructions and, if the length of need is not met, document to the Design Documentation Package (DDP) that the length of need is not addressed because it is beyond the intent of this program.

**HMA Overlays:** An HMA pavement overlay that is placed to minimize the aging effects and minor surface irregularities of the existing HMA pavement structure and to protect the public investment.

**HOV/HOT:** Main line mobility Improvement projects completing the freeway Core HOV lane system in the Puget Sound region and providing level of service C on HOV lanes (including business access transit lanes) within congested highway corridors. For Interstate see New/Reconstruction.

**HOV Bypass:** NHS and non-NHS ramp mobility Improvement projects to improve mobility within congested highway corridors by providing HOV bypass lanes on freeway ramps. Congested highway corridors have high congestion index values as described in the Highway System Plan (footnote in text for Improvement/Mobility). For Interstate see New/Reconstruction.

**Intersection:** Within available resources, Safety Improvement projects to reduce and prevent collisions, increase the safety of highways, and improve pedestrian safety.

**Median Barrier:** Limited safety Improvement projects: mainly new median barrier, with a focus on cable barrier, to reduce median crossover collisions.

**Milling with HMA Inlays:** Removing a specified thickness of the existing HMA pavement, typically from the traveled lanes, and then filling with HMA.

**New/Reconstruction projects** include the following types of work:

- Capacity changes: add a through lane, convert a general-purpose (GP) lane to a special-purpose lane (such as an HOV or HOT lane), or convert a high-occupancy vehicle (HOV) lane to GP.
- Other lane changes: add or eliminate a collector-distributor or auxiliary lane (a rural truck-climbing lane that, for its entire length, meets the warrants in [Chapter 1270](#) is not considered new/reconstruction).
- New interchange.
- Changes in interchange type such as diamond to directional or adding a ramp.
- New or replacement bridge (on or over, main line or interchange ramp).
- New Safety Rest Areas Interstate.

**Non-Interstate Freeway (mobility):** On non-NHS and NHS interchanges and on NHS main line, these are mobility Improvement projects on multilane divided highways with limited access control within congested highway corridors.

**Non-Interstate Freeway (safety):** NHS and non-NHS (main line and interchanges) safety Improvement projects on multilane divided highways with limited access control to increase the safety within available resources.

**PCCP Single Lane Rehab:** Rehabilitation projects that removes a contiguous single lane of PCCP and replaces with PCCP in excess of ½ mile. Short sections of PCCP rehab should be considered preventative maintenance.

**Preventive Maintenance:** Includes roadway work such as pavement patching, crack sealing, restoration of drainage system, panel replacement, and joint and shoulder repair, and bridge work such as crack sealing, joint repair, slope stabilization, seismic retrofit, scour countermeasures, and painting. Preventive maintenance projects must not degrade any existing safety or geometric aspects of the facility. Any elements that will be reconstructed as part of a preventive maintenance project are to be addressed in accordance with full design level for NHS Routes and modified design level for non-NHS Routes.

**Replace HMA w/PCCP at I/S (intersections):** NHS and non-NHS main line roadway Preservation projects that restore existing safety features and replace existing HMA intersection pavement that has reached the point of lowest life cycle cost (11–15 years old) with PCCP that has about a 40-year life cycle.

**Rest Areas (New):** NHS and non-NHS main line economic development and safety Improvement projects to provide rest areas every 60 miles and some RV dump stations. For Interstate see New/Reconstruction.

**Rural:** Mobility Improvement projects providing uncongested level of service on rural highways within congested highway corridors. Congested highway corridors have high congestion index values as described in the Highway System Plan.

**Urban:** NHS and two-lane non-NHS (main line and interchange) mobility Improvement projects within congested urban highway corridors. Congested highway corridors have high congestion index values as described in the Highway System Plan.

**Urban (multilane):** Non-NHS mobility Improvement projects within congested urban multilane highway corridors. Congested highway corridors have high congestion index values as described in the Highway System Plan.

### 1100.03(2) *Design Elements*

The column headings on a design matrix are **Design Elements**. Not all potential design elements have been included in the matrices.

The design elements that are included are based on the following thirteen Federal Highway Administration (FHWA) controlling design criteria: design speed, lane width, shoulder width, bridge width, structural capacity, horizontal alignment, vertical alignment, grade, stopping sight distance, cross slope, superelevation, vertical clearance, and horizontal clearance. For the column headings, some of these controlling criteria have been combined (for example, design speed is part of horizontal and vertical alignment).

If addressing a design element that is not on the assigned matrix, use full design level as found elsewhere in this manual. With justification, on non-NHS routes, modified design level may be used.

If including a design element that is not covered in this manual, use an approved manual or guidance on the subject and document the decision and the basis for the decision.

The following elements are shown on the design matrices with references to chapters on those topics.

**Horizontal Alignment:** The horizontal attributes of the roadway, including horizontal curvature, superelevation, and stopping sight distance: all based on design speed. (See [Chapter 1210](#) for horizontal alignment, [Chapter 1250](#) for superelevation, [Chapter 1260](#) for stopping sight distance, and Chapters [1130](#), [1140](#), or [1360](#) for design speed.)

**Vertical Alignment:** The vertical attributes of the roadway, including vertical curvature, profile grades, and stopping sight distance: all based on design speed. (See [Chapter 1220](#) for vertical alignment, Chapters [1130](#), [1140](#), [1220](#), and [1360](#) for grades, Chapters [1130](#) and [1260](#) for stopping sight distance, and Chapters [1130](#), [1140](#), or [1360](#) for design speed.)

**Lane Width:** Defined in [Chapter 1140](#) (also see Chapters [1130](#), [1240](#), and [1360](#)).

**Shoulder Width:** Defined in [Chapter 1140](#) (also see Chapters [1130](#), and [1360](#)). For shy distance requirements when barrier is present, see [Chapter 1610](#).

**Lane Transitions (pavement transitions):** The rate and length of transition of changes in width of lanes (see Chapters [1210](#) and [1310](#)).

**On/Off Connection:** The widened portion of pavement at the end of a ramp connecting to a main lane of a freeway (see [Chapter 1360](#)).

**Median Width:** The distance between inside edge lines (see Chapters [1130](#), [1140](#), and [1230](#)).

**Cross Slope: Lane:** The rate of elevation change across a lane. This element includes the algebraic difference in cross slope between adjacent lanes (see Chapters [1130](#) and [1230](#)).

**Cross Slope: Shoulder:** The rate of elevation change across a shoulder (see Chapters [1130](#) and [1230](#)).

**Fill/Ditch Slopes:** The downward slope from edge of shoulder to bottom of ditch or catch (see Chapters [1130](#) and [1230](#)).

**Access:** The means of entering or leaving a public road, street, or highway with respect to abutting private property or another public road, street, or highway (see Chapters [520](#) and [1340](#)).

**Clear Zone:** The total roadside border area, starting at the edge of the traveled way, available for use by errant vehicles. This area may consist of a shoulder, a recoverable slope, a nonrecoverable slope, and/or a clear run-out area. The median is part of a clear zone (see [Chapter 1600](#)).

**Signing, Delineation, Illumination, ITS:** Signs, guideposts, pavement markings, lighting, and intelligent transportation systems equipment. (See Chapters [720](#) for bridge signs and [1020](#) for signing, [Chapter 1030](#) for delineation, [Chapter 1040](#) for illumination, and [Chapter 1050](#) for ITS.)

**Vertical Clearance:** Defined in [Chapter 720](#).

**Bicycle and Pedestrian:** Defined in [Chapter 1510](#), [Pedestrian Facilities](#), [Chapter 1515](#), [Shared-Use Paths](#), and [Chapter 1520](#), [Roadway Bicycle Facilities](#).

**Bridges: Lane Width:** The width of a lane on a structure (see [Chapters 720, 1130, 1140, 1240, and 1360](#)).

**Bridges: Shoulder Width:** The distance between the edge of traveled way and the face of curb or barrier, whichever is less (see [Chapters 720, 1130, 1140, and 1360](#); also see [Chapter 1610](#) for shy distance requirements).

**Bridges/Roadway: Vertical Clearance:** The minimum height between the roadway, including shoulder, and an overhead obstruction (see [Chapter 720](#)).

**Bridges: Structural Capacity:** The load-bearing ability of a structure (see [Chapter 720](#)).

**Intersections/Ramp Terminals: Turn Radii:** Defined in [Chapter 1310](#).

**Intersections/Ramp Terminals: Angle:** Defined in [Chapters 1130 and 1310](#).

**Intersections/Ramp Terminals: Intersection Sight Distance:** Defined in [Chapter 1310](#), [Intersections at Grade](#), and [Chapter 1320](#), [Roundabouts](#).

**Barriers: Terminals and Transition Sections:**

- Terminals: Crashworthy end treatments for longitudinal barriers that are designed to reduce the potential for spearing, vaulting, rolling, or excessive deceleration of impacting vehicles from either direction of travel. Impact attenuators are considered terminals. Beam guardrail terminals include anchorage.
- Transition Sections: Sections of barriers used to produce a gradual stiffening of a flexible or semirigid barrier as it connects to a more rigid barrier or fixed object (see [Chapters 1600, 1610, and 1620](#)).

**Barriers: Standard Run:** Guardrail and other barriers as shown in the [Standard Plans for Road, Bridge, and Municipal Construction](#), excluding terminals, transitions, attenuators, and bridge rails (see [Chapter 1610](#)).

**Barriers: Bridge Rail:** Barrier on a bridge, excluding transitions (see [Chapter 1610](#)).

### 1100.03(3) *Design Level*

The design levels of basic, modified, and full (B, M, and F) were used to develop the design matrices. Each design level is based on the investment intended for the highway system and Project Type. (For example, the investment is greater for an Interstate overlay than for an overlay on a non-NHS route.)

#### 1100.03(3)(a) **Blank Cell**

A blank cell in a design matrix row signifies that the design element will not be addressed because it is beyond the scope of the typical project. In rare instances, a design element with a blank cell may be included if that element is linked to the original need that generated the project and is identified in the Project Summary or a Change [Management Form](#).

**1100.03(3)(b) Basic Design Level (B)**

Basic design level preserves pavement structures, extends pavement service life, and maintains safe highway operations. (See [Chapter 1120](#) for design guidance.)

**1100.03(3)(c) Modified Design Level (M)**

Modified design level preserves and improves existing roadway geometrics, safety, and operational elements. (See [Chapter 1130](#) for design guidance.) Use full design level for design elements or portions of design elements that are not covered in [Chapter 1130](#).

**1100.03(3)(d) Full Design Level (F)**

Full design level improves roadway geometrics, safety, and operational elements. (See [Chapter 1140](#) and other applicable *Design Manual* chapters, including [1150](#), for design guidance.)

**1100.03(4) Safety Improvement Projects**

In an effort to provide the greatest safety benefit with limited funding, it is WSDOT policy to focus highway safety project modifications on improvements that have the greatest potential to reduce severe or fatal injuries. The intent of this policy is to:

- Address the elements that are associated with severe-injury collision.
- Consider a range of solutions that include minor operational modifications, lower-cost improvements such as channelization, and higher-cost improvements such as, roundabouts, signalization, and widening.
- Recognize the substantial tradeoffs that must be made with the numerous competing needs and costs a highway designer faces in project development.
- Because these projects are developed on a “substantive safety” basis, a matrix approach is not the most efficient method of scoping them. (See [Chapter 321, Sustainable Safety](#).)

**1100.03(5) Design Variances**

Types of design variances are design exceptions, evaluate upgrades, and deviations. (See [Chapter 300](#) regarding the Design Variance Inventory System (DVIS).)

**1100.03(5)(a) Design Exception (DE)**

A design exception in a matrix cell indicates that WSDOT has determined the design element is usually outside the scope of the Project Type. Therefore, an existing condition that does not meet or exceed the design level specified in the matrix may remain in place unless a need has been identified in the Highway System Plan and prioritized in accordance with the programming process. (See [Chapter 300](#) regarding documentation.) Design exception provisions may also be found throughout the *Design Manual*.

### 1100.03(5)(b) Evaluate Upgrade (EU)

An evaluate upgrade in a matrix cell indicates that WSDOT has determined the design element is an item of work that is to be considered for inclusion in the project. For an existing element that does not meet or exceed the specified design level, an analysis is required to determine the impacts and cost-effectiveness of including the element in the project. The EU analysis must support the decision regarding whether or not to upgrade that element. (See [Chapter 300](#) regarding documentation.) Evaluate upgrade provisions may also be found throughout the [Design Manual](#).

### 1100.03(5)(c) Deviation

A deviation is required when an existing or proposed design element differs from the specified design level for the project and neither DE nor EU processing is indicated. (See [Chapter 300](#) regarding documentation.)

### 1100.03(5)(d) DE or EU with /F or /M

DE or EU with /F or /M in a cell means that the design element is to be analyzed with respect to the specified design level. For instance, a DE/F is analyzed with respect to full design level and might be recorded as having an existing design element that does not meet or exceed current full design level. An EU/M is analyzed to decide whether or not to upgrade any existing design element that does not meet or exceed the current modified design level.

### 1100.03(6) Terminology in Notes

The **Access Control Tracking System** mentioned in note [3] in Design Matrices 3, 4, and 5 is a database list related to highway route numbers and mileposts. The database is available at: [www.wsdot.wa.gov/design/accessandhearings](http://www.wsdot.wa.gov/design/accessandhearings). (See [Chapter 520](#) for access control basics and [Chapters 530](#) and [540](#) for limited and managed access, respectively.)

The **corridor or project analysis** mentioned in notes [2] and [4] in Design Matrices 3, 4, and 5 is the documentation needed to support a change in design level from the indicated design level and to support decisions to include, exclude, or modify design elements. The first step is to check for recommendations for future improvements in an approved route development plan or other approved study. If no approved plans or studies are available, an analysis can be based on route continuity and other existing features. (See [Chapter 300](#) regarding documentation.) A project analysis is also used for multiple related design variances. Check with the HQ Design Office before using this approach. A corridor analysis is also used to establish design speed, as discussed in [Chapters 1130](#) and [1140](#).

*See the following pages for Design Matrices 1–5.*

Exhibit 1100-2 Design Matrix 1: Interstate Routes (Main Line)

↓ Project Type	Main Line															Bridges			Barriers			
	Horizontal Alignment	Vertical Alignment	Lane Width	Shoulder Width [13]	On / Off Connection	Median Width	Cross Slope Lane	Cross Slope Shoulder	Fill / Ditch Slopes	Clear Zone	Signing [10]	Delineation [9]	Illumination & ITS	Vertical Clear. [11]	Bike and Pedestrian	Lane Width	Shoulder Width	Structural Capacity	Term. & Trans. Section [12]	Standard Run	Bridge Rail [14] [19]	
(1-1) Preventative Maintenance																						
<b>Pavement Restoration</b>																						
(1-2) Diamond Grinding/Dowel Bar Retrofit												B										
(1-3) BST												B										
(1-4) Milling with HMA Inlays							B					B										
(1-5) HMA Overlays							B	B	[29]			B		F					B	B		
(1-6) PCCP Single Lane Rehab							B	B	[29]			B		EU/F								
<b>Bridge Rehabilitation</b>																						
(1-7) Bridge Deck Rehabilitation												F		F				[11]				
<b>Safety</b>																						
(1-8) Median Barrier																			F <sup>[20]</sup>	F <sup>[20]</sup>		
(1-9) Bridge Rail Upgrades																			F	F <sup>[22]</sup>	F	
(1-10) CAL/CAC/IAL	Design Elements determined based on identified Counter Measures [27]																					
<b>Reconstruction<sup>[16]</sup></b>																						
(1-11) New / Reconstruction	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F



Exhibit 1100-4 Design Matrix 3: Main Line NHS Routes (Except Interstate)

↓ Project Type	Main Line														Bridges <sup>[11]</sup>				Intersections			Barriers				
	Horizontal Alignment	Vertical Alignment	Lane Width	Shoulder Width	Lane Transition	On / Off Connection	Median Width	Cross Slope Lane	Cross Slope Shoulder	Fill / Ditch Slopes	Access <sup>[3]</sup>	Clear Zone <sup>[18]</sup>	Sign., Del., Illum., & ITS	Basic Safety	Bike & Ped.	Lane Width	Shoulder Width	Vertical Clearance	Structural Capacity	Turn Radii	Angle	I/S Sight Distance	Term. & Trans. Section <sup>[12]</sup>	Standard Run	Bridge Rail <sup>[14] [19]</sup>	
(3-1) Preventative Maintenance																										
<b>Preservation</b>																										
<b>Roadway</b>																										
(3-2) BST													[15]													
(3-3) Milling With HMA Inlays								B					[15]		M											
(3-4) HMA Overlays								B	B				[15]		M			EU/F						B	B	
(3-5) Replace HMA w/PCCP at I/S			EU/M	EU/M	EU/F			EU/M	EU/M				[15]		M			F		EU/F	EU/F					
<b>Structures</b>																										
(3-6) Bridge Replacement	F <sup>[2]</sup>	F <sup>[2]</sup>	F <sup>[2]</sup>	F <sup>[2]</sup>	F	F <sup>[2]</sup>	F <sup>[2]</sup>	F <sup>[2]</sup>	F <sup>[2]</sup>	F <sup>[2]</sup>		F	F		F	F <sup>[2]</sup>	F <sup>[2]</sup>	F	F	F <sup>[2]</sup>	F <sup>[2]</sup>	F	F	F	F	F
(3-7) Bridge Deck Rehab.													[15]		M			F	[11]							
<b>Improvements<sup>[16]</sup></b>																										
<b>Mobility</b>																										
(3-8) Non-Interstate Freeway	F	F	F	F	F	F	F	F	F	F	F	F	F		F	F	F	F	F	F	F	F	F	F	F	F
(3-9) Urban	F <sup>[2]</sup>	F <sup>[2]</sup>	F <sup>[2]</sup>	F <sup>[2]</sup>	F	F <sup>[2]</sup>	F <sup>[2]</sup>	F <sup>[2]</sup>	F <sup>[2]</sup>	F <sup>[2]</sup>	F	F	F		F	F <sup>[2]</sup>	F <sup>[2]</sup>	F	F	F <sup>[2]</sup>	F <sup>[2]</sup>	F	F	F	F	F
(3-10) Rural	F <sup>[2]</sup>	F <sup>[2]</sup>	F <sup>[2]</sup>	F <sup>[2]</sup>	F	F <sup>[2]</sup>	F <sup>[2]</sup>	F <sup>[2]</sup>	F <sup>[2]</sup>	F <sup>[2]</sup>	F	F	F		F	F <sup>[2]</sup>	F <sup>[2]</sup>	F	F	F <sup>[2]</sup>	F <sup>[2]</sup>	F	F	F	F	F
(3-11) HOV	F <sup>[2]</sup>	F <sup>[2]</sup>	F <sup>[2]</sup>	F <sup>[2]</sup>	F	F <sup>[2]</sup>	F <sup>[2]</sup>	F <sup>[2]</sup>	F <sup>[2]</sup>	F <sup>[2]</sup>	F	F	F		F	F <sup>[2]</sup>	F <sup>[2]</sup>	F	F	F <sup>[2]</sup>	F <sup>[2]</sup>	F	F	F	F	F
(3-12) Bike/Ped. Connectivity <sup>[5]</sup>			F <sup>[2]</sup>	F <sup>[2]</sup>											F	F <sup>[2]</sup>	F <sup>[2]</sup>									
<b>Safety</b>																										
(3-13) Non-Interstate Freeway	F	F	F	F	F	F	F	F	F	F	F	F	F		F	F	F	F		F	F	F	F	F	F	F
(3-14) Intersection <sup>[1]</sup>			F <sup>[2]</sup>	F <sup>[2]</sup>	F					F <sup>[2]</sup>	F	F	F		M					F	F	F	F	F	F	F
(3-15) Corridor <sup>[1] [24]</sup>	M <sup>[4]</sup>	M <sup>[4]</sup>	M <sup>[4]</sup>	M <sup>[4]</sup>	F	F <sup>[17]</sup>	M <sup>[4]</sup>	M <sup>[4]</sup>	M <sup>[4]</sup>	M <sup>[4]</sup>	F	F	F		F	M <sup>[4]</sup>	M <sup>[4]</sup>	F		M <sup>[4]</sup>	M <sup>[4]</sup>	F	F	F	F	F
(3-16) Median Barrier				DE/F																				F <sup>[20]</sup>	F <sup>[20]</sup>	
(3-17) Guardrail Upgrades				DE/F																				F	F <sup>[23]</sup>	
(3-18) Bridge Rail Upgrades																								F	F <sup>[22]</sup>	F
(3-19) CAL/CAC/IAL	Design Elements determined based on identified Counter Measures <sup>[27]</sup>																									
<b>Economic Development</b>																										
(3-20) Freight & Goods (Frost Free) <sup>[8]</sup>	F <sup>[2]</sup>	F <sup>[2]</sup>	F <sup>[2]</sup>	F <sup>[2]</sup>	F	F <sup>[2]</sup>	F <sup>[2]</sup>	F <sup>[2]</sup>	F <sup>[2]</sup>	F <sup>[2]</sup>	EU/F	F	F		EU/F <sup>[26]</sup>	DE/F	DE/F	F	F	EU/F	EU/F	EU/F	F	F	F	F
(3-21) Four-Lane Trunk System	F	F	F	F	F	F	F	F	F	F	F	F	F		F	F	F	F	F	F	F	F	F	F	F	F
(3-22) Rest Areas (New)	F	F	F	F	F	F	F	F	F	F	F	F	F		F	F	F	F		F	F	F	F	F	F	F
(3-23) Bridge Restrictions	F <sup>[2]</sup>	F <sup>[2]</sup>	F <sup>[2]</sup>	F <sup>[2]</sup>	F	F <sup>[2]</sup>	F <sup>[2]</sup>	F <sup>[2]</sup>	F <sup>[2]</sup>	F <sup>[2]</sup>		F	F		EU/F <sup>[26]</sup>	F <sup>[2]</sup>	F <sup>[2]</sup>	F	F	F <sup>[2]</sup>	F <sup>[2]</sup>	F	F	F	F	F
(3-24) Bike Routes (Shldrs)			EU/M	[7]	EU/F				EU/M	EU/M		[28]	[28]	B	F	EU/M	EU/M	F					[28]	F	[28]	EU/F



Exhibit 1100-6 Design Matrix 5: Main Line Non-NHS Routes

↓ Project Type	Main Line														Bridges <sup>[11]</sup>				Intersections			Barriers		
	Horizontal Alignment	Vertical Alignment	Lane Width	Shoulder Width	Lane Transition	Median Width	Cross Slope Lane	Cross Slope Shoulder	Fill / Ditch Slopes	Access <sup>[3]</sup>	Clear Zone <sup>[18]</sup>	Sign., Del., Illum., & ITS	Basic Safety	Bike & Ped.	Lane Width	Shoulder Width	Vertical Clearance	Structural Capacity	Turn Radii	Angle	I/S Sight Distance	Term. & Trans. Section <sup>[12]</sup>	Standard Run	Bridge Rail <sup>[19]</sup>
(5-1) Preventative Maintenance																								
<b>Preservation</b>																								
<b>Roadway</b>																								
(5-2) BST												[15]												
(5-3) Milling with HMA Inlays							B					[15]	M											
(5-4) HMA Overlays							B	B				[15]	M				EU/F					B	B	
(5-5) Replace HMA w/PCCP at I/S			EU/M	EU/M	EU/F		EU/M	EU/M				[15]	M				F		EU/F	EU/F			B	
<b>Structures</b>																								
(5-6) Bridge Replacement	M	F	M	M	F		M	M	M		F	F		F	F <sup>[2]</sup>	F <sup>[2]</sup>	F	F	M	M	F	F	F	F
(5-7) Bridge Repl. (Multilane)	F <sup>[2]</sup>	F <sup>[2]</sup>	F <sup>[2]</sup>	F <sup>[2]</sup>	F	F <sup>[2]</sup>	F <sup>[2]</sup>	F <sup>[2]</sup>	F <sup>[2]</sup>		F	F		F	F <sup>[2]</sup>	F <sup>[2]</sup>	F	F	F <sup>[2]</sup>	F <sup>[2]</sup>	F	F	F	F
(5-8) Bridge Deck Rehab.												[15]	M					[11]						
<b>Improvements<sup>[16]</sup></b>																								
<b>Mobility</b>																								
(5-9) Urban (Multilane)	F <sup>[2]</sup>	F <sup>[2]</sup>	F <sup>[2]</sup>	F <sup>[2]</sup>	F	F <sup>[2]</sup>	F <sup>[2]</sup>	F <sup>[2]</sup>	F <sup>[2]</sup>	F	F	F		F	F <sup>[2]</sup>	F <sup>[2]</sup>	F	F	EU/F	EU/F	F	F	F	F
(5-10) Urban	M	M	M	M	F		M	M	M	F	F	F		F	M	M	F	F	EU/M	EU/M	F	F	F	F
(5-11) Rural	M	M	M	M	F	M	M	M	M	F	F	F		F	M	M	F	F	EU/M	EU/M	F	F	F	F
(5-12) HOV	M	M	M	M	F	M	M	M	M	F	F	F		F	M	M	F	F	EU/M	EU/M	F	F	F	F
(5-13) Bike/Ped. Connectivity <sup>[5]</sup>			F <sup>[2]</sup>	F <sup>[2]</sup>										F	F <sup>[2]</sup>	F <sup>[2]</sup>								
<b>Safety</b>																								
(5-14) Non-Interstate Freeway	F <sup>[2]</sup>	F <sup>[2]</sup>	F <sup>[2]</sup>	F <sup>[2]</sup>	F <sup>[2]</sup>	F <sup>[2]</sup>	F <sup>[2]</sup>	F <sup>[2]</sup>	F <sup>[2]</sup>	F <sup>[2]</sup>	F	F	F		F	F <sup>[2]</sup>	F <sup>[2]</sup>	F		F <sup>[2]</sup>	F <sup>[2]</sup>	F	F	F
(5-15) Intersection <sup>[1]</sup>			M <sup>[4]</sup>	M <sup>[4]</sup>	F					M <sup>[4]</sup>	F	F	F		M				M <sup>[4]</sup>	M <sup>[4]</sup>	F	F	F	F
(5-16) Corridor <sup>[1][24]</sup>	M <sup>[4]</sup>	M <sup>[4]</sup>	M <sup>[4]</sup>	M <sup>[4]</sup>	F	M <sup>[4]</sup>	M <sup>[4]</sup>	M <sup>[4]</sup>	M <sup>[4]</sup>	F	F	F		M	M <sup>[4]</sup>	M <sup>[4]</sup>	F		M <sup>[4]</sup>	M <sup>[4]</sup>	F	F	F	F
(5-17) Median Barrier				DE/F																		F <sup>[20]</sup>	F <sup>[20]</sup>	
(5-18) Guardrail Upgrades				DE/F																		F	F <sup>[23]</sup>	
(5-19) Bridge Rail Upgrades																						F	F <sup>[22]</sup>	F
(5-20) CAL/CAC/IAL	Design Elements determined based on identified Counter Measures <sup>[27]</sup>																							
<b>Economic Development</b>																								
(5-21) Freight & Goods (Frost Free) <sup>[8]</sup>	EU/M	EU/M	EU/M	EU/M	EU/M	EU/M	M	M	EU/M		F	[28]	B	EU/F <sup>[26]</sup>	DE/M	DE/M	F		EU/M	EU/M	EU/F	F	[28]	F
(5-22) Rest Areas (New)	F	F	F	F	F	F	F	F	F	F	F	F		F	F	F	F		F	F	F	F	F	F
(5-23) Bridge Restrictions	M	F	M	M	F	M	M	M	M		F	F		EU/F <sup>[26]</sup>	M	M	F	F	M	M	F	F	F	F
(5-24) Bike Routes (Shldr)			EU/M	[7]	EU/F			EU/M	EU/M		[28]	[28]	B	F	EU/M	EU/M					[28]	F	[28]	EU/F

## Exhibit 1100-7 Design Matrix Notes

**Design Matrix Notes:**

- A blank cell indicates that the element is not applicable.
  - B** Basic Design Level (see [Chapter 1120](#)).
  - F** Full design level (see [Chapter 1140](#)).
  - M** Modified design level (see [Chapter 1130](#)).
  - DE** Design Exception to design level indicated.
  - EU** Evaluate Upgrade to design level indicated.
- [1] Collision Reduction or Collision Prevention (At-Grade Removal, Signalization & Channelization). Specific deficiencies that created the project must be upgraded to design level as stated in the matrix.
  - [2] Modified design level may apply based on a corridor or project analysis (see [1100.03\(6\)](#)).
  - [3] If designated as L/A acquired in the Access Control Tracking System, limited access requirements apply. If not, managed access applies (see [1100.03\(6\)](#)).
  - [4] Full design level may apply based on a corridor or project analysis (see [1100.03\(6\)](#)).
  - [5] For bike/pedestrian design, see Chapters [1510](#), [1515](#), and [1520](#).
  - [6] Vacant
  - [7] 4-ft minimum shoulders.
  - [8] If all-weather structure can be achieved with spot digouts and overlay, modified design level applies to NHS highways and basic design level applies to non-NHS highways.
  - [9] Continuous shoulder rumble strips required in rural areas (see [Chapter 1600](#)).
  - [10] See [Chapter 1020](#).
  - [11] See [Chapter 720](#).
  - [12] Impact attenuators are considered as terminals.
  - [13] See Chapters [1140](#) and [1230](#).
  - [14] Includes crossroad bridge rail (see [Chapter 1610](#)).
  - [15] Install and replace delineation in accordance with [Chapter 1030](#). (This includes pavement markings, guideposts, and barrier delineation.)
  - [16] For design elements not in the matrix headings, apply full design level as found in the applicable chapters and see [1100.03\(2\)](#). Document with an evaluate upgrade.
  - [17] DE for existing acceleration/deceleration lanes when length meets posted freeway speed and no significant crash history (see [Chapter 1360](#)).
  - [18] On managed access highways within the limits of incorporated cities and towns, city and county design standards apply to areas outside the curb or outside the paved shoulder where no curb exists.
  - [19] The funding sources for bridge rail are a function of the length of the bridge. Consult programming personnel.
  - [20] Applies to median elements only.
  - [21] Vacant
  - [22] Upgrade barrier, if necessary, within 200 ft of the end of the bridge.
  - [23] See description of Guardrail Upgrades Project Type, [1100.03\(1\)](#), regarding length of need.
  - [24] Apply full design level to projects that realign or reconstruct significant portions of the alignment.
  - [25] For impacts to the main line, use the Project Type row for Safety, Non-Interstate Freeway on Matrix 3 for NHS and on Matrix 5 for non-NHS.
  - [26] Sidewalk ramps must be addressed for ADA compliance (see [Chapter 1510](#)).
  - [27] Collision Analysis Locations (CALs), Collision Analysis Corridors (CACs), and Intersection Analysis Locations (IALs) require a collision data analysis to identify the contributing factors to the crashes from which counter measures will be identified to reduce the frequency and severity of the collisions. (See [Safety Project Scoping process flowchart](#).)
  - [28] See [Chapter 1120](#), Basic Design Level, for further information.
  - [29] EU for Fill and Ditch foreslopes steeper than 4H:1V. Addressing of the back slope or slopes protected by barrier is not required.

[1120.01](#) [General](#)

[1120.02](#) [Basic Design Level](#)

[1120.03](#) [Documentation](#)

## 1120.01 General

Basic design level (B) preserves pavement structures, extends pavement service life, and restores the roadway for reasonably safe operations.

## 1120.02 Basic Design Level

Basic design level includes the following items of work:

- Adjust existing features (such as monuments, catch basins, and access covers) that are affected by resurfacing.
- Address ADA requirements according to WSDOT policy (see [Chapter 1510](#)).
- When recommended by the region Traffic Engineer, follow the criteria in [Chapter 1110](#) for channelizing intersections. Justify any resulting changes in the Design Documentation Package.

### 1120.02(1) Cross Slope Lane

- Rebuild the cross slope to 1.5% when the existing cross slope is flatter than 1.5% and the steeper slope is needed to provide adequate highway runoff in areas of intense rainfall (see [Chapter 1230](#)).

### 1120.02(2) Cross Slope Shoulder

- When rebuilding the lane cross slope, evaluate shoulder cross slope in accordance with [Chapter 1130](#), Modified Design Level.

### 1120.02(3) Delineation, Signing, Illumination & ITS

- Install and replace delineation in accordance with [Chapter 1030](#) (this includes only pavement markings, guideposts, and barrier delineation).
- Replace rumble strips when recommended by the Materials Engineer (see [Chapter 1600](#)).
- Note that Signing, Illumination, and ITS are not addressed under basic design level.

### 1120.02(4) Basic Safety

- Evaluate drainage grates and replace as needed to address bicycle safety (see [Drainage Grates and Manhole Covers in Chapter 1520](#)).

### 1120.02(5) **Standard Run and Terminals**

- Evaluate guardrail height during the preliminary engineering phase on HMA Overlay projects. When the height will be reduced to less than 26 inches from the ground to the top of the rail element, adjust the height to a minimum of 26 inches and a maximum of 28 inches in accordance with [1610.04\(1\)](#) and [1610.04\(2\)\(a\)](#). This guardrail work may be programmed under a separate project.
- Evaluate the guardrail length of need for runs that need to be raised as a result of an HMA overlay in accordance with [Chapter 1610](#). Up to 250 feet of additional run length within each run is provided for in preservation projects.
- Note that removal is an option if guardrail is no longer needed based on validation of the original guardrail purpose from past project documentation and after consulting [Chapters 1600](#) and [1610](#).
- When the height of an existing terminal will be reduced to less than 26 inches from the ground to the top of the rail element, adjust the height to a minimum of 26 inches and a maximum of 28 inches. A rail height of 28 inches is desirable to accommodate future overlays. When adjusting terminals that are equipped with CRT posts, the top-drilled holes in the posts need to remain at the surface of the ground.
- When the height of an existing transition section will be reduced to less than 26 inches from the ground to the top of the rail element, adjust the height to a minimum of 26 inches and a maximum of 28 inches. A rail height of 28 inches is desirable to accommodate future overlays.
- Evaluate Upgrade (see [Chapter 300](#)) for Fill and Ditch in-slopes steeper than 4H:1V on Interstate HMA Overlays (Matrix row 1-5) and PCCP Single Lane Rehab (Matrix row 1-6) projects.

### 1120.03 **Documentation**

Refer to [Chapter 300](#) for design documentation requirements.

- 1130.01 General
- 1130.02 Design Speed
- 1130.03 Alignment
- 1130.04 Roadway Widths
- 1130.05 Cross Slopes
- 1130.06 Sideslopes
- 1130.07 Bike and Pedestrian
- 1130.08 Bridges
- 1130.09 Intersections
- 1130.10 Documentation

### 1130.01 General

Modified design level (M) preserves and improves existing roadway geometrics, safety, and operational elements. This chapter provides the design criteria that are unique to the modified design level.

Modified design level criteria have been developed to apply to all applicable functional classes. As a result, for the lower volumes and urban highways, modified design level criteria might exceed full design level criteria. In these cases, full design level criteria may be used.

For projects developed to correct a deficiency, address all design elements contributing to that deficiency, even when those elements meet modified design level criteria.

Design elements that do not have modified design level guidance include:

- Access control (see [Chapter 520](#))
- Basic safety (see [Chapter 1120](#))
- Clear zone (see [Chapter 1600](#))
- Intersection sight distance (see [Chapter 1310](#))
- Lane transitions (see [Chapter 1210](#))
- On- and off-connections (see [Chapter 1360](#))
- Signing, delineation, and illumination (see [Chapters 1020, 1030, and 1040](#))
- Structural capacity (see [Chapter 720](#))
- Traffic barriers (see [Chapter 1610](#))
- Vertical clearance (see [Chapter 720](#))

Depending on the project context, guidance on context and modally integrated design may apply; see [Chapter 1150](#) for more information about this guidance, and how to determine where it applies.

## 1130.02 Design Speed

When applying modified design level to a project, select a design speed for use in the design process that reflects the character of the terrain and the type of highway. The desirable design speed for modified design level is one that is consistent with both the operating speed and posted speed limit within the project limits, while also remaining consistent with design, operating, and posted speeds in the corridor. The minimum design speed is not less than the posted speed or the proposed posted speed. Document the speed used, including any supporting studies and data. (See [Chapter 1140](#) for additional information on design speed.)

### **Vacant** *Exhibit 1130-1*

When the posted speed exceeds the design speed for existing geometric features that are to remain in place (curve radius, superelevation, sight distance, or other elements that the design speed controls), make one of the following two choices:

- When appropriate, work with the region Traffic Office to lower the posted speed to be consistent with the existing design speeds for the geometric features on the facility.
- Complete a corridor analysis in order to leave the posted speed unchanged and identify design elements that do not meet the criteria for the existing posted speed. Identify each appropriate location for cautionary signing, including road approach sight distance, and work with the region Traffic Office to install the cautionary signing as provided for in the [MUTCD](#), either by contract or region sign personnel. Consult with and obtain guidance from region project development leadership prior to progressing with the corridor analysis and the design.

## 1130.03 Alignment

### (1) *Horizontal Alignment*

Consideration of horizontal alignment for modified design level is normally limited to curves. Curve design is controlled by the design speed (see [1130.02](#)), superelevation (see [1130.03\(4\)](#)), and stopping sight distance (see [1130.03\(3\)](#)).

Identify major modifications to horizontal alignment in the Project Summary. (Examples of major modifications are total removal of pavement and reconstruction of the subgrade.)

### (2) *Vertical Alignment*

Vertical alignment consists of a series of profile grades connected by vertical curves.

#### (a) **Vertical Curves**

- Stopping sight distance controls crest vertical curves. [Exhibit 1130-8](#) gives the minimum curve length for crest vertical curves to remain in place for modified design level stopping sight distance. (See [1130.03\(3\)](#) for additional information on modified design level stopping sight distance.)

	Multilane Divided				Multilane Undivided			
	Trucks Under 10%		Trucks 10% and Over		Trucks Under 10%		Trucks 10% and Over	
Design Class	MDL-1	MDL-2	MDL-3	MDL-4	MDL-5	MDL-6	MDL-7	MDL-8
Current ADT <sup>[1]</sup>	Under 4000	Over 4000	Under 4000	Over 4,000	Under 4000	Over 4000	Under 4000	Over 4000
Design Speed	See <a href="#">1130.02</a>							
Traffic Lanes Number Width	4 or more 11 ft	4 or more 11 ft	4 or more 11 ft	4 or more 12 ft	4 or more 11 ft	4 or more 11 ft	4 or more 11 ft	4 or more 12 ft
Shoulder Width Right <sup>[3]</sup> Left <sup>[4]</sup>	4 ft 2 ft	6 ft 2 ft	4 ft 2 ft	6 ft 2 ft	4 ft	6 ft <sup>[5]</sup>	4 ft	6 ft <sup>[5]</sup>
Parking Lanes Urban	None	None	None	None	8 ft	8 ft <sup>[2]</sup>	8 ft	8 ft <sup>[2]</sup>
Median Width <sup>[15]</sup> Rural Urban	Existing Existing	Existing Existing	Existing Existing	Existing Existing	2 ft 2 ft	4 ft 2 ft	4 ft 2 ft	4 ft 2 ft
Minimum Width for Bridges to Remain in Place <sup>[6][7][8]</sup>	24 ft <sup>[9]</sup>	26 ft <sup>[9]</sup>	24 ft <sup>[9]</sup>	26 ft <sup>[10]</sup>	48 ft <sup>[9]</sup>	50 ft <sup>[9][11]</sup>	50 ft <sup>[9][11]</sup>	54 ft <sup>[10][11]</sup>
Minimum Width for Rehabilitation of Bridges to Remain in Place <sup>[6][8][12]</sup>	28 ft <sup>[9]</sup>	30 ft <sup>[9]</sup>	28 ft <sup>[9]</sup>	32 ft <sup>[10]</sup>	54 ft <sup>[9]</sup>	60 ft <sup>[9][11][13]</sup>	56 ft <sup>[9][11]</sup>	64 ft <sup>[10][11][13]</sup>
Minimum Width for Replacement Bridges	Full Design Level Applies <sup>[14]</sup>							
Access Control	For limited access highways, see Chapters <a href="#">530</a> and <a href="#">540</a> and the Limited Access and Managed Access Master Plan, or <a href="#">WAC 468-52</a> and the region's Highway Management Classification Report.							

**Notes:**

- [1] If current ADT is approaching a borderline condition, consider designing for the higher classification.
- [2] Parking restricted when ADT is over 15,000.
- [3] When a curb section is used, the minimum shoulder width from the edge of traveled way to the face of curb is 4 ft. In urban areas, see [Chapter 1140](#). On a route identified as a local, state, or regional significant bicycle route, the minimum shoulder width is 4 ft (see [Chapter 1520](#)).
- [4] When a curb section is used, the minimum shoulder width from the edge of traveled way to the face of curb is 1 ft on the left.
- [5] May be reduced by 2 ft under urban conditions.
- [6] Width is the clear distance between curbs or rails, whichever is less.
- [7] Use these widths for bridge deck treatment or thrie beam retrofit only.
- [8] For bridge median guidance, see [Chapter 720](#).
- [9] Add 11 ft for each additional lane.
- [10] Add 12 ft for each additional lane.
- [11] Includes a 4-ft median, which may be reduced by 2 ft under urban conditions.
- [12] Use these widths for any bridge work beyond the treatment of the deck, such as bridge rail replacement, deck replacement, or widening.
- [13] Includes 6-ft shoulders; may be reduced by 2 ft on each side under urban conditions.
- [14] Modified design level lane and shoulder widths may be used, when justified, with a corridor or project analysis.
- [15] When guardrail is installed along existing shoulders with a width greater than 4 ft, the shoulder width may be reduced by up to 4 inches.

**Multilane Highways and Bridges: Modified Design Level****Exhibit 1130-10**

	Two-Lane Highways					
	Trucks Under 10%			Trucks 10% and Over		
Design Class	MDL-9	MDL-10	MDL-11	MDL-12	MDL-13	MDL-14
Current ADT <sup>[1]</sup>	Under 1000	1000-4000	Over 4000	Under 1000	1000-4000	Over 4000
Design Speed	See <a href="#">1130.02</a>					
Traffic Lane Width <sup>[2]</sup>	11 ft	11 ft	11 ft	11 ft	11 ft	12 ft
Shoulder Width <sup>[4]</sup>	2 ft	3 ft <sup>[5]</sup>	4 ft	2 ft	3 ft <sup>[5]</sup>	4 ft
Parking Lanes Urban	8 ft	8 ft	8 ft <sup>[3]</sup>	8 ft	8 ft	8 ft <sup>[3]</sup>
Minimum Width for Bridges to Remain in Place <sup>[6][7]</sup>	22 ft <sup>[8]</sup>	24 ft	28 ft	22 ft <sup>[8]</sup>	24 ft	28 ft
Minimum Width for Rehabilitation of Bridges to Remain in Place <sup>[7][9]</sup>	28 ft <sup>[10]</sup>	32 ft	32 ft	28 ft <sup>[10]</sup>	32 ft	32 ft
Minimum Width for Replacement Bridges	Full Design Level Applies <sup>[11]</sup>					
Access Control	For limited access highways, see Chapters <a href="#">530</a> and <a href="#">540</a> and the Limited Access and Managed Access Master Plan, or <a href="#">WAC 468-52</a> and the region's Highway Management Classification Report.					

**Notes:**

- [1] If current ADT is approaching a borderline condition, consider designing for the higher classification.
- [2] For turning roadways, see Exhibits [1130-12a](#) and [1130-12b](#).
- [3] Parking restrictions are desirable when ADT exceeds 7500.
- [4] When a curb section is used, the minimum shoulder width from the edge of traveled way to the face of curb is 4 ft. In urban areas, see [Chapter 1140](#). On a route identified as a local, state, or regional significant bicycle route, the minimum shoulder width is 4 ft (see [Chapter 1520](#)).
- [5] For design speeds of 50 mph or less on roads of 2000 ADT or less, width may be reduced by 1 ft, with justification.
- [6] Use these widths for bridge deck treatment or thrie beam retrofit only.
- [7] Width is the clear distance between curbs or rails, whichever is less.
- [8] 20 ft when ADT is 250 or less.
- [9] Use these widths when a for any bridge work beyond the treatment of the deck, such as bridge rail replacement, deck replacement, or widening.
- [10] 26 ft when ADT is 250 or less.
- [11] Modified design level lane and shoulder widths may be used, when justified, with a corridor or project analysis.

**Two-Lane Highways and Bridges: Modified Design Level**  
*Exhibit 1130-11*

1140.01	General	1140.11	Curbs
1140.02	References	1140.12	Parking
1140.03	Definitions	1140.13	Pavement Type
1140.04	Functional Classification	1140.14	Structure Width
1140.05	Terrain Classification	1140.15	Right of Way Width
1140.06	Geometric Design Data	1140.16	Grades
1140.07	Design Speed	1140.17	Fencing
1140.08	Traffic Lanes	1140.18	Traffic Signal Control, Illumination, and Intelligent Transportation Systems (ITS)
1140.09	Shoulders	1140.19	Documentation
1140.10	Medians		

## 1140.01 General

Full design level is the highest level of design and is used on new and reconstructed highways. These projects are designed to provide optimum mobility, safety, and efficiency of traffic movement. The overall objective is to move the greatest number of vehicles, at the highest allowable speed, and at optimum safety. Major design controls are: functional classification; terrain classification; urban or rural surroundings; traffic volume; traffic character and composition; design speed; and access control. Depending on the project context, guidance on context and modally integrated design may apply; see [Chapter 1150](#) for more information about this guidance and how to determine where it applies.

## 1140.02 References

### (1) Federal/State Laws and Codes

[Revised Code of Washington \(RCW\) 46.61.575](#), Additional parking regulations

[RCW 47.05.021](#), Functional classification of highways

[RCW 47.24](#), City streets as part of state highways

[Washington Administrative Code \(WAC\) 468-18-040](#), Design standards for rearranged county roads, frontage roads, access roads, intersections, ramps and crossings

### (2) Design Guidance

[Local Agency Guidelines \(LAG\)](#), M 36-63, WSDOT

[Plans Preparation Manual](#), M 22-31, WSDOT

[Standard Plans for Road, Bridge, and Municipal Construction \(Standard Plans\)](#), M 21-01, WSDOT

[Standard Specifications for Road, Bridge, and Municipal Construction \(Standard Specifications\)](#), M 41-10, WSDOT

### (3) Supporting Information

[A Policy on Design Standards: Interstate System](#), AASHTO, 2005

[A Policy on Geometric Design of Highways and Streets \(Green Book\)](#), AASHTO, [Current edition](#)

### 1140.03 Definitions

**auxiliary lane** The portion of the roadway adjoining the traveled way for parking, speed change, turning, storage for turning, weaving, truck climbing, passing, and other purposes supplementary to through-traffic movement.

**collector system** Routes that primarily serve the more important intercounty, intracounty, and intraurban travel corridors; collect traffic from the system of local access roads and convey it to the arterial system; and on which, regardless of traffic volume, the predominant travel distances are shorter than on arterial routes ([RCW 47.05.021](#)).

**design speed** The speed used to determine the various geometric design features of the roadway.

**divided multilane** A roadway with two or more through lanes in each direction and a median that physically or legally prohibits left turns, except at designated locations.

**expressway** A divided highway that has a minimum of two lanes in each direction for the exclusive use of traffic and that may or may not have grade separations at intersections.

**freeway** A divided highway that has a minimum of two lanes in each direction for the exclusive use of traffic and with full control of access.

**frontage road** A road that is a local road or street located parallel to a highway for service to abutting property and adjacent areas and for control of access.

**functional classification** The grouping of streets and highways according to the character of the service they are intended to provide.

**high pavement type** Portland cement concrete pavement or hot mix asphalt (HMA) pavement on a treated base.

**highway** A general term denoting a street, road, or public way for the purpose of vehicular travel, including the entire area within the right of way.

**incorporated city or town** A city or town operating under [RCW 35](#) or [35A](#).

**intermediate pavement type** Hot mix asphalt pavement on an untreated base.

**Interstate System** A network of routes designated by the state and the Federal Highway Administration (FHWA) under terms of the federal-aid acts as being the most important to the development of a national system. The Interstate System is part of the principal arterial system.

**lane** A strip of roadway used for a single line of vehicles.

**lane width** The lateral design width for a single lane, striped as shown in the [Standard Plans](#) and the [Standard Specifications](#). The width of an existing lane is measured from the edge of traveled way to the center of the lane line or between the centers of adjacent lane lines.

**limited access highway** Highways where the rights of direct access to or from abutting lands have been acquired from the abutting landowners.

**low pavement type** Bituminous surface treatment (BST).

**managed access highway** Highways where the rights of direct access to or from abutting lands have not been acquired from the abutting landowners.

**median** The portion of a highway separating the traveled ways for traffic in opposite directions.

## 1140.06 Geometric Design Data

### (1) State Highway System

For projects on all highways in rural design areas and on limited access highways in urban design areas, the geometric design data is controlled by the functional class and traffic volume (see Exhibits 1140-5 through 1140-8). The urban managed access highway design class, based on traffic volume and design speed (see Exhibit 1140-9), may be used on managed access highways in urban design areas, regardless of the functional class.

### (2) City Streets as State Highways

For a state highway within an incorporated city or town that is a portion of a city street, develop the design features in cooperation with the local agency. For facilities on the NHS, use *Design Manual* criteria as the minimum for the functional class of the route. For facilities not on the NHS, the *Local Agency Guidelines* may be used as the minimum design criteria; however, the use of *Design Manual* criteria is encouraged whenever feasible. On managed access highways within the limits of incorporated cities and towns, the cities or towns have full responsibility for design elements, including access, outside of curb, or outside the paved shoulder where no curb exists, using the *Local Agency Guidelines*.

### (3) City Streets and County Roads

Plan and design facilities that cities or counties will be requested to accept as city streets or county roads according to the applicable design criteria shown in:

- [WAC 468-18-040](#).
- *Local Agency Guidelines*.
- The design criteria of the local agency that will be requested to accept the facility.

## 1140.07 Design Speed

Vertical and horizontal alignment, sight distance, and superelevation vary with design speed. Such features as traveled way width, shoulder width, and lateral clearances are usually not affected. For the relationships between design speed, geometric plan elements, geometric profile elements, superelevation, and sight distance, see Chapters 1210, 1220, 1250, 1260, 1310, and 1360.

The choice of a design speed is primarily influenced by functional classification, posted speed, operating speed, terrain classification, traffic volumes, collision history, access control, and economic factors. A geometric design that adequately allows for future improvements is also a major criterion. Categorizing a highway by a terrain classification often results in arbitrary reductions of the design speed, when, in fact, the terrain would allow a higher design speed without materially affecting the cost of construction. Savings in vehicle operation and other costs alone might be sufficient to offset the increased cost of right of way and construction.

It is important to consider the geometric conditions of adjacent sections. Maintain a uniform design speed for a significant segment of highway. Consider both year of construction and design year. Maintain continuity throughout the corridor, with changes (such as a change in roadside development) at logical points. When terrain or existing development limits the ability to achieve the design speed for the design class, use a corridor analysis to determine the appropriate design speed.

**(1) Setting Design Speed Using Highway Classification**

For projects on all rural highways and limited access highways in urban design areas on new or reconstructed alignment (vertical or horizontal) or full width pavement reconstruction, the design speed for each design class is given in Exhibits 1140-5 through 1140-8. For other projects, see [1140.07\(2\)](#). Do not select a design speed less than the posted speed.

**(2) Setting Design Speed Using Posted and Operating Speeds**

On urban managed access highways, the design speed is less critical to the operation of the facility. Closely spaced intersections and other operational constraints usually limit vehicular speeds more than the design speed.

For managed access facilities in urban design areas, the desirable design speed is one that is consistent with both the operating speed and posted speed limit within the project limits, while also remaining consistent with design, operating, and posted speeds in the corridor. Select a design speed not less than the posted speed that is logical with respect to topography, operating speed (or anticipated operating speed for new alignment), adjacent land use, design traffic volume, collision history, access control, and the functional classification.

**Vacant**  
*Exhibit 1140-1*

**1140.08 Traffic Lanes**

The minimum lane width is based on the highway design class, terrain type, and whether it is in a rural or urban design area. Lanes 12 feet wide provide desirable clearance between large vehicles where traffic volumes are high and sizable numbers of large vehicles are expected. The added cost for 12-foot lanes is offset, to some extent, by the reduction in shoulder maintenance costs due to the lessening of wheel load concentrations at the edge of the lane.

Highway capacity is also affected by the width of the lanes. With narrow lanes, drivers operate their vehicles closer (laterally) to each other than they normally desire. To compensate, drivers increase the headway, which results in reduced capacity.

Exhibits 1140-5 through 1140-8 give the minimum lane widths for the various design classes for use on all rural highways and limited access highways in urban design areas. [Exhibit 1140-9](#) gives the minimum lane widths for urban managed access highways.

The roadway on a curve may need to be widened to make the operating conditions comparable to those on tangents. For guidance on turning roadway width, see [Chapter 1240](#).

## 1140.12 Parking

In urban design areas and rural communities, land use might make parking along the highway desirable. In general, on-street parking decreases capacity, increases collisions, and impedes traffic flow; therefore, it is desirable to prohibit parking.

Although design data for parking lanes are included in Exhibits 1140-6 through 1140-9, consider them only in cooperation with the municipality involved. The lane widths given are the minimum for parking; provide wider widths when feasible.

Angle parking is not permitted on any state route without WSDOT approval ([RCW 46.61.575](#)). This approval is delegated to the State Traffic Engineer. Angle parking approval is to be requested through the Headquarters (HQ) Design Office. Provide an engineering study, approved by the region Traffic Engineer, with the request documenting that the parking will not unduly reduce safety and that the roadway is of sufficient width that parking will not interfere with the normal movement of traffic.

## 1140.13 Pavement Type

The pavement types given in Exhibits 1140-5 through 1140-8 are those recommended for each design class. (See [Chapter 620](#) for information on pavement type selection.) When a roadway is to be widened and the existing pavement will remain, the new pavement type may be the same as the existing without a pavement type determination.

## 1140.14 Structure Width

Provide a clear width between curbs or barrier on a structure not less than the approach roadway width (lanes plus shoulders). The structure widths given in Exhibits 1140-5 through 1140-9 are the minimum structure widths for each design class.

Additional width for shy to barriers is not normally added to the roadway width on structures. When a structure is in a run of roadside barrier with the added width, consider adding the width on shorter structures to keep a constant roadway width.

## 1140.15 Right of Way Width

Provide right of way width sufficient to accommodate roadway elements and appurtenances for the current design and known future improvements. To allow for construction and maintenance activities, provide 10 feet desirable, 5 feet minimum, wider than the slope stake for fill and slope treatment for cut. For slope treatment information, see [Chapter 1230](#) and the *Standard Plans*.

For new alignment requiring purchase of new right of way, refer to Exhibits 1140-5 through 1140-8. For additional information on right of way acquisition, see [Chapter 510](#).

### 1140.16 Grades

Grades can have a pronounced effect on the operating characteristics of the vehicles negotiating them. Generally, passenger cars can readily negotiate grades as steep as 5% without appreciable loss of speed from that maintained on level highways. Trucks, however, travel at the average speed of passenger cars on the level roadway, but they display up to a 5% increase in speed on downgrades and a 7% or greater decrease in speed on upgrades (depending on length and steepness of grade as well as weight-to-horsepower ratio).

The maximum grades for the various functional classes and terrain conditions are shown in [Exhibits 1140-5](#) through [1140-8](#). For the effects of these grades on the design of a roadway, see Chapters [1220](#), [1260](#), [1270](#), [1310](#), and [1360](#).

### 1140.17 Fencing

Remove rigid top rails and brace rails from existing fencing and retrofit with a tension wire design. For information on fencing, see [Chapter 560](#).

### 1140.18 Traffic Signal Control, Illumination, and Intelligent Transportation Systems (ITS)

For information on intelligent transportation systems (ITS), see [Chapter 1050](#). ITS installation is determined by the mobility, traveler information, safety, maintenance, and other operational needs of the highway system. Consult with the region Traffic Engineer and review the WSDOT ITS plan to determine the full design level requirements for ITS. Contact WSDOT HQ [Traffic Operations](#) for a current copy of the [ITS Plan](#).

### 1140.19 Documentation

Refer to [Chapter 300](#) for design documentation requirements.

- 1150.01 Background and Intent
- 1150.02 Main Street Context Considerations
- 1150.03 Community Design Vision – Process Before Design
- 1150.04 Main Street Segment Cross-Section Zones
- 1150.05 Design Guidance and Considerations for Main Street Contexts
- 1150.06 Maintenance Elements, Planning, and Considerations
- 1150.07 Retrofitting Main Street Segments
- 1150.08 Documentation Support
- 1150.09 References

### 1150.01 Background and Intent

The Washington State Department of Transportation (WSDOT) considers main street roadways to be more than just a means of moving people and goods efficiently. Main streets can also contribute to the fabric of place, just as buildings and pedestrian furnishings do. Experienced together as a whole, main streets are valued by people as social destinations and centers of economic activity, which promote livable, vibrant, and safe communities. This chapter provides practical design guidance for a subset of main street context environments, and reinforcement for the collaborative partnerships necessary to identify and address all potential stakeholder objectives.

This chapter will be revised in the future as WSDOT expands the context-driven and modally integrated design policy and guidance aimed at best adapting the mature state highway system to modern day contexts. WSDOT's intent is to provide practical and flexible design guidance based on the natural and built environmental contexts, as well as presenting acceptance of low-cost interim retrofit solutions when funding is constrained. WSDOT's past research and coordination with local agencies emphasized a need for flexibility to address the multiple trade-off aspects in design, especially on state highway segments that serve as city streets. It is important to understand how the specific land use and transportation contexts contribute to design when accounting for and weighting trade-offs.

This guidance provides an optional approach for both independent local agency projects and local-state partnership projects. It can be applied to both National Highway System (NHS) and non-NHS routes, where appropriate. The decision to use this guidance for main street state highways is arrived at through consultation between local, state, and federal partners. Ideally, the decision to use this guidance will occur no later than the scoping phase. Document this decision on the Project Summary Form, and by initiating the Context and Modally Integrated Design Collaborative Memorandum (see [1150.08](#)).

### 1150.02 Main Street Context Considerations

This guidance is not intended to apply to all "main street" context segments identified by WSDOT research reports, planning offices, and communities. In general, this guidance will apply to access managed, nonfreeway highway segments in urban areas and rural town centers. Applicable segments demonstrate a need for very low-speed, low-traffic throughput roadway and roadside environments.

The following are general characteristics that typically indicate a “main street” context. These characteristics are listed to help identify locations appropriate for application of this chapter; however, these characteristics are not necessarily conditional aspects of guidance use.

- State highway access class 4 and 5 segments
- State highway access class 3 segments within city limits
- On-street parking
- Wide streetside (and sidewalks)
- Storefronts with no or minimal setbacks
- Small block network
- Minimal number of driveway access points
- Well-developed street network or grid system
- Identified need for bike and/or pedestrian mobility and/or access
- Urban revitalization

### **1150.02(1) When Main Street is a State Highway**

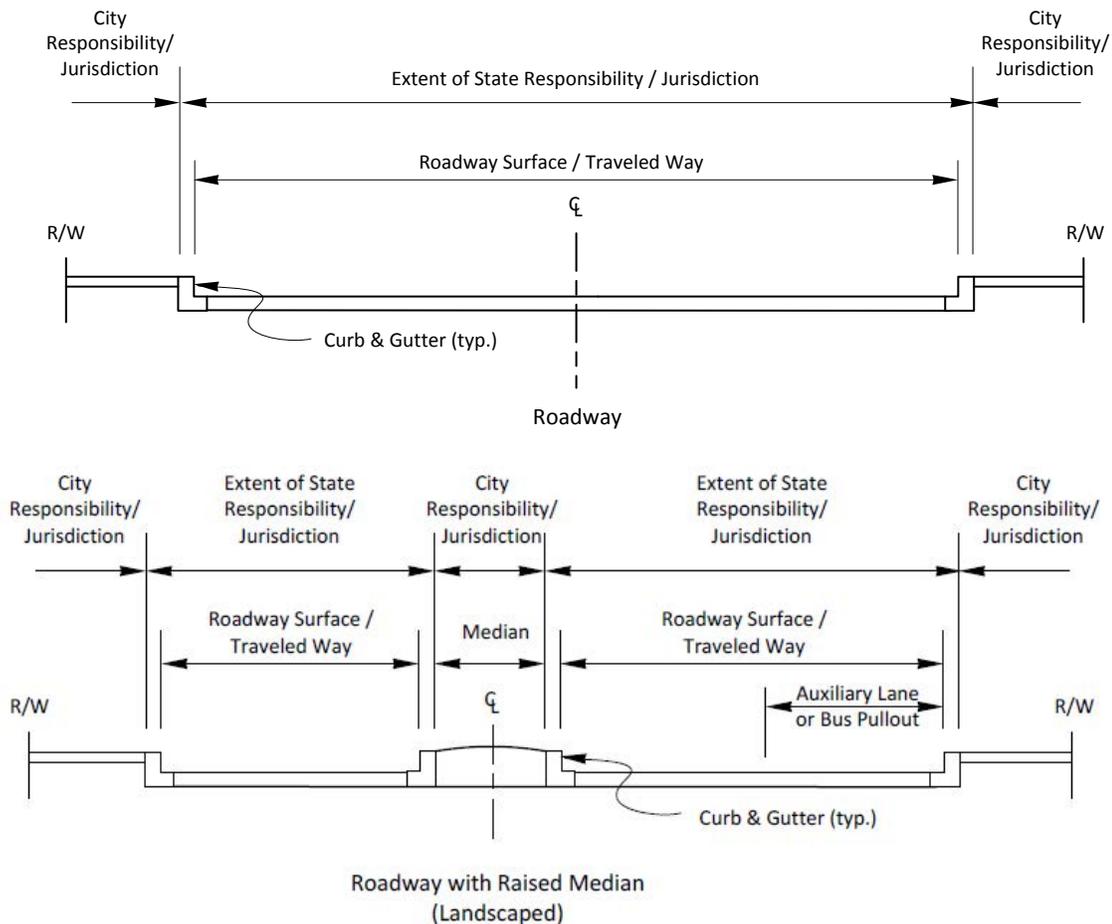
Main street state highways are challenged to provide regional mobility needs in addition to serving important local functions. WSDOT typically holds jurisdictional authority on the traveled way, between and including the curbs. The local agency typically holds jurisdictional authority over the streetside, from the curb outward and between curbed median areas. [Exhibit 1150-1](#) shows how responsibilities and jurisdictional authority are typically split between a city and state. Additional discussion of jurisdictional responsibilities and clear zone designation is provided in [1600.03](#).

This guidance assists WSDOT partners and approvers with context-based flexibility to achieve the local agency main street vision. A proposed transportation project must be planned not only as a facility serving specific transportation objectives, but also must consider how the street contributes to the aesthetic, social, economic, and environmental values, needs, constraints, and opportunities in a larger community setting, per [Executive Order 1028](#). WSDOT is required to consult with local agencies on projects affecting state highways that are also designated as local streets ([RCW 47.04.330](#)). WSDOT Local Programs staff are recommended for coordinating department participation in locally led planning/design development, and will also help incorporate the intent of this guidance in state-led planning/design development.

WSDOT and local agencies should seek partnerships necessary to understand how to optimize operation of the existing system, and how to implement demand management strategies and the shared funding needed for project completion. Funding limitations may constrain the ability to construct the ultimate main street as envisioned. Partners should discuss and plan for interim phasing solutions to address fiscal constraints, ultimately adapting the vision over time. The resulting partnering funding plans will assist with phasing the ultimate vision, using lower-cost interim design options such as striping new “curb” locations inward (see [1150.07](#) for interim design options).

State, local agency, and community partners need to develop an understanding of shared responsibilities in providing both the initial interim “curb” and post-construction maintenance obligations (see [1150.06](#)). Document these aspects initially in the Context and Modally Integrated Concurrence Memorandum (see [1150.08](#)), and finalize in the appropriate agreements, outlining the specific roles and responsibilities of each party.

Exhibit 1150-1 City and State Responsibilities and Jurisdictions



### 1150.03 Community Design Vision – Process Before Design

The community vision for a street influences the design of that street. Establishing the vision first helps build consensus locally and ultimately provides advantages to project schedules. Where the city street is a state highway, the vision must be established and documented before detailed design proceeds. The vision needs to be described in sufficient detail that the design process can reasonably accommodate and not preclude implementation of all or a portion of the vision for the street.

Planners/Designers need to review the comprehensive plans and any subarea or neighborhood plans that may cover the area. Local complete streets policies, if in place, also need to be reviewed and considered. Depending on the route and focus of these plans, the details of the information may vary. There could be specific route visioning or, at a minimum, broader visioning statements for the local agency as a whole. There will always be important information regarding the existing and planned land use plans that will help establish the land use context. These plans are important to understand, since the comprehensive planning process requires public involvement, which reflects specific community objectives and goals that the project design should reflect when considering design trade-offs. Region Planning and Design offices should extract applicable information from the planning documents and list them within the [Community and Corridor Vision](#) section of the Context and Modally Integrated Collaborative Memorandum, for simplicity.

If the community's vision is not established in other planning documents, or it needs additional detail, the vision should be developed before or during the scoping process. State and local agencies should collaborate with the community during the scoping phase to develop the vision. Community design exercises are held during project planning and scoping phases to help all parties understand the objectives, costs, and outcomes that define the vision for the street. Ideally, the results of community design exercises will ultimately inform designs or visualizations developed for the project. The needs of all users are considered by applying modally integrated, context sensitive design solutions consistent with this chapter.

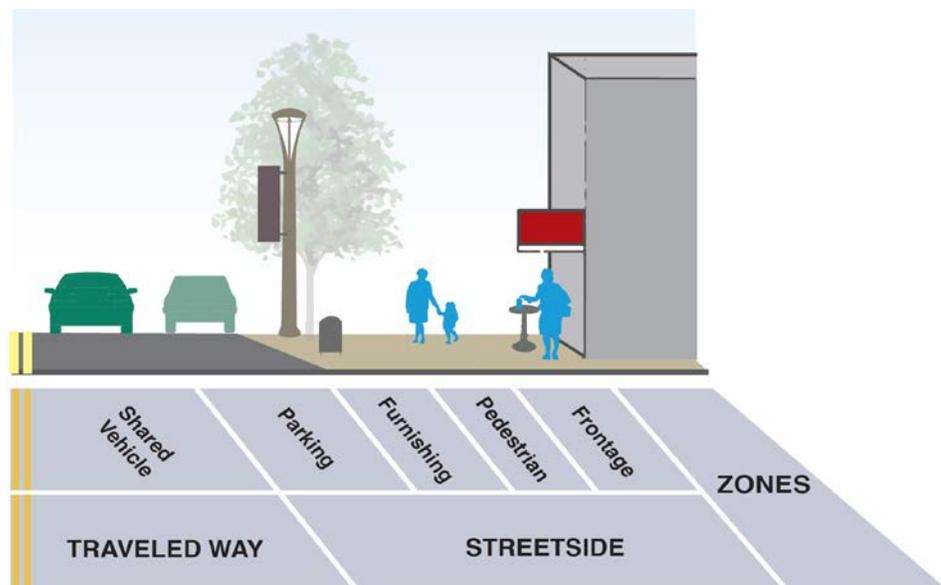
Not all streetside details need to be defined to stage implementation and accomplish visions on the ground in a timely manner. The minimum need may only be the overall streetside width and traveled way width to help facilitate early interim staging opportunities with developer, minor improvement, and other projects. Specific detailed trade-offs within the traveled way and streetside zones can be determined in later community planning groups. If the vision is already established or is being developed for the first time, it is necessary to document initial decisions and principle trade-offs considered in establishing the vision in order to reinforce future decision making. Use the [Context and Modally Integrated Collaborative Memorandum](#) to document the collaborative community and corridor visions during project conception and development, as well as for comparing future decisions made throughout the iterative planning/design process. Update the Memorandum frequently and when required by [1150.08](#).

#### 1150.04 Main Street Segment Cross-Section Zones

Main streets serve multiple functions and travel modes, with emphasis on serving active pedestrian traffic associated with commerce and the social functions typically present. It is important for the community and planning/design process to consider how different cross-sectional zones contribute to this focus. Every community has unique constraints and desires that require evaluation and trade-offs to optimize the use of constrained right of way.

The discussion below, Exhibits [1150-2](#) through [1150-8](#), and [Exhibit 1150-10](#) demonstrate how zones can be configured and applied to realize a community's main street vision.

**Exhibit 1150-2 Potential Main Street Cross Section**



### 1150.04(1) Streetside

A robust streetside design supports the main street context and typical focus as a pedestrian thoroughfare and destination place by providing accessibility. The streetside may be the most important component of a community's main street vision. Several existing guidance documents use a variety of terms to define the zones that comprise a streetside. The following presents guidance for four potential streetside zones: frontage zone, pedestrian zone, furnishing zone, and parking zone. Not all zones may be present in any given streetside design, depending on constraints and the vision for the segment.

#### 1150.04(1)(a) Frontage Zone

The frontage zone serves the retail functions found within the main street contexts. The primary purpose is access to retail space without interfering with the pedestrian thoroughfare. This area may also provide space to display temporary retail products or advertisements, ingress and egress from buildings, and/or outdoor seating for customers. Conduct early discussions with Real Estate Services to understand how these uses and features within the frontage zone can be accommodated, whether additional documentation is necessary within each specific project, and if a lease with applicable rent is required.

#### 1150.04(1)(b) Pedestrian Zone

The pedestrian zone is the access route provided for pedestrian movement, and is the only streetside zone with a required minimum design width. Consider exceeding minimum values for the pedestrian zone, because a generous zone promotes the necessary mobility and access typically anticipated within a main street context. Americans with Disabilities Act (ADA) features are a necessary element of the pedestrian zone. Refer to [Chapter 1510](#) for detailed ADA design guidance for pedestrian access routes.

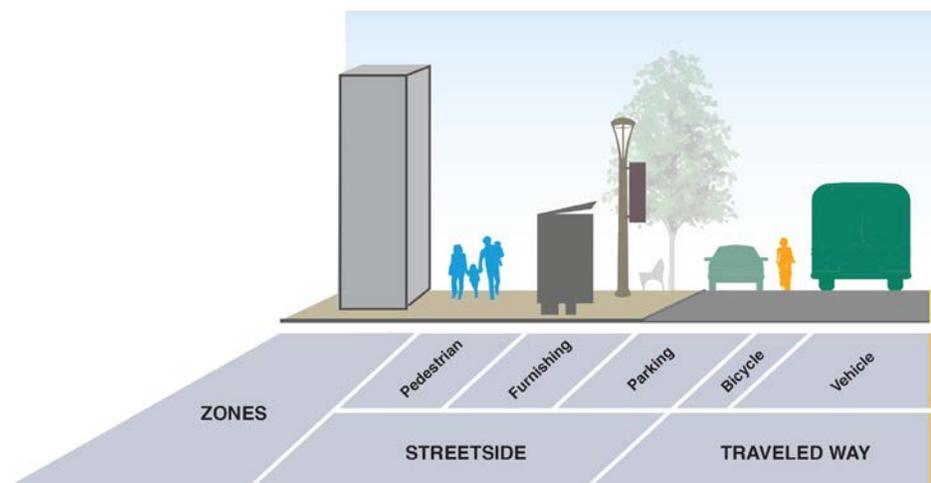
Exhibit 1150-3 Streetside on 4th Ave, Olympia, WA



Photo credit: Andrew Beagle

#### 1150.04(1)(c) Furnishing Zone

Exhibit 1150-4 Potential Main Street Cross Section



The furnishing zone provides areas for multiple potential functions. It is commonly used to promote environmental and aesthetic features that improve people’s experience—like street trees, benches, planter boxes, green street/low-impact development opportunities (see [1150.04\(1\)\(d\)\(2\)](#)) and artwork—while providing for the modal separation that promotes improved travel of the various modes. Traffic signs, parking meters, transit shelters/stops, and bike racks are also generally found within this zone. Other width accommodations within this zone may be necessary for on-street parking may be needed for vehicle overhang or entering/exiting movements.

**Exhibit 1150-5 Streetside Swale, Portland, OR**



Photo credit: Chris Workman

To ensure well-planned vegetation, involve the local and region Landscape Architect; responsible maintenance jurisdiction(s) and urban forestry experts; and human factors/safety professionals to consider and determine what constitutes optimal vegetation in terms of plant and road maintenance, operations, landscape, roadway, roadside, and potential modal interactions within the furnishing zone. Document early discussions related to evaluating trade-offs in the [Context and Modally Integrated Design Collaborative Memorandum](#). If landscaping is a requirement of the local jurisdiction that issues an occupancy permit to an abutting business, the landscaping in the furnishing zone should not count toward the business’s landscaping requirements. The local jurisdiction may choose to enter into a lease with the abutting business owner, allowing them to mitigate all or part of their landscaping requirement in the furnishing zone with payment of rent.

### **1150.04(1)(d) Parking Zone**

The parking zone allows width for on-street parking typically provided on main street context segments, but is not necessarily required. Refer to municipal codes regarding parking requirements. On-street parking can be either parallel or angled. However, at this time, angled parking on any state route requires approval from WSDOT (see [1140.12](#)). If angled parking is selected, provide width for vehicle overhang within the furnishing zone. If bike lanes are present, consider back-in angled parking to improve conflict management through increased visibility. On-street parking can help to visually narrow the street in places to assist in conveying the surrounding context for the segment.

#### **1150.04(1)(d)(1) Curb Extensions**

Curb extensions occupy the same cross-sectional area as the parking zone and they visually reduce the vehicular zone. They can be a desirable choice for main street intersections, midblock crossings, and transit stop locations (see [1510.10\(5\)](#)).

Curb extensions primarily facilitate pedestrian movement. They can lower pedestrian collisions by reducing pedestrian exposure to vehicles, increasing pedestrian visibility, maintaining lower vehicular turning speeds, and providing loading zones for transit stop locations.

**Exhibit 1150-6 Curb Extension With Angled Parking: Olympia City Hall**



Photo credit: Andrew Beagle

Curb extensions can also be beneficial when designing ADA retrofits by providing additional area to accommodate ADA design features.

In summary, curb extensions are a primary element used to set the pace of the street. By visually reducing the openness, width, and feel of the street, motorists respond by approaching the area more slowly. This in turn has a positive effect on pedestrians. Since the primary function of a curb extension is to increase visibility and reduce exposure for pedestrian traffic, it is important not to obstruct sightlines with other elements such as plantings.

#### **1150.04(1)(d)(2) Low-Impact Development and Green Street Opportunities**

Curb extensions, the furnishing zone, and interim curb solutions (see [1150.07](#)) also provide an opportunity to incorporate planter strips, rain gardens, or swales. Green street alternatives may be aesthetic in nature and/or address stormwater management needs. If you consider swales and rain gardens, you will need appropriate hydraulic analysis and design to ensure infiltration and overflow drains are designed appropriately. If the shared vision incorporates low-impact development (LID) and/or green street alternatives on a state highway main street, consult the [Roadside Policy Manual](#), [Highway Runoff Manual](#), and HQ Hydraulics Office for more information about LID benefits and requirements. Document the LID and green street preferences within the [Context and Modally Integrated Design Concurrence Memorandum](#).

#### **1150.04(2) Traveled Way**

The traveled way is the roadway area between the curbs, exclusive of parking. It typically provides zones for vehicle thoroughfares, including bicycles. Under main street retrofit projects, it is often advantageous to reduce the traveled way width in order to provide additional width for more vulnerable modes. This bolsters streetside zones, increases distance between modal operations, and encourages lower vehicular speeds.

#### **1150.04(3) Vehicle Zone**

The vehicle zone is an area within the traveled way intended to facilitate the movement of motorized vehicles. Due to their low-speed nature in the main street context, motor vehicle lanes can be shared with bicycles and are legally allowed to do so on many roadways. Consider bicycles in the vehicle zone where constrained right of way or the community vision cannot accommodate a separate bicycle zone.

### 1150.04(4) Bicycle Zone

The bicycle zone provides a dedicated lane and potential buffer treatments that provide separation between the modes. The community vision may include accommodations for bicycle travel, including, but not limited to: shared lane, dedicated bicycle lane, or separated shared-use paths. The NACTO *Urban Bikeway Design Guide* and the AASHTO *Guide for Development of Bicycle Facilities* are recognized sources for potential designs that may accomplish the community vision. In general, the *Manual on Uniform Traffic Control Devices* (MUTCD) approved designs presented in these guides may be used on main street state highways.

Consult, as appropriate, the Federal Highway Administration's (FHWA's) website for bicycle facilities and the MUTCD for a listing of the current status of bicycle-related designs and treatments:

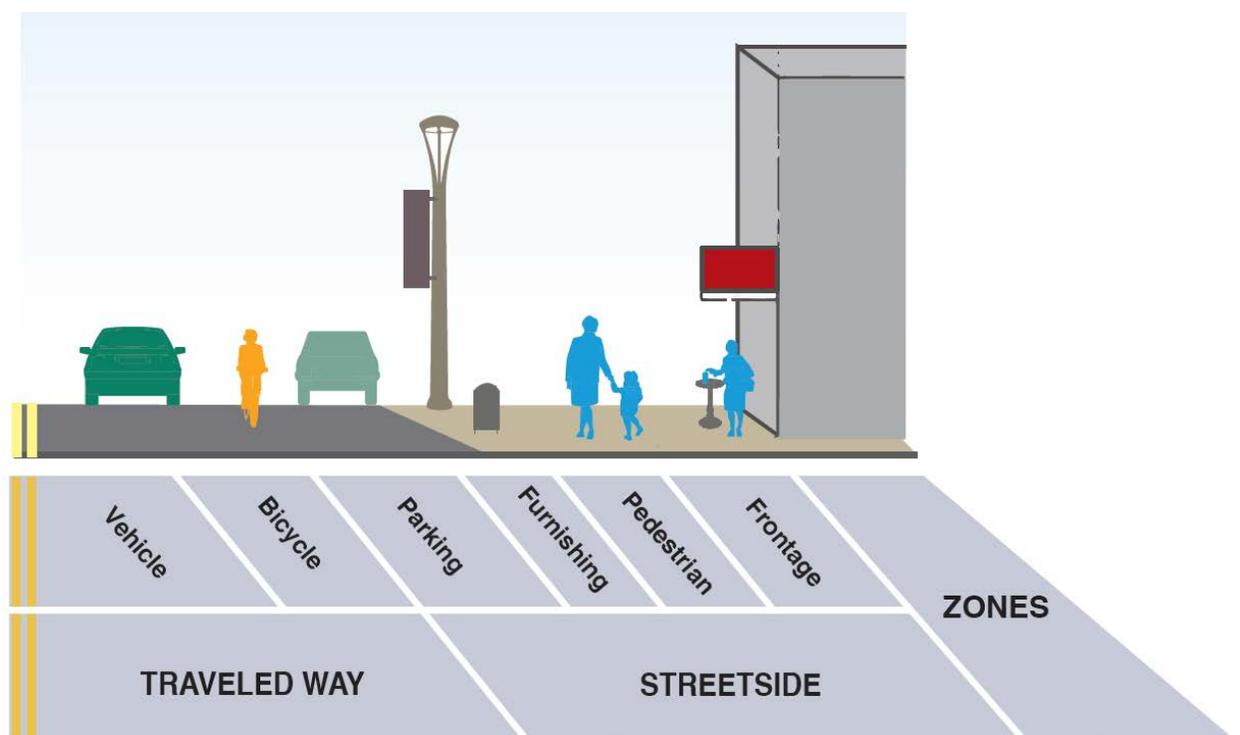
[http://www.fhwa.dot.gov/environment/bicycle\\_pedestrian/guidance/design\\_guidance/mutcd\\_bike.cfm](http://www.fhwa.dot.gov/environment/bicycle_pedestrian/guidance/design_guidance/mutcd_bike.cfm)

Exhibit 1150-7 Bike Lane With On-Street Bike Parking, Portland, OR



Photo credit: Chris Workman

Exhibit 1150-8 Potential Main Street Cross Section



### 1150.05 Design Guidance and Considerations for Main Street Contexts

Exhibit 1150-9 provides ranges of values for design zones and elements appropriate for main street context segments. The ranges provide significant design flexibility to help a community realize its main street vision. Use the AASHTO *Highway Safety Manual* and associated tools to quantify potential alternatives and countermeasures.

Exhibit 1150-9 Design Data: Main Street Context

Roadway Type	Low-Speed Main Street
AADT	Up to 20,000
Proposed Number of Vehicle Lanes	2–4 <sup>[9]</sup>
Target Speed	up to 30 mph <sup>[8]</sup>
Frontage Zone Width	0–8 ft <sup>[1]</sup>
Pedestrian Zone Width	5–8 ft <sup>[2]</sup>
Furnishing Zone Width	0–8 ft <sup>[3]</sup>
Vehicle Parking Zone Width	0 or 8 ft <sup>[4]</sup>
Vehicle Zone – Motorized Lane Width	10–12 ft <sup>[5]</sup>
Vehicle Zone – Bike Lane Width	Shared with motorized lane or 5–8 ft <sup>[4]</sup>
Medians	Optional <sup>[6]</sup>
Cross Slope	1.5 to 2.0% normal crown section <sup>[7]</sup>
Horizontal Alignment	Refer to <a href="#">Chapter 1210</a>
Vertical Alignment	Refer to <a href="#">Chapter 1220</a>
Vertical Clearance	Refer to <a href="#">Chapter 720</a>
Clear Zone	Refer to <a href="#">Chapter 1600</a>

**Notes:**

- [1] Frontage zone width may not be needed if local zoning and/or the built environment has a setback requirement.
- [2] Pedestrian zone minimum is 5 ft, per [Chapter 1510](#); however, additional width is recommended to promote the intended use within the main street context.
- [3] Furnishing zone will typically include a 6-ft tree well as an architectural minimum. If parking zone utilizes angled parking, accommodate anticipated 1.5-ft overhang from parked vehicles.
- [4] Parking zone width shown is for parallel parking. If parallel parking width is adjacent to a planned bike lane, consider an additional 2-ft-wide striped (or other MUTCD-approved) bike buffer. Angled parking will require additional width; if on a state route, it will require WSDOT approval (see [1140.12](#)).
- [5] If turning lanes are necessary at intersections, turning lane widths may be reduced to a minimum of 9 ft, with justification documented within the [Context and Modally Integrated Design Collaborative Memorandum](#) identifying the selected design vehicle and users for the specific turning movements. (See [Chapter 1310](#) for turn lane geometric design considerations.) If transit or heavy freight uses are anticipated, consider 11-ft lanes as a minimum.
- [6] Medians within the main street avenue segment will likely be vegetated; the Landscape Architect should consult with responsible maintenance jurisdiction and traffic engineer prior to finalization of plant type selection. Medians may also be used as pedestrian refuges; consult [Chapter 1510](#) for ADA design requirements if this function is provided. The median width will vary depending on function, but should not be less than that required to support plants, curbs, and other features. Median openings shall be carefully located to provide for preplanned, appropriately spaced intersections.
- [7] Refer to [Chapter 1230](#) if normal crown section cannot be achieved.
- [8] If measured speeds are higher than the target speed entering the main street segment, refer to [1150.02](#) and consider traffic calming designs to reduce speeds.
- [9] Locations planned for four lanes should consider applying a median treatment with use as a pedestrian refuge island.

### 1150.05(1) Target Design Speed

When designing with a specific context in mind, designs should “target” a specific speed. Deciding on a design speed requires that you consider the greater corridor context and the context of segments adjacent to the main street. It may be necessary to include speed transition segments to responsibly reduce operating speeds to the targeted values. Within the main street segment, select design elements and features, from lane widths to roadside treatments, that help maintain the operating speed at the desired target value to reduce speed differential and support modal integration. Traffic calming speed-reducing treatments are inherent with the main street design, and will likely be sufficient to maintain operating speeds within the main street segment. Many main streets have the advantage of winding through towns on old alignments that may also assist in maintaining targeted vehicle speeds.

### 1150.05(2) Speed Management

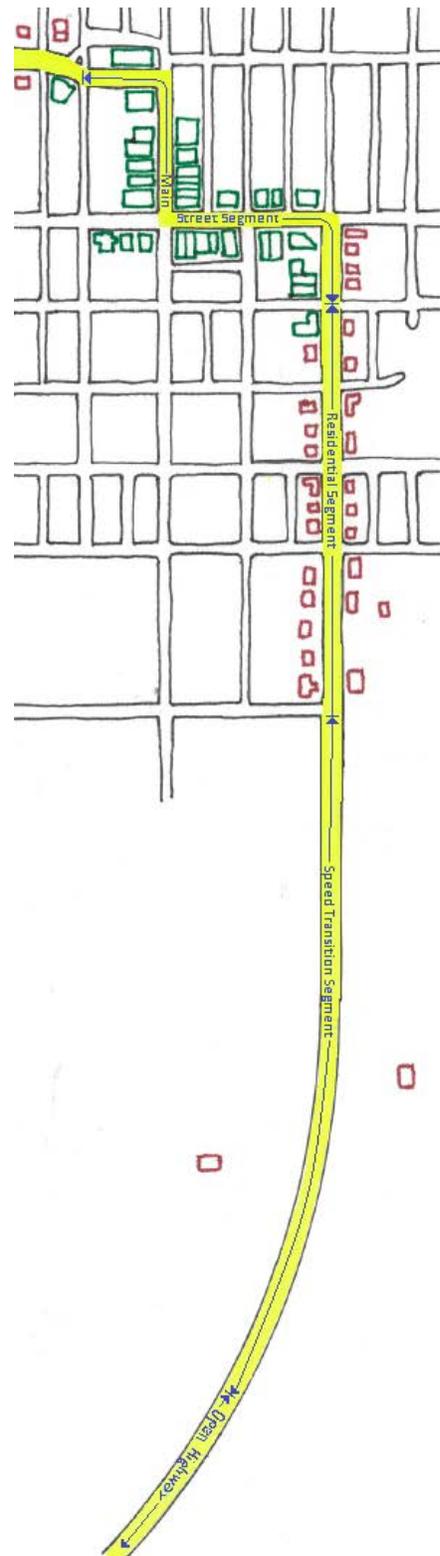
Speed management is necessary within the main street segment to achieve an optimal multimodal transportation environment. Speed management may also be necessary preceding the main street segment to ensure vehicles enter the main street at the desired targeted speed. If existing operations demonstrate a speed management need preceding the main street segment, consider the possible need for speed transition segment(s), and identify the appropriate milepost limits when scoping main street projects.

#### 1150.05(2)(a) Speed Transition Segments

Include a speed transition segment where there is a need to lower speeds preceding the main street segment. You can exclude the speed transition segment when speed studies indicate that existing operating speeds are within 5 mph of the target speed upon entering the main street segment. Carefully plan the location of any speed transition segment. The transition segment may not always directly precede the main street segment. There could be other low-speed context segments (like a residential segment) that would benefit from introducing a speed transition segment earlier.

The speed transition segment may incorporate a variety of traffic calming treatments, which are intended to alert motorists to a changing roadway environment. These treatments may narrow driver focus and have impacts on decisions necessary to operate on that segment. These demands on the driver will influence the transition segment location and length. Driver focus should be on speed reduction, not on other decisions or information.

Exhibit 1150-10 Speed Transition Segment



### **1150.05(2)(b) Vehicular Speed Reduction and Traffic Calming Treatments**

Posting speed reductions, without other treatments, is not considered a reliable method to reduce operating speeds. You may apply a number of traffic calming treatments independently or combine them to either maintain speeds or lower operating speeds. Given that many speed management treatments have demonstrated varied effectiveness in research to date, any project implementing a speed transition segment should contact the HQ Design Office to coordinate monitoring treatments and their effectiveness.

Consider the elements in each treatment before applying it to the design. You must understand the specific transportation context for the corridor and segment needs in order to evaluate the potential trade-offs utilizing any individual or combination of treatments. Consider the following potential traffic calming treatments within the main street design.

#### **1150.05(2)(a)(1) Geometric Treatments**

Geometric treatments can include overall changes of the horizontal alignment to introduce both curves that will support maintaining the targeted speed and vertical elements such as raised intersections. [Exhibit 1150-10](#) shows geometric traffic calming treatments and potential considerations when selecting the treatments.

#### **1150.05(2)(a)(2) Roadside and Pavement Treatments**

There are a number of treatments that rely on creating an environment that influences human factors and perception. Several of the roadside treatments utilize landscaping benefits to create the desired behavioral effect. Landscaping will generally fall outside WSDOT jurisdictional control; however, it is important to coordinate with project partners and evaluate landscaping features to ensure traveled way operations and sight lines occur as desired. At the very least, you can introduce roadside features like trees, parking, and/or bicycle lanes to alert travelers to a change in conditions. Applying features like vegetated medians or trees can improve the experience of all modes. Carefully plan the trees planted for traffic calming purpose and prepare soil appropriately so that the desired effect occurs when the trees reach maturity. In landscaping discussions, include Traffic Engineers, Maintenance, Urban Forestry, Landscape Architects, and Human Factors/Safety Experts.

Pavement-related treatments can also produce undesirable impacts on other users. For pavement treatments, include Materials Engineers, Maintenance, and ADA Compliance Experts to ensure a sustainable and effective treatment is employed without impacting the needs of other users.

[Exhibit 1150-11](#) lists roadside and pavement-oriented traffic calming treatments and considerations to evaluate when selecting the appropriate treatments.

Exhibit 1150-11 Geometric Traffic Calming Treatments and Considerations

Treatment	Considerations
<b>Taper for Narrow Lanes</b>	Narrowing the lane width can be achieved by restriping lane lines. A decision to taper in or out may depend on other treatments planned, such as introducing a median or chicanes. Taper rates should be based on the posted speed entering the context or speed transition segment, as appropriate. It is recommended that this be the first treatment employed.
<b>Chicanes/Lane Shifts</b>	This treatment may be achieved with curbed features, like planter strips, or striping combined with additional fixed delineators. These treatment types are more appropriate when lowering from an initial speed of 45 mph or less and on existing curbed roadway sections. When introducing this treatment with initial speeds higher than 45 mph, the treatment should utilize paint striping, in addition to using other treatments preceding the chicane/lane shift.
<b>Pinchpoints</b>	Pinchpoints are not appropriate when transitioning from high speed to main street target speeds unless completed with striping or other pavement markings. This treatment uses striping, roadside features, or curb extensions to narrow the vehicle thoroughfare. This treatment is likely more appropriate within the main street segment than within a speed transition segment.
<b>Speed Cushion/Humps/Tables</b>	On state highways, this treatment will likely have limited application, but should not be excluded from consideration. Impacts to freight, transit, and emergency service vehicles need to be evaluated prior to selecting these vertical types of treatments. These treatments may only be used within the main street segment, and are not to be used within the speed transition segment.
<b>Raised Intersections</b>	Raised Intersections, similar to other vertical treatments, will have limited application on state highways. This treatment typically has higher costs to construct due to the pavement needs and impacts to drainage. This treatment may be a good option when a roundabout cannot be accommodated. This treatment can also be considered where there is a need to improve visibility of the intersection and modal conflicts, especially at problematic stop control intersections planned to remain in place.
<b>Roundabouts</b>	Roundabouts can be a unique feature, providing reduced serious injury collision potential, traffic calming, and gateway functions. (See <a href="#">Chapter 1320</a> and the <i>Roadside Policy Manual</i> for details on roundabout design.) Roundabouts are effective from a collision reduction and operational perspective, and provide reduced decision making, lower speeds, and limited conflict points. They can assist with access management or when turning movements are limited or restricted on a segment. To determine if a roundabout is appropriate at a specific location, follow the Intersection Control Analysis process described in <a href="#">Chapter 1300</a> .

Exhibit 1150-12 Roadside and Pavement-Oriented Traffic Calming Treatments

Treatment	Considerations
<b>Landscaping</b>	Landscaping can be used in conjunction with other treatments to reinforce the surrounding context and the driver's perception of the context. It also can provide width for modal separation. Annual maintenance impacts need to be considered, weighed, and documented prior to selecting types of vegetation to be included.
<b>Vegetative Medians</b>	Introduction of a raised vegetated median should follow other treatments that prepare the driver for this feature within the roadway.
<b>Transverse Rumble Strips</b>	These in-lane rumble strips are intended to alert drivers to a condition change. They are likely placed in conjunction with and prior to traffic signing revisions or in advance of other speed-reducing traffic calming treatments.
<b>Transverse Edge Striping</b>	This treatment is intended to influence a driver's perception. The treatment consists of transverse paint strips from the fog line to edge of pavement (or curb). The striping intervals sequentially decrease, providing the perception of increasing speed, an indication to drivers to slow their operating speed. Transverse edge striping is ideal for speed transition segments, and is recommended to be applied in conjunction with narrow lanes. It should be understood that this treatment may not be effective at locations where snow may frequently cover the shoulders.
<b>Gateways</b>	The intent of a gateway feature is to alert travelers to a context change. A gateway feature is typically found on the edge of cities or towns, but can be used to highlight specific segments within cities or towns. The gateway can be anything from a banner/structure spanning the facility, to artistic work, landscaping, and/or a roundabout at the first intersection approaching a defined environment context. The gateway feature should be developed by the community. It may be of interest to design a gateway feature fitting the cultural and historic character of the main street context segment. Consideration for potential fixed object collisions is an important aspect of gateway design. Gateway features that span or are placed within state right of way will need specific approvals, as identified in <a href="#">Chapter 950</a> . Include Region Real Estate Services, as a lease or other future impacts from the gateway feature need to be understood.

### 1150.05(3) Design Vehicle

The main street design vehicle selection should represent the majority of modal users characterized by the segment context, which may lead to a complex evaluation. Historically, highways have been designed and built for freight traffic, and these vehicles should not be excluded from planning or design. It is important to understand the needs of large vehicles at both the corridor and segment levels, keeping in mind that design vehicle selection may vary along the segment and at different intersection locations. It is important to determine the local origins and destinations of large vehicles, and strategically plan to accommodate their uses at specific intersection locations and when considering what types of speed-reducing traffic calming treatments are selected in later design. Planners/designers need to work with community and service providers (like school buses and emergency services) to define the threshold for infrequent use. The purpose of providing this flexibility is to avoid overbuilding elements of the main street segment that may create unnecessary trade-offs for other modes.

The main street segment design vehicle will likely be different than the design vehicle needed on adjacent segments of the same corridor. Where a main street intersection supports transit or a school bus route, the CITY-BUS design vehicle may be your logical choice. Some routes may cater to seasonal recreational travel demands that you may need to consider when determining the transportation context for the segment and appropriate design vehicle. Document the design vehicle selection within the Context and Modally Integrated Design Collaborative Memorandum (see [1150.08](#)).

#### **1150.05(4) Intersection Curb Radius**

The main street intersection curb return radii without curb extensions should be designed as small as practicable, considering the benefits and impacts to pedestrians, bicycles, and freight, by providing for the common vehicle type. Use turn simulation software (such as AutoTURN®) to lay out how turning movement accommodations will operate, for both the selected design vehicle and infrequent larger vehicles. Work with the community to properly plan intersection locations that provide additional accessibility for large vehicles within the project limits and elsewhere on the local network. Consult [Chapter 1300](#) to determine the appropriate intersection type, and [Chapter 300](#) for intersection design approval documentation processes.

#### **1150.06 Maintenance Elements, Planning, and Considerations**

When considering adapting or retrofitting main street areas, it is important to understand how the proposed design will impact maintenance, at both the state and local level. Involve maintenance jurisdiction(s) throughout the planning and design process; they can help you understand their capabilities and the reasonable accommodations necessary for frequent maintenance operations. To understand the likely split between local and state jurisdictions, refer to the *Conformed Agreement... for the Construction, Operations and Maintenance Responsibilities...*: [www.wsdot.wa.gov/localprograms/lag/construction.htm](http://www.wsdot.wa.gov/localprograms/lag/construction.htm)

Some maintenance and operations agreements between state and local agencies exist for streets that are also state highways, and are important to the success of main street projects. These agreements may need to be created, updated, or replaced due to the nature of the main street project or retrofit. They need to identify the maintenance, operation, and jurisdictional boundaries, roles, and responsibilities of the parties entering into the agreement, including liability, indemnification, and insurance. The Conformed Agreement (above) lists the likely split of jurisdictional responsibilities; however, maintenance jurisdiction(s) may want to create an operational plan or agreement for the infrequent maintenance functions that designs may not be able to accommodate. It is possible that one maintenance jurisdiction will be better equipped to handle certain maintenance elements than another. It will be necessary to document the split of maintenance responsibilities even if responsibilities remain the same as those listed within the Conformed Agreement.

Agreements require a level of detail that will not be known early in project development, so it is important that you document trade-offs, benefits, and impacts with the affected maintenance jurisdictions while early decisions are being made. Use the [Context and Modally Integrated Design Collaborative Memorandum](#) to capture these early discussions, potential solutions, and decisions until they can be formalized in an agreement. The following sections list some elements and specific treatments that should be given attention if proposed within the main street design. The final maintenance agreement needs to be part of all main street projects; it should be entered into as early as possible during project development and executed prior to construction completion, preferably prior to beginning of construction.

### 1150.06(1) Treatment Considerations for Maintenance

Several permanent and interim treatments are likely to change the characteristics of the traveled way and streetside areas. These changes may have an effect on the maintenance methods, frequency, and/or operations needed to support the maintenance activity. It is important to partner early with the maintenance jurisdiction(s) to help you understand the potential capabilities and long-term benefits/impacts related to any individual or series of treatments.

#### 1150.06(1)(a) Curb Extensions and Striping Treatments

In some cases, retrofitted curb extensions are placed in such a manner that the original stormwater drainage path is maintained (see Exhibit 1150-13). Grates are used to provide both drainage and accessibility to the curb extensions. Grates can help filter leaves, and when designed appropriately, they can be easily removed to clean the gutter flow path.

When interim solutions are pursued, there may be situations where a painted curb extension or extended sidewalk is evaluated in the planning/design process. Interim design options allow for painted curb extensions when combined with an MUTCD-approved fixed delineator. These painted treatments may prevent traditional mechanical street sweeping from accessing the curb line, and may require alternate maintenance methods.

Explore the following additional considerations when evaluating these types of retrofit and interim treatments:

- Understand the treatment maintenance frequency, including how any selected landscaping included with the treatment may affect seasonal maintenance needs.
- Discuss the likely method of maintaining these features and the necessary support operations.
- Ensure the catch basins remain easily accessible for cleaning.
- Understand the annual maintenance costs.
- Depending on the duration planned for the interim fix, determine the cost impact of providing the treatment and supporting features. Weigh this trade-off against the benefits of providing the long-term treatment option.
- As applicable, determine which maintenance jurisdiction should be responsible for the maintenance.

**Exhibit 1150-13 Curb Extension Retrofit With Drain Grate, Olympia, WA**



*Photo credit: Andrew Beagle*

### 1150.06(1)(b) Various Traffic Calming Treatments

Many traffic calming treatments include additional paint for delineation of desired geometrics. As vehicles traverse these paint lines, there are potential needs to increase the maintenance for these painted treatments. Maintenance jurisdictions need to be aware of the potential impacts as these treatments are deployed, in order to maintain the desired targeted speed. Discuss the additional impacts of snow plows on segments that have frequent snowfall and take the impacts into account when selecting the material type and placement method.

Vertical traffic calming and speed-reducing treatments like raised intersections or speed humps can expect advanced pavement degradation at the joints, as additional forces are exerted while traversing off the vertical treatment. Additional maintenance patching will likely be needed to prevent potholing and cracking in these areas. Vertical treatments are likely not appropriate for locations that experience snowfall and have frequent plowing needs.

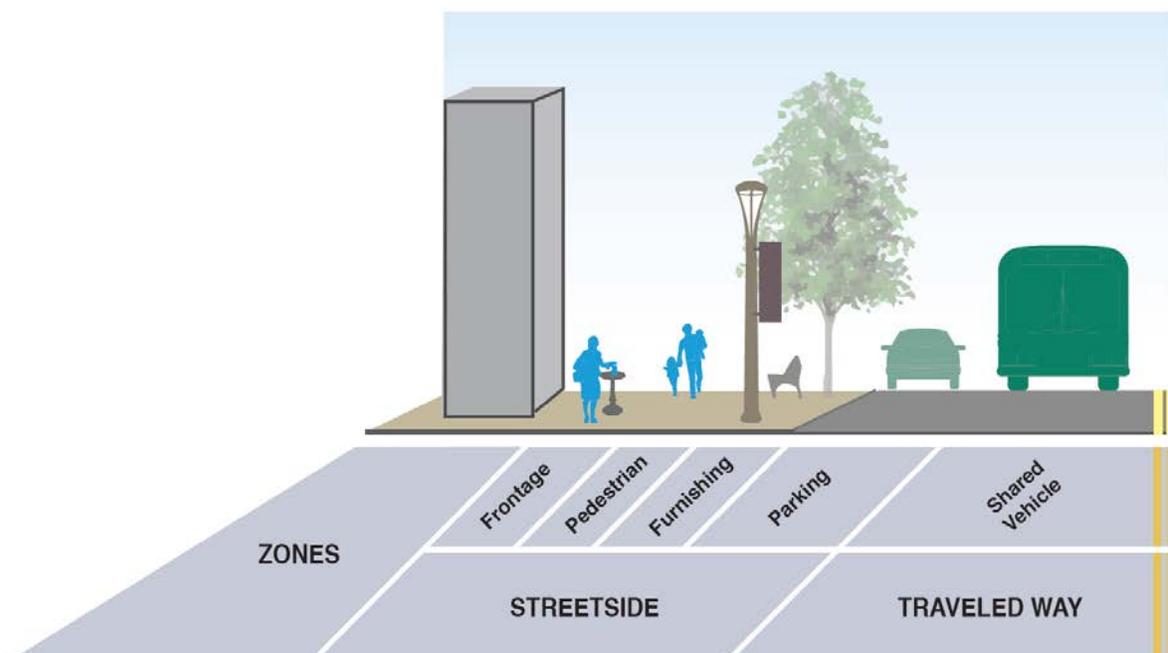
### 1150.06(1)(c) Landscaping Treatments

Different types of landscaping may affect other elements (such as stormwater conveyance and sight distance), and will be reflected in the maintenance needs. Landscaping presents potential for both maintenance and operational concerns that may not be apparent until vegetation reaches maturity. At all stages of planning and design, applicable maintenance jurisdictions and traffic engineers need to identify potential concerns and considerations for type and location of landscaping features and work with the Landscape Architect to understand how the landscaping will change over time.

### 1150.06(1)(d) Snow Plowing Considerations

In locations that regularly receive snow fall that necessitates frequent plowing, it is important to understand the equipment limitations of the maintenance jurisdiction as well as providing planned locations along the segment for snow banking. When curb extensions are present, consider vertical features, such as bollards, to increase visibility for the snow plow operator.

Exhibit 1150-14 Potential Main Street Cross Section



### **1150.06(1)(e) Signal, Illumination and ITS Considerations**

Devices and support systems for signal, illumination, and ITS elements will likely be placed within the furnishing zone or other streetside zone if the furnishing zone is not applied in a given project. Once maintenance responsibility and ownership for these systems is defined, it is important to work with Traffic Engineers and Maintenance to consider providing consistent systems throughout the segment or corridor, as well as equipment that meets the needs of the identified maintenance jurisdiction.

## **1150.07 Retrofitting Main Street Segments**

The majority of main street projects will likely be retrofit projects conducted by local agencies or in partnership with local agencies as part of a WSDOT project. Retrofit projects are often constrained by available cross-sectional right of way, existing built environment, and funding. Implementing a retrofit project will require coordination and may include interim low-cost options such as painted sidewalk widening, planter boxes, and bollards. These interim designs can help a community reach practical design goals and realize its main street vision.

### **1150.07(1) Interim Design Options**

When the target speed and overall widths are determined, lower-cost interim options can be implemented as funding allows. Interim options should be evaluated periodically, and may be kept as permanent treatments if performance is consistent with stated goals, and the community and WSDOT agree.

Implementing interim design options on a state highway requires documentation within the [Context and Modally Integrated Design Concurrence Memorandum](#). In this documentation, include additional discussions related to prioritizing and phasing plans for the ultimate features planned, with considerations for potential funding constraints.

Consider the following low-cost options for temporary or permanent installations.

#### **1150.07(1)(a) Relocate Curbs**

Several interim options become viable simply by moving the “curb” to the ultimate streetside width. While installing a new curb may be preferred, there are a number of additional considerations (like stormwater conveyance and treatment) that make it cost-prohibitive. However, there are multiple potential solutions that can provide effective accommodation, including, but not limited to:

- Striping combined with [MUTCD](#)-approved channelizing devices.
- Curbed extensions offset from the original curb. Depending on the use of the new curbed section, designs may include slotted grates tying the original curb and new curb section together for pedestrian needs, while maintaining the original stormwater conveyance system.

Use these interim features to create wider sidewalk areas, curb extensions, bicycle parking areas, parklets, and/or green street alternatives.

### 1150.07(1)(b) Parklets

In either a permanent planned condition or as an interim filler, parklets reuse existing right of way to provide public space and support commercial activities (see [Exhibit 1150-15](#)), which might offer the local jurisdiction a way to collect rental revenue for their road and street fund. Their design will vary depending on local regulations within each main street jurisdiction, but typically includes a raised platform extending into the parking zone from the existing curb. The platforms are free draining and allow stormwater collection using the existing system. Parklets typically include railing and/or planter boxes to provide a separation of uses between people and traffic. Parklet design should not cover catch basins or other features that may require frequent maintenance. Parklets interact with the vehicular modes best when placed on a tangent alignment.

The primary intent of presenting these treatments is not to preclude their potential placement, when appropriate; however, there are many other potential constraints external to the engineering design that need to be identified and resolved first. Consult Real Estate Services to discuss the specific property management-related concerns and any potential lease and economic payment considerations proportionally appropriate for utilization of the highway space in this manner, as further detailed in [RCW 47.24.020\(15\)](#).

[Exhibit 1150-15](#) Parklet on 5th Ave, Olympia, WA



Photo credit: Sandy Salisbury

## 1150.08 Documentation Support

The importance of collaboratively documenting decisions during the project conception and development process cannot be overstated. It is vital that all partners understand how and why decisions were made throughout development. Early discussions and decisions enable the project to focus on known decisions rather than assumptions. Context and modally integrated design depends on collaboratively understanding the community and corridor visions and how specific performance targets informed evaluating trade-offs for decision making.

### 1150.08(1) *Evaluating Trade-offs*

Perform a trade-off evaluation as part of the documentation process for designs that implement the guidance in this chapter. The purpose of this trade-off evaluation is to determine the optimum design approach given the corridor vision; the various physical, social, and environmental constraints; and applicable policies. The decisions necessary to determine the benefits and impacts associated with design options and criteria during the course of a trade-off evaluation are more complex and interrelated on a main street highway segment than on a typical open highway segment. Many trade-offs identified during an evaluation will result in both benefits and potential impacts to specific users or stakeholders. NCHRP [Report 642 – Quantifying the Benefits of Context Sensitive Solutions](#) and WSDOT’s [Understanding Flexibility in Transportation Design – Washington](#) are the primary references for understanding the methods for establishing collaborative performance measures and evaluating trade-offs.

Prior to the trade-off evaluation, develop a project purpose and need statement based on an examination of the goals, objectives, and visions established in consultation with the project stakeholders. During this process, also identify specific performance measures that reference documented stakeholder needs. As the design work proceeds, reference these performance measures to evaluate and select project design options and specific features, such as the type of vegetation used for landscaping or the design vehicle required at specific locations along the project.

Begin trade-off evaluations with a preliminary qualitative analysis, comparing the proposed elements against the agreed upon performance measures (see above). The qualitative trade-off evaluation may result in consensus on a preferred design option; however, it may only help narrow the field of options. In case of the latter, perform a more quantitative trade-off evaluation to compare the remaining design options.

Multiple performance measures are expected when evaluating design options using this chapter. Pending conversations with the community and other stakeholders regarding potential performance measures, consider the following list of suggested trade-off categories:

- Maintenance requirements
- Local accessibility
- Pedestrian connectivity and safety
- Network operation
- Segment vehicular capacity
- Freight mobility and large vehicular accommodations
- Bicycle connectivity and safety
- Parking accommodations

- Speed management
- Support of existing and/or planned land use
- Livability and social integration
- Cultural/historic resources
- Environmental/natural resources
- Other categories established by the vision

Once identified, use performance measures to evaluate both the overall design options and the design features or options as described above. As planning and design progress and details are understood, it will be necessary to revisit the evaluation at project milestones to confirm the suitability of the preferred design option, or to trigger reevaluation of design options or features based on new information or unidentified constraints.

### **1150.08(2) Context and Modally Integrated Design Collaborative Memorandum**

A Context and Modally Integrated Design Collaborative (CMIDC) Memorandum is the mechanism for documenting both the evaluation of trade-offs and early decision making. Note that there is no strict format for the CMIDC Memorandum. The general elements for the memorandum are provided below. It is understood that each project memorandum will have a varied complexity of project development and partnering needs. The Memorandum should include the following information:

- **Introduction and CMIDC Memorandum Intent**

It needs to be understood and clearly communicated with the community and stakeholders that consensus reached by this document does not constitute a commitment. This is a living document to provide a design framework and shared understanding of trade-offs, preliminary agreements, potential benefits, and other issues. The document will help guide and facilitate decision making as the project design progresses. The iterative process of design needs to be discussed, and the potential need to revise this Memorandum as opportunities or risks are realized must be identified.

- **Community and Corridor Vision**

Discuss elements and objectives of the shared vision established by the community and stakeholders. As discussed in [1150.03](#), the comprehensive plan and other local plans will contain information related to the city or community's vision. Local complete streets policies, if in place, also need to be identified and sited in this section of the memo. It is also important to incorporate WSDOT's vision for the corridor as identified by the corridor summary reports and/or the Highway System Plan. The objective is to find consistency and balance between potential conflicts in the local and regional visions to guide the project development and decision making. Consult with the region Planning Office for assistance, particularly regarding local planning efforts.

- **Existing Route Geometric Characteristics**

Describe the general route characteristics and the location of the main street segment, as well as any other potential adjacent segment context environments (this may be qualitatively assessed). Both the route and segments within the route should provide tabular data listing milepost, functional class, NHS status, number of lanes, posted speed, operating speed (if known), ADT, and truck percentage. Augment the discussion with photos from each location described.

- **Collision Diagnostics**

Consult with the region Planning or Traffic Office to present collision information and diagnosis. Describe the collision frequency, severity, type, user, impairment, lighting, and roadway conditions. A collision diagram will assist in diagnosing any collision-related issues currently present that may benefit from corrective action or countermeasures on the project. A Safety Analyst can assist with the above diagnostic evaluation (see [Chapter 321](#)).

- **Performance Measures**

Discuss the selected performance measures, how they were established, who participated, descriptions of each, and how they contribute to the vision, as well as the corridor and segment level purpose and need.

- **Trade-Off Methodology and Procedures**

Discuss methods used to evaluate trade-offs, such as qualitative and quantitative evaluation matrices, who participated, and descriptions of each design option weighed. Methods identified by NCHRP [Report 642 – Quantifying the Benefits of Context Sensitive Solutions](#), or those described in WSDOT’s [Understanding Flexibility in Transportation Design – Washington](#), can be used to assist in trade-off evaluations.

- **Discussion of Specific Design Controls and Speed Management Treatments**

Establish the preliminary design speed and vehicles being targeted for the segment or at specific locations. This section will also discuss the need for and location of the speed transition segment. For example, the primary design vehicle for the segment may be an SU-30, but at certain intersections, large-vehicle accommodations are made as the result of discussions or analysis of their needs. Assumptions and a qualitative risk matrix developed with the community are encouraged.

- **Potential Deviations or Documentation Requirements**

This is a preliminary understanding of design elements and how specific elements may require additional documentation as design progresses; for example, the decisions to include a midblock crossing and/or preliminary intersection control types. Information and decisions documented here may assist with early deviation identification and reporting through the Design Variance Inventory System (DVIS) (see [Chapter 300](#)).

- **Preliminary Maintenance Decisions and Jurisdictional Understanding**

This will provide a preliminary framework for any potential maintenance agreement(s) that may be necessary. It is important that all maintenance jurisdictions are present during these discussions, so that the alternatives that may adversely impact maintenance can be discussed, and a preliminary understanding of the potential obligations of each respective jurisdiction can be outlined.

- **Discussion of Project Design Options**

Provide a written description of the different project design options considered. If possible, provide visuals that illustrate each option and the various cross-sectional elements.

- **Schedule, Phasing, and Funding**

There is potential that funding partnerships will need to be discussed as early as possible. WSDOT representatives may need to assist in discussing potential funding limitations, potentially available funding sources with the community or local agency, and how to pursue those funding needs and the effect on the schedule.

- **Endorsement**

Given the importance of decisions resulting from this Memorandum, it is necessary that several WSDOT representatives are signatories, such as: Region Traffic Engineer, Project Development Engineer, Program Manager, Planning Manager, Highways and Local Programs Manager, Maintenance Superintendent, Region Landscape Architect and the Assistant State Design Engineer. Local agency partners and the community participants will also endorse this document. The number of signatories is necessary to demonstrate that decisions are made under a collaborative effort, with an interdisciplinary team.

Depending on when the CMIDC Memorandum is first produced, it will require re-engaging the community and stakeholders at various planning and design milestones. The Memorandum will be updated and endorsed preceding completion of the following project milestones:

- Corridor Summary Report Submittal
- Project Summary Complete (required)
- NEPA/SEPA<sup>1</sup> Complete (as applicable)
- Design Approval (required)
- Project Development Approval (required)

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<sup>1</sup> National Environmental Policy Act/State Environmental Policy Act

## 1150.09 References

### 1150.09(1) *Federal/State Laws and Codes*

- [RCW 35.78.040](#) – City streets – Design standards.... – Approval of deviations
- [RCW 46.61.400](#) – Speed restrictions – Basic rule and maximum limits
- [RCW 46.61.415](#) – Speed restrictions – When local authorities may... alter maximum limits
- [RCW 47.04.330](#) – Street projects – Consultation with local jurisdictions – Context sensitive design solutions
- [RCW 47.24.010](#) – Designation – Construction, maintenance – Return to city or town
- [RCW 47.24.020](#) – City streets as part of state highways – Jurisdiction
- [RCW 47.30.060](#) – Expenditures deemed to be for highway purposes – Powers and duties of department – Restrictions on use of paths and trails
- [WAC 468-18-050](#) – DOT city/county project coordination – Policy on the construction, improvement and maintenance of intersections

### 1150.09(2) *Design Guidance*

- [Local Agency Guidelines](#) (LAG), M 36-63, WSDOT, used for local agency projects
- [Manual on Uniform Traffic Control Devices for Streets and Highways](#), USDOT, FHWA; as adopted and modified by [Chapter 468-95 WAC](#) “Manual on uniform traffic control devices for streets and highways” (MUTCD)
- [Plans Preparation Manual](#), M 22-31, WSDOT
- [Right of Way Manual](#), M 26-01, WSDOT
- [Roadside Policy Manual](#), M 3110.01, WSDOT
- [Utilities Manual](#), M 22-87, WSDOT

### 1150.09(3) *Supporting Information*

- [A Guide to Achieving Flexibility in Highway Design](#), AASHTO, 2004
- [A Policy on Geometric Design of Highways and Streets](#) (Green Book), AASHTO, current version
- [Designing Walkable Urban Thoroughfares: A Context Sensitive Approach](#), ITE, 2010
- [Executive Order 1028, Context Sensitive Solutions](#), WSDOT
- [Guide for the Development of Bicycle Facilities](#), AASHTO, 1999
- [Guide for the Planning, Design and Operation of Pedestrian Facilities](#), AASHTO, 2004
- [Main Street...when a highway runs through it: A Handbook for Oregon Communities](#), ODOT, 1999

NCHRP *Report 600 – Human Factors Guidelines for Road Systems: Second Edition*, TRB, 2012

NCHRP *Report 642 – Quantifying the Benefits of Context Sensitive Solutions*, TRB, 2009

*State Highways as Main Streets: A Study of Community Design and Visioning*, WSDOT, 2009

*Understanding Flexibility in Transportation Design – Washington*, WSDOT, 2005

*Urban Bikeway Design Guide*, 2<sup>nd</sup> Edition, NACTO

*Urban Street Design Guide*, NACTO

*Washington’s Complete Streets & Main Street Highways Program*, WSDOT, 2011

- 1300.01 General
- 1300.02 References
- 1300.03 Intersection Control Objectives
- 1300.04 Common Types of Intersection Control
- 1300.05 Design Vehicle Selection
- 1300.06 Procedures
- 1300.07 Documentation

## 1300.01 General

It is WSDOT practice to analyze potential intersection solutions at all intersection improvement locations in accordance with *Business Practices for Moving Washington*, and strive to provide the optimum solution within available limited resources. The analysis may be done for individual intersections, or on a corridor basis. This chapter provides guidance on preliminary intersection analysis and selection of control type. Intersection design is completed using [Chapter 1310](#) for the geometrics of intersections, [Chapter 1320](#) for roundabouts, and [Chapter 1330](#) for traffic signals.

Intersections are an important part of highway design. They comprise only a small percentage of the overall highway system miles, yet they account for a high percentage of reported collisions.

Traffic and driver characteristics, bicycle and pedestrian needs, physical features, and economics are considered in selecting traffic control that facilitates efficient multimodal traffic flow through intersections. Signs, signals, channelization, and physical geometric layout are the major tools used to establish intersection control.

Typically, potential project locations will have been identified through the safety improvement priority programming process [described in Chapter 321](#), a necessity for a mobility project for congestion improvement, commercial development, or other improvement project.

An Intersection Control Analysis (ICA) should be completed as early in the design development process as feasible. ***The level of effort of the ICA should be scalable to the project***; for example, evaluation of adding a turn lane to an existing intersection control may take less effort than evaluating new intersection control. This may occur during planning or corridor studies, but should not be initiated later than the scoping stage of a project. Data-based knowledge and scientific evaluation provides the basis for a rational engineered improvement.

When analysis determines that an at-grade intersection cannot provide adequate service, consider a grade separation, or partial or full interchange. Evaluate grade separation alternatives for intersections on rural expressways, both National Highway System (NHS) and non-NHS. The ramp terminal intersections are subject to the analysis requirements of this chapter. (See [Chapters 1360](#) and [550](#) for further guidance.)

For additional information, see the following chapters:

Chapter	Subject
<a href="#">320</a>	Traffic analysis
<a href="#">321</a>	<u>Sustainable Safety</u>
<a href="#">530</a>	Limited access control
<a href="#">540</a>	Managed access control
<a href="#">550</a>	Interchange Justification Report
<a href="#">1310</a>	Intersections
<a href="#">1320</a>	Roundabouts
<a href="#">1330</a>	Traffic signals
<a href="#">1360</a>	Interchanges
<a href="#">1510</a>	Pedestrian facilities
<a href="#">1515</a>	Shared-use paths
<a href="#">1520</a>	Bicycle facilities

## 1300.02 References

### 1300.02(1) Federal/State Laws, Codes, and Policies

[Revised Code of Washington \(RCW\) 46.61](#), Rules of the road

[Washington Administrative Code \(WAC\) 468-52](#), Highway access management – access control classification system and standards

Intersection Control/Modification Process, Highway Safety Executive Committee (HSEC) Policy Paper, April 2012, WSDOT

[Secretary's Executive Order: E 1082](#), Business Practices for Moving Washington, August 2012, WSDOT

### 1300.02(2) Design Guidance

*A Policy on Geometric Design of Highways and Streets* (Green Book), AASHTO

*Highway Capacity Manual* (HCM), latest edition, Transportation Research Board, National Research Council

[Local Agency Guidelines](#) (LAG), M 36-63, WSDOT

[Manual on Uniform Traffic Control Devices for Streets and Highways](#), USDOT, FHWA; as adopted and modified by [Chapter 468-95 WAC](#) "Manual on uniform traffic control devices for streets and highways" (MUTCD)

[Standard Plans for Road, Bridge, and Municipal Construction](#) (*Standard Plans*), M 21-01, WSDOT

### 1300.02(3) Supporting Information

*Highway Safety Manual* (HSM), AASHTO

*Roundabouts: An Informational Guide*, FHWA-RD-00-067, USDOT, FHWA

*Roundabouts: An Informational Guide*, Second Edition, NCHRP Report 672, Transportation Research Board, 2010

*A Review of the Signalized Intersections: Informational Guide*. FHWA-HRT-04-092, USDOT, FHWA, APRIL 2004

[www.fhwa.dot.gov/publications/research/safety/04092/](http://www.fhwa.dot.gov/publications/research/safety/04092/)

Buckholz, "Choosing Intersection Control." *IMSA Journal*, Nov/Dec 2002.

[www.imsasafety.org/journal/nd02/buckholz.pdf](http://www.imsasafety.org/journal/nd02/buckholz.pdf)

Kuciemba, S. R., and J. A. Cirillo. *Safety Effectiveness of Highway Design Features, Volume V: Intersections*, Report No. FHWA-RD-91-048, Federal Highway Administration, November 1992.

Luttrell, Greg, Eugene R. Russell, and Margaret Rys. "A Comparison of a Roundabout to Two-way Stop Controlled Intersections with Low and High Traffic Volumes," Kansas State University

NCHRP Report 500, *Guidance for Implementation of the AASHTO Strategic Highway Safety Plan, Volume 5: A Guide for Addressing Unsignalized Intersection Collisions*, Transportation Research Board, 2003

[http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp\\_rpt\\_500v5.pdf](http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_500v5.pdf)

NCHRP Report 500, *Guidance for Implementation of the AASHTO Strategic Highway Safety Plan Volume 12: A Guide for Reducing Collisions at Signalized Intersections*, Transportation Research Board, 2004

[onlinepubs.trb.org/onlinepubs/nchrp/nchrp\\_rpt\\_500v12.pdf](http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_500v12.pdf)

*Synthesis of the Median U-Turn Intersection Treatment, Safety, and Operational Benefits*, FHWA-HRT-07-033, USDOT, FHWA

*Alternative Intersections/Interchanges: Informational Report (AIIR)*, FHWA-HRT-09-060, Hughes et al., USDOT, FHWA, 2010

*Field Evaluation of a Restricted Crossing U-Turn Intersection*, FHWA-HRT-12-037, USDOT, FHWA  
[Roundabouts and Sustainable Design](#), Ariniello et al., *Green Streets and Highways – ASCE*, 2011

### 1300.03 Intersection Control Objectives

Intersections make up the majority of potential transportation conflict areas. Good intersection design is used for reasonably safe and efficient travel by auto, truck, bus, motorcycle, pedestrian, and other travel modes. Coordinate design with existing adjacent intersections.

Intersection control choice requires consideration of all potential users of the facility, including drivers of motorcycles, passenger cars, heavy vehicles of different classifications, public transit, and bicyclists and pedestrians.

Drivers have varying skills and abilities. Elderly drivers in particular are subject to increased reaction time, decreased ability to perceive visual cues, and decreased head and neck flexibility. While there is evidence that older drivers are aware of some decline in their abilities and therefore adjust their driving patterns, some of their changes can lead to more travel on local roads and thus more exposure to intersection conflict. *These considerations have been factored into the guidance for intersection design.*

Meeting the needs of one user group can result in compromising service to others. The selection process balances these competing needs, resulting in appropriate levels of operation for all users.

With consideration for sustainable transportation practices, four basic elements should be well thought out in intersection design:

<b>Intersection Design Elements</b>	
<b>Human Factors</b>	
➤ Driving habits	➤ Conformance to natural paths of movement
➤ Ability of drivers to make decisions	➤ Pedestrian use and habits
➤ Driver expectancy	➤ Bicycle traffic use and habits
➤ Decision and reaction time	➤ Demand for alternative mode choices
<b>Traffic Considerations</b>	
➤ Classification of each intersecting roadway	➤ Vehicle speeds
➤ Design and actual capacities	➤ Transit involvement
➤ Design-hour turning movements	➤ Crash experience
➤ Size and operating characteristics of vehicle	➤ Bicycle movements
➤ Variety of movements (diverging/merging/weaving/crossing)	➤ Pedestrian movements
<b>Physical Elements</b>	
➤ Character and use of abutting property	➤ Traffic control devices
➤ Vertical alignments at the intersection	➤ Illumination
➤ Sight distance	➤ Roadside design features
➤ Angle of the intersection	➤ Environmental factors
➤ Conflict area	➤ Crosswalks
➤ Speed-change lanes	➤ Driveways
➤ Geometric design features	➤ Access management treatments
<b>Economic Factors</b>	
➤ Cost of improvements, maintenance, and life cycle costs	
➤ Effects of controlling right of way on abutting properties where channelization restricts or prohibits vehicular movements	
➤ Energy consumption	

## 1300.04 Common Types of Intersection Control

### 1300.04(1) Uncontrolled Intersections

- Uncontrolled intersections do not have signing, and the normal right of way rule ([RCW 46.61.180](#)) applies.
- Most uncontrolled intersections are found on local roads and streets where the volumes of the intersecting roadways are low and roughly equal, speeds are low, and there is little to no collision history.
- Uncontrolled intersections are generally not appropriate for intersections with state routes.



### 1300.04(2) Yield Control

- Intersections with yield control assign right of way without requiring a stop.
- It is mainly used at roundabouts, ramps, and wye (Y) intersections.

Refer to the [MUTCD](#) for information on the locations where yield control may be appropriate.

### 1300.04(3) Two-Way Stop Control

- Intersections with two-way stop control are a common, low-cost control, which require the traffic on the minor roadway to stop before entering the major roadway. It is used where application of the normal right of way rule ([RCW 46.61.180](#)) is not appropriate for certain approaches at the intersection.
- Where U-turn opportunities exist within a corridor, consider limiting access at two-way stops to “right-in, right-out only.”



### 1300.04(4) Multi-Way Stop Control

Intersections with multi-way stop control:

- Normally require all traffic to stop before entering the intersection.
- Increase traffic delays, fuel consumption, and air pollution.
- Are most effectively used on low-speed facilities with approximately equal volumes on all legs and total entering volumes not exceeding 1,400 vehicles during the peak hour.
- Are often used as an interim measure when a traffic signal is warranted and has been determined to be the best solution, but has yet to be installed.



Guidance for consideration of the application of multi-way stop control is provided in the [MUTCD](#).

On multilane facilities, they present more operational issues than on two-lane two-way facilities and are not recommended on multilane state routes. Multi-way stop control is less desirable at intersections with very unbalanced directional traffic due to the delay introduced on the major-volume leg.

### 1300.04(5) Roundabouts

Roundabouts are traditionally near circular at-grade intersections, but can be a variety of shapes and sizes. Properly designed, located, and maintained roundabouts are an effective intersection type that normally offer the following:

- Fewer conflict points.
- Lower speeds.
- An alternative for areas where wrong-way driving is a concern.
- Reduced fatal- and severe-injury collisions.
- Reduced traffic delays.
- Traffic-calming.
- More capacity than a two-way or all-way stop.
- More consistent delay relative to other intersection treatments.



- The ability to serve high turning volumes.
- Improved operations where space for queuing is limited.
- At ramp terminals where left-turn volumes are high, improved capacity without widening the structure.
- Facilitation of U-turn movements.

Roundabouts are site-specific solutions. There are no warranting conditions; each is justified on its own merits as the most appropriate choice (see [Chapter 1320](#) for more information on [roundabout types and design](#)). However, there is modeling software for roundabouts, making the comparison of intersection control types and justification possible from an operations perspective.

### 1300.04(6) Traffic Control Signals

Properly designed, located, operated, and maintained traffic control signals may offer the following:

- Allow for the orderly movement of traffic.
- Increase the traffic-handling capacity of the intersection.
- Reduce the frequency of severe collisions, especially right-angle collisions.
- Can be coordinated to provide for continuous or nearly continuous movement of traffic at a definite speed along a given corridor under favorable conditions.
- Can be used to interrupt heavy traffic at intervals to permit other traffic, vehicular or pedestrian, to cross.
- Can be preempted to allow emergency vehicle passage.

Traffic control signals are not the solution for all intersection traffic concerns. Indiscriminate installation of signals can adversely affect the safety and efficiency of vehicle, bicycle, and pedestrian traffic.

As a result, installation of a traffic control signal must meet specific “warrants,” which are found in the [MUTCD](#). A signal warrant is a minimum condition in which a signal may be installed. Satisfying a signal warrant does not mandate the installation of a traffic signal; it only indicates that an engineering study, as described in this chapter, is needed to determine whether the signal is an appropriate traffic control solution.

Some collisions are usually not correctable with the installation of a traffic signal; in fact, the installation of a signal often increases rear-end collisions. These types of collisions are only used to satisfy the collision warrant in special circumstances. If they are used, include an explanation of the conditions that support using them to satisfy the crash experience warrant.



State statutes ([RCW 46.61.085](#)) require WSDOT approval for the design and location of all conventional traffic signals and for some types of beacons located on city streets forming parts of state highways. The Traffic Signal Permit (DOT Form 242-014 EF) is the formal record of the department's approval of the installation and type of signal. For traffic signal permit guidance, see [Chapter 1330](#).

### 1300.04(7) **Alternative Intersections**

A number of alternative intersections have been developed to reduce the delay to through traffic, the number of conflict points, and the number of signal phases for signalized intersections.

Alternative intersections work mainly by rerouting U and left turns, and/or separating movements. Alternative intersections include:

Median U-turn	Split intersection
Jug handle	Quadrant roadway intersection
Bowtie	Single quadrant interchange
<u>Restricted crossing U-turn</u>	Echelon
Continuous flow intersection	Center turn overpass
Continuous green tee (T)	

Like any intersection control solution, alternative intersection designs are site specific in how well they operate. Performance must be addressed during the intersection control selection process prior to proceeding with the actual design. Trade-offs in selecting alternative intersections may include higher construction costs, driver education, longer left-turn travel distance, circuitous access to adjacent property, and less direct pedestrian crossing.

Two types of alternative intersections are reviewed in the sections below: Median U-Turn and Restricted Crossing U-Turn (Superstreets). For more information about these and other intersection design solutions, see the Federal Highway Administration (FHWA) *Alternative Intersections/Interchanges: Informational Report (AIIR)*:

🔗 <http://www.fhwa.dot.gov/publications/research/safety/09060/index.cfm>, and the Applied Technology and Traffic Analysis Program (ATTAP) website, jointly initiated by the Maryland State Highway Administration and the University of Maryland: 🔗 [attap.umd.edu/uaid.php](http://attap.umd.edu/uaid.php)

### 1300.04(7)(a) Median U-Turn

The Median U-Turn (MUT) intersection treatment is an approach to simplifying operations at an intersection by removing left-turning movements from the major and/or minor approaches. Left-turning drivers proceed straight through the at-grade intersection, and then must execute a U-turn at some distance downstream from the intersection location in place of the traditional left-turning movement. The MUT intersection design is best applied in situations where:

- The intersection is failing due to congestion.
- There is an existing median (on at least one of the roadways) and/or sufficient or low-cost right of way needs can be accommodated.
- Minimal bicycle accommodations are needed.
- There is a need to improve pedestrian mobility.
- There is a need to reduce vehicle and pedestrian/vehicular conflict points.
- There is a need to shorten cycle lengths of signal timing or improve progression.

Refer to FHWA's [Alternative Intersection/Interchanges: Informational Report \(AIIR\)](#) for geometric design considerations and recommendations. (See [1310.05](#) for geometrics when designing the U-turn movement for the MUT intersection. )

### 1300.04(7)(b) Restricted Crossing U-Turn Intersection

Restricted crossing U-turn (RCUT) intersections, also known as superstreets, work by moving the minor road through and left-turning movements up- and downstream from the intersection location itself. ([Exhibit 1300-1](#) shows an example of an RCUT intersection.)

RCUT intersections:

- Operate by forcing drivers entering from the minor road to turn right onto the major road, and then make a U-turn maneuver at a one-way median opening downstream.
- Provide potential increased traffic safety advantages, due to the reduction of conflict points as compared to a more traditional intersection approach.
- May or may not warrant signalization due to traffic volumes, and those with signalization may require fewer phases and shorter cycles than a similar four-way intersection.

RCUT intersections are best applied in situations where:

- There is a rural expressway or urban arterial.
- There is partial control or managed access facilities.
- Major and minor traffic flows intersect.
- There is a high ratio of through movements to left turns on the main line.
- There are low through traffic volumes on the minor road.
- The major roadway is multilane.
- The major roadway contains sufficient median width, or total right of way width, to support the U-turn movements.

Exhibit 1300-1 RCUT Intersection US23, North Carolina



Photo Credit: NCDOT

The RCUT intersection may be a competitive alternative compared to a grade-separated interchange, at locations meeting grade-separated considerations identified in [530.04\(3\)](#). Refer to FHWA's *Alternative Intersection/Interchanges: Informational Report (AIIR)* for geometric design considerations and recommendations. (See [1310.05](#) for geometrics when designing the U-turn movement for the RCUT.)

### 1300.05 Design Vehicle Selection

When selecting a design vehicle for an intersection, address the needs of all users, including bicyclists and pedestrians, and the costs associated with the intersection control type. The primary use of the design vehicle is to determine radii for each of the intersections. It is possible for each turning movement to have a different design vehicle. [Exhibit 1300-2](#) shows commonly used design vehicle types in Washington State. Additional design vehicle types can be found in the AASHTO Green Book.



Evaluate the existing and anticipated future traffic to select a practical design vehicle that is the largest vehicle that will frequently use the intersection. [Exhibit 1300-3](#) shows the minimum design vehicles for expected uses. Justify the decision to use a smaller vehicle, which may be practical; include a traffic analysis showing that the proposed vehicle(s) is appropriate. Consider oversized vehicles for intersections that are commonly used to route oversized loads.

**Exhibit 1300-2 Design Vehicle Types**

Vehicle Type	Design Symbol
Passenger car, including light delivery trucks	P
City transit bus	CITY-BUS
Articulated bus	A-BUS
Single-unit truck	SU-30
Semitrailer truck, overall wheelbase of 40 ft	WB-40
Semitrailer truck, overall wheelbase of 67 ft	WB-67

**Exhibit 1300-3 Minimum Intersection Design Vehicle**

Intersection Types and Use	Minimum Design Vehicle
Junction of Major Truck Routes, Junction of State Routes, Ramp Terminals, Roundabouts	WB-67
Other Rural & Industrial	WB-40
Commercial & Residential	SU-30 <sup>[1][2]</sup>
<p><b>Notes:</b></p> <p>[1] To accommodate pedestrians, the P vehicle may be used as the design vehicle when justified in a traffic analysis.</p> <p>[2] When the intersection is on a transit or school bus route, use the CITY-BUS design vehicle as a minimum. (See <a href="#">Chapter 1430</a> for additional guidance on transit facilities.)</p>	

## 1300.06 Procedures

For new intersections, determine and document traffic control according to the applicable procedures in this chapter.

For intersection improvement projects involving pavement construction and/or reconstruction, or signal replacement/rehabilitation, evaluate intersection control in accordance with this chapter unless there is documentation that this analysis has already been completed and is referenced in the Project Summary.

Control for existing intersections that are unaffected by the project or are receiving minor revisions such as signal phasing changes (as shown through the analysis) may remain in place without further evaluation. Document the impacts and recommended revisions to all intersections affected by the project.

### 1300.06(1) Intersection Control Analysis (ICA)

Use the following steps when screening intersection control alternatives for selection, or to support the need for modifications to existing intersection control:

- **Determine the right of way requirements and feasibility.** Discuss the right of way requirements and the feasibility of acquiring that right of way in the analysis. Include sketches or plan sheets with sufficient detail to identify topography (including utilities), environmental constraints, drainage, buildings, and other fixed objects. An economic evaluation will be useful if additional right of way is needed. Include the right of way costs in the benefit/cost analysis.
- **Check signal warrants.** Evaluate existing peak period counts to determine the need for additional count data. If these counts do not meet a warrant, obtaining 12- or 24-hour count information is likely unnecessary. In some cases, the project may alter traffic patterns at an existing signal enough that it may no longer meet a warrant. For a list of the traffic signal warrants and information on how to apply them, see the [MUTCD](#).

For new intersections, project hourly volumes, and movements using established methodology, see [Chapter 320](#).

If warrants are met, evaluate multi-way stop, roundabout, and signal. If warrants are not met, evaluate yield, two-way stop, multi-way stop, and roundabout. Alternative configurations can also be considered if standard forms of control do not satisfy the objectives.

- **Determine environmental impacts.** Evaluate the impacts and permit requirements of each intersection control option (see the [Environmental Manual](#)). Any environmental risks that may substantially increase the cost of the project should be identified early in the process. Risk impacts to each alternative should be quantified for comparison.
- **Analyze alternatives and document the selection.** In addition to documenting the screening process for selecting the alternatives to be analyzed, the Intersection Control Analysis should include the following information: Existing Conditions, Delay Analysis, Operational Considerations, including a Safety Analysis if appropriate (see [Chapter 321](#)), Benefit/Cost Analysis, Bicycle and Pedestrian Facilities, Context-Specific/Sustainable Design, and any Additional Information that is relevant. ***The single-lane roundabout is the preferred alternative. If selected, no comparison with other alternatives is required.***



#### 1300.06(1)(a) Existing Conditions

The physical characteristics of the site include posted speed, traffic counts (Tuesday through Thursday average and peak hour manual counts), sight distance, channelization, pedestrian and bicycle facilities, and design vehicle.

Analyze the collision history and use current diagnostic tools described in [Chapter 321](#) to determine the expected and predicted collision rates for the existing conditions. Identify any problematic movements.

### 1300.06(1)(b) Delay Analysis

Since two or more traffic streams cross, converge, or diverge at intersections, the capacity of an intersection is normally less than the roadway between intersections. (See [Chapter 320](#) for additional details about traffic analysis.)

Provide a plan of the intersection used for modeling. Include recommendations for channelization, turn lanes, and acceleration and deceleration lanes for the preferred option for each intersection. Turn prohibitions may be used to increase intersection capacity. Analyze all relevant peak periods (with A.M. and P.M. as a minimum) for all intersection control alternatives. Holidays and special or seasonal events of short duration are generally not considered in the level of service (LOS) determination, although there are situations where a minor leg peak hour determines the hour used in analysis. Evaluating the 24-hour volumes may be necessary to maximize capacity and support the choice of intersection control that performs with the least overall delay.

Include the following in the delay analysis:

- Use 20 years after the year construction is scheduled to begin as the design year of the analysis for WSDOT projects. The design year will vary for developers and local agency projects (see [Chapter 320](#)).
- Identify and justify any growth rate used for design year analyses.
- Provide turning-movement volumes for all scenarios.
- Discuss the steps taken to arrive at the peak hour volume determination and how it relates to design hourly volume (DHV).

When the intersection improvements will be staged (for example, a roundabout opened as a single lane roundabout with plans to expand to a multilane roundabout when needed for capacity), include the anticipated date when the second stage will be required.

There are several deterministic and microsimulation programs for analyzing delay and intersection performance. Traffic volumes and the proximity of the project to other access points will dictate the modeling effort required. Contact the region Traffic Office to determine the appropriate approved program. With each iteration, ensure the proposed design for the intersection is in agreement with what is being modeled. For example, in modeling signals, a free right turn affects timings and also removes those vehicles from consideration in warrant analysis.

#### 1. Two-Way Stop Control

When the through roadway daily traffic is 3,500 or less, delay analysis is not required except in cases where the higher-volume roadway is controlled or where channelization is proposed. This is because adequate LOS for channelization projects does not always correlate to operational safety.

#### 2. Multi-Way Stop Control

Analyze according to the guidance provided in the [MUTCD](#).

### 3. Roundabouts

Provide a capacity analysis to estimate the entry capacity of each roundabout entry leg. Innovative capacity analysis is occasionally needed on projects where metering a heavy leg for short periods of the day allows the most efficient operation 24 hours a day. Contact the region Traffic Office for the specific calibration information to use.

### 4. Signals

When modeling signals, consider the phasing design criteria contained in [Chapter 1330](#). This may be guided by available opposing left-turn clearances at an intersection. Also, evaluate pedestrian movements and accommodate them in the proposed cycle lengths. Check the modeled signal phasing and timing for its ability to be programmed into the signal controller.

Progression of main line traffic is one reason given for using traffic signals; however, there are several reasons why progression may not realistically be obtained or sustained. Signal spacing, left-turn movements, speed, volume (particularly side street volume), and pedestrian movements can all affect the ability to achieve progression.

Consult the region Traffic Office for information on current signal operations practices. (See [Chapter 1310](#) for additional guidance on turn lane considerations.)

### 5. Alternative Intersections

Operational considerations for modeling depend on the intersection design in question. They may include the LOS for turning movements, weaving requirements, the need for vehicle storage, acceleration lanes, and the LOS at the merge points. The analyst and reviewer should agree on what measures of effectiveness will be used.

## 1300.06(1)(c) Operational Considerations

The transportation network has a mix of intersection controls. Delay analysis focuses on determining the peak-hour letter-graded LOS of an individual intersection. Operational analysis is a more encompassing review of the ability of the intersection to provide sufficient capacity in the network, and includes consideration of the environment that users will encounter at all hours of the day.

Intersection control has an influence on approaches and other intersections, even at acceptable LOS. Increased delay affects route choice. A driver's willingness to accept delay depends on the current circumstances and the driver's knowledge of the transportation network. The arrival of in-vehicle guidance systems will only increase the tendency of drivers to seek out routes with shorter travel times. Thus, it is important to consider the effects of intersection control on the surrounding network. Document the existing and proposed design. Points that may need to be addressed include the following:

- Use access management alternatives such as rerouting traffic to an existing intersection with available capacity. Check with the WSDOT region Planning Office for future land use plans or comprehensive plans to provide for future growth accommodation. Discuss options and strategies that have been developed through a collaborative planning process with the local agency or, where appropriate, the regional or metropolitan transportation planning organization.

- Consider the volume to capacity (V/C) ratio, the delay, and the queue length of the legs. Roundabout V/C ratios above 0.92 may require additional sensitivity analysis to determine the impacts of small changes in volume. Discuss the results of the capacity analysis and the lanes necessary for each leg of the intersection.
- Compare the geometry/number of lanes required by different alternatives to achieve similar results.
- Consider the effect on other travel modes: rail, bus, pedestrian, and bicycle.
- Examine the effects of existing conditions. Discuss progression through nearby intersections (corridor and network analysis) and known risky or illegal driving maneuvers. Work with the region Traffic Office to verify the network area of influence.
- Determine how the proposed control will meet the objectives for intersection control (see 1300.04) at all hours compared to other alternatives. This is particularly applicable when only the peak hour warrant is met for a signal, since it is used only in rare cases.
- Consider the possibility that traffic from other intersections with lower levels of service will divert to the new/revised intersection.
- Compare the predicted collision frequency of the alternatives using the tools described in Chapter 321. Discuss how each proposed solution might affect safety performance and collision types.
- Identify the design vehicle (see 1300.05). Include truck types and sizes (including oversized vehicles) that travel through the area both currently and in the future. Include verification of turning movements based on turn simulation software (such as AutoTURN®).
- Examine queue lengths in areas where there are intersections or approaches in close proximity. When other intersections are affected, if needed, use a calibrated simulation to fully evaluate the operational effects of the proposed traffic control on the system.
- Evaluate sight distances (stopping, intersection, decision) for the proposed designs prior to selection of an alternative.

#### 1300.06(1)(d) Benefit/Cost Analysis

Benefit/cost analysis compares the value of benefits against costs. There is considerable debate on what can and should be included in this analysis, particularly in the area of environmental and societal benefits and costs. Generally, and in keeping with the objectives of intersection control, the only societal costs/benefits WSDOT evaluates are those due to collisions and delay. Include the following in the analysis:

- Project costs related to design, right of way, and construction.
- Annual maintenance cost differences between the options. For signals, this also includes the cost to review the signal timings in accordance with current signal operations guidelines. This value can be obtained from the region Traffic Office.
- 24-hour travel time savings. Workbook and annual information can be found at: [www.wsdot.wa.gov/mapsdata/travel/mobility.htm](http://www.wsdot.wa.gov/mapsdata/travel/mobility.htm)
- A predictive method to compare societal benefits or costs calculated from the change in collision severity and/or frequency using the tools described in Chapter 321.
- Salvage value of right of way, grading and drainage, and structures.

### 1300.06(1)(e) Bicycle and Pedestrian Facilities

Discuss the facilities to be provided for and used by bicycles and pedestrians. Include required ADA accommodations.

For consideration of bicycle and pedestrian needs at intersections, see Chapters 1510, 1515, and 1520. Additional emerging practices information can be found at the Pedestrian and Bicycle Information Center ([www.pedbikeinfo.org/](http://www.pedbikeinfo.org/)) and the *NACTO Urban Bikeway Design Guide* (<http://nacto.org/cities-for-cycling/design-guide/>).

### 1300.06(1)(f) Context Sensitive/Sustainable Design

Context sensitive design is a model for transportation project development. A proposed transportation project must be planned not only for its physical aspects as a facility serving specific transportation objectives, but also for its effects on the aesthetic, social, economic, and environmental values, needs, constraints, and opportunities in a larger community setting. Projects designed using this model:

- Optimize safety of the facility for both the user and the community.
- Promote multimodal solutions.
- Are in harmony with the community, and preserve the environmental, scenic, aesthetic, historic, and natural resource values of the area.
- Are designed and built with minimal disruption to the community.
- Involve efficient and effective use of the resources (time, budget, community) of all involved parties.



### 1300.06(1)(g) Additional Information

Discuss the following in the intersection analysis as needed to further support the selection (is it an item that will have a significant effect on the decision?):

- Information from the Route Development Plan or other approved corridor study.
- Environmental permitting restrictions, such as the ones in place in scenic areas and other locations with similar restrictions.
- Current and future land use and whether or not the intersection control will reasonably accommodate future land use traffic changes.
- Current/proposed speed limits (changes in speed limits can affect signal warrants).
- Public meeting comments.
- Outside agency coordination and comments.
- Medians, lane widths, and parking.
- Effect on future local agency projects.
- Other elements considered in the selection of the intersection control.

### 1300.06(2) *Public Involvement*

Public acceptance of stop and signal control is currently such that outreach efforts are seldom required beyond keeping the public informed as to the status of the project. In contrast, roundabouts, particularly the first in an area, require a holistic approach. Technical, public, and political aspects must be considered. Education and outreach efforts, if necessary, are collaborative and are most useful during the analysis and early design stages. (See [Chapter 210](#) for further information.)



### 1300.06(3) *Approval*

Refer to [Chapter 300](#) for additional information on approval authorities. Approval of intersection control type (to be completed no later than the scoping phase) requires the following:

- HQ Concurrence
- Region Approval

### 1300.06(4) *Corridor Analyses*

Intersections included in approved Route Development Plans or approved Corridor Analyses are eligible for Intersection Control Approval by the Region Traffic Engineer, provided they have been analyzed in accordance with this chapter. Approval is valid for three years.

### 1300.06(5) *Local Agency or Developer-Initiated Intersections*

[Chapter 320](#) provides guidance for preparation of a Traffic Impact Analysis (TIA). Early in the design process, coordinate with the region to identify specific intersections for further analysis. The project initiator provides an Intersection Control Analysis (ICA) for approaches and intersections with state routes per [1300.06\(1\)](#), or references this information in the TIA. The project initiator documents the design considerations and submits the ICA and all documentation to the region for approval (per [1300.06\(1\)](#)). After the ICA is approved, finalize the intersection design and obtain approval per [Chapters 300](#) (for documentation), [1310](#) (for intersections), [1320](#) (for roundabouts), and [1330](#) (for traffic signals).

Intersections in local agency projects submitted for grants administered by the department are subject to the requirements of this chapter. Intersections on state routes must receive intersection control approval as a condition of application.

## 1300.07 *Documentation*

Refer to [Chapter 300](#) for design documentation requirements.



Storage Length* (ft)	% Trucks in Left-Turn Movement				
	10	20	30	40	50
100	125	125	150	150	150
150	175	200	200	200	200
200	225	250	275	300	300
250	275	300	325	350	375
300	350	375	400	400	400

\*Length from Exhibits [1310-7b](#) and [1310-8a](#), [8b](#), or [8c](#).

### Left-Turn Storage With Trucks (ft) *Exhibit 1310-9*

At signalized intersections with high left-turn volumes, double (or triple) left-turn lanes may be needed to maintain the desired level of service. For a double left-turn, a throat width of 30 to 36 feet is desirable on the exit leg of the turn to offset vehicle offtracking and the difficulty of two vehicles turning abreast. Use turn simulation software (such as AutoTURN<sup>®</sup>) to verify that the design vehicle can complete the turn. Where the design vehicle is a WB 40 or larger, it is desirable to provide for the design vehicle in the outside lane and an SU-30 vehicle turning abreast rather than two design vehicles turning abreast.

Exhibits [1310-10a](#) through [10f](#) show left-turn lane geometrics, which are described as follows:

#### 1. Widening

It is desirable that offsets and pavement widening (see [Exhibit 1310-10a](#)) be symmetrical about the centerline or baseline. Where right of way or topographic restrictions, crossroad alignments, or other circumstances preclude symmetrical widening, pavement widening may be on one side only.

#### 2. Divided Highways

Widening is not needed for left-turn lane channelization where medians are 11 feet wide or wider (see Exhibits [1310-10b](#) through [10d](#)). For medians between 13 feet and 23 feet or where the acceleration lane is not provided, it is desirable to design the left-turn lane adjacent to the opposing lane (see [Exhibit 1310-10b](#)) to improve sight distance and increase opposing left-turn clearances.

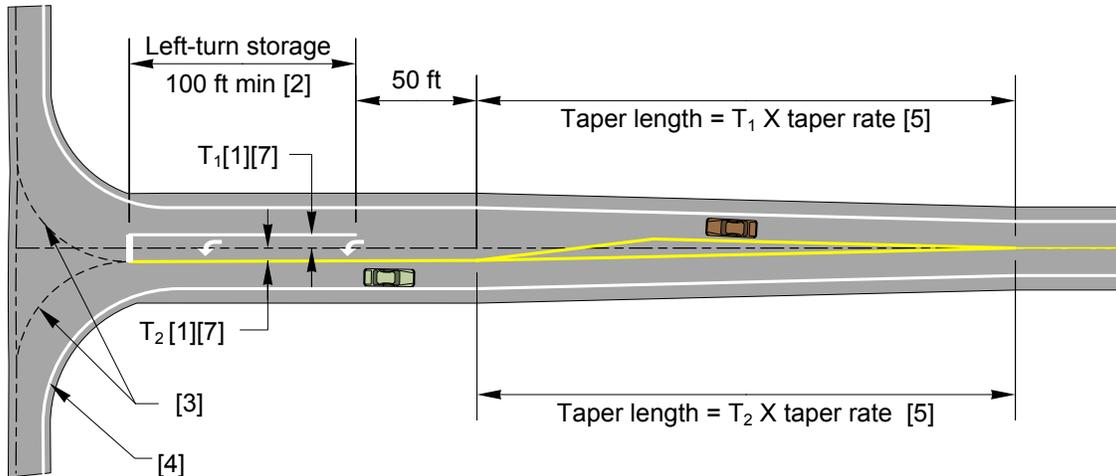
A median acceleration lane (see Exhibits [1310-10c](#) and [10d](#)) may be provided where the median is 23 feet or wider. The median acceleration lane might not be needed at a signalized intersection. When a median acceleration lane is to be used, design it in accordance with [1310.04\(4\)](#), Speed Change Lanes. Where medians have sufficient width, provide a 2-foot shoulder adjacent to a left-turn lane.

#### 3. Minimum Protected Left Turn With a Median

At intersections on divided highways where channelized left-turn lanes are not provided, provide the minimum protected storage area (see [Exhibit 1310-10e](#)).

#### 4. Modifications to Left-Turn Designs

With justification, the left-turn lane designs discussed above and given in Exhibits 1310-10a through 10e may be modified. Document the benefits and impacts of the modified design, including changes to vehicle-pedestrian conflicts; vehicle encroachment; deceleration length; capacity restrictions for turning vehicles or other degradation of intersection operations; and the effects on other traffic movements. Provide a modified design that is able to accommodate the design vehicle, and provide for the striping (see the *Standard Plans* and the *MUTCD*). Verify the design vehicle can make the turn using turn simulation software (such as AutoTURN®); include a plot of the design and verification.



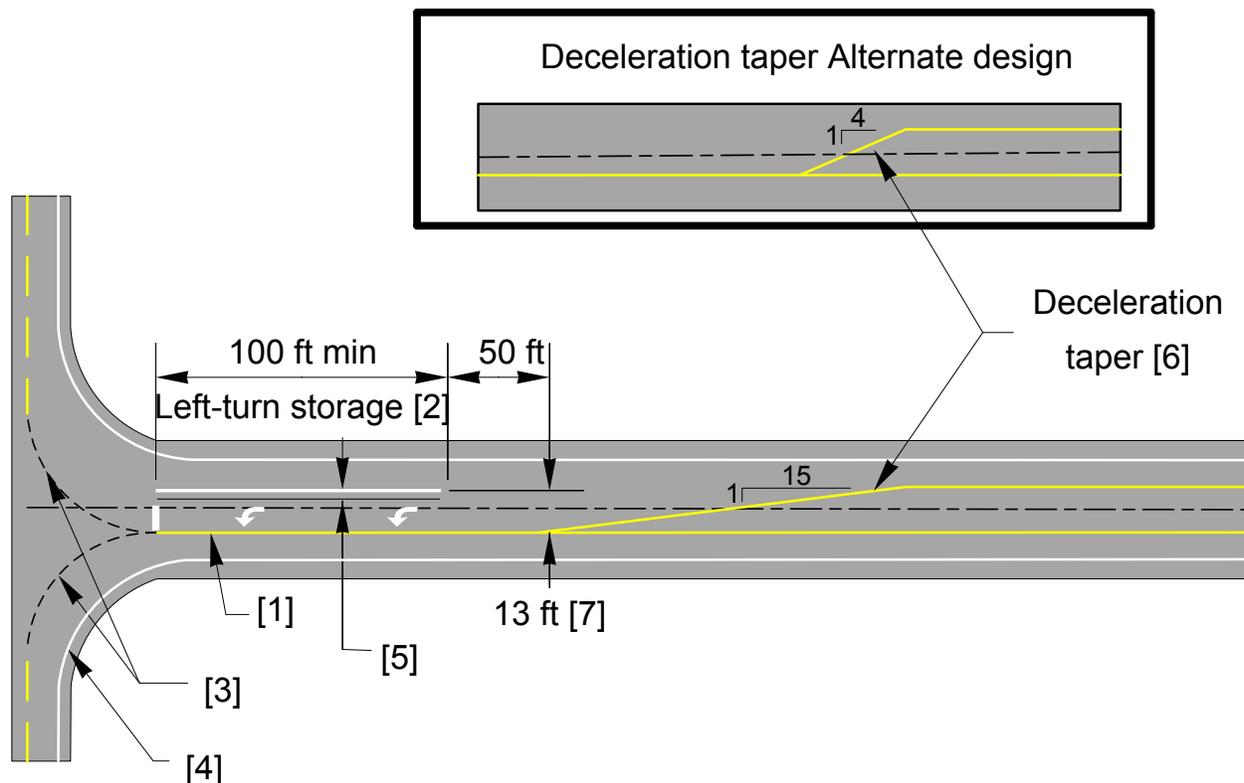
**Notes:**

- [1] The minimum width of the left-turn storage lane ( $T_1+T_2$ ) is 11 ft.
- [2] For left-turn storage length, see Exhibits 1310-7b for 4-lane roadways or 1310-8a through 8c for 2-lane roadways.
- [3] Use turn simulation software (such as AutoTURN®) to verify the design vehicle can make the turn.
- [4] For right-turn corner design, see Exhibit 1310-6.
- [5] For desirable taper rates, see Table on this Exhibit. With justification, taper rates from the Table in Exhibit 1310-10c may be used.
- [6] For pavement marking details, see the *Standard Plans* and the *MUTCD*.
- [7] Where curb is provided, add the width of the curb and the shoulders to the left-turn lane width. For shoulder widths at curbs, see 1310.04(6) and Chapter 1140.

- $T_1$  = Width of left-turn lane on approach side of centerline
- $T_2$  = Width of left-turn lane on departure side of centerline

Posted Speed	Desirable Taper Rate [6]
55 mph	55:1
50 mph	50:1
45 mph	45:1
40 mph	40:1
35 mph	35:1
30 mph	30:1
25 mph	25:1

**Median Channelization: Widening**  
Exhibit 1310-10a

**Notes:**

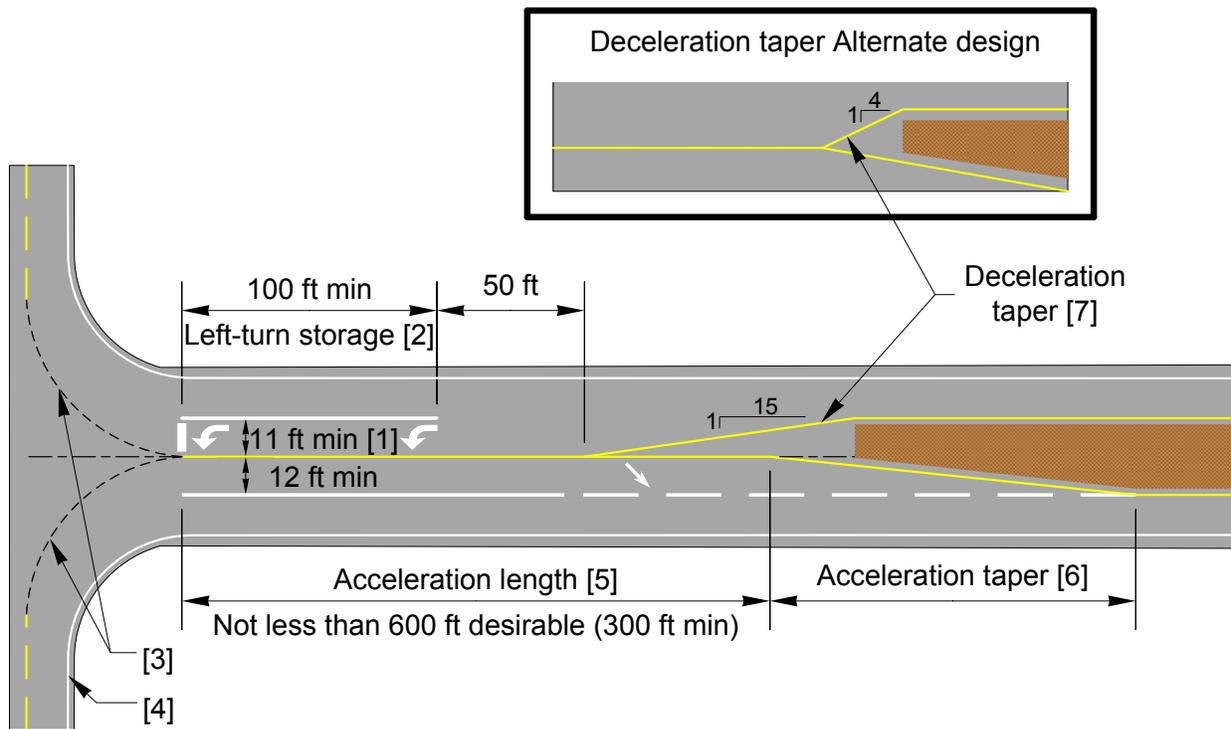
- [1] Where curb is provided, add the width of the curb and the shoulders. For shoulder widths at curbs, see [1310.04\(6\)](#) and [Chapter 1140](#).
- [2] For left-turn storage length, see Exhibits [1310-7b](#) for 4-lane roadways or [1310-8a](#) through [8c](#) for 2-lane roadways.
- [3] Verify the design vehicle can make the turn using turn simulation software (such as AutoTURN®).
- [4] For right-turn corner design, see [Exhibit 1310-6](#).
- [5] For median widths greater than 13 ft, it is desirable to locate the left-turn lane adjacent to the opposing through lane with excess median width between the same-direction through lane and the turn lane.
- [6] For increased storage capacity, the left-turn deceleration taper alternate design may be used.
- [7] Reduce to lane width for medians less than 13 ft wide.

**General:**

For pavement marking details, see the [Standard Plans](#) and the [MUTCD](#).

**Median Channelization: Median Width 11 ft or More**

*Exhibit 1310-10b*



**Notes:**

- [1] When curb is provided, add the width of the curb.
- [2] For left-turn storage length, see Exhibits [1310-7b](#) for 4-lane roadways or [1310-8a](#) through [8c](#) for 2-lane roadways.
- [3] Verify the design vehicle can make the turn using turn simulation software (such as AutoTURN®).
- [4] For right-turn corner design, see [Exhibit 1310-6](#).
- [5] The minimum total length of the median acceleration lane is shown in [Exhibit 1310-14](#).
- [6] For acceleration taper rate, see Table on this exhibit.
- [7] For increased storage capacity, the left-turn deceleration taper alternate design may be used.

Posted Speed	Taper Rate
55 mph	55:1
50 mph	50:1
45 mph	45:1
40 mph	27:1
35 mph	21:1
30 mph	15:1
25 mph	11:1

**General:**

For pavement marking details, see the [Standard Plans](#) and the [MUTCD](#).

**Median Channelization: Median Width 23 ft to 26 ft**  
*Exhibit 1310-10c*

- 1330.01 General
- 1330.02 References
- 1330.03 Definitions
- 1330.04 Procedures
- 1330.05 Signal Warrants
- 1330.06 Conventional Traffic Signal Design
- 1330.07 Documentation

### 1330.01 General

Traffic control signals are power-operated traffic control devices that warn or direct motorists to take a specific action. They are used to control the assignment of right of way at locations where conflicts with motorists, bicyclists, and pedestrians exist or where passive devices such as signs and markings do not provide the necessary flexibility of control to move motorists, bicyclists, and pedestrians in an efficient manner.

The decision to install a traffic signal is the result of an Intersection Control Analysis (ICA) that is approved by the region Traffic Engineer or other designated authority.

### 1330.02 References

The following references are used in the planning, design, construction, and operation of traffic control signals installed on state highways. The RCWs noted are specific state laws concerning traffic control signals, and conformance to these statutes is required.

#### (1) *Federal/State Laws and Codes*

Americans with Disabilities Act of 1990 (ADA) (23 CFR Part 36, Appendix A)

[Revised Code of Washington \(RCW\) 35.77](#), Streets – Planning, establishment, construction, and maintenance

[RCW 46.04.450](#), Railroad sign or signal

[RCW 46.04.600](#), Traffic control signal

[RCW 46.04.62250](#), Signal preemption device

[RCW 46.61.050](#), Obedience to and required traffic control devices

[RCW 46.61.055](#), Traffic control signal legend

[RCW 46.61.060](#), Pedestrian control signals

[RCW 46.61.065](#), Flashing signals

[RCW 46.61.070](#), Lane-direction-control signals

[RCW 46.61.072](#), Special traffic control signals – Legend

[RCW 46.61.075](#), Display of unauthorized signs, signals, or markings

[RCW 46.61.080](#), Interference with official traffic-control devices or railroad signs or signals

[RCW 46.61.085](#), Traffic control signals or devices upon city streets forming part of state highways – Approval by department of transportation

[RCW 46.61.340](#), Approaching train signal

[RCW 47.24.020\(6\)](#) and [\(13\)](#), Jurisdiction, control

[RCW 47.36.020](#), Traffic control signals

[RCW 47.36.060](#), Traffic devices on county roads and city streets

[Washington Administrative Code \(WAC\) 468-18-040](#), Design standards for rearranged county roads, frontage roads, access roads, intersections, ramps and crossings

[WAC 468-18-050](#), Policy on the construction, improvement and maintenance of intersections of state highways and city streets

“City Streets as Part of State Highways: Guidelines Reached by the Washington State Department of Transportation and the Association of Washington Cities on the Interpretation of Selected Topics of [RCW 47.24](#) and Figures of [WAC 468-18-050](#) for the Construction, Operations and Maintenance Responsibilities of WSDOT and Cities for Such Streets,” April 30, 1997.

## **(2) Design Guidance**

*A Policy on the Geometric Design of Highways and City Streets* (Green Book), AASHTO, 2004

*Guide for Determining Time Requirements for Traffic Signal Preemption at Highway-Rail Grade Crossings*, MNDOT, 2006

[http://safety.fhwa.dot.gov/xings/com\\_roaduser/07010/appeniform.pdf](http://safety.fhwa.dot.gov/xings/com_roaduser/07010/appeniform.pdf)

*Instructions for the Guide for Determining Time Requirements for Signal Preemption at Highway-Rail Grade Crossings*, Texas Department of Transportation

[http://safety.fhwa.dot.gov/xings/com\\_roaduser/07010/appeni.htm](http://safety.fhwa.dot.gov/xings/com_roaduser/07010/appeni.htm)

*Manual on Uniform Traffic Control Devices for Streets and Highways*, USDOT, FHWA; as adopted and modified by Chapter [468-95 WAC](#) “Manual on uniform traffic control devices for streets and highways” (MUTCD)

*Plans Preparation Manual*, M 22-31, WSDOT

*Revised Draft Guidelines for Accessible Public Rights-of-Way*, November 23, 2005, U.S. Access Board

*Standard Plans for Road, Bridge, and Municipal Construction (Standard Plans)*, M 21-01, WSDOT

*Standard Specifications for Road, Bridge, and Municipal Construction (Standard Specifications)*, M 41-10, WSDOT

WSDOT Traffic Design Resources

[www.wsdot.wa.gov/Design/Traffic/](http://www.wsdot.wa.gov/Design/Traffic/)

### (3) Intersection Design Considerations

Intersection design can have a considerable effect on how a traffic signal will operate, and careful consideration is to be given to this aspect of the design. (See [Chapter 1310](#) for further guidance.)

Left-turning traffic can be better accommodated when the opposing left-turn lanes are directly opposite each other. When a left-turn lane is offset into the path of the approaching through lane, the left-turning driver might assume the approaching vehicles are also in a left-turn lane and fail to yield. To prevent this occurrence, less efficient split phasing may be necessary. (See [Chapter 1310](#) for guidance on opposing left-turn clearance.)

Where a railroad crossing is within 88 feet of a signalized intersection, consider installing turn pockets for the movements leading to the leg of the intersection with the railroad crossing. This greatly improves the efficiency of the signal during railroad preemption when turns are restricted. Also consider providing a left-turn pocket for the minor leg opposing the railroad crossing. This will allow limited service during long periods of railroad preemption.

Consider providing an unrestricted through lane on the major street of a T intersection. This design allows for one traffic movement to flow without restriction. At high-speed intersections where this is used, the through lane is to be separated by a physical barrier or the through movement must also be signalized.

Skewed intersections, because of their geometry, are challenging to signalize and delineate. Where feasible, modify the skew angle to provide more normal approaches and exits. In many cases, the large paved areas for curb return radii at skewed intersections can be reduced when the skew angle is reduced. (See [Chapter 1310](#) for requirements and design options.)

If roadway approaches and driveways are located too close to an intersection, the traffic from these facilities can affect signal operations. Consider eliminating the accesses or restricting them to “right in/right out.” This should be determined early so it can be considered and addressed in the design. (See [Chapters 530](#) and [540](#) for further guidance.) Consider shifting the location of the advance loops upstream to clear an access point so that vehicles entering from the access point will not affect the loops.

Transit stop and pullout locations can affect signal operation. (See [Chapter 1430](#) for transit stop and pullout designs.) When feasible, locate these stops and pullouts on the far side of the intersection to:

- Minimize overall intersection conflict, particularly the right-turn conflict.
- Minimize impact to the signal operation when buses use preemption to pull out at a traffic signal with transit preemption.
- Provide extra pavement area where U-turn maneuvers are allowed.
- Eliminate sight distance obstructions for drivers attempting to turn right on red.
- Eliminate conflict with right-turn pockets.

Large right-turn curb radii at intersections sometimes have impacts on traffic signal operation. Larger radii allow faster turning speeds and might move the pedestrian entrance point farther away from the intersection area. Pedestrian crossing times are increased because of the longer crossing, thereby reducing the amount of time available for vehicular traffic. (See [Chapter 1310](#) for guidance on determining these radii.)

At intersections with large right-turn radii, consider locating signal standards on raised traffic islands to reduce mast arm lengths. These islands are primarily designed as pedestrian refuge areas. (See [Chapter 1510](#) for pedestrian refuge islands and traffic island designs.) Locating signal standards on islands may decrease the required pedestrian clearance intervals; however, large radii and raised traffic islands may make it difficult for pedestrians to navigate the intersection. Place stop bars so they are out of the path of conflicting left turns. Check the geometric layout by using the turning path templates in [Chapter 1310](#) or a computerized vehicle turning path program to determine whether the proposed layout and phasing can accommodate the design vehicles. Also, check the turning paths of opposing left-turn movements. In many cases, the phase analysis might recommend allowing opposing left turns to run concurrently, but the intersection geometrics are such that this operation cannot occur.

Coordinate with all stakeholders (Maintenance, Signal Operations, Civil Design Engineer, Drainage Engineer, and so on) in the placement of signal equipment to avoid any possible conflicts. Arrange field reviews with the appropriate stakeholders as necessary.

#### **(4) Crosswalks and Pedestrians**

When designing pedestrian signals, consider the needs of all pedestrians, including older pedestrians and pedestrians with disabilities who might walk at a significantly slower pace than the average pedestrian. Determine whether there are pedestrian generators in the project vicinity that might attract older people and pedestrians with disabilities, and adjust signal timing accordingly. Include accessible pedestrian pushbuttons and countdown pedestrian displays at all locations and crossings unless a specific crossing is prohibited. Consult with region and city maintenance personnel regarding maintenance requirements for these devices. (See [Chapter 1510](#) for more information on accessible pedestrian routes.)

- Locate pedestrian push buttons in accordance with the most current edition of the *Public Rights-of-Way Accessibility Guidelines* (PROWAG) and the [MUTCD](#).
- Clearly identify which crossing is controlled by the push button.
- Provide a level clear space (maximum 2% slope in any direction, 48 inches minimum by 30 inches minimum) within reach range at each push button for wheelchair users. The level clear space must be connected to the crosswalk it serves by a pedestrian access route.
- Mount push button at a maximum height of 3 feet 6 inches and a maximum horizontal distance of 2 feet from the level clear space surface.

**(a) Accessible Pedestrian Signals (APS)**

At all locations where pedestrian signals are newly installed, replaced, or significantly modified, the installation of accessible pedestrian signals (APS) and countdown pedestrian displays is required. (Note: Simply moving existing pedestrian push buttons to satellite poles to improve accessibility is not by itself considered a significant modification of the pedestrian signal.) When APS and countdown pedestrian display improvements are made, they shall be made for all locations associated with the system being modified. APS includes audible and vibrotactile indications of the WALK interval. Installation of these devices may require improvements to existing sidewalks and curb ramps to meet ADA compliance regulations (see [Chapter 1510](#)).

Refer to the [MUTCD](#) and the most current edition of the PROWAG for design requirements. Also, consult with region Traffic Office, HQ Traffic Operations, the HQ Design Office, and region and city maintenance personnel for current equipment specifications and additional design and maintenance requirements.

Crosswalks, whether marked or not, exist on all legs of a signalized intersection. For closing a crossing at a signalized intersection, see [Chapter 1510](#).

**Vacant**

*Exhibit 1330-5*

If a crosswalk is installed across the leg where right-turning or left-turning traffic enters, the vehicle display cannot have a green turn arrow indication during the pedestrian WALK phase. If this cannot be accomplished through a negative ped overlap, provide a separate pedestrian or vehicle turn phase. Use of exclusive pedestrian phases should be avoided because of the negative effect they can have on efficient traffic signal operations.

### **(5) Control Equipment**

Controller assemblies can be Type 170, Type 2070, or National Electrical Manufacturers Association (NEMA) controllers with dual ring, eight vehicle phases, four pedestrian phases, four overlaps, emergency vehicle preemption, railroad preemption, transit preemption, and start and end daylight savings time dates operational capabilities. From a design perspective, identical operation can be obtained from each controller. Specify Type 2070 unless region policy is to use 170 or NEMA controllers. The local controller software can impact the brand and model of the control equipment installed. Contact the region Signal Operations Engineer for software and controller specifications. The designer needs to specify the type of controller and the operating software to be installed. Include documentation of selected control equipment in the Project File.

Intersections within ½ mile of each other on low-speed state highways should be interconnected. Intersections within 1 mile of each other on high-speed state highways should be interconnected. The preferred method for interconnection is fiber optic cable, but other methods such as IP over copper or wireless interconnect may be considered after discussion with the region Signal Operations Engineer and approval by the region Traffic Engineer. Add a construction note in the plans stating to coil additional cable in the adjacent junction box, not the controller cabinet. Consider using a separate vault or junction box for coiling the fiber optic interconnect cable to allow for the large-bend radii. This will save on space in the controller cabinet and also allow additional cable in case the cabinet is hit by an errant vehicle. In situations where it is necessary to coordinate the traffic movements with another agency, it is important that the agencies work together.

1510.01	General	1510.10	Crosswalks
1510.02	References	1510.11	Raised Medians/Traffic Islands
1510.03	Definitions	1510.12	Pedestrian Pushbuttons at Signals
1510.04	Policy	1510.13	At-Grade Railroad Crossings
1510.05	ADA Requirements by Project Type	1510.14	Pedestrian Grade Separations (Structures)
1510.06	Pedestrian Circulation Paths	1510.15	Other Pedestrian Facilities
1510.07	Pedestrian Access Routes (PARs)	1510.16	Illumination and Signing
1510.08	Sidewalks	1510.17	Work Zone Pedestrian Accommodation
1510.09	Curb Ramps	1510.18	Documentation

## 1510.01 General

Pedestrian travel is a vital transportation mode. It is used at some point by nearly everyone and is a critical link to everyday life for many. Designers must be aware of the various physical needs and abilities of pedestrians in order to ensure facilities provide universal access.

Section 504 of the Rehabilitation Act and the Americans with Disabilities Act of 1990 (ADA) require pedestrian facilities to be designed and constructed so they are readily accessible to and usable by persons with disabilities. This chapter provides accessibility criteria for the design of pedestrian facilities that meet applicable state and federal standards.

The pedestrian facilities included in a project are determined during the planning phase based on: access control of the highway; local transportation plans; comprehensive plans and other plans (such as Walk Route Plans developed by schools and school districts); the roadside environment; pedestrian volumes; user age group(s); and the continuity of local walkways along or across the roadway.

When developing pedestrian facilities within a limited amount of right of way, designers can be faced with multiple challenges. It is important that designers become familiar with the ADA accessibility criteria in order to appropriately balance intersection design with the often competing needs of pedestrians and other roadway users.

Similar to the roadway infrastructure, pedestrian facilities (and elements) require periodic maintenance in order to prolong the life of the facility and provide continued usability. Title II of the ADA requires that all necessary features be accessible and maintained in operable working condition for use by individuals with disabilities.

## 1510.02 References

### 1510.02(1) Federal/State Laws and Codes

[ADA](#) – 28 Code of Federal Regulations (CFR) Part 35, as revised September 15, 2010

[23 CFR Part 652](#), Pedestrians and Bicycle Accommodations and Projects

[49 CFR Part 27](#), Nondiscrimination on the Basis of Disability in Programs or Activities Receiving Federal Financial Assistance (Section 504 of the Rehabilitation Act of 1973 implementing regulations)

[Revised Code of Washington \(RCW\) 35.68](#), Sidewalks, gutters, curbs and driveways – All cities and towns

[RCW 35.68.075](#), Curb ramps for persons with disabilities – Required – Standards and Requirements

[RCW 46.04.160](#), Crosswalk (definition)

[RCW 46.61](#), Rules of the Road

[RCW 47.24.020](#), City streets as part of state highways – Jurisdiction, control

### **1510.02(2) Design Guidance**

*ADA Standards for Accessible Design*, U.S. Department of Justice (USDOJ), 2010; consists of 28 CFR parts 35 & 36 and the *ADA and Architectural Barriers Act (ABA) Accessibility Guidelines for Buildings and Facilities (ADA-ABAAG)*; also referred to as the 2004 ADAAG), July 23, 2004, U.S. Access Board. (For buildings and on-site facilities; applies to new construction or alterations as of March 15, 2012.)

☞ <http://www.access-board.gov/guidelines-and-standards>

*ADA Standards for Transportation Facilities*, USDOT, 2006; consists of 49 CFR Parts 37 & 38 and the *ADA and ABA Accessibility Guidelines for Buildings and Facilities (ADA-ABAAG)*; also referred to as the 2004 ADAAG), July 23, 2004, U.S. Access Board as modified by USDOT. (For transit, light rail, and similar public transportation facilities.)

☞ <http://www.access-board.gov/guidelines-and-standards>

*Department of Justice/Department of Transportation Joint Technical Assistance on the Title II of the Americans with Disabilities Act Requirements to Provide Curb Ramps when Streets, Roads, or Highways are Altered through Resurfacing*, USDOJ and USDOT, July 2013

☞ <http://www.ada.gov/doj-fhwa-ta.htm>

☞ <http://www.ada.gov/doj-fhwa-ta-glossary.htm>

*Manual on Uniform Traffic Control Devices for Streets and Highways*, USDOT, FHWA; as adopted and modified by [Chapter 468-95 WAC](#) “Manual on uniform traffic control devices for streets and highways” (MUTCD)

☞ [www.wsdot.wa.gov/publications/manuals/mutcd.htm](http://www.wsdot.wa.gov/publications/manuals/mutcd.htm)

*Revised Draft Guidelines for Accessible Public Rights-of-Way (PROWAG)*, November 23, 2005, U.S. Access Board. The current best practices for evaluation and design of pedestrian facilities in the public right of way per the following FHWA Memoranda:

☞ <http://www.fhwa.dot.gov/environment/bikeped/prwaa.htm>

☞ [http://www.fhwa.dot.gov/civilrights/memos/ada\\_memo\\_clarificationa.htm](http://www.fhwa.dot.gov/civilrights/memos/ada_memo_clarificationa.htm)

☞ <http://www.access-board.gov/guidelines-and-standards>

*Standard Plans for Road, Bridge, and Municipal Construction (Standard Plans)*, M 21-01, WSDOT

☞ [www.wsdot.wa.gov/publications/manuals/m21-01.htm](http://www.wsdot.wa.gov/publications/manuals/m21-01.htm)

### **1510.02(3) Supporting Information**

*1991 ADA Standards for Accessible Design*, USDOJ; consists of 28 CFR parts 35 & 36 and the *ADA Accessibility Guidelines for Buildings and Facilities (ADAAG)*, July 1991, U.S. Access Board. (For buildings and on-site facilities: Expired for new construction and alterations. To be used only for evaluating the adequacy of new construction or alteration that occurred prior to March 15, 2012.)

☞ [www.access-board.gov/ada/](http://www.access-board.gov/ada/)

*A Policy on Geometric Design of Highways and Streets (Green Book)*, AASHTO, Current version adopted by FHWA

### 1510.10(2) Crosswalks at Intersections

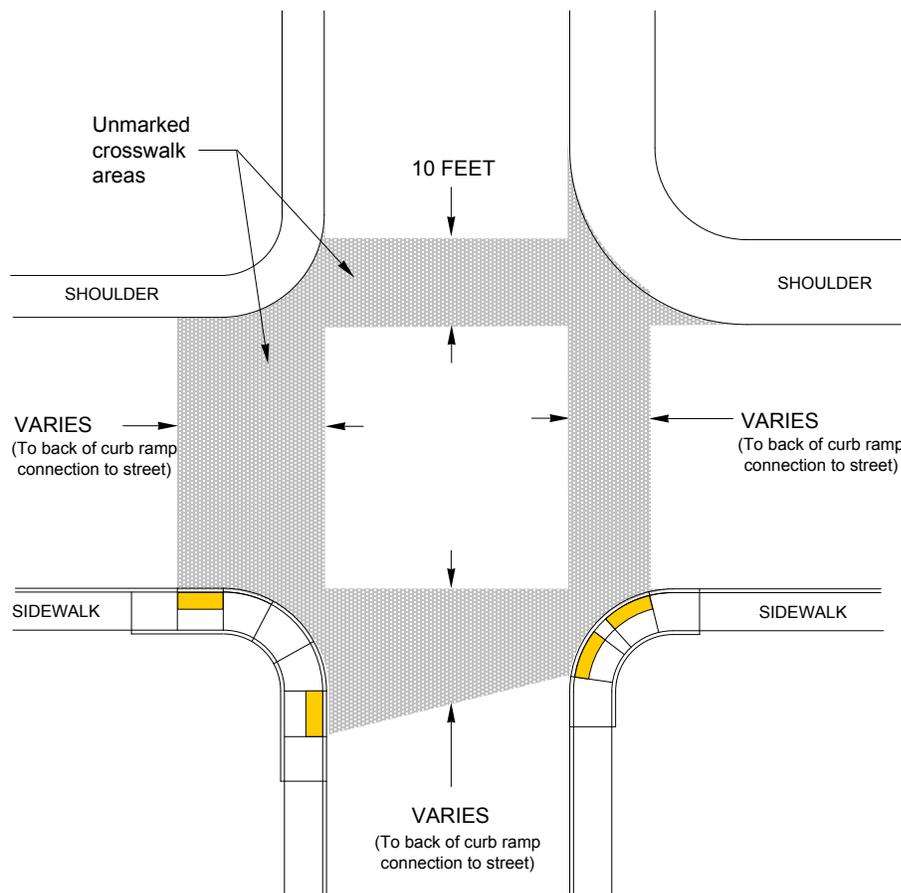
Provide a pedestrian access route within marked and unmarked pedestrian crossings. (See [1510.07](#) for accessibility criteria for pedestrian access routes.)

Crosswalks are provided on all legs of an intersection, except in rare cases. There are normally three crosswalks at a “T” intersection and four crosswalks at a “four-leg” intersection. For pedestrian route continuity, the minimum number of crosswalks is two at “T” intersections and three at “four-leg” intersections. One example where crosswalks might not be provided on all interaction legs is a diamond interchange with heavy left-turn movements from the off-ramp approach. (See [1510.10\(2\)\(c\)](#) for Closed Crossings policy.)

[The Traffic Manual](#) provides recommendations for determining pedestrian markings based on lane configuration, vehicular traffic volume, and speed. However, coordinate with the region Traffic Engineer early on with any existing or proposed crosswalks. The Traffic Engineer makes the final determination on appropriate signing and delineation.

#### 1510.10(2)(a) Unmarked Crossings

Legal crosswalks exist at all intersections, whether marked or not, regardless of the number of legs at the intersection. An unmarked crosswalk (see [Exhibit 1510-15](#)) is the portion of the roadway behind a prolongation of the curb or edge of the through traffic lane and a prolongation of the farthest sidewalk connection or, in the event there are no sidewalks, between the edge of the through traffic lane and a line 10 feet from there ([RCW 46.04.160](#)).



**Unmarked Crosswalks**  
*Exhibit 1510-15*

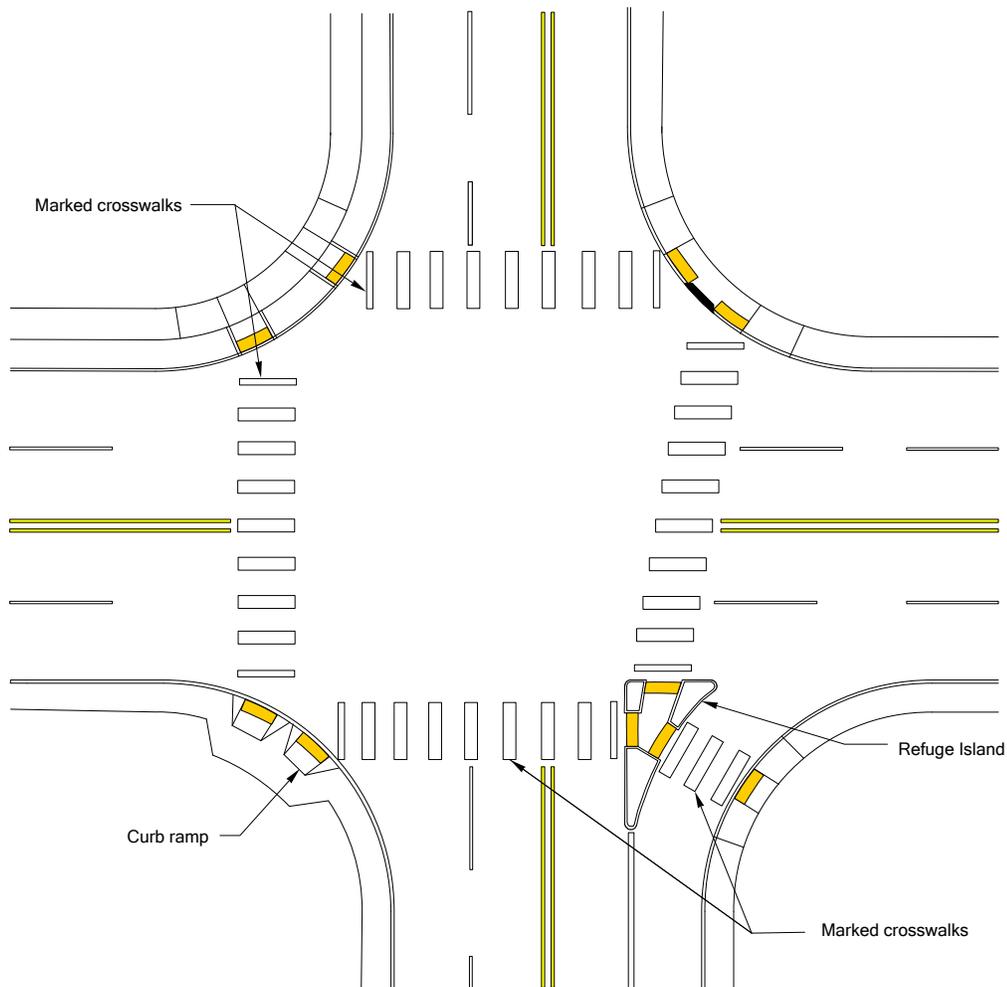
**1510.10(2)(b) Marked Crossings**

Marked crosswalks are used at intersections or midblock crossings. They are not to be used indiscriminately. Maintenance agreements and [RCW 47.24.020\(30\)](#) provide jurisdictional authority for decisions to mark crosswalks based on a population threshold of 25,000 and should be consulted prior to a decision to mark a crosswalk. Consult region Traffic Offices for “best practices” for marking crosswalks based on intersection type. The [MUTCD](#) is a good resource to use when evaluating locations for marking consideration.

The desirable width for a marked crosswalk is 10 feet (6 feet minimum, with justification). The preferred type of marked crosswalk is a longitudinal pattern known as a Ladder Bar, which is shown in the [Standard Plans](#) and [Exhibit 1510-16](#). Stop and yield line dimensions and placement must conform to the [MUTCD](#) and are shown in the [Standard Plans](#).

Some decorative crosswalk materials (such as colored pavement or bricks) may cause confusion for visually impaired pedestrians and can create discomfort for wheelchair users. Supplement decorative crosswalks with pavement markings to enhance visibility and delineate the crosswalk. Refer to the [MUTCD](#) and the Local Agency Crosswalk Options website:

[www.wsdot.wa.gov/design/standards/plansheet/pm-2.htm](http://www.wsdot.wa.gov/design/standards/plansheet/pm-2.htm)



**Marked Pedestrian Crossing**  
*Exhibit 1510-16*

**1510.10(2)(c) Closed Crossings**

Pedestrian crossings shall only be closed for documented potential or observed crash concerns or for essential signal operations. If a crossing has been previously closed as indicated by existing signing and ADA facilities are being evaluated, provide an appropriate treatment that is detectable by people with vision difficulties who navigate with a cane, such as directional pedestrian curbing and removal of ramps at these closed crossing. The region Traffic Engineer is the approval authority for the closing of crossings.

**Vacant**

*Exhibit 1510-17*

**1510.10(3) Midblock Crosswalks**

On roadways with pedestrian crossing traffic caused by nearby pedestrian generators, a midblock crossing may be appropriate. (See [1510.10\(2\)](#) for crosswalk criteria and [the \*Traffic Manual\*](#) for marked crosswalk recommendations at unsignalized intersections.) The approval authority is the Traffic Engineer.

Engineering judgment of conditions that might increase the value of a midblock crossing includes the following:

- High pedestrian crossing volume present with long block spacing.
- Evidence of pedestrian-vehicular midblock conflicts (site observations, law enforcement reporting, and city traffic engineers).
- Proposed crossing with a realistic opportunity to channel multiple pedestrian crossings to a single location.
- Sight lines that enable sufficient eye contact between motorists and pedestrians.
- Community commitment for a successful outcome.
- Ability to mitigate risks associated with the location using proven countermeasures such as, but not limited to, refuge islands, rectangular rapid flashing beacons, and/or pedestrian hybrid beacons.
- Modal interchange points where high volumes crossing pedestrians occur (e.g., transit stop to apartment complex).

To meet the accessibility criteria, the pedestrian access route in the crosswalk may have a cross slope that matches the grade of the roadway. An example of a midblock crossing is shown in [Exhibit 1510-18](#). (See [Chapter 530](#) for further information on pedestrian access and paths on limited access facilities.)



**Midblock Pedestrian Crossing**  
*Exhibit 1510-18*

#### **1510.10(4) Sight Distance at Crosswalks**

When locating crosswalks at intersections, it is important to evaluate the sight lines between pedestrians and motorists. Shrubbery, signs, parked cars, and other roadside elements can block motorists' and pedestrians' views of one another. [Exhibit 1510-19](#) illustrates these sight distance concerns.

- One or more of the conditions stated above exists in conjunction with a well-defined pedestrian origin and destination (such as a residential neighborhood across a busy street from a school).

### 1510.14(1) Pedestrian Bridges

Pedestrian grade-separation bridges (see [Exhibit 1510-28](#)) are more effective when the roadway is below the natural ground line, as in a cut section. Elevated grade separations in cut sections, where pedestrians climb stairs or use long approach ramps, tend to be underused. Pedestrian bridges need adequate right of way to accommodate accessible ramp approaches leading up to and off of the structure. The bridge structure must comply with ADA requirements and meet the accessibility criteria for either a pedestrian circulation path (if the grade is 5% or less) or an access ramp (if the grade is greater than 5% but less than or equal to 8.3%), and must include a pedestrian access route. (See [1510.06](#) and [1510.07](#) for pedestrian circulation path and pedestrian access route accessibility criteria; see [1510.15\(2\)](#) for access ramp accessibility criteria.)

For the minimum vertical clearance from the bottom of the pedestrian structure to the roadway beneath, see [Chapter 720](#). The height of the structure can affect the length of the pedestrian ramp approaches to the structure. When access ramps are not feasible, provide both elevators and stairways.

Provide railings on pedestrian bridges. Protective screening is sometimes desirable to deter pedestrians from throwing objects from an overhead pedestrian structure (see [Chapter 720](#)).

The minimum clear width for pedestrian bridges is 8 feet. Consider a clear width of 14 feet where a pedestrian bridge is enclosed or shared with bicyclists, or equestrians, or if maintenance or emergency vehicles will need to access.



**Pedestrian Bridges**  
*Exhibit 1510-28*

### 1510.14(2) Pedestrian Tunnels

Tunnels are an effective method of providing crossings for roadways located in embankment sections. Well-designed tunnels can be a desirable crossing for pedestrians. When feasible, design the tunnel with a nearly level profile to provide an unobstructed line of sight from portal to portal (see [Exhibit 1510-29](#)). People may be reluctant to enter a tunnel with a depressed profile because they are unable to see whether the tunnel is occupied. Law enforcement also has difficulty patrolling depressed profile tunnels.

Provide vandal-resistant daytime and nighttime illumination within the pedestrian tunnel. Installing gloss-finished tile walls and ceilings can enhance light levels within the tunnel. The minimum overhead clearance for a pedestrian tunnel is 10 feet. The minimum width for a pedestrian tunnel is 12 feet. Consider a tunnel width between 14 and 18 feet depending on usage and the length of the tunnel.



**Pedestrian Tunnel**  
*Exhibit 1510-29*

Pedestrian tunnels need adequate right of way to accommodate accessible approaches leading to the tunnel structure. The tunnel structure must comply with ADA requirements and meet the accessibility criteria for either a pedestrian circulation path (if the grade is less than or equal to 5%) or an access ramp (if the grade is greater than 5% and less than or equal to 8.3%), and must include a pedestrian access route. (See [1510.06](#) and [1510.07](#) for pedestrian circulation path and pedestrian access route accessibility criteria; see [1510.15\(2\)](#) for access ramp accessibility criteria.)

## 1510.15 Other Pedestrian Facilities

### 1510.15(1) Transit Stops and School Bus Stops

The location of transit stops is an important element in providing appropriate pedestrian facilities. (Coordinate with the local transit provider.) Newly constructed transit stops must conform to ADA requirements. Design newly constructed transit stops so that they are accessible from the sidewalk or paved shoulder. A transit stop on one side of a street usually has a counterpart on the opposite side because transit routes normally function in both directions on the same roadway. Provide adequate crossing facilities for pedestrians.

When locating a transit stop (see [Traffic Manual 7.9](#)), consider transit ridership and land use demand for the stop. Also, take into account compatibility with the following roadway/traffic characteristics:

- ADT
- Traffic speed
- Crossing distance
- Collision history
- Sight distance
- Connectivity to a pedestrian access route
- Traffic generator density

If any of these suggests an undesirable location for a pedestrian crossing, consider a controlled crossing or another location for the transit stop. (See [Chapter 530](#) for further information on bus stops on limited access facilities.)

When analyzing a transit stop location with high pedestrian collision frequency, take into account the presence of nearby transit stops and opportunities for pedestrians to cross the street in a reasonably safe manner. At-grade midblock pedestrian crossings may be effective at transit stop locations on roadways with lower vehicular volumes. Pedestrian grade separations are appropriate at midblock locations when vehicular traffic volumes prohibit pedestrian crossings at grade. (See the [Traffic Manual](#) for recommendations for marked crosswalks at unsignalized intersections.)

School bus stops are typically adjacent to sidewalks in urban areas and along shoulders in rural areas. Determine the number of children using the stop and provide a waiting area that allows the children to wait for the bus. Coordinate with the local school district. Because of their smaller size, children might be difficult for motorists to see at crossings or stops. Determine whether utility poles, vegetation, and other roadside features interfere with motorists' ability to see the children. When necessary, remove or relocate the obstructions or move the bus stop. Parked vehicles can also block visibility, and parking prohibitions might be advisable near the bus stop. Coordinate transit and school bus stop locations with the region Traffic Office.

### **1510.15(2) Access Ramps Serving Transit Stops, Park & Ride Lots, Rest Areas, Buildings, and Other Facilities**

An access ramp (see [Exhibit 1510-30](#)) provides an accessible pedestrian route from a pedestrian circulation path to a facility such as a transit stop, park & ride lot, rest area, pedestrian overcrossing/undercrossing structure, or building. When the running slope is 5% or less, it can be designed as a pedestrian circulation path that includes a pedestrian access route. When the running slope is greater than 5% to a maximum of 8.3%, it must be designed as an access ramp. (See [1510.06](#) and [1510.07](#) for pedestrian circulation path and pedestrian access route accessibility criteria; see [1510.15\(2\)\(a\)](#) for access ramp accessibility criteria.)

#### **1510.15(2)(a) Accessibility Criteria for Access Ramps**

Access ramps are composed of one or more ramp segments interconnected by level landings. Unless superseded by the following specific accessibility requirements for access ramps, the accessibility requirements for pedestrian access routes also apply:

- Ramp segments shall have a maximum running slope of 8.3%.
- The cross slope of ramp segments shall be 2% maximum.
- The minimum clear width of ramps is 4 feet; however, it is desirable to match the width of the connecting pedestrian facility.
- The rise for any ramp segment shall be 30 inches maximum.
- A level landing (2% maximum running and cross slopes) shall be provided at the top and bottom of each access ramp segment.
- An access ramp landing's clear width shall be at least as wide as the widest ramp segment leading to the landing.
- An access ramp landing's length shall be 5 feet minimum.
- Access ramps that change direction between ramp segments at landings shall have a level landing 5 feet minimum width by 5 feet minimum length.
- All access ramp segments with a rise greater than 6 inches shall have ADA-compliant handrails (see [1510.15\(3\)](#) for handrail accessibility criteria).

Provide edge protection complying with one of the two following options on each side of access ramp segments:

- The surface of the ramp segment and landing shall extend 12 inches minimum beyond the inside face of the handrail.
- A curb or barrier shall be provided that does not allow the passage of a 4-inch-diameter sphere, where any portion of the sphere is within 4 inches of the ramp/landing surface.



**Access Ramp With Accessible Handrails**  
*Exhibit 1510-30*

### **1510.15(3) Railings and Handrails for Pedestrian Facilities**

Accessible handrails are required on stairs and also on access ramps that have a rise greater than 6 inches (see [1510.15\(2\)\(a\)](#) for access ramp accessibility criteria). If the height of a drop-off (typically greater than 30 inches) adjacent to a pedestrian facility necessitates the need to protect pedestrians from falls, then a more robust railing system designed for fall protection should be used. If the drop-off is adjacent to either a stairway or an access ramp with a rise greater than 6 inches, then a combined railing system that meets the requirements for both accessibility and fall protection must be used.

#### **1510.15(3)(a) Fall Protection Railing**

Railing designed for fall protection alone is typically placed adjacent to pedestrian facilities other than stairs or access ramps to prevent pedestrians or bicyclists from falls. The minimum railing height for pedestrian fall protection is 42 inches. For facilities where bicycle traffic is anticipated, such as on a grade-separation structure on a shared-use facility (see [Chapter 1515](#)), the minimum railing height for bicyclist fall protection is 54 inches.

#### **1510.15(3)(b) Accessible Fall Protection Railing**

When fall protection is needed adjacent to stairs or an access ramp that has a rise greater than 6 inches, then a combined railing system that meets both the accessibility criteria for handrail outlined in [1510.15\(3\)\(d\)](#) and the requirements for fall protection must be used. The minimum railing height for pedestrian fall protection is 42 inches. For facilities where bicycle traffic is anticipated, such as on the approach to a grade-separation structure on a shared-use facility (see [Chapter 1515](#)), the minimum railing height for bicyclist fall protection is 54 inches.

Provide walkways that are clearly marked and pedestrian barriers that are continuous, rigid, and detectable to vision-impaired persons who navigate with a cane. Also, keep:

- The pedestrian head space clear.
- Walkways free from pedestrian hazards such as holes, debris, and abrupt changes in grade or terrain.
- Access along sidewalks clear of obstructions such as construction traffic control signs.
- A minimum clear width path throughout: 4 feet for pedestrians or 10 feet for pedestrians and bicyclists.

Temporary pedestrian facilities within the work zone must meet accessibility criteria to the maximum extent feasible. (See [1510.06](#) and [1510.07](#) for pedestrian circulation path and pedestrian access route accessibility criteria.)

Consider the use of flaggers if pedestrian generators such as schools are in the work zone vicinity. Consider spotters who are prepared to help pedestrians through the work zone.

Provide for advance public notification of sidewalk closures in the contract special provisions and plans.

Where transit stops are affected or relocated because of work activity, provide an accessible route to temporary transit stops.



Meets ADA requirements



Does not meet ADA requirements

### Work Zones and Pedestrian Facilities *Exhibit 1510-31*

## 1510.18 Documentation

Refer to [Chapter 300](#) for design documentation requirements.



**(c) Cross Slope**

The maximum cross slope on a paved shared-use path is to be 2%. The cross slope of the shoulders can be no steeper than 6H:1V. To accommodate drainage, the entire section, including shoulders, should transition through curves. It is desirable to design the pivot point on the outside edge of one side of the shoulder or the other to avoid a pavement crown (see Exhibits 1515-3 through 1515-5).

It is recommended that cross slopes be designed to be less than the allowed maximum to account for some tolerance in construction. For example, design for a 1.5% cross slope (rather than the 2% maximum).

Sloping the pavement surface to one side is desirable and usually simplifies drainage design and surface construction. Generally, surface drainage from the path is dissipated as it flows down the side slope.

**(d) Side Slopes and Pedestrian Rail**

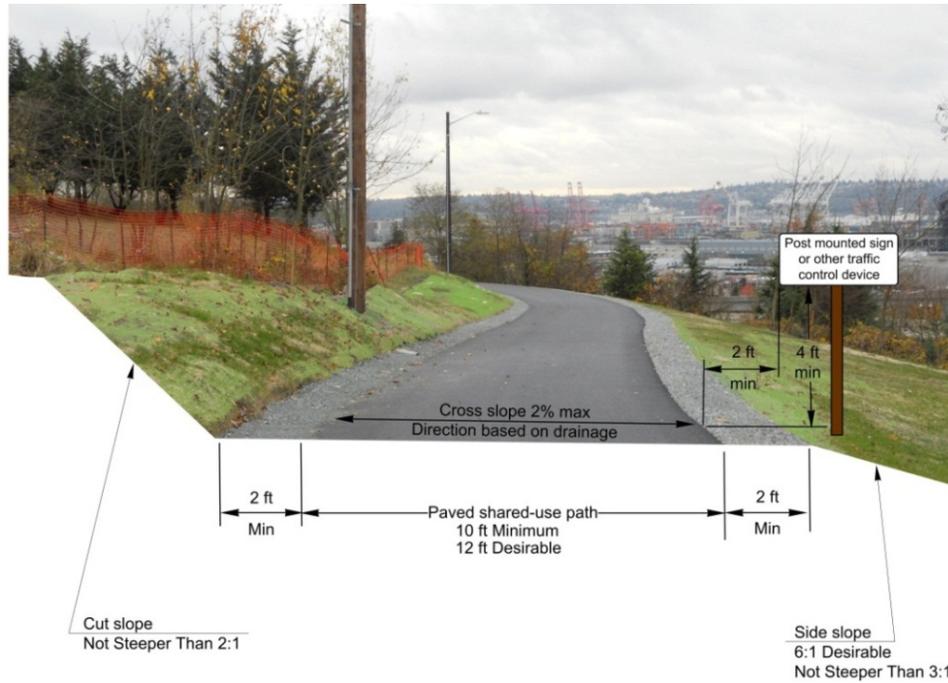
Side slopes along shared-use paths are an important design feature. Embankment side slopes of 6H:1V or flatter provide a gently sloping path border.

For shared-use paths with side slopes steeper than 3H:1V, or where obstacles or waterways may exist, evaluate the potential risk and provide mitigation such as:

- A minimum 5-foot separation from the edge of the pavement to the embankment edge. This can be accomplished by providing a 5-foot shoulder as shown in Exhibit 1515-5, Example 2.
- A natural barrier such as dense shrubbery on the side slopes.
- A physical barrier, such as pedestrian rail.
- Where a shared-use path is adjacent to a vertical drop of 2 feet 6 inches or more, a pedestrian rail is needed (see Exhibit 1515-5, Example 4).
- If the vertical drop is less than 2 feet 6 inches, a pedestrian rail, chain link fence, or 4-inch curb at the edge of the shared-use path may be installed to delineate the edge.
- Where a shared-use path is constructed on the side of a hill, drainage facilities may need to be considered.

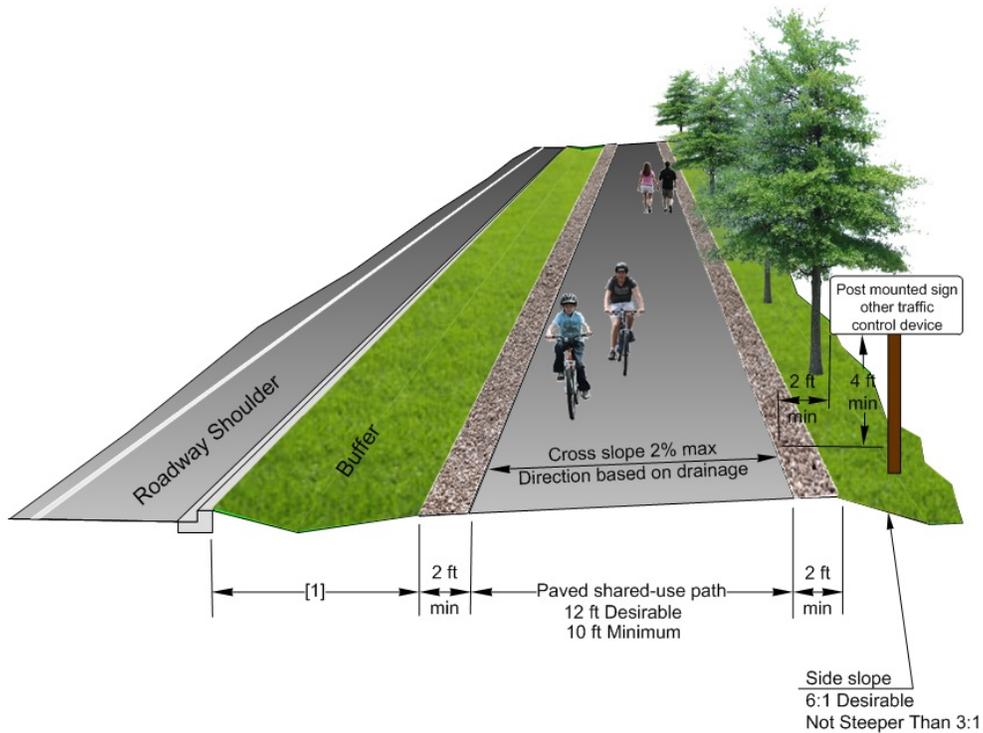
**(e) Clearances**

The minimum horizontal clearance from the edge of pavement to an obstruction (such as bridge piers or guardrail) is 2 feet. Provide a minimum vertical clearance of 10 feet from the pavement surface to overhead obstructions to accommodate maintenance vehicles, bicyclists, and equestrians.



**Two-Way Shared-Use Path: Independent Alignment**

*Exhibit 1515-3*



**Note:**

[1] 3 ft minimum. Provide as much separation from the roadway as practicable.

**Two-Way Shared-Use Path: Adjacent to Roadway (≤ 35 mph)**

*Exhibit 1515-4a*

(a) **Stopping Sight Distance on Crest Vertical Curves**

[Exhibit 1515-15](#) provides a chart or equations to obtain the minimum lengths of crest vertical curves for varying stopping sight distances and algebraic differences in grade. The values are based on a 4.5-foot eye height for the bicyclist and a 0-foot height for the object (path surface).

(b) **Stopping Sight Distance on Horizontal Curves**

[Exhibit 1515-16](#) gives the minimum clearances to line-of-sight obstructions for sight distance on horizontal curves. Provide lateral clearance based on the sum of stopping sight distances from Exhibits [1515-14a](#) and [14b](#) for bicyclists traveling in both directions and the proposed horizontal curve radius. Where this minimum clearance cannot be obtained, provide curve warning signs and use centerline pavement markings in accordance with the [MUTCD](#).

Exhibits [1515-14a](#), [14b](#), [15](#), and [16](#) are presented at the end of the chapter.

## 1515.05 Intersections and Crossings Design

This section covers path/roadway intersections and grade-separated crossings. Detectable warning surfaces are required where shared-use paths connect to the roadway.

### (1) *Intersections With Roadways*

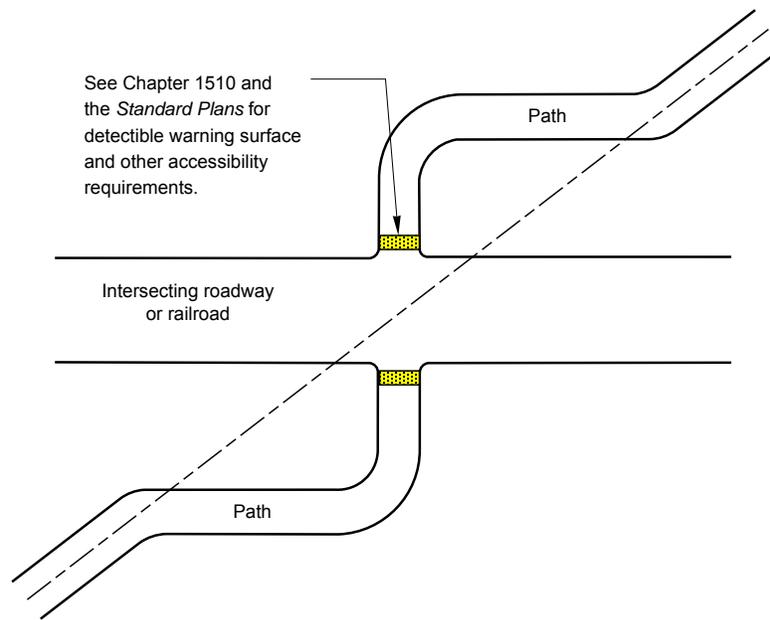
Clearly define who has the right of way and provide sight distance for all users at shared-use path and roadway intersections.

The common types of shared-use path/roadway at-grade intersection crossings are midblock and adjacent.

For roadway intersections with roundabouts, see [Chapter 1320](#).

**Midblock crossings** are located between roadway intersections. When possible, locate the path crossings far enough away from intersections to minimize conflicts between the path users and motor vehicle traffic. It is preferable for midblock path crossings to intersect the roadway at an angle as close to perpendicular as practicable. A minimum 60-degree crossing angle is acceptable to minimize right of way needs. A diagonal midblock crossing can be altered as shown in [Exhibit 1515-8](#).

There are other considerations when designing midblock crossings. They include traffic right of way assignments; traffic control devices; sight distances for both bicyclists and motor vehicle operators; refuge island use; access control; and pavement markings.

**Notes:**

- For path and highway signing and markings, see the [MUTCD](#) and the [Standard Plans](#).  
[http://www.wsdot.wa.gov/publications/fulltext/Standards/english/PDF/m09.60-00\\_e.pdf](http://www.wsdot.wa.gov/publications/fulltext/Standards/english/PDF/m09.60-00_e.pdf)
- For radii approaching roadway intersections, see [Exhibit 1515-2](#).

**Typical Redesign of a Diagonal Midblock Crossing****Exhibit 1515-8**

**Adjacent path crossings** are located at or near public intersection crosswalks and are normally placed with them. These crossings are usually placed with pedestrian crossings, where motorists can be expected to stop. If alternate intersection locations for a shared-use path are available, select the one with the greatest sight distance.

Adjacent path crossings occur where a path crosses an existing intersection of two roadways, a T intersection (including driveways), or a four-way intersection, as shown in [Exhibit 1515-9](#). It is desirable to integrate this type of crossing close to an intersection so that motorists and path users recognize one another as intersecting traffic. The path user faces potential conflicts with motor vehicles turning left (A) and right (B) from the parallel roadway and on the crossed roadway (C, D, and E).

Consider crossing improvements on a case-by-case basis. Suggested improvements include: move the crossing; evaluate existing or proposed intersection control type; change signalization timing; or provide a refuge island and make a two-step crossing for path users.

Important elements that greatly affect the design of these crossings are traffic right of way assignments, traffic control devices, and the separation distance between path and roadway.

Analyze the potential risk to motorists and the benefits of treating bodies of water located within the Design Clear Zone. A cost-effectiveness analysis that considers the consequences of doing nothing versus installing a longitudinal barrier can be used to determine the appropriate treatment.

For fencing considerations along water features, see [Chapter 560](#).

## 1600.05 Medians

Medians are to be analyzed for the potential of an errant vehicle to cross the median and encounter oncoming traffic. Median barriers are normally used on limited access, multilane, high-speed, high-volume highways. These highways generally have posted speeds of 45 mph or higher. Median barrier is not normally placed on collectors or other state highways that do not have limited access control. Providing access through median barrier results in openings; therefore, end-treatments are needed.

Provide median barrier on full access control multilane highways with median widths of 50 feet or less and posted speeds of 45 mph or higher. Consider median barrier on highways with wider medians or lower posted speeds when there is a history of cross-median collisions.

When installing a median barrier, provide left-side shoulder widths as shown in Chapters [1130](#) and [1140](#) and shy distance as shown in [Chapter 1610](#). Consider a wider shoulder area where the barrier might cast a shadow on the roadway and hinder the melting of ice. (See [Chapter 1230](#) for additional criteria for placement of median barrier, [Chapter 1610](#) for information on the types of barriers that can be used, and [Chapter 1260](#) for lateral clearance on the inside of a curve to provide the needed stopping sight distance.) Consideration of drainage is an important factor when designing median barrier treatments.

When median barrier is being placed in an existing median, identify the existing crossovers and enforcement observation points. Provide the needed median crossovers in accordance with [Chapter 1370](#), considering enforcement needs. [Chapter 1410](#) provides guidance on HOV enforcement.

## 1600.06 Other Roadside Safety Features

### 1600.06(1) Rumble Strips

Rumble strips are grooves or rows of raised pavement markers placed perpendicular to the direction of travel to alert inattentive drivers. There are three kinds of rumble strips: roadway, shoulder, and centerline.

In Washington, most rumble strips consist of grooves milled into the pavement surface. Although most installations have not adversely affected the pavement, there have been a few instances where milled rumble strips have been associated with advanced levels of pavement deterioration, resulting in continuous ruts or large areas of pavement delamination. Poor pavement performance has most commonly been associated with rumble strip installations in bituminous surface treatment (BST) pavement and hot mix asphalt (HMA) pavement with low density, particularly along longitudinal joints. Rumble strip installation should be avoided in open-graded pavements. Consult with the Region Materials Engineer to determine installation procedure and verify that the pavement structure is adequate. When installing both rumble strips and recessed lane markers, follow the Standard Plan to avoid overlapping the grindings. Installing rumble strips in bituminous surface treatment (or BST) or other thin surface treatments can expose pavement structure and lead to delamination.

The best practice is to install the rumble strips immediately prior to placing the surface treatment in order to seal the installation. In all cases, avoid placing HMA pavement joints and centerline rumble strips along the same (coincident) line wherever practical (see [Standard Plan 65.10-02](#)). Where rumble strips currently exist and an additional BST application is contemplated, evaluate whether the depth of the grooves following paving will support their continuing function to alert drivers. If not, or in the case of an HMA overlay, it may be necessary to remove existing rumble strips and install new ones. **Note:** WSDOT experience has shown that BST can be placed over existing rumble strips at least once and still be effective.

For additional guidance on surface preparation and pavement stability, refer to [the WSDOT Pavement Policy \(June 2011\)](#).

#### **1600.06(1)(a) Roadway Rumble Strips**

Roadway rumble strips are placed transversely to the traveled way to alert drivers who are approaching a change of roadway condition or object that requires substantial speed reduction or other maneuvering. Some locations where roadway rumble strips may be used are in advance of:

- Stop-controlled intersections.
- Port of entry/customs stations.
- Lane reductions where collision history shows a pattern of driver inattention.
- Horizontal alignment changes where collision history shows a pattern of driver inattention.

They may also be placed at locations where the character of the roadway changes, such as at the end of a freeway.

Contact the HQ Design Office for additional guidance on the design and placement of roadway rumble strips.

Document decisions to use roadway rumble strips in the Design Documentation Package.

#### **1600.06(1)(b) Shoulder Rumble Strips**

Shoulder rumble strips (SRS) are placed parallel to the traveled way just beyond the edge line to warn drivers they are entering a part of the roadway not intended for routine traffic use. Shoulder rumble strips are effective in reducing run-off-the-road collisions when the contributing circumstances are human factors related, such as inattention, apparently fatigued, or apparently asleep.

When shoulder rumble strips are used, discontinue them where no edge stripe is present, such as at intersections and where curb and gutter are present. Discontinue shoulder rumble strips where shoulder driving is allowed. Where bicycle travel is allowed, discontinue shoulder rumble strips at locations where shoulder width reductions can cause bicyclists to move into or across the area where rumble strips would normally be placed, such as shoulders adjacent to bridges or longitudinal barrier with reduced shoulder widths.

Shoulder rumble strip patterns vary depending on the likelihood of bicyclists being present along the highway shoulder and whether they are placed on divided or undivided highways. Rumble strip patterns for undivided highways are shallower and may be narrower than patterns used on divided highways. They also provide gaps in the pattern, providing opportunities for bicycles to move across the pattern without having to ride across the grooves. There are four shoulder rumble strip patterns. Consult the [Standard Plans](#) for the patterns and construction details.

## 1. Divided Highways

Install shoulder rumble strips on both the right and left shoulders of rural Interstate highways. Consider them on both shoulders of rural divided highways. Use the Shoulder Rumble Strip Type 1 pattern on divided highways.

Omitting shoulder rumble strips on rural Interstate highways is a design exception (DE) under any of the following conditions:

- When another project scheduled within two years of the proposed project will overlay or reconstruct the shoulders or will use the shoulders for detours.
- When a pavement analysis determines that installing shoulder rumble strips will result in inadequate shoulder strength.
- When overall shoulder width will be less than 4 feet wide on the left and 6 feet wide on the right.

## 2. Undivided Highways

Shoulder rumble strip usage on the shoulders of undivided highways demands strategic application because bicycle usage is more prevalent along the shoulders of the undivided highway system. Rumble strips affect the comfort and control of bicycle riders; consequently, their use is to be limited to highway corridors that experience high levels of run-off-the-road collisions. Apply the following criteria in evaluating the appropriateness of rumble strips on the shoulders of undivided highways.

- Consult the region and Headquarters Bicycle and Pedestrian Coordinators to determine bicycle usage along a route, and involve them in the decision-making process when considering rumble strips along bike touring routes or other routes where bicycle events are regularly held.
- Use on rural roads only.
- Determine that shoulder pavement is structurally adequate to support milled rumble strips.
- Posted speed is 45 mph or higher.
- Provide for at least 4 feet of usable shoulder between the rumble strip and the outside edge of shoulder. If guardrail or barrier is present, increase the dimension to 5 feet of usable shoulder. Field-verify these dimensions.
- Preliminary evaluation indicates a run-off-the-road collision experience of approximately 0.6 crashes per mile per year. (This value is intended to provide relative comparison of crash experience and is not to be used as absolute guidance on whether rumble strips are appropriate.)
- Do not place shoulder rumble strips on downhill grades exceeding 4% for more than 500 feet in length along routes where bicyclists are frequently present.
- An engineering analysis indicates a run-off-the-road collision experience considered correctable by shoulder rumble strips.

For projects that will remove and potentially replace existing shoulder rumble strips, evaluate the criteria for shoulder width and downhill grades for compliance with placement guidance. Discontinue rumble strips where the downhill grade exceeds 4% for more than 500 feet. If the usable shoulder width between the rumble strip and outer edge of shoulder is less than 4 feet (5 feet if guardrail or barrier is present) reevaluate the appropriateness of the rumble strips. Assess the existing shoulder rumble strip's impact on run-off-the-road crash experience and bicycling. Assess alternate rumble strip patterns and placement options. Consult the region and Headquarters Bicycle and Pedestrian Coordinators. Document decisions to continue or discontinue shoulder rumble strip usage where the existing usable shoulder width between the rumble strip and outer edge of shoulder is less than 4 feet (5 feet if guardrail or barrier is present).

Consult with the region or Headquarters Bicycle and Pedestrian Coordinator for determining levels of bicycle traffic for your project. The Shoulder Rumble Strip Type 2 or Type 3 pattern is used on highways with minimal bicycle traffic. When bicycle traffic on the shoulder is determined to be high, the Shoulder Rumble Strip Type 4 pattern is used.

Shoulder rumble strip installation considered at any other locations must involve the region and Headquarters Bicycle and Pedestrian Coordinators as a partner in the decision-making process.

Consult the following website for guidance on conducting an engineering analysis:

 [www.wsdot.wa.gov/design/policy/roadsidesafety.htm](http://www.wsdot.wa.gov/design/policy/roadsidesafety.htm)

#### **1600.06(1)(c) Centerline Rumble Strips**

Centerline rumble strips are placed on the centerline of undivided highways to alert drivers that they are entering the opposing lane. They are applied as a countermeasure for crossover collisions. Centerline rumble strips are installed with no differentiation between passing permitted and no passing areas. Refresh pavement markings when removed by centerline rumble strips.

A March 2011 WSDOT study found that centerline rumble strips were highly effective across the state highway network, and most effective on roadways where: the AADT is less than 8,000, the combined paved lane and shoulder width is 12 to 17 feet, and the posted speed is 45 to 55 mph.

Centerline rumble strips are evaluated using a programmatic approach, starting with a preliminary review of each rural undivided highway as a potential installation site. The HQ Design Office conducts the preliminary review, evaluating cross-centerline crash history and pavement width. A list of sites is generated from this review and periodically updated and distributed to the regions for a more detailed analysis of each site. The presence of a particular site on the preliminary list does not imply that rumble strips must be installed.

The preliminary review conducted in the Design Office does not assess pavement structure; traffic volume and composition; type and volume of nonmotorized users; or proximity to roadside residents. Region project development staff are expected to evaluate these items, and to field-verify roadway widths and appropriate project limits. The final determination about the appropriateness of centerline rumble strips is the responsibility of region project development staff. Although these decisions are made in the region, it is important that they be evaluated in a consistent manner from region to region. Evaluate the following criteria in determining the appropriateness of centerline rumble strips.

## 1. Crash Experience

WSDOT has evaluated the effectiveness of centerline rumble strips on roadways with various lane and shoulder widths. For roadways with a combined lane and shoulder width of 15 feet or more, the benefits are substantial. These highways exhibited a 50% reduction in fatal and serious injury crashes, when looking at both cross-centerline and run-off-the-road-right (ROTRR) crashes. For roadways with 12 to 14 feet of combined lane and shoulder width, the benefits are more closely aligned with reductions in cross-centerline crashes. There are mixed results with ROTRR crashes on 12- to 14-foot-wide roadways, although when combined with the cross-centerline crashes, the net result indicates an overall 25% reduction in fatal and serious injury crashes. Further evaluation of apparent run-off-the-road vehicles that cross the centerline and end on the opposing roadside may be of value.

Review the collision history to determine the frequency of collisions with human factors contributing circumstances such as inattention, apparently fatigued, apparently asleep, over the centerline, or on the wrong side of the road. These types of cross-centerline crashes are considered to be correctable with centerline rumble strips.

## 2. Highway Type

Centerline rumble strips are most appropriate on rural roads, but with special consideration, may also be appropriate for urban roads. Some concerns specific to urban areas are more residents impacted by noise in more densely populated areas, the frequent need to interrupt the rumble strip pattern to accommodate left-turning vehicles, and a reduced effectiveness at lower speeds (35 mph and below). Centerline rumble strips are not appropriate where two-way left-turn lanes exist.

## 3. Roadway Width

A 2004 study of the effects of centerline rumble strips on lateral placement and speed of vehicles determined that drivers tend to shift their lane position 3 to 5½ inches to the right to avoid driving on centerline rumble strips. This results in the vehicle driving closer to the pavement edge and to bicyclists who may be traveling on the outer edges of the lane. Centerline rumble strips are inappropriate when the combined lane and shoulder widths in either direction are less than 12 feet. (See Chapters [1130](#) and [1140](#) for guidance on lane and shoulder widths.)

The narrower roadways within this range warrant additional consideration. Where the combined lane and shoulder width is 14 feet or less, consider the level of bicycle and pedestrian use along the route. When drivers shift their lane position away from centerline to avoid the rumble strips, they are moving closer to pedestrians and bicyclists on the shoulder. Also consider the roadside characteristics and the potential for a lane position adjustment to result in a run-off-the-road event, evaluating clear zone width along the route. Balance these issues with the frequency and severity of cross-centerline crashes.

## 4. Traffic Volume

Higher-volume routes equate to greater exposure, with more opportunities for: cross-centerline crashes, conflicts with nonmotorized users on the shoulder, and incidental contact with the rumble strips. The March 2011 WSDOT centerline rumble strip study noted that lower-volume routes had higher rates of cross-centerline collisions.

## 5. Noise for Roadside Residents

Most rumble strip noise complaints result from incidental contact where the vehicle might not have been heading toward a crash. Left-turning or passing vehicles, along with the off-tracking of large trucks or trailers may result in incidental contact with centerline rumble strips. With some specific attention to details, some of these contacts can be significantly reduced by discontinuing the rumble strip installations through intersections or frequently used road approaches. For roadways with limited passing opportunities, evaluate the frequency and position of neighboring residents and site-specific crash experience to determine if the rumble strip should be discontinued in a potential passing location. Attention to horizontal curvature, curve widening, and large-vehicle usage may help identify locations where the rumble strips may need to be discontinued through a tight radius curve.

### 1600.06(2) Headlight Glare Considerations

Headlight glare from opposing traffic can cause potential safety problems. This can include glare from frontage roads. Glare can be reduced by the use of wide medians, separate alignments, earth mounds, plants, concrete barrier, and glare screens. Glare screen fencing may be effective for frontage roads. Consider long-term maintenance when selecting the treatment for glare. When considering glare screens, see [Chapter 1260](#) for lateral clearance on the inside of a curve to provide the necessary stopping sight distance. In addition to reducing glare, taller concrete barriers also provide improved crash performance for larger vehicles such as trucks.

Glare screen is relatively expensive, and its use is to be justified. It is difficult to justify the use of glare screen where the median width exceeds 20 feet, the ADT is less than 20,000 vehicles per day, or the roadway has continuous lighting. Consider the following factors when assessing the need for glare screen:

- Higher frequency of night collision compared to similar locations or statewide experience.
- Higher than normal ratio of night-to-day collisions.
- Unusual distribution or concentration of nighttime collisions.
- Over-representation of older drivers in night collisions.
- Combination of horizontal and vertical alignment, particularly where the roadway on the inside of a curve is higher than the roadway on the outside of the curve.
- Direct observation of glare.
- Public complaints concerning glare.

The most common area with the potential for glare is between opposing main line traffic. Other conditions for which glare screen might be appropriate are:

- Between a highway and an adjacent frontage road or parallel highway, especially where opposing headlights might seem to be on the wrong side of the driver.
- At an interchange where an on-ramp merges with a collector-distributor and the ramp traffic might be unable to distinguish between collector and main line traffic. In this instance, consider other solutions such as illumination.
- Where headlight glare is a distraction to adjacent property owners. Playgrounds, ball fields, and parks with frequent nighttime activities might benefit from screening if headlight glare interferes with these activities.

- 1610.01 General
- 1610.02 References
- 1610.03 Definitions
- 1610.04 Project Criteria
- 1610.05 Barrier Design
- 1610.06 Beam Guardrail
- 1610.07 Cable Barrier
- 1610.08 Concrete Barrier
- 1610.09 Special-Use Barriers
- 1610.10 Bridge Traffic Barriers
- 1610.11 Other Barriers
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## 1610.01 General

The Washington State Department of Transportation (WSDOT) uses traffic barriers to reduce the overall severity of collisions that occur when a vehicle leaves the traveled way. Consider whether a barrier is preferable to the recovery area it replaces. In some cases, installation of a traffic barrier may result in more collisions, as it presents an object that can be struck. Barriers are designed so that such encounters might be less severe and not lead to secondary or tertiary collisions. However, when impacts occur, traffic barriers are not guaranteed to redirect vehicles without injury to the occupants or additional collisions.

Barrier performance is affected by the characteristics of the types of vehicles that collide with them. For example, motor vehicles with large tires and high centers of gravity are commonplace on our highways and they are designed to mount obstacles. Therefore, they are at greater risk of mounting barriers or of not being decelerated and redirected as conventional vehicles would be.

When barriers are crash-tested, it is impossible to replicate the innumerable variations in highway conditions. Therefore, barriers are crash-tested under standardized conditions. These standard conditions were previously documented in National Cooperative Highway Research Program (NCHRP) Report 350. These guidelines have been updated and are now presented in the *Manual for Assessing Safety Hardware (MASH)*.

Barriers are not placed with the assumption that the system will restrain or redirect all vehicles in all conditions. It is recognized that the designer cannot design a system that is foolproof or will address every potential collision situation. Instead, barriers are placed with the assumption that, under normal conditions, they might provide lower potential for occupant deceleration and vehicle redirection for given roadside collisions when compared to a location without barrier.

Traffic barriers do not prevent collisions or injuries from occurring. They are intended to lower the potential severity for crash outcomes based on the conditions for which they are installed. Consequently, barriers should not be used unless a reduced crash frequency and severity potential is likely. No matter how well a barrier system is designed, optimal performance is dependent on drivers' proper use, maintenance, and operation of their vehicles and the proper use of vehicle restraint systems. At the time of installation, the ultimate choice of barrier type and placement is made by gaining an understanding of site and traffic conditions, having a thorough understanding of and using the criteria presented in Chapters 1600 and 1610, and using engineering judgment.

## 1610.02 References

### 1610.02(1) Design Guidance

*Bridge Design Manual*, M 23-50, WSDOT

*Roadside Design Guide*, AASHTO, 2011

*Standard Plans for Road, Bridge, and Municipal Construction (Standard Plans)*, M 21-01, WSDOT

*Traffic Manual*, M 51-02, WSDOT

### 1610.02(2) Supporting Information

NCHRP 350, TRB, 1993

*Manual for Assessing Safety Hardware (MASH)*, AASHTO, 2009

*Determining Length of Need*. This e-learning course for WSDOT employees covers the “Length of Need,” which is a calculation of how much longitudinal barrier is necessary to shield objects on the roadside. Request this training via the web-based Learning Management System.

## 1610.03 Definitions

Refer to the *Design Manual Glossary* for many of the terms used in this chapter.

## 1610.04 Project Criteria

Any project that introduces new barrier onto the roadside (including median) should be placed using full design level guidance (1610.04(2)(b)). This section identifies the barrier elements that are addressed according to notes in the Design Matrices in Chapter 1100. Remove barrier that is not needed. Use the criteria in Chapter 1600 as the basis for removal.

### 1610.04(1) Barrier Terminals and Transitions

Install, replace, or upgrade transitions as discussed in 1610.06(5), Transitions and Connections.

Impact attenuator criteria can be found in Chapter 1620, Impact Attenuator Systems. Concrete barrier terminal criteria can be found in 1610.08(3).

When installing new terminals, consider extending the guardrail to meet the length-of-need criteria found in 1610.05(5) as a spot safety enhancement, which is a modification to isolated roadway or roadside features that, in the engineer’s judgment, reduce potential for collision frequency or severity.

When the end of a barrier has been terminated with a small mound of earth, remove and replace with a crash-tested terminal, except as noted in 1610.09.

Redirectional landforms, also referred to as earth berms, were formerly installed to help mitigate collisions with fixed objects located in depressed medians and at roadsides. They were constructed of materials that provided support for a traversing vehicle. With slopes in the range of 2H:1V to 3H:1V, they were intended to redirect errant vehicles. The use of redirection landforms has been discontinued. Where redirection landforms currently exist as mitigation for a fixed object, provide alternative means of mitigation of the fixed object, such as remove, relocate, upgrade with crash-tested systems, or shield with barrier. Landforms may be used to provide a smooth surface at the base of a rock cut slope.

Replace guardrail terminals that do not have a crash-tested design with crash-tested guardrail terminals (see [1610.06\(4\)](#), Terminals and Anchors). Common features of systems that do not meet current crash-tested designs include:

- No cable anchor.
- A cable anchored into concrete in front of the first post.
- Second post not breakaway (CRT).
- Design A end section (Design C end sections may be left in place—see the *Standard Plans* for end section details).
- Terminals with beam guardrail on both sides of the posts (two-sided).
- Buried guardrail terminals that slope down such that the guardrail height is reduced to less than 26 inches.

When the height of an existing terminal will be reduced to less than 26 inches from the ground to the top of the rail element, adjust the height to a minimum of 26 inches and a maximum of 28 inches. A rail height of 28 inches is desirable to accommodate future overlays. When adjusting terminals that are equipped with CRT posts, the top-drilled holes in the posts need to remain at the surface of the ground.

One terminal that was used extensively on Washington’s highways was the Breakaway Cable Terminal (BCT). This system used a parabolic flare similar to the Slotted Rail Terminal (SRT) and a Type 1 anchor. (Type 1 anchor posts are wood set in a steel tube or a concrete foundation.) Replace BCTs on Interstate routes. On non-Interstate routes and Interstate ramps, BCTs that have at least a 3-foot offset may remain in place unless the guardrail run or anchor is being reconstructed or reset. (Raising the rail element is not considered reconstruction or resetting.)

Existing transitions that do not have a curb but are otherwise consistent with the designs shown in the *Standard Plans* may remain in place.

### **1610.04(2) Standard Run of Barrier**

In [Chapter 1100](#), the Design Matrices offer guidance on how to address standard barrier runs for different project types. A “Standard Run” of barrier consists of longitudinal barrier as detailed in the *Standard Plans*.

#### **1610.04(2)(a) Barrier Height Criteria**

For HMA Overlay Projects that will reduce the height of W-beam guardrail to less than 26 inches from the ground to the top of the rail element, adjust the height to a minimum of 26 inches and a maximum of 28 inches. A rail height of 28 inches is desirable to accommodate future overlays.

If Type 1 Alternate W-beam guardrail is present, raise the rail element after each overlay. If Type 1 Alternate is not present, raise the existing blockout up to 4 inches higher than the top of the existing post by boring a new hole in the post.

Overlays in front of safety shape concrete barriers can extend to the top of the lower, near-vertical face of the barrier before adjustment is necessary.

- Allow no more than 1 foot 1 inch from the pavement to the beginning of the top near-vertical face of the safety shape barriers.

- Allow no less than 2 feet 8 inches from the pavement to the top of the single-slope barrier.
- Allow no less than 35 inches to the center of the top cable for four-cable high-tension cable barriers.

*Note:* There are new high-tension cable barrier systems under development, which may change the selection and placement criteria. The Headquarters (HQ) Design Office will circulate guidance on these new developments as they are adopted as WSDOT policy.

### 1610.04(2)(b) Full Design Level (F)

When the full design level (F) is indicated the barrier is to meet the criteria in the following:

Chapter/Section	Subject
<a href="#">1600.05</a>	Medians
<a href="#">1610.05(2)</a>	Shy distance
<a href="#">1610.05(3)</a>	Barrier deflections
<a href="#">1610.05(4)</a>	Flare rate
<a href="#">1610.05(5)</a>	Length of need
<a href="#">1610.05(6)</a>	Median barrier selection and placement considerations
<a href="#">1610.06</a>	Beam guardrail
<a href="#">1610.07</a>	Cable barrier
<a href="#">1610.08</a>	Concrete barrier

Examples of barriers that are not acceptable as a “Standard Run” are:

- W-beam guardrail with 12-foot-6-inch post spacing or no blockouts, or both.
- W-beam guardrail on concrete posts.
- Cable barrier on wood or concrete posts.
- Half-moon or C-shaped rail elements.

### 1610.04(3) Bridge Rail

When the Bridge Rail column of a Design Matrix applies to the project, the bridge rails, including crossroad bridge rail, are to meet the following criteria:

- Use an approved, crash-tested concrete bridge rail on new bridges or bridges to be widened. The *Bridge Design Manual* provides examples of typical bridge rails. Consult the HQ Bridge and Structures Office regarding bridge rail selection and design and for design of the connection to an existing bridge.
- An existing bridge rail on a highway with a posted speed of 30 mph or below may remain in place if it is not located on a bridge over a National Highway System (NHS) highway. When Type 7 bridge rail is present on a bridge over an NHS highway with a posted speed of 30 mph or below, it may remain in place regardless of the type of metal rail installed. Other bridge rails are to be evaluated for strength and geometrics. (See [1610.10](#) for guidance on retrofit techniques.)
- The Type 7 bridge rail is common. Type 7 bridge rails have a curb, a vertical-face parapet, and an aluminum top rail. The curb width and the type of aluminum top rail are factors in determining the adequacy of the Type 7 bridge rail, as shown in [Exhibit 1610-1](#). Consult the HQ Bridge and Structures Office for assistance in evaluating other bridge rails.

Barrier Type	System Type	Deflection
Cable barrier or beam guardrail, Types 20 and 21, on G-2 posts	Flexible	Up to 12 ft (face of barrier to object)
Beam guardrail, Types 1, 1a, 2, 10, and 31	Semirigid	3 ft (face of barrier to object)
Two-sided W-beam guardrail, Types 3 and 4	Semirigid	2 ft (face of barrier to object)
Permanent concrete barrier, unanchored	Rigid Unrestrained	3 ft <sup>[1]</sup> (back of barrier to object)
Temporary concrete barrier, unanchored	Rigid Unrestrained	2 ft <sup>[2]</sup> (back of barrier to object)
Precast concrete barrier, anchored	Rigid Anchored	6 inches (back of barrier to object)
Rigid concrete barrier	Rigid	No deflection

**Notes:**

[1] When placed in front of a 2H:1V or flatter fill slope, the deflection distance can be reduced to 2 feet.

[2] When used as temporary bridge rail, anchor all barrier within 3 feet of a drop-off.

### Longitudinal Barrier Deflection

*Exhibit 1610-2*

#### 1610.05(4) Flare Rate

Flare the ends of longitudinal barriers where practicable. The four functions of a flare are to:

- Locate the barrier and its terminal as far from the traveled way as feasible.
- Reduce the length of need.
- Redirect an errant vehicle.
- Minimize a driver's reaction to the introduction of an object near the traveled way.

Keeping flare rates as flat as practicable preserves the barrier's redirection performance and minimizes the angle of impact. However, it has been shown that an object (or barrier) close to the traveled way might cause a driver to shift laterally, slow down, or both. The flare reduces this reaction by gradually introducing the barrier so the driver does not perceive the barrier as an object to be avoided. The flare rates in [Exhibit 1610-3](#) are intended to satisfy the four functions listed above. More gradual flares may be used. Flare rates are offset parallel to the edge of the traveled way. Transition sections are not normally flared.

Posted Speed (mph)	Rigid & Rigid Anchored System	Unrestrained Rigid System	Semirigid System
65–70	20:1	18:1	15:1
60	18:1	16:1	14:1
55	16:1	14:1	12:1
50	14:1	12:1	11:1
45	12:1	11:1	10:1
40 or below	11:1	10:1	9:1

### Longitudinal Barrier Flare Rates

*Exhibit 1610-3*

#### 1610.05(5) Length of Need

The length of traffic barrier needed to shield a fixed feature (length of need) is dependent on the location and geometrics of the object, direction(s) of traffic, posted speed, traffic volume, and type and location of traffic barrier. When designing a barrier for a fill slope (see [Chapter 1600](#)), the length of need begins at the point where the need for barrier is recommended. For fixed objects and water, Exhibits [1610-10a](#) and [10b](#) show design parameters for determining the needed length of a barrier for both adjacent and opposing traffic on relatively straight sections of highway.

When barrier is to be installed on the outside of a horizontal curve, the length of need can be determined graphically, as shown in [Exhibit 1610-10c](#). For installations on the inside of a curve, determine the length of need as though it were straight. Also, consider the flare rate, barrier deflection, and barrier end treatment to be used.

When beam guardrail is placed in a median, consider the potential for impact from opposing traffic when conducting a length of need analysis. When guardrail is placed on either side of objects in the median, consider whether the trailing end of each run of guardrail will shield the leading end of the opposing guardrail. Shield the leading end when it is within the Design Clear Zone of opposing traffic (see [Exhibit 1610-10d](#)). This is also a consideration when objects are placed in the outer separations between the main line and collector-distributors.

Before the actual length of need is determined, establish the lateral distance between the proposed barrier installation and the object shielded. Provide a distance that is greater than or equal to the anticipated deflection of the longitudinal barrier. (See [Exhibit 1610-2](#) for barrier deflections.) Place the barrier as far from the edge of the traveled way as possible while maintaining the deflection distance.

If the end of the length of need is near an adequate cut slope, extend the barrier and embed it in the slope (see [1610.06\(4\)](#)). Avoid gaps of 300 feet or less. Short gaps are acceptable when the barrier is terminated in a cut slope. If the end of the length of need is near the end of an existing barrier, it is recommended that the barriers be connected to form a continuous barrier. Consider maintenance access issues when determining whether or not to connect barriers.

## 1610.06 Beam Guardrail

### 1610.06(1) Beam Guardrail Systems

Beam guardrail systems are shown in the *Standard Plans*.

Strong post W-beam guardrail (Types 1 through 4, and 31) and thrie beam guardrail (Types 10 and 11) are semirigid barriers used predominantly on roadsides. They have limited application as median barrier. Installed incorrectly, strong post W-beam guardrail can cause vehicle snagging or spearing. This can be avoided by lapping the rail splices in the direction of traffic (as shown in the *Standard Plans*), by using crash-tested end treatments, and by blocking the rail away from the strong posts. However, avoid the use of blockouts that extend from the post to the rail element for a distance exceeding 16 inches. Placement of curb at guardrail installations also requires careful consideration.

Previously, WSDOT standard practice was to install W-beam guardrail at a rail height of 27 inches. However, there are newer designs that use a 31-inch rail height. One is the 31-inch-high WSDOT Type 31. The Type 31 system uses many of the same components as the WSDOT Type 1 system. However, the main differences are that the blockouts extend 12 inches from the posts, the rail height is 31 inches from the ground to the top of the rail, and the rail elements are spliced between posts.

The 31-inch-high system offers tolerance for future HMA overlays. The Type 31 system allows a 3-inch tolerance from 31 inches to 28 inches without adjustment of the rail element.

### 1610.06(2) W-Beam Barrier Selection and Placement

During the project development processes, consult with maintenance staff to help identify guardrail runs that may need to be upgraded.

- Use the 31-inch-high guardrail design for new runs. When guardrail is installed along existing shoulders with a width greater than 4 feet, the shoulder width may be reduced by 4 inches to accommodate the 12-inch blockout without processing a deviation.
- Existing runs with rail height at 27 inches are acceptable to leave in place and can be extended if the design height of 27 inches is maintained in the extended section. Where future overlays are anticipated, extend with Type 1 alternate or the 31-inch design.
- For existing runs below 26 inches, adjust or replace the rail to a height of 26 inches minimum to 28 inches maximum, or replace the run with the 31-inch-high guardrail design.
- Some 31-inch-high proprietary guardrail designs that do not incorporate the use of blockouts have been successfully crash-tested. The use of this type of system may be appropriate for some applications. Contact the HQ Design Office for further details.

Some designs for Type 31 applications are under development and will be added to the HQ Design Standards (Plan Sheet Library: [www.wsdot.wa.gov/design/standards/plansheet](http://www.wsdot.wa.gov/design/standards/plansheet)) as soon as they are completed. Plans will be housed at this location until they are transitioned into the *Standard Plans*. **Note:** If a design is not available for the Type 31 guardrail system, a Type 1 guardrail design may be used.

**1610.06(3) Additional Guidance**

- Weak post W-beam guardrail (Type 20) and three beam guardrail (Type 21) are flexible barrier systems that can be used where there is adequate deflection distance (see the [Standard Plans](#)). These systems use weak steel posts. The primary purpose of these posts is to position the guardrail vertically, and they are designed to bend over when struck. These more flexible systems will likely result in less damage to the impacting vehicle. Since the weak posts will not result in snagging, blockouts are not necessary.
- Keep the slope of the area between the edge of the shoulder and the face of the guardrail 10H:1V or flatter. On fill slopes between 6H:1V and 10H:1V, avoid placing within 12 feet of the break point. Do not place beam guardrail on a fill slope steeper than 6H:1V. (See [Exhibit 1610-4](#) for additional guidance on beam guardrail slope placement.)
- On the high side of superelevated sections, place beam guardrail at the edge of shoulder prior to the slope break.
- For W-beam guardrail installed at or near the shoulder, 2 feet of shoulder widening behind the barrier is generally provided from the back of the post to the beginning of a fill slope (see [Exhibit 1610-11](#), Case 2). If the slope is 2H:1V or flatter, this distance can be measured from the face of the guardrail rather than the back of the post (see [Exhibit 1610-11](#), Case 1).
- On projects where no roadway widening is proposed and the minimum 2-foot shoulder widening behind the barrier is not practicable, long post installations are available as shown in [Exhibit 1610-11](#), Cases 3, 4, 5, and 6. When guardrail is to be installed in areas where the roadway is to be widened or along new alignments, the use of Cases 5 and 6 requires a design deviation.
- Rail washers on beam guardrail are not normally used. If rail washers are present, removal is not necessary except for posts 2 through 8 of an existing BCT installation. However, if the rail element is removed for any reason, do not reinstall rail washers. In areas where heavy snow accumulations are expected to cause the bolts to pull out, specify snowload post washers and rail washers in the contract documents. (Snowload post washers are used to help prevent the bolts from pulling through the posts, and snowload rail washers are used to help prevent the bolt head from pulling through the rail.) In other installations, it is normal to have the rail pull loose from the bolt head when impacted. Do not use rail washers within the limits of a guardrail terminal except at the end post where they are needed for anchorage of the rail.

- The use of curb in conjunction with beam guardrail is discouraged. If a curb is needed, the 3-inch-high curb is preferred. If necessary, the 4-inch-high extruded curb can be used behind the face of rail at any posted speed. The 6-inch-high extruded curb can be used at locations where the posted speed is 50 mph or below. When replacing extruded curb at locations where the posted speed is above 50 mph, use 3-inch-high or 4-inch-high curb. (See the [Standard Plans](#) for extruded curb designs.)
- **Note:** When used in conjunction with the 31-inch-high Type 31 W-beam guardrail, an acceptable option is to place up to a 6-inch-high extruded curb at a maximum 6-inch offset outside the face of the rail at any posted speed. Contact the WSDOT Design Office for more information.
- Beam guardrail is usually galvanized and has a silver color. It can also be provided in weathering steel that has a brown or rust color. Along Scenic Byways, Heritage Tour Routes, state highways through national forests, or other designated areas where aesthetic barrier is needed, consider using weathering steel guardrail, colored terminals (powder-coated galvanized steel), and colored steel posts (galvanized weathering steel or powder-coated galvanized steel) to minimize the barrier's visual impact (see [1610.05\(7\)](#)).
- There are new methods under development that may change the options for providing colored guardrail to meet the aesthetic barrier. The HQ Design Office will circulate guidance on these new developments as they are adopted as WSDOT policy.

#### **1610.06(4) Terminals and Anchors**

A guardrail anchor is needed at the end of a run of guardrail to develop tensile strength throughout its length. In addition, when the end of the guardrail is subject to head-on impacts, a crash-tested guardrail terminal is needed (see the [Standard Plans](#)).

##### **1610.06(4)(a) Buried Terminal (BT)**

A buried terminal is designed to terminate the guardrail by burying the end in a backslope. The BT is the preferred terminal because it eliminates the exposed end of the guardrail.

The BT uses a Type 2 anchor to develop the tensile strength in the guardrail. The backslope needed to install a BT is to be 3H:1V or steeper and at least 4 feet in height above the roadway. The entire BT can be used within the length of need for backslopes of 1H:1V or steeper if the barrier remains at full height in relation to the roadway shoulder to the point where the barrier enters the backslope. For backslopes between 1H:1V and 3H:1V, design the length of need beginning at the point where the W-beam remains at full height in relation to the roadway shoulder—usually beginning at the point where the barrier crosses the ditch line. If the backslope is flatter than 1H:1V, provide a minimum 20-foot-wide by 75 foot-long distance behind the barrier and between the beginning length of need point at the terminal end to the mitigated object to be protected.

For new BT installations, use the Buried Terminal Type 2. **Note:** Previously, another BT option (the Buried Terminal Type 1) was an available choice. For existing situations, it is acceptable to leave this option in service as long as height requirements and other previous design criteria can still be met.

## 1. Buried Terminal Type 2

Flare the guardrail to the foreslope/backslope intersection using a flare rate that meets the criteria in 1610.05(4). Provide a 4H:1V or flatter foreslope into the face of the guardrail and maintain the full guardrail height to the foreslope/backslope intersection in relation to a 10H:1V line extending from edge of shoulder breakpoint. (See the *Standard Plans* for details.)

### 1610.06(4)(b) Nonflared Terminal

If a BT terminal cannot be installed as described in 1610.06(4)(a), consider a nonflared terminal (see *Exhibit 1610-12a*). For Type 31 guardrail systems, there are currently two acceptable sole source proprietary designs: the ET-31 and the SKT-MGS. Both the ET-31 and the SKT-MGS can be supplied with wood or steel posts. These systems use W-beam guardrail with a special end piece that fits over the end of the guardrail. When hit head on, the end piece is forced over the rail and either flattens or bends the rail and then forces it away from the impacting vehicle.

Both the SKT-MGS and the ET-31 terminals include an anchor for developing the tensile strength of the guardrail. The length of need begins at the third post for both terminals. Both of these terminals are available in two designs, which are based on the posted speed of the highway. For highways with a posted speed of 45 mph or above, use the ET-31 (TL3) or the SKT-MGS (TL3) terminal. For lower-speed highways (a posted speed of 40 mph or below), use the ET-31 (TL2) or SKT-MGS (TL2).

While these terminals do not need to have an offset at the end, a flare is recommended so that the end piece does not protrude into the shoulder. These terminals may have a 2-foot offset to the first post. Four feet of widening is needed at the end posts to properly anchor the system. When widening includes an embankment, fill material will be necessary for optimum terminal performance. (See the *Standard Plans* for widening details.)

When the entire barrier run is located farther than 12 feet beyond the shoulder break point and the slopes are greater than 10H:1V and 6H:1V or flatter, additional embankment at the terminal is not needed.

No snowload rail washers are allowed within the limits of these terminals.

When a Beam Guardrail Type 1 nonflared terminal is needed, two sole source proprietary terminals, the ET-PLUS or the Sequential Kinking Terminal (SKT), may be used (see *Exhibit 1610-12b*). Both of these Type 1 barrier terminals are available in two designs based on the posted speed of the highway. The primary difference in these designs is the length of the terminal. For highways with a posted speed of 45 mph or above, use the 50-foot-long ET PLUS TL3 or the SKT 350 terminal. For lower-speed highways (a posted speed of 40 mph or below), use the 25 foot-long ET PLUS TL2 or SKT-TL2.

The FHWA has granted approval to use the above sole source nonflared proprietary terminals without justification.

**Note:** Approved shop drawings for terminals can be found by accessing the following website:  
[www.wsdot.wa.gov/design/policy/trafficbarriers.htm](http://www.wsdot.wa.gov/design/policy/trafficbarriers.htm)

### 1610.06(4)(c) Flared Terminal

WSDOT does not use a flared terminal system for the Type 31 system. However, if a flared terminal is needed for other applications, there are currently two acceptable sole source proprietary designs: the Slotted Rail Terminal (SRT) and the Flared Energy Absorbing Terminal (FLEAT). Both of these designs include an anchor for developing the tensile strength of the guardrail. The length of need begins at the third post for both flared terminals.

1. The SRT uses W-beam guardrail with slots cut into the corrugations and posts throughout the length of the terminal. The end of the SRT is offset from the tangent guardrail run by the use of a parabolic flare. When struck head on, the first two posts are designed to break away, and the parabolic flare gives the rail a natural tendency to buckle, minimizing the possibility of the guardrail end entering the vehicle. The buckling is facilitated by the slots in the rail. The remaining posts provide strength to the system for redirection and deceleration without snagging the vehicle. The SRT has a 4 foot offset of the first post.

The SRT terminal can be supplied with wood or steel posts. Match the type of SRT posts with those of the longitudinal barrier run to which the terminal will be connected.

2. The FLEAT uses W-beam guardrail with a special end piece that fits over the end of the guardrail and posts. The end of the FLEAT is offset from the tangent guardrail run by the use of a straight flare. When struck head on, the end piece is forced over the rail, bending the rail and forcing it away from the impacting vehicle.

**Note:** Approved shop drawings for terminals can be found by accessing the following website:  
[www.wsdot.wa.gov/design/policy/trafficbarriers.htm](http://www.wsdot.wa.gov/design/policy/trafficbarriers.htm)

The FLEAT is available in two designs based on the posted speed of the highway. For highways with a posted speed of 45 mph or above, use a FLEAT 350, which has a 4-foot offset at the first post. For lower-speed highways (a posted speed of 40 mph or below), use a FLEAT TL-2, which has a 1 foot-8-inch offset at the first post.

The FLEAT terminal can be supplied with wood or steel posts. Match the type of FLEAT posts with those of the longitudinal barrier run to which the terminal will be connected.

When a flared terminal is specified, it is critical that the embankment quantity also be specified so that the area around the terminal can be constructed as shown in the [Standard Plans](#).

When the entire barrier run is located greater than 12 feet beyond the shoulder break point and the slopes are greater than 10H:1V and 6H:1V or flatter, additional embankment at the terminal is not needed.

Snowload rail washers are not allowed within the limits of these terminals.

The FHWA has granted approval to use the SRT and the FLEAT sole source proprietary flared terminals without justification.

### 1610.06(4)(d) Terminal Evolution Considerations

Some currently approved terminals have been in service for a number of years. During this time, there have been minor design changes. However, these minor changes have not changed the devices' approval status. Previous designs for these terminals may remain in place. (For guidance on BCT terminals, see [1610.04\(1\)](#).)

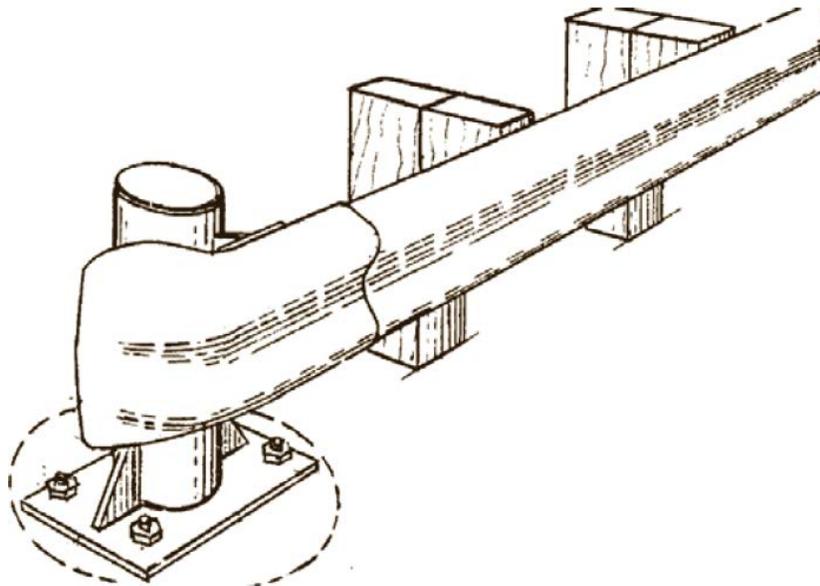
**Note:** If questions arise concerning the current approval status of a device, contact the HQ Design Office for clarification when replacement is being considered.

### 1610.06(4)(e) Other Anchor Applications

Use the Type 10 anchor to develop the tensile strength of the guardrail on the end of Type 31 guardrail runs where a crash-tested terminal is not needed. The Type 1 or Type 4 anchor is used for older Beam Guardrail Type 1 where a crash-tested terminal is not needed. Use the Type 5 anchor with the Weak Post Intersection Design (see 1610.06(6)(b), Cases 12 and 13). Use the Type 7 anchor to develop tensile strength in the middle of a guardrail run when the guardrail curves and weak posts are used (see 1610.06(6)(b), Cases 9, 12, and 13).

The old Type 3 anchor was primarily used at bridge ends (see Exhibit 1610-5). This anchor consisted of a steel pipe mounted vertically in a concrete foundation. Bridge approach guardrail was then mounted on the steel pipe.

- On one-way highways, these anchors were usually positioned so that neither the anchor nor the bridge rail posed a snagging potential. When these cases are encountered, the anchor may remain in place if a stiffened transition section is provided at the connection to the post.
- On two-way highways, the anchor may present a snagging potential. In these cases, install a connection from the anchor to the bridge rail if the offset from the bridge rail to the face of the guardrail is 1 foot 6 inches or less. If the offset is greater than 1 foot 6 inches, remove the anchor and install a new transition and connection.



**Old Type 3 Anchor**  
Exhibit 1610-5

Locations where crossroads and driveways cause gaps in the guardrail create situations for special consideration. Elimination of the need for the barrier is the preferred solution. Otherwise, a barrier flare might be needed to provide sight distance. If the slope is 2H:1V or flatter and there are no fixed features on or at the bottom of the slope, a terminal can be used to end the rail (see Chapters 1310 and 1340 for additional sight distance guidance). Place the anchor of this installation as close as possible to the road approach radius PC.

### 1610.06(5) Transitions and Connections

When there is an abrupt change from one barrier type to a more rigid barrier type, a vehicle hitting the more flexible barrier is likely to be caught in the deflected barrier pocket and directed into the more rigid barrier. This is commonly referred to as “pocketing.” A transition stiffens the more flexible barrier by decreasing the post spacing, increasing the post size, and using stiffer beam elements to eliminate the possibility of pocketing.

When connecting beam guardrail to a more rigid barrier or a structure, or when a rigid object is within the deflection distance of the barrier, use the transitions and connections that are shown in Exhibits 1610-6 and 1610-9 and detailed in the *Standard Plans*. The transition pay item includes the connection.

Condition	Connection
Unrestrained concrete barrier	A
Rigid, rigid anchored, untapered safety shape bridge rails or barriers <sup>[1]</sup>	B
Bridge rails with curbs 9 inches or less in width	B
Bridge rails with curbs between 9 and 18 inches wide	C
Vertical walls, single slope, or tapered safety shape barrier <sup>[1]</sup>	D
<b>Note:</b>	
[1] New single slope and safety shape bridge rails are designed with the toe of the barrier tapered so that it does not project past the face of the approach guardrail.	

#### Guardrail Connections

Exhibit 1610-6

### 1610.06(6) Guardrail Placement Cases

The *Standard Plans* contains placement cases that show beam guardrail elements needed for typical situations. For some applications, the *Standard Plans* provides options for both Type 1 and Type 31 guardrail for similar installations. For new installations, use the appropriate Type 31 placement option. Additional placement cases incorporate other combinations of barrier types.

#### 1610.06(6)(a) Beam Guardrail Type 31 Placements (for new installations)

- **Case 1-31** is used where there is one-way traffic. It uses a crash-tested terminal on the approach end and a Type 10 anchor on the trailing end.
- **Case 2-31** is used where there is two-way traffic. A crash-tested terminal is used on both ends.
- **Case 3-31** is used at railroad signal supports on one-way or two-way roadways. A terminal is used on the approach end, but usually cannot be used on the trailing end because of its proximity to the railroad tracks. If there is a history of crossover accidents, consider additional protection such as an impact attenuator.
- **Case 4-31** is used where guardrail on the approach to a bridge is to be shifted laterally to connect with the bridge rail. A terminal is used on the approach end and a transition is needed at the bridge end. A curve in the guardrail is shown to shift it to the bridge rail. However, the length of the curve is not critical. The criterion is to provide a smooth curve that is not more abrupt than the allowable flare rate (see Exhibit 1610-3).

- **Case 5-31** is a typical bridge approach where a terminal and a transition are needed.
- **Case 6** is used on bridge approaches where opposing traffic is separated by a median that is 36 feet or wider. This case is designed so that the end of the guardrail will be outside the Design Clear Zone for the opposing traffic.
- **Case 10 (A-31, B-31, and C-31)** is used at roadside fixed features (such as bridge piers) when 3 or more feet are available from the face of the guardrail to the feature. The approach end is the same for one-way or two-way traffic. Case 10A-31 is used with two-way traffic; therefore, a terminal is needed on the trailing end. Case 10B-31 is used for one-way traffic when there is no need to extend guardrail past the bridge pier and a Type 10 anchor is used to end the guardrail. Case 10C-31 is used for one-way traffic when the guardrail will extend for a distance past the bridge pier.
- **Case 11 (A-31, B-31, and C-31)** is used at roadside fixed features (such as bridge piers) when the guardrail is to be placed within 3 feet of the feature. Since there is no room for deflection, the rail in front of the feature is to be considered a rigid system and a transition is needed. The trailing end cases are the same as described for Case 10.
- **Beam Guardrail Type 31 (12'6", 18'9", or 25' Span)** is used when it is necessary to omit one, two, or three posts. This application is typically used when guardrail is installed over drainage structures but may have other applications if adequate deflection distance is present. Three CRT posts are provided on each end of the omitted post(s).
- **Guardrail Placement Strong Post – Type 31** is the “Strong Post Intersection Design for Type 31 barrier” that provides a stiff barrier. This design is used at crossroads or road approaches where a barrier is needed and where the length of need cannot be achieved using standard components such as standard longitudinal barrier runs, transitions, and terminals.

*Note:* Some placement cases for use with Beam Guardrail Type 31 are currently under development. As plans become available, they will be housed in the HQ Design Standards (Plan Sheet Library) until they become Standard Plans ([www.wsdot.wa.gov/design/standards/plansheet](http://www.wsdot.wa.gov/design/standards/plansheet)).

#### **1610.06(6)(b) Additional Placement Cases (typically, for existing installations)**

- **Case 1** is used where there is one-way traffic. It uses a crash-tested terminal on the approach end and a Type 4 anchor on the trailing end.
- **Case 2** is used where there is two-way traffic. A crash-tested terminal is used on both ends. When flared terminals are used on both ends, use a minimum of 25 feet of guardrail between the terminal limits when feasible.
- **Case 3** is used at railroad signal supports on one-way or two-way roadways. A terminal is used on the approach end, but usually cannot be used on the trailing end because of its proximity to the railroad tracks. If there is a history of crossover accidents, consider additional protection such as an impact attenuator.
- **Case 4** is used where guardrail on the approach to a bridge is to be shifted laterally to connect with the bridge rail. A terminal is used on the approach end and a transition is needed at the bridge end. A curve in the guardrail is shown to shift it to the bridge rail. However, the length of the curve is not critical. The criterion is to provide a smooth curve that is not more abrupt than the allowable flare rate (see [Exhibit 1610-3](#)).
- **Case 5** is a typical bridge approach where a terminal and a transition are needed.
- **Case 6** is used on bridge approaches where opposing traffic is separated by a median that is 36 feet or wider. This case is designed so that the end of the guardrail will be outside the Design Clear Zone for the opposing traffic.

To address public safety, stormwater, and wetland concerns, assess whether concrete barrier or beam guardrail placement will cause the need for an evaluation by the HQ Environmental Services Office. Conduct this evaluation early in the project development process to allow adequate time for discussion of options.

### 1610.09 Special-Use Barriers

The following barriers may be used on designated Scenic Byway and Heritage Tour routes if funding can be arranged (see [1610.05](#) and [Chapter 120](#)).

#### 1610.09(1) Steel-Backed Timber Guardrail

Steel-backed timber guardrails consist of a timber rail with a steel plate attached to the back to increase its tensile strength. There are several variations of this system that have passed crash tests. The nonproprietary systems use a beam with a rectangular cross section that is supported by either wood or steel posts. A proprietary (patented) system called the Ironwood Guardrail is also available. This system uses a beam with a round cross section and is supported by steel posts with a wood covering to give the appearance of an all-wood system from the roadway.

The Ironwood Guardrail can be allowed as an alternative to the nonproprietary system. However, specifying this system exclusively needs approval by an Assistant State Design Engineer of a public interest finding for the use of a sole source proprietary item.

The most desirable method of terminating the steel-backed timber guardrail is to bury the end in a backslope, as described in [1610.06\(4\)](#). When this type of terminal is not possible, use of the barrier is limited to highways with a posted speed of 45 mph or below. On these lower-speed highways, the barriers can be flared away from the traveled way and terminated in a berm outside the Design Clear Zone.

For details on these systems, contact the HQ Design Office.

#### 1610.09(2) Stone Guardwalls

Stone guardwalls function like rigid concrete barriers but have the appearance of natural stone. These walls can be constructed of stone masonry over a reinforced concrete core wall or of simulated stone concrete. These types of barriers are designed to have a limited projection of the stones to help aid in the redirection characteristics of the barrier. The most desirable method of terminating this barrier is to bury the end in a backslope, as described in [1610.08\(3\)](#). When this type of terminal is not possible, use of the barrier is limited to highways with a posted speed of 45 mph or below. On these lower-speed highways, the barrier can be flared away from the traveled way and terminated in a berm outside the Design Clear Zone.

For details on these systems, contact the HQ Design Office.

### 1610.10 Bridge Traffic Barriers

Bridge traffic barriers redirect errant vehicles and help to keep them from going over the side of the structure. (See the [Bridge Design Manual](#) for information regarding bridge barrier on new bridges and replacement bridge barrier on existing bridges.)

For new bridge rail installations, use a 2-foot-10-inch-high single-slope or a 2 foot-8-inch-high safety shape (F Shape) bridge barrier. A transition is available to connect the New Jersey shape (Type 2 concrete barrier) and the F-Shape bridge barrier. (See the [Standard Plans](#) for further details.)

Use taller 3-foot-6-inch single-slope or safety shape bridge barriers on Interstate or freeway routes where accident history suggests a need or where taller barrier is required on approaching roadways with narrow medians, as defined in [1610.08\(2\)](#). Also, consider taller 3-foot-6-inch barrier when geometrics increase the possibility of larger trucks hitting the barrier at a high angle (such as on-ramps for freeway-to-freeway connections with sharp curvature in the alignment).

For further guidance on bridges where high volumes of pedestrian traffic are anticipated, see Chapters [720](#), [1510](#), [1515](#), and [1520](#).

Approach barriers, transitions, and connections are usually needed on all four corners of bridges carrying two-way traffic and on both corners of the approach end for one-way traffic. (See [1610.06\(5\)](#) for guidance on transitions.)

If the bridge barrier system does not meet the criteria for strength and geometrics, modifications to improve its redirection characteristics and its strength may be needed. The modifications can be made using one of the retrofit methods described in [1610.10\(1\)](#) and [1610.10\(2\)](#).

### **1610.10(1) Concrete Safety Shape**

Retrofitting with a new concrete bridge barrier is costly and needs to have justification when no widening is proposed. Consult the HQ Bridge and Structures Office for design details and to determine whether the existing bridge deck and other superstructure elements are of sufficient strength to accommodate this bridge barrier system.

### **1610.10(2) Thrie Beam Retrofit**

Retrofitting with thrie beam is an economical way to improve the strength and redirection performance of bridge barriers. The thrie beam can be mounted to steel posts or the existing bridge barrier, depending on the structural adequacy of the bridge deck, the existing bridge barrier type, the width of curb (if any), and the curb-to-curb roadway width carried across the structure.

The HQ Bridge and Structures Office is responsible for the design of thrie beam bridge barrier. [Exhibit 1610-14](#) shows typical retrofit criteria. Contact the HQ Bridge and Structures Office for assistance with thrie beam retrofit design.

Consider the Service Level 1 (SL-1) system on bridges with wooden decks and for bridges with concrete decks that do not have the needed strength to accommodate the thrie beam system. Contact the HQ Bridge and Structures Office for information needed for the design of the SL-1 system.

A sidewalk reduction of up to 6 inches as a result of a thrie beam retrofit can be documented as a design exception.

The funding source for retrofit of existing bridge rail is dependent on the length of the structure. Bridge rail retrofit, for bridges less than 250 feet in length, or a total bridge rail length of 500 feet, is funded by the project (Guardrail Preservation or Improvement). For longer bridges, the retrofit will be included in the I-2 Bridge Rail upgrades program. Contact the HQ Program Development Office to determine whether funding is available.

## 1610.11 Other Barriers

### 1610.11(1) Dragnet

The Dragnet Vehicle Arresting Barrier consists of chain link or fiber net that is attached to energy absorbing units. When a vehicle hits the system, the Dragnet brings the vehicle to a controlled stop with limited damage. Possible uses for this device include the following:

- Reversible lane entrances and exits
- Railroad crossings
- Truck escape ramps (instead of arrester beds—see [Chapter 1270](#))
- T-intersections
- Work zones
- Swing span bridges

For permanent installations, this system can be installed between towers that lower the unit into position when needed and lift it out of the way when it is no longer needed. For work zone applications, it is critical to provide deflection space for stopping the vehicle between the system and the work zone. For additional information on the Dragnet, contact the HQ Design Office.

## 1610.12 Documentation

Refer to [Chapter 300](#) for design documentation requirements.

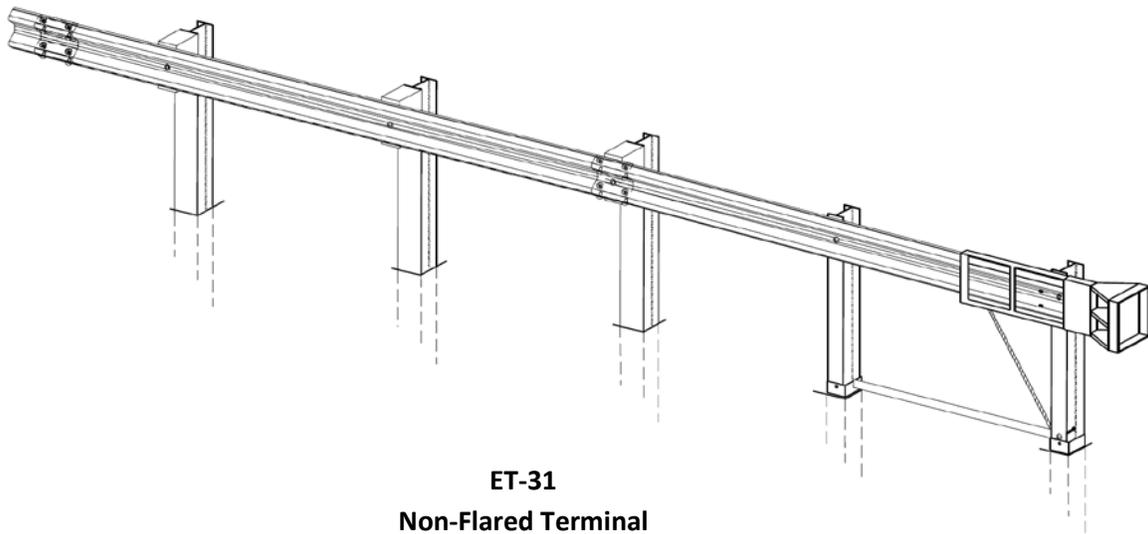
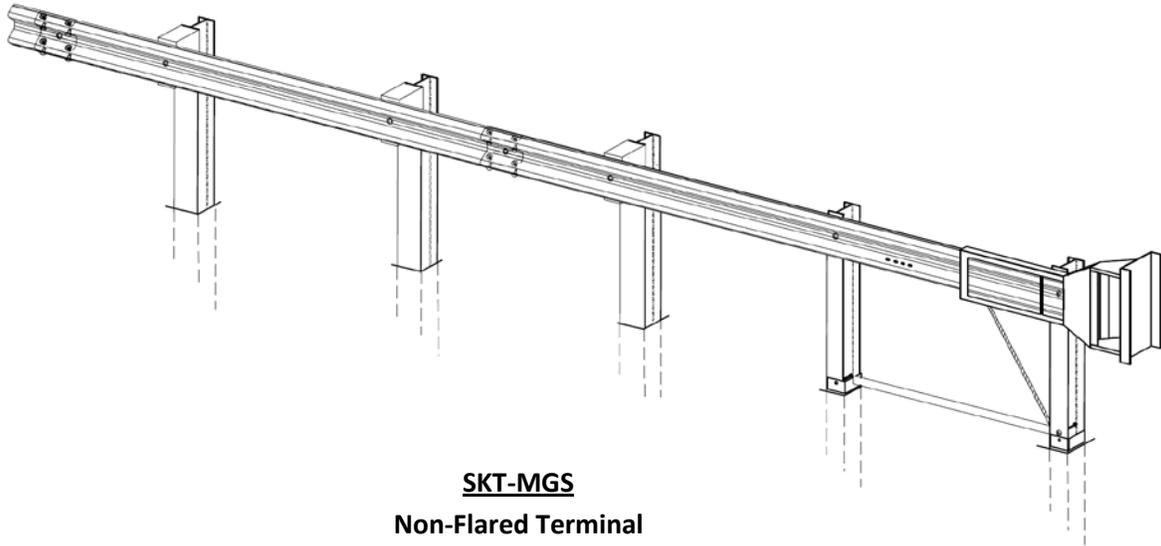
Connecting W-Beam Guardrail to: Transitions and Connections		Transition Type*	Connection	
Bridge Rail	New Installation	20, 21	D	
	Existing Concrete	Concrete Parapet > 20 inches	20, 21, 4 <sup>[4]</sup>	Exhibit 1610-6 <sup>[6]</sup>
		Concrete Parapet < 20 inches	20, 21, 2, 4 <sup>[4]</sup>	Exhibit 1610-6 <sup>[6]</sup>
		Existing W-Beam Transition	2 <sup>[1][5]</sup> , 4 <sup>[4]</sup>	[1]
	Thrie Beam at Face of Curb <sup>[3]</sup>	Approach End	23	n/a
		Trailing End (two-way traffic only)	23	n/a
	Thrie Beam at Bridge Rail (curb exposed) <sup>[3]</sup>	Approach End	22	n/a
		Trailing End (two-way traffic only)	22	n/a
	Weak Post Intersection Design (see 1610.06(6)(b), Cases 12 & 13)		5	Exhibit 1610-6
Concrete Barrier	Rigid & Rigid Anchored	21	Exhibit 1610-6	
	Unrestrained	21, 2, 4 <sup>[4]</sup>	A	
Weak Post Barrier Systems (Type 20 and 21)		6	n/a	
Rigid Structures such as Bridge Piers	New Installation (see Cases 11–31)	21	n/a	
	Existing W-Beam Transition	[2]	n/a	
Connecting Thrie Beam Guardrail to:		Transition Type*	Connection	
Bridge Rail or Concrete Barrier	New Installation (example: used with thrie beam bull nose)	1B	Exhibit 1610-6	

\*Consult Section C of the [Standard Plans](#) for details on transition types.

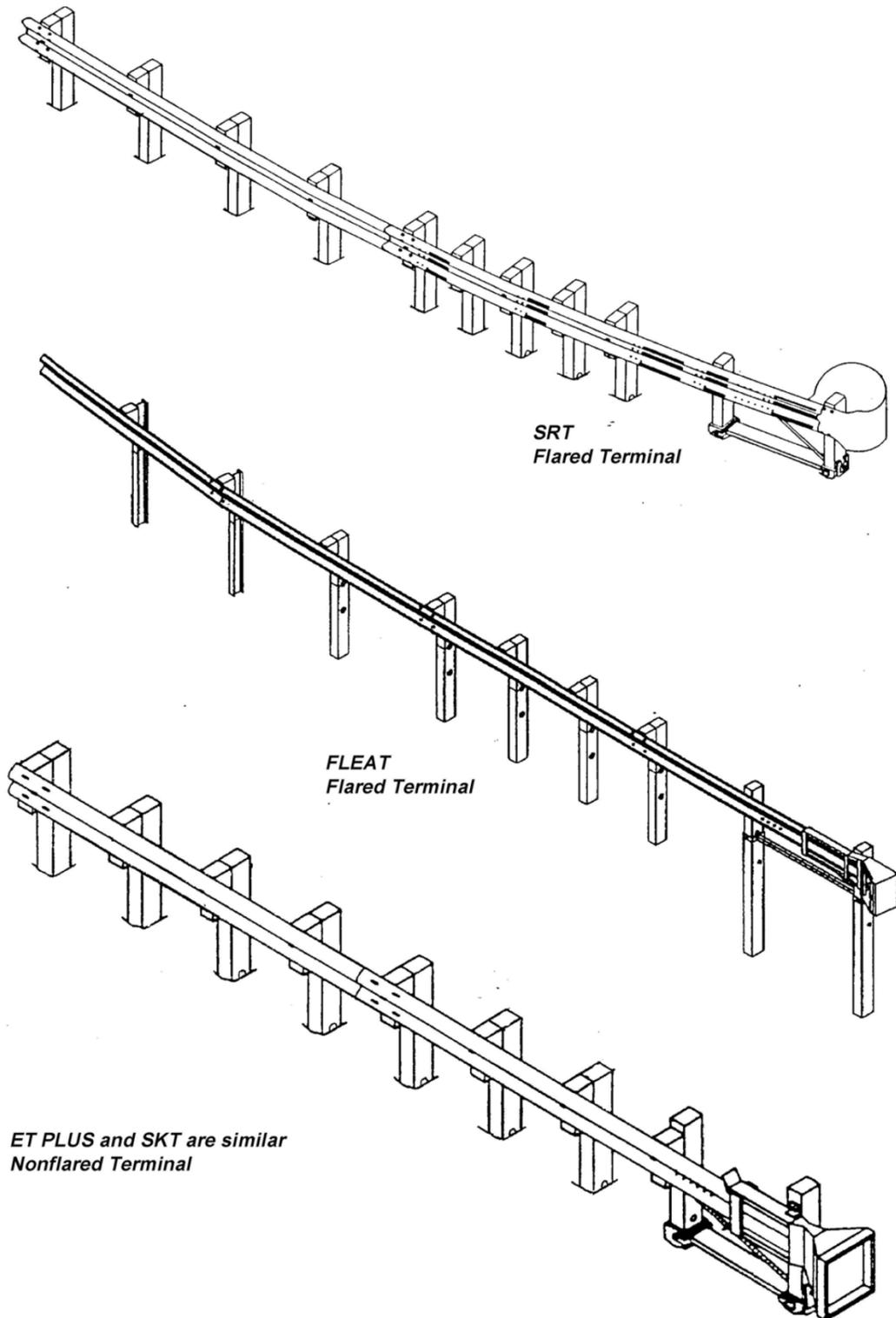
**Notes:**

- [1] If work creates the need for reconstruction or resetting of the transition, upgrade as shown above. Raising the guardrail is not considered reconstruction. If the transition is not being reconstructed, the existing connection may remain in place. When Type 3 anchors are encountered, see [1610.06\(4\)\(e\)](#) for guidance.
- [2] For new/reconstruction, use Case 11 (thrie beam). For existing Case 11 with W-beam, add a second W-beam rail element.
- [3] For Service Level 1 bridge rail, see [1610.06\(6\)\(b\)](#), Case 14.
- [4] Use on highways with speeds 45 mph or below.
- [5] If existing transition has the needed guardrail height—three 10" x 10" (nominal) posts and three 6" x 8" (nominal) posts spaced 3'-1.5" apart—it is acceptable to nest existing single W-beam element transitions.
- [6] When connecting a Type 20 or Type 21 Transition to an existing bridge rail, a special connection plate may be required. Contact the WSDOT Bridge and Structures Office for details.

**Transitions and Connections**  
*Exhibit 1610-9*



**Beam Guardrail Terminals**  
*Exhibit 1610-12a*



**Beam Guardrail Terminals**  
*Exhibit 1610-12b*

- 1620.01 General
- 1620.02 Design Criteria
- 1620.03 Selection
- 1620.04 Impact Attenuator Systems
- 1620.05 Documentation

### 1620.01 General

Impact attenuator systems are protective systems that help aid an errant vehicle from impacting an object by either gradually decelerating the vehicle to a stop when hit head-on or by redirecting it away from the feature when struck on the side. These systems are used for rigid objects or other features that cannot be removed, relocated, or made breakaway.

Approved systems are shown in Exhibits [1620-1a](#) and [1620-1b](#) and on the Washington State Department of Transportation (WSDOT) Headquarters (HQ) Design Office web page:

 [www.wsdot.wa.gov/design/policy/roadsidesafety.htm](http://www.wsdot.wa.gov/design/policy/roadsidesafety.htm)

Approved systems shall meet standardized testing defined in National Cooperative Highway Research Program (NCHRP) Report 350 or the American Association of State Highway and Transportation Officials (AASHTO) *Manual for Assessing Safety Hardware* (MASH). In addition, these devices shall have an acceptance letter from FHWA that certifies that the device meets the appropriate crash test criteria and is eligible for federal-aid reimbursement.

### 1620.02 Design Criteria

The following design criteria apply to new or reset permanent and temporary impact attenuators. The design criteria also apply to existing systems to be left in place when the Barrier Terminals and Transition Sections columns on a design matrix apply to the project (see [Chapter 1100](#)).

Impact attenuators are placed so that they do not present a feature that needs mitigating in relation to opposing traffic. For median and reversible lane locations, the backup structure or attenuator-to-object connection is designed to help in aiding opposing traffic from being snagged.

Avoid placement of curbs between attenuators and traffic. Refer to the specific attenuator manufacturer's instructions if considering placement of curbing between an attenuator and the travelled way. It is desirable that existing curbing be removed and the surface smoothed with asphalt or cement concrete pavement before an impact attenuator is installed. However, mountable curbs 4 inches or less in height may be retained depending on the feasibility of their removal.

In general, attenuators are aligned parallel to the roadway except the inertial barriers.

Consult with the Area Maintenance Superintendent who will be maintaining the system prior to selecting the attenuator systems to include in a construction contract.

### 1620.03 Selection

To select an appropriate impact attenuator system, the following factors must be assessed:

- Posted speed
- Operating speed
- Average daily traffic (ADT)
- Repair crew exposure
- Proximity to the roadway
- Anticipated number of yearly impacts
- Available space (length and width)
- Maintenance costs
- Initial cost
- Duration (permanent or temporary use)
- Portion of the impact attenuator that is redirective/nonredirective (see [Exhibit 1620-2](#))
- Width of object to be shielded

It is very important for designers to take into account the portion of an impact attenuator that is designed to redirect vehicles during a side impact of the unit. It is crucial that fixed objects, either permanent or temporary (such as construction equipment), are not located behind the nonredirective portion of these devices.

The posted speed is a factor in the selection of many impact attenuators. Use Exhibits [1620-1a](#) and [1620-1b](#) to select the system and configuration appropriate for the posted speed. In the interest of a cost-effective design, selecting a system applicable for the posted speed is recommended (although using a system tested for a higher speed is acceptable). Where there is evidence that the average operating speed of the facility is higher than the posted speed, consider selecting an attenuator system rated at the facility's operating speed. Manufacturer's product information may indicate that a longer system (than what is in Exhibits [1620-1a](#) and [1620-1b](#)) is required for speeds of 70 mph or greater. These models are generally referred to as "high speed" or "70 mph" systems. Use of these systems on facilities with 70 mph posted speeds is not required, and selection of a system rated for at least 60 mph will typically be appropriate for most sites on these facilities. For permanent installations where unusual conditions warrant consideration of a high-speed device, these systems are available and may be used with justification. Contact the HQ Design Office for guidance when selecting one of these systems.

For a comparison summary of space and initial cost information related to impact attenuator systems, see Exhibits [1620-1a](#) and [1620-1b](#).

When maintenance costs are considered, anticipate the average annual impact rate. If few impacts are anticipated, lower-cost devices such as inertial barriers might meet the need. (See [Chapter 301](#) for examples of how to determine lifecycle costs for proposed hardware). Inertial barriers have the lowest initial cost and initial site preparation. However, maintenance will be costly and necessary after each impact. Labor and equipment are needed to clean up the debris and install new containers (barrels). Inertial barriers are not be used where flying debris might be a danger to pedestrians.

In selecting a system, one consideration is the anticipated exposure to traffic that the workers making the repairs may encounter. In areas with high traffic exposure, a low-maintenance system that can be repaired quickly is most desirable. Some systems need nearly total replacement or replacement of critical components (such as cartridges or braking mechanisms) after a head-on impact, while others simply need resetting.

It is very important to consider that each application is unique when selecting impact attenuators for use in particular applications. This applies to both permanent and temporary installations. When specifying the system or systems that can be used at a specific location, the list shown in Exhibits [1620-1a](#) and [1620-1b](#) are to be used as a starting point. As the factors discussed previously are analyzed, inappropriate systems may be identified and eliminated from further consideration. Systems that are not eliminated may be appropriate for the project. When the site conditions vary, it might be necessary to have more than one list of acceptable systems within a contract. Systems are not to be eliminated without documented reasons. Also, wording such as “or equivalent” is not to be used when specifying these systems. If only one system is found to be appropriate, then approval from the Assistant State Design Engineer of a public interest finding for the use of a sole source proprietary item is needed.

When a transition to connect with a concrete barrier, fixed object, or beam guardrail is needed (see impact attenuator descriptions in [1620.04](#)), the transition type and connection may need to be specified. In most cases, the transition type and connection required will be a custom design per the manufacturer (these transitions are included in the cost of the impact attenuator). In a few cases, the transition type and connection to use will be as described in [Chapter 1610](#) and the *Standard Plans* (these transition sections are not included in the cost of the impact attenuator and must be included as a separate bid item in the construction contract). Consult with the Area Maintenance Superintendent who will be maintaining the systems before finalizing the list of attenuators to be included in the contract.

### **1620.03(1) Low-Maintenance Category**

The QuadGuard Elite, SCI100GM/SCI70GM, and REACT 350 are considered low-maintenance devices. These devices have a higher initial cost, requiring substantial site preparation, including a backup or anchor wall in some cases and cable anchorage at the front of the installation. However, repair costs are comparatively low, with labor typically being the main expense. Maintenance might not be needed after minor side impacts with these systems.

Installation of a low-maintenance device is desirable at locations that meet at least one of the following criteria:

- Sites with an ADT of 25,000 or greater
- Sites with a history/anticipation of more than one impact-per year
- Sites with unusually challenging conditions, such as limitations on repair time, a likelihood of frequent night repairs, or narrow gore locations

Document the decision in the DDP to use any device other than a low-maintenance device at locations meeting at least one of the criteria above.

Consider upgrading existing ADIEM, G-R-E-A-T, and Hex-Foam Sandwich impact attenuators to low-maintenance devices when the repair history shows one or more impacts per year over a three- to five-year period.

The HQ Design Office conducts an annual review of maintenance records to consider which devices should be included in the Low-Maintenance category. For a description of requirements that need to be met in order to be included in the Low-Maintenance category, see:

🔗 [www.wsdot.wa.gov/publications/fulltext/design/roadsidesafety/low\\_maint.pdf](http://www.wsdot.wa.gov/publications/fulltext/design/roadsidesafety/low_maint.pdf)

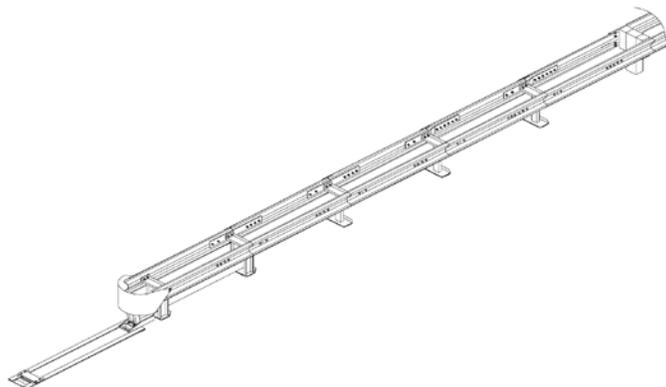
## 1620.04 Impact Attenuator Systems

### 1620.04(1) Permanent Installations

For systems used in permanent installations, a description of the system's purpose, parts, and function, as well as transition needs, foundation, and slope requirements are provided as follows and in Exhibits 1620-1a and 1620-1b.

#### 1620.04(1)(a) Brakemaster 350

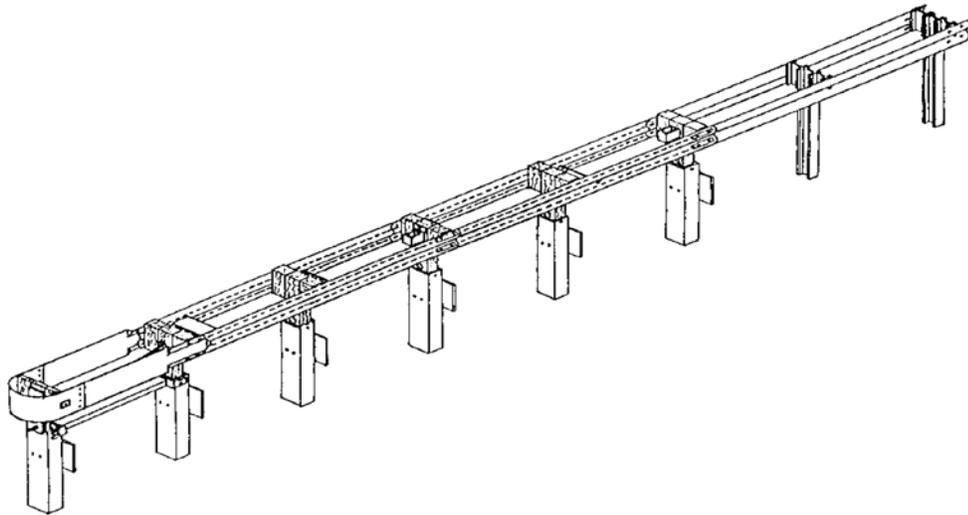
1. **Purpose:** The Brakemaster 350 system is an end treatment for W-beam guardrail and concrete barrier.
2. **Description:** The system contains an embedded anchor assembly, brake cable, W-beam fender panels, steel posts, tension and transition straps, and diaphragms.
3. **Function:** The system uses a brake and cable device for head-on impacts and for redirection. The cable is embedded in a concrete anchor at the end of the system.
4. **Foundation:** A concrete foundation is not needed for this system, but a paved surface is recommended.
5. **Slope:** 10H:1V or flatter slope between the edge of the traveled way and the near face of the unit.
6. **Transitions:** If used as an end treatment for concrete barrier, the system must be connected to the barrier with a transition section (not included in the cost of the attenuator). See [Chapter 1610](#) and the [Standard Plans](#) for the type of transition section and connection required.
7. **Manufacturer/Supplier:** Energy Absorption Systems



**Brakemaster 350 – Permanent Installations**

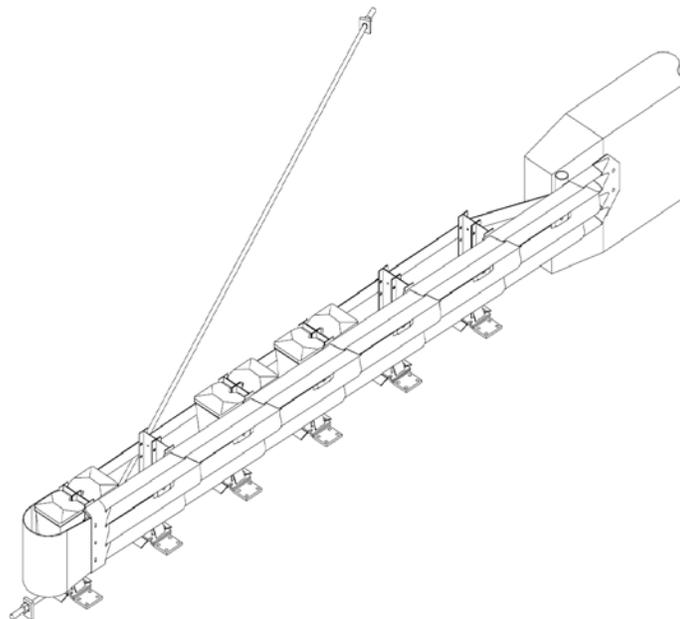
**1620.04(1)(b) Crash Cushion Attenuating Terminal (CAT-350)**

1. **Purpose:** The CAT-350 is an end treatment for W-beam guardrail and concrete barrier.
2. **Description:** The system consists of slotted W-beam guardrail mounted on both sides of breakaway timber posts. Steel sleeves with soil plates hold the timber posts in place.
3. **Function:** When hit head-on, the slotted guardrail is forced over a pin that shears the steel between the slots. This shearing helps dissipate the energy of the impact.
4. **Foundation:** A concrete foundation or paved surface is not needed. Can be installed in soil.
5. **Slope:** 10H:1V or flatter slope between the edge of the traveled way and the near face of the unit.
6. **Transitions:** If used as an end treatment for concrete barrier, the system must be connected to the barrier with a transition section (not included in the cost of the attenuator). (See [Chapter 1610](#) and the [Standard Plans](#) for the type of transition section and connection required.)
7. **Manufacturer/Supplier:** Trinity Industries, Inc.

**CAT 350 – Permanent Installations**

**1620.04(1)(c) QuadTrend 350**

1. **Purpose:** The QuadTrend 350 is an end treatment for 2-foot-8-inch-high concrete barriers. The system's short length may allow it to be used at the ends of certain bridges where the installation of a beam guardrail transition and terminal is not feasible and manufacturer's requirements for slope and clear area behind the device can be met.
2. **Description:** This system consists of telescoping quadruple corrugated fender panels mounted on steel posts with slip bases, a tension strap, sand-filled boxes, and a ground-level redirective cable.
3. **Function:** Sand-filled boxes attached to the posts help dissipate a portion of the energy of an impact. In head-on impacts, the anchored ground-level cable installed behind the fender panels directs the vehicle behind and away from the barrier end. Side impacts within the redirective portion of the system, which begins 10.5 ft. from the nose of the system, are redirected toward the roadway.
4. **Foundation:** The system is installed on a concrete foundation to support the steel posts.
5. **Slope:** A 10H:1V or flatter slope is needed on the approaches to the device and to 3 ft. behind the system. A 6H:1V or flatter slope is needed behind the barrier to allow for vehicle recovery.
6. **Transitions:** No transition section is needed for connection to a vertical wall or vertical concrete barrier. A custom transition section per manufacturer's specifications is needed for connection to non-vertical concrete barrier such as New Jersey or F-Shape barrier (included in the cost of the attenuator).
7. **Manufacturer/Supplier:** Energy Absorption Systems

**QuadTrend 350 – Permanent Installations**

**1620.04(1)(d) Universal TAU-II**

1. **Purpose:** The Universal TAU-II crash cushion system is an end treatment for concrete barrier, beam guardrail, and fixed objects up to 8 feet wide.
2. **Description:** The system is made up of overlapping thrie beam panels, structural support diaphragms, supported cables, energy absorbing cartridges, and foundation anchors.
3. **Function:** During a head-on hit, energy-absorbing cartridges and structural support diaphragms help dissipate the energy of the impact as they are guided by high strength galvanized steel cables and overlapping thrie beam panels. In a side impact, the thrie beam rail panels redirect the vehicle back toward the roadway.
4. **Foundation:** The system is installed on either a concrete foundation or an asphalt foundation that conforms to the manufacturer's recommendations.
5. **Slope:** 10H:1V or flatter slope between the edge of the traveled way and the near face of the unit.
6. **Transitions:** A transition section is not needed for concrete barrier or fixed objects exposed to traffic from only one direction. A custom transition section per manufacturer's specifications is needed for all connections to beam guardrail and for connection to a concrete barrier or fixed object exposed to bi-directional traffic (included in the cost of the attenuator).
7. **Manufacturer/Supplier:** Barrier Systems, Inc.

**Universal TAU-II – Permanent Installations**

**1620.04(1)(e) QuadGuard and QuadGuard II**

1. **Purpose:** The QuadGuard and QuadGuard II provide end treatments for concrete barrier and beam guardrail. The QuadGuard can be used to mitigate fixed objects up to 10 feet wide and the QuadGuard II can be used to mitigate fixed objects up to 7 feet 6 inches wide.
2. **Description:** These systems consist of a series of Hex-Foam cartridges surrounded by a framework of steel diaphragms and quadruple corrugated fender panels. The QuadGuard and QuadGuard II use the same framework, but the QuadGuard II is shorter in length than the QuadGuard for any given posted speed.
3. **Function:** The internal shearing of the cartridges and the crushing of the energy absorption material dissipates impact energy from end-on hits. The fender panels redirect vehicles impacting the attenuator on the side.
4. **Foundation:** The systems are installed on a concrete foundation.
5. **Slope:** If the site has excessive grade or cross slope, additional site preparation or modification to the units in accordance with the manufacturer's literature is needed. "Excessive" is defined as steeper than 8% for the QuadGuard and QuadGuard II.
6. **Transitions:** A transition section is not needed for concrete barrier and fixed objects exposed to traffic from only one direction. A custom transition section per manufacturer's specifications is needed for all connections to beam guardrail and for connection to a concrete barrier or fixed object exposed to bi-directional traffic (included in the cost of the attenuator).
7. **Manufacturer/Supplier:** Energy Absorption Systems

**QuadGuard – Permanent and Work Zone Installations**

**1620.04(1)(f) QuadGuard Elite**

1. **Purpose:** The QuadGuard Elite is an end treatment for concrete barrier, beam guardrail, and fixed objects up to 7 feet 6 inches wide.
2. **Description:** The system consists of telescoping quadruple corrugated fender panels mounted on both sides of a series of polyethylene cylinders contained within steel diaphragms.
3. **Function:** The cylinders are compressed during a head-on impact and typically return to their original shape, which may provide continued shielding of the fixed object after the impact. The fender panels redirect vehicles impacting the attenuator on the side. It is anticipated that this system will not need many replacement parts or extensive repair following an impact.
4. **Foundation:** The system is installed on a concrete foundation.
5. **Slope:** If the site has excessive grade or cross slope, additional site preparation or modification to the units in accordance with the manufacturer's literature is needed. "Excessive" is defined as steeper than 8% for the QuadGuard Elite.
6. **Transitions:** A transition section is not needed for concrete barrier and fixed objects exposed to traffic from only one direction. A custom transition section per manufacturer's specifications is needed for all connections to beam guardrail and for connection to a concrete barrier or fixed object exposed to bi-directional traffic (included in the cost of the attenuator).
7. **Manufacturer/Supplier:** Energy Absorption Systems



**QuadGuard Elite – Permanent and Work Zone Installations**

**1620.04(1)(g) QuadGuard M10**

1. **Purpose:** The QuadGuard M10 is an end treatment for concrete barrier, beam guardrail, and fixed objects up to 7 feet 6 inches wide.
2. **Description:** The system consists of a series of energy-absorbing cartridges surrounded by a framework of steel diaphragms and quadruple corrugated fender panels.
3. **Function:** The internal shearing of the cartridges and the crushing of the energy absorption material dissipates impact energy from end-on hits. The fender panels redirect vehicles impacting the attenuator on the side.
4. **Foundation:** The system is installed on a concrete foundation.
5. **Slope:** If the site has excessive grade or cross slope, additional site preparation or modification to the unit in accordance with the manufacturer's literature is needed. "Excessive" is defined as steeper than 8% for the QuadGuard M10.
6. **Transitions:** A transition section is not needed for concrete barrier and fixed objects exposed to traffic from only one direction. A custom transition section per manufacturer's specifications is needed for all connections to beam guardrail and for connection to a concrete barrier or fixed object exposed to bi-directional traffic (included in the cost of the attenuator).
7. **Manufacturer/Supplier:** Energy Absorption Systems



**QuadGuard M10 – Permanent and Work Zone Installations**

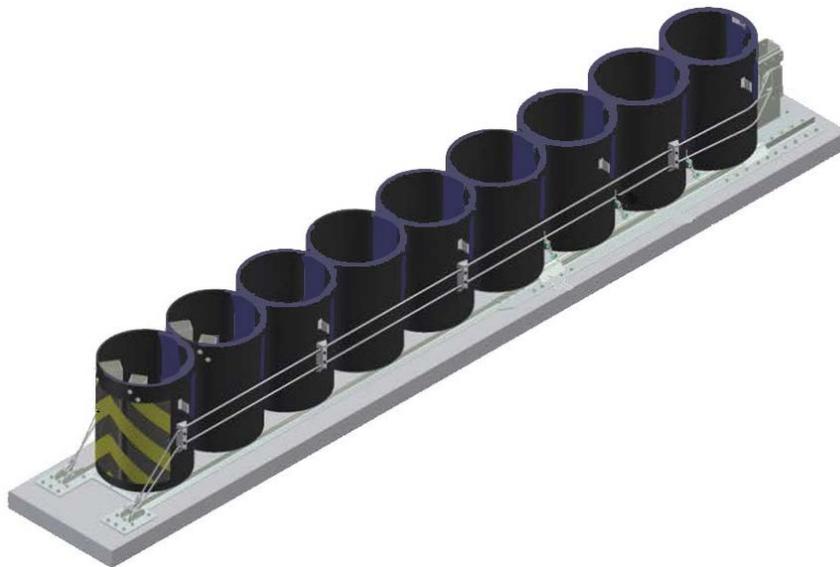
**1620.04(1)(h) HEART**

1. **Purpose:** The HEART is an end treatment for concrete barriers and fixed objects up to 2 feet wide.
2. **Description:** The system consists of High Density Polyethylene (HDPE) side panels and a rounded nose piece connected to steel diaphragms with tensioning cables that are mounted on a tubular steel track.
3. **Function:** During an end-on impact, the side panels and steel diaphragms help dissipate impact energy as they are pushed toward the rear of the system along the track. In a side impact, the side panels and tensioning cables redirect the vehicle.
4. **Foundation:** The system is installed on a concrete foundation or paved surface conforming to the manufacturer's recommendations.
5. **Slope:** 12H:1V or flatter slope between the edge of the traveled way and the near face of the unit.
6. **Transitions:** A transition section is not needed for concrete barrier and fixed objects exposed to traffic from only one direction. A custom transition section per manufacturer's specifications is needed for connection to a concrete barrier or fixed object exposed to bi-directional traffic (included in the cost of the attenuator).
7. **Other:** The HEART should not be installed behind a curb.
8. **Manufacturer/Supplier:** Trinity Industries, Inc.

**HEART – Permanent and Work Zone Installations**

**1620.04(1)(i) Reusable Energy Absorbing Crash Terminal (REACT 350)**

1. **Purpose:** The REACT 350 is an end treatment for concrete barriers and fixed objects up to 3 feet wide.
2. **Description:** The system consists of polyethylene cylinders with varying wall thicknesses, redirecting cables, a steel frame base, and a backup structure.
3. **Function:** The redirecting cables are anchored in the concrete foundation at the front of the system and in the backup structure at the rear of the system. When hit head-on, the cylinders compress, absorb the impact energy, and immediately return to much of their original shape, position, and capabilities. For side impacts, the cables restrain the system enough to help prevent penetration and redirect the vehicle. It is anticipated that this system will not need many replacement parts or extensive repairs following an impact.
4. **Foundation:** The system is installed on a concrete foundation.
5. **Slope:** If the site has excessive grade or cross slope, additional site preparation or modification to the units in accordance with the manufacturer's literature is needed. "Excessive" is defined as steeper than 8% for the REACT 350.
6. **Transitions:** Depending on traffic flow directions, the shape of the toe of the concrete barrier, and the ability to offset the system on the site, modifications to the toe of the concrete barrier and/or a custom transition section per manufacturer's specifications may be needed to prevent vehicle snagging (included in the cost of the attenuator).
7. **Manufacturer/Supplier:** Energy Absorption Systems

**REACT 350 – Permanent and Work Zone Installations**

**1620.04(1)(j) REACT 350 Wide**

1. **Purpose:** The REACT 350 Wide is a device that can be used to shield fixed objects with widths up to 10 feet wide.
2. **Description:** The system consists of polyethylene cylinders with varying wall thicknesses, internal struts, space frame diaphragms, and a monorail.
3. **Function:** When hit head-on, the cylinders compress, absorb the impact energy, and immediately return to much of their original shape, position, and capabilities. For side impacts, the system is designed to restrain and redirect the vehicle. It is anticipated that this system will not need many replacement parts or extensive repairs following an impact.
4. **Foundation:** The system is installed on a concrete foundation.
5. **Slope:** If the site has excessive grade or cross slope, additional site preparation or modification to the units in accordance with the manufacturer's literature is needed. "Excessive" is defined as steeper than 8% for the REACT 350 Wide.
6. **Transitions:** A transition section is not needed for fixed objects exposed to traffic from only one direction. If the attenuator is exposed to bi-directional traffic, modification to the shielded object or a custom transition section per manufacturer's recommendations may be needed if the width of the attenuator's backstop exceeds the width of the shielded object (included in the cost of the attenuator).
7. **Manufacturer/Supplier:** Energy Absorption Systems



**REACT 350 Wide – Permanent and Work Zone Installations**

**1620.04(1)(k) Compressor**

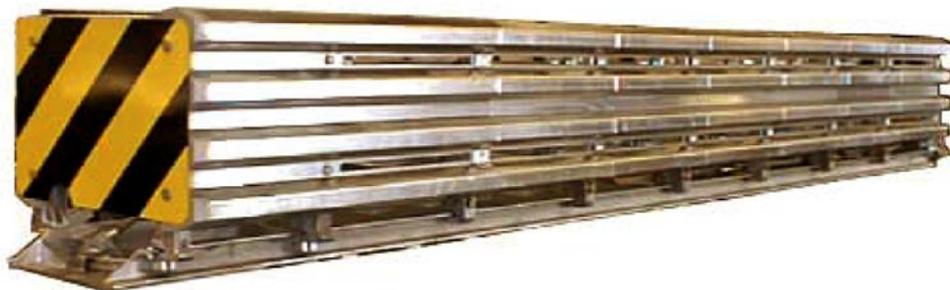
1. **Purpose:** The Compressor is an end treatment for concrete barrier and fixed objects up to 3 feet wide.
2. **Description:** The system consists of High Density Polyethylene (HDPE) modules with varying heights and wall thicknesses, a mounting base, and fender panels.
3. **Function:** When hit head-on, the modules compress, absorb the impact energy, and immediately return to much of their original shape, position, and capabilities. When impacted from the side, the fender panels redirect the vehicle.
4. **Foundation:** The system is installed on a concrete or asphalt foundation.
5. **Slope:** An 8% or flatter slope between the edge of the traveled way and the near face of the unit is required.
6. **Transitions:** A transition section is not needed for concrete barrier and fixed objects exposed to traffic from only one direction. A custom transition section per manufacturer's specifications is needed for connection to a concrete barrier or fixed object exposed to bi-directional traffic (included in the cost of the attenuator).
7. **Manufacturer/Supplier:** Traffix Devices



**Compressor – Permanent and Work Zone Installations**

**1620.04(1)(I) Smart Cushion Innovations SCI100GM / SCI70GM**

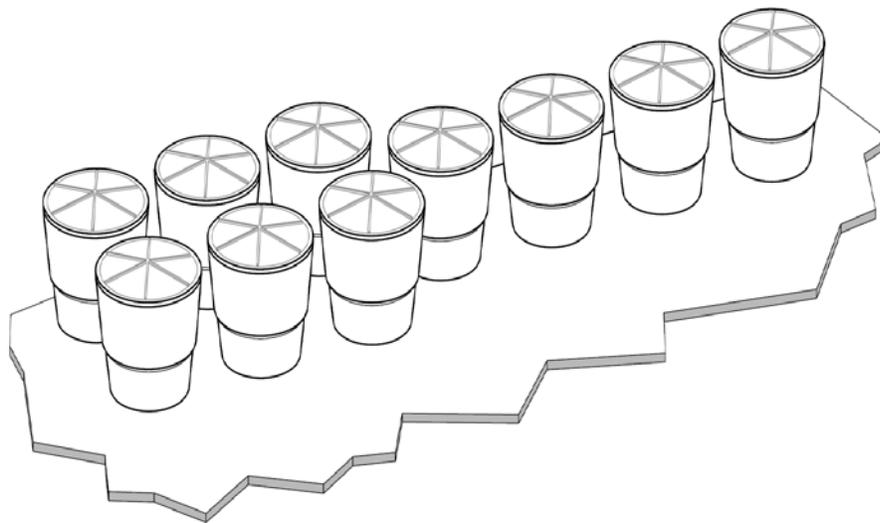
1. **Purpose:** The SCI100GM and SCI70GM are end treatments that can be used for concrete barrier and beam guardrail with widths up to 2 feet.
2. **Description:** The system for both models consists of a front sled assembly, telescoping steel side panels mounted to collapsing steel frames, a shock arresting cylinder, and a steel cable routed around sheave assemblies. It is mounted on a base with a series of tubular steel side frame assemblies.
3. **Function:** During a head-on impact, the system telescopes backwards and dissipates impact energy with a combination of friction between the steel cable and sheaves as well as variable resistance from the shock arresting cylinder. In a side impact, a vehicle is redirected by the steel side panels. It is anticipated that this system will not need many replacement parts or extensive repairs following an impact.
4. **Foundation:** The system is installed on a concrete foundation (see manufacturer's installation information for details).
5. **Slope:** Longitudinal and cross slopes at the installation site must be 10H:1V or flatter.
6. **Transitions:** A transition section is not needed for concrete barrier and fixed objects exposed to traffic from only one direction. A custom transition section per manufacturer's specifications is needed for connection to a concrete barrier or fixed object exposed to bi-directional traffic (included in the cost of the attenuator). If used as an end treatment for beam guardrail, the system must be connected to a transition section (not included in the cost of the attenuator). (See [Chapter 1610](#) and the *Standard Plans* for the type of transition section required.) Connection of the transition section to the attenuator must be per the manufacturer's specifications using custom connection pieces (included in the cost of the attenuator).
7. **Other:** The SCI100GM and SCI70GM should not be installed behind a curb.
8. **Manufacturer/Supplier:** Work Area Protection Corp.

**SCI100GM – Permanent and Work Zone Installations**

**1620.04(1)(m) Inertial Barrier**

Inertial barrier configurations are shown in the [Standard Plans](#). If a situation is encountered where the configurations in the Standard Plans are not appropriate, contact the HQ Design Office for further information.

1. **Purpose:** Inertial barrier is an end treatment for concrete barrier and is used to mitigate fixed objects. This system does not provide redirection from a side impact.
2. **Description:** This system consists of an array of plastic containers filled with varying weights of sand.
3. **Function:** The inertial barriers slow an impacting vehicle by the transfer of the momentum of the vehicle to the mass of the barrier. This system is not suitable where space is limited to less than the widths shown in the [Standard Plans](#). Whenever possible, align inertial barriers so that an errant vehicle deviating from the roadway by 10° would be on a parallel path with the attenuator alignment (see the [Standard Plans](#)). In addition, inertial barriers do not provide any redirection and are not appropriate where high-angle impacts are likely.
4. **Foundation:** A concrete or paved surface is recommended.
5. **Slope:** If the site has excessive grade or cross slope, additional site preparation or modification to the units in accordance with the manufacturer's literature is needed. "Excessive" is defined as steeper than 5% for inertial barriers.
6. **Manufacturer/Supplier:** Approved Inertial Barrier systems (sand barrel arrays) are listed in the [Qualified Products List](#).



**Inertial Barrier – Permanent and Work Zone Installations**

### **1620.04(2) Work Zone (Temporary) Installation**

Several of the impact attenuators previously listed under the heading “Permanent Installations” are also appropriate for use in work zones or other temporary locations. The following is a list of these devices:

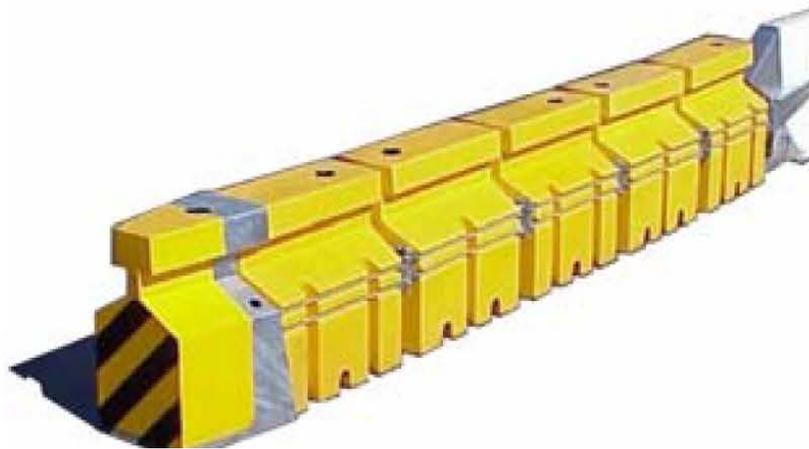
- QuadGuard
- QuadGuard II
- QuadGuard Elite
- QuadGuard M10
- HEART
- REACT 350
- REACT 350 Wide
- Compressor
- SCI100GM
- SCI70GM
- Inertial Barriers

The systems described in the following sections are appropriate only in work zones or other temporary installations. However, the TRACC impact attenuator may be considered for permanent use with the concurrence of the WSDOT Area Maintenance Superintendent who will be maintaining the system.

Descriptions of each work zone (or other temporary) system’s purpose, parts, and functionality, as well as guidance for transition, foundation, and slope, are provided as follows and in Exhibits [1620-1a](#) and [1620-1b](#).

**1620.04(2)(a) ABSORB 350**

1. **Purpose:** The ABSORB 350 is an end treatment limited to temporary installations for both concrete barrier and the Quickchange Moveable Barrier (QMB).
2. **Description:** The system contains water-filled Energy Absorbing Elements. Each element is 2 feet wide, 2 feet 8 inches high, and 3 feet 3½ inches long.
3. **Function:** The low-speed (rated for 45 mph or less) system uses five Energy Absorbing Elements, and the high-speed (rated for 60 mph and above) system uses nine elements. The energy of an impact is dissipated as the elements are crushed.
4. **Foundation:** The system does not need a paved foundation.
5. **Slope:** 12H:1V or flatter slope between the edge of the traveled way and the near face of the unit.
6. **Transitions:** A custom transition section per manufacturer's specifications is needed for all connections to concrete barrier or QMB (included in the cost of the attenuator).
7. **Other:** Although manufacturer's information may show configurations using different numbers of Energy Absorbing Elements, use only the five or nine Energy Absorbing Element configurations. Proper antifreeze agents must be used when the Absorb 350 is used in areas where low temperatures can be anticipated.
8. **Manufacturer/Supplier:** Barrier Systems, Inc.

**ABSORB 350 – Work Zone Installations**

**1620.04(2)(b) Advanced Dynamic Impact Extension Module 350 (ADIEM 350)**

1. **Purpose:** The ADIEM 350 is limited to temporary installations where vehicle speeds are 45 mph or lower. It is generally used as an end treatment for concrete barrier. Currently, there are a few existing permanent units in service. It is permissible to reset these existing devices. However, some of these units may exhibit significant deterioration and replacement may be the appropriate option.
2. **Description:** The system is 30 feet long and consists of ten lightweight concrete modules on an inclined base.
3. **Function:** An inclined base provides a track for placement of the modules and provides redirection for side impacts for roughly half the length. The energy of an impact is dissipated as the concrete modules are crushed.
4. **Foundation:** The system does not need a paved foundation.
5. **Slope:** If the site has excessive grade or cross slope, additional site preparation or modification to the units in accordance with the manufacturer's literature is needed. "Excessive" is defined as steeper than 8% for the ADIEM 350.
6. **Transitions:** Custom bracket attachments per manufacturer's specifications that act as transition sections to prevent snagging are needed for all connections to concrete barrier (included in the cost of the attenuator).
7. **Manufacturer/Supplier:** Trinity Industries, Inc.

**ADIEM 350 – Work Zone Installations**

**1620.04(2)(c) QuadGuard CZ**

This system is similar to the QuadGuard listed for permanent systems above, except that it is mounted on an integral steel plate for ease of transport and resetting and can be installed on a 6-inch-minimum-depth asphalt concrete surface that has a 6-inch-minimum-depth compacted base.

**QuadGuard CZ – Work Zone Installations****1620.04(2)(d) Reusable Energy Absorbing Crash Terminal (REACT 350)**

This is the same system listed for permanent systems above except that it can be installed on a 6-inch-minimum-depth asphalt concrete surface that has a 6-inch-minimum-depth compacted base.

**1620.04(2)(e) Non-Redirecting Energy Absorbing Terminal (N-E-A-T)**

1. **Purpose:** The N-E-A-T system is an end treatment for temporary concrete barrier where vehicle speeds are 45 mph or lower.
2. **Description:** The N-E-A-T system's cartridge weighs about 300 pounds and is 9 feet 8 inches long. The system consists of aluminum cells encased in an aluminum shell with steel backup, attachment hardware, and transition panels. It can be attached to the ends of New Jersey and F-Shaped portable concrete barrier as well as the Quickchange Moveable Barrier.
3. **Function:** The energy of an impact is dissipated as the aluminum cells are crushed.
4. **Foundation:** The system does not need a paved foundation.
5. **Slope:** 10H:1V or flatter slope between the edge of the traveled way and the near face of the unit.
6. **Transitions:** Custom transition panels per manufacturer's specifications that act as transition sections to prevent snagging are needed for all connections to concrete barrier (included in the cost of the attenuator).
7. **Manufacturer/Supplier:** Energy Absorption Systems

**N-E-A-T – Work Zone Installations**

**1620.04(2)(f) Trinity Attenuating Crash Cushion (TRACC)**

1. **Purpose:** The TRACC is an end treatment for concrete barriers. It is limited to use in construction or other work zones on a temporary basis.
2. **Description:** The 21.3-foot-long (not including the plastic nosepiece and front end shoes) TRACC includes four major components: a pair of guidance tracks, an impact sled, intermediate steel frames, and 10 gauge W-beam fender panels. The low-speed version (45 mph or less) is called the ShorTRACC and is 14.3 feet long (not including the plastic nosepiece and front end shoes).
3. **Function:** The sled (impact face) is positioned over the upstream end of the guidance tracks and contains a hardened steel blade that cuts the metal plates on the sides of the guidance tracks as it is forced backward when hit head-on, dissipating the impact energy. In a side impact, the fender panels redirect the vehicle.
4. **Foundation:** The system needs a concrete foundation.
5. **Slope:** 10H:1V or flatter slope between the edge of the traveled way and the near face of the unit.
6. **Transitions:** A transition section is not needed for concrete barrier exposed to traffic from only one direction. A custom transition section per manufacturer's specifications is needed for connection to a concrete barrier exposed to bi-directional traffic (included in the cost of the attenuator).
7. **Manufacturer/Supplier:** Trinity Industries, Inc.

**TRACC – Work Zone Installations**

**1620.04(2)(g) Triton CET**

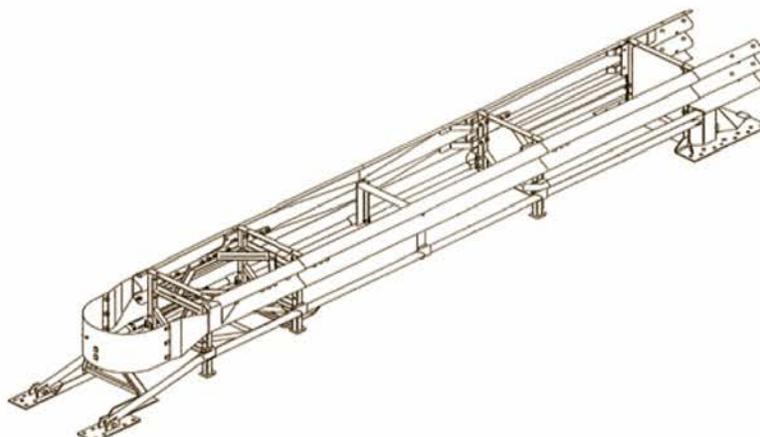
1. **Purpose:** The Triton CET is an end treatment limited to temporary concrete barrier installations.
2. **Description:** The system contains water-filled energy absorbing elements.
3. **Function:** The system uses six energy absorbing elements. The energy of an impact is dissipated as the elements are crushed.
4. **Foundation:** The system does not need a paved foundation.
5. **Slope:** Longitudinal and cross slopes at the installation site must be 20H:1V or flatter.
6. **Transitions:** A custom transition connection per manufacturer's specifications that acts as transition section to prevent snagging is needed for all connections to concrete barrier (included in the cost of the attenuator).
7. **Other:** Proper antifreeze agents must be used when the Triton CET is used in areas where low temperatures can be anticipated.
8. **Manufacturer/Supplier:** Energy Absorption, Inc.



**Triton CET– Work Zone Installations**

**1620.04(2)(h) QUEST**

1. **Purpose:** The QUEST is an end treatment for concrete barrier, guardrail, or fixed features and is limited to temporary applications. This system is designed to shield features 3 feet or less in width.
2. **Description:** The system consists of two front anchor assemblies; a nose assembly containing an integrated trigger assembly; two shaper rail assemblies; a support rail assembly with two energy-absorbing tube shapers; a diaphragm assembly; a bridge assembly; two rear rails; a freestanding backup assembly; and W-beam fender panels.
3. **Function:** During head-on impacts, the QUEST system telescopes rearward and energy is absorbed through momentum transfer, friction, and deformation. When impacted from the side, the QUEST system restrains lateral movement by dynamic tension developed between the end restraints.
4. **Foundation:** The system is installed on a concrete or asphalt foundation. (See manufacturer's installation information for details.)
5. **Slope:** 12H:1V (8%) or flatter slope between the edge of the traveled way and the near face of the unit is needed.
6. **Transitions:** A transition section is not needed for concrete barrier, guardrail, and fixed objects exposed to traffic from only one direction. A custom transition section per manufacturer's specifications is needed for connection to a concrete barrier or fixed object exposed to bi-directional traffic (included in the cost of the attenuator). If used as an end treatment for beam guardrail exposed to bi-directional traffic, the system must be connected to a transition section (not included in the cost of the attenuator). (See [Chapter 1610](#) and the *Standard Plans* for the type of transition section required.) Connection of the transition section to the attenuator must be per the manufacturer's specifications and may require custom side panels (included in the cost of the attenuator).
7. **Manufacturer/Supplier:** Energy Absorption Systems, Inc.

**QUEST – Work Zone Installations**

**1620.04(2)(i) ACZ 350**

1. **Purpose:** The ACZ 350 is an end treatment limited to temporary concrete barrier installations.
2. **Description:** The system consists of water-filled plastic sections and an integrated steel nose section. The low-speed (rated for 45 mph and below) system uses two water-filled sections, and the high-speed (rated for 60 mph and above) system uses four.
3. **Function:** The energy of an impact is dissipated as the water-filled sections are crushed.
4. **Foundation:** The system does not need a paved foundation.
5. **Slope:** If the site has excessive cross slope, additional site preparation in accordance with the manufacturer's literature is needed. Excessive is defined as steeper than 5% for the ACZ 350.
6. **Transitions:** A custom transition connection per manufacturer's specifications that acts as a transition section to prevent snagging is needed for all connections to concrete barrier (included in the cost of the attenuator).
7. **Other:** Proper antifreeze agents must be used when the ACZ 350 is used in areas where low temperatures can be anticipated.
8. **Manufacturer/Supplier:** Energy Absorption Systems, Inc.



**ACZ 350 – Work Zone Installations**

**1620.04(2)(j) Sentry Longitudinal Energy Dissipater (SLED)**

1. **Purpose:** The SLED is an end treatment limited to temporary concrete barrier installations.
2. **Description:** The system contains energy absorbing modules, some filled with water. The low-speed (rated for 45 mph and below) system uses three energy absorbing modules, and the high-speed (rated for 60 mph and above) system uses four.
3. **Function:** The energy of an impact is dissipated as the modules are crushed.
4. **Foundation:** The system does not need a paved foundation.
5. **Slope:** 10H:1V or flatter slope between the edge of the traveled way and the near face of the unit.
6. **Transitions:** A custom transition section per manufacturer's specifications is needed for all connections to concrete barrier (included in the cost of the attenuator).
7. **Other:** Proper antifreeze agents must be used when the SLED is used in areas where low temperatures can be anticipated.
8. **Manufacturer/Supplier:** Traffix Devices Inc.



**SLED – Work Zone Installations**

**1620.04(2)(k) Transportable Attenuators (Truck-Mounted and Trailer-Mounted)**

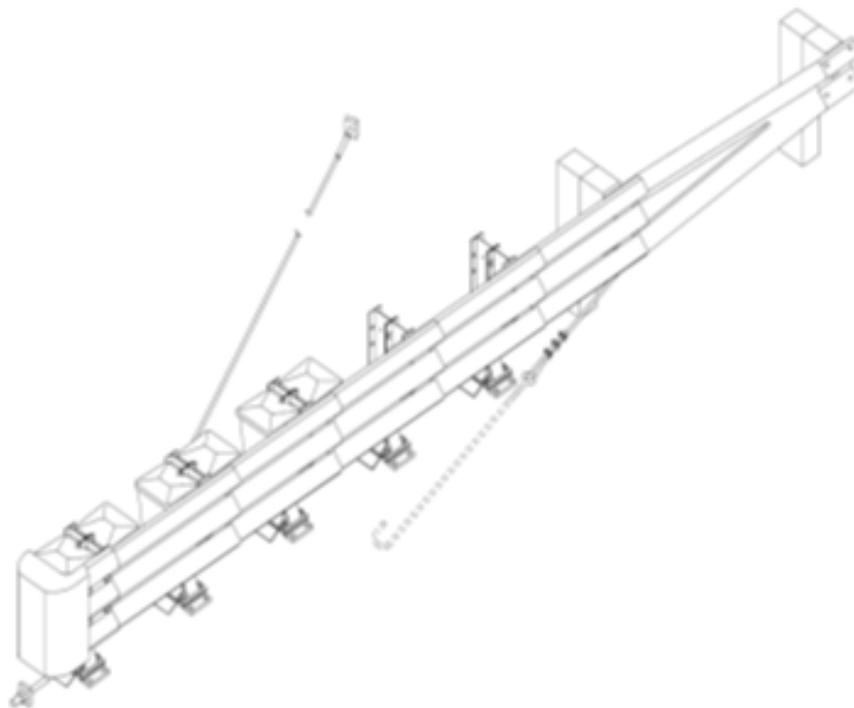
Truck Mounted Attenuators and Trailer-Mounted Attenuators are portable systems mounted on trucks or trailers. They are intended for use in work zones and for temporary applications.

**1620.04(3) Older Systems**

The following systems are in use on Washington State highways and may be left in place or reset with concurrence of the WSDOT Area Maintenance Superintendent who maintains the system. New installations of these systems need approval from the HQ Design Office.

**1620.04(3)(a) Sentre**

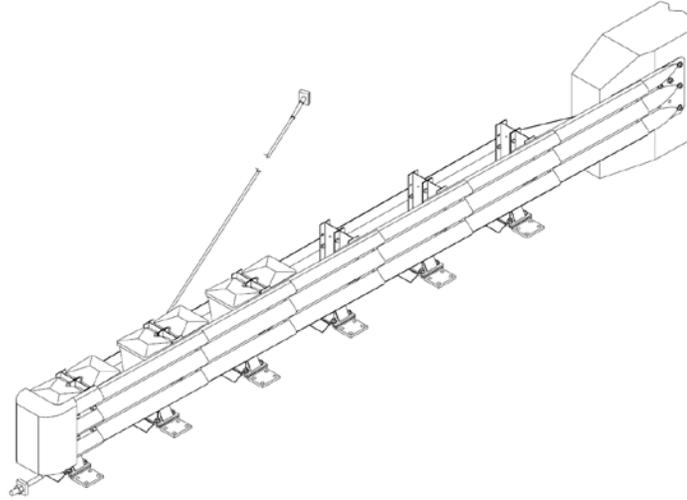
The Sentre is a guardrail end treatment. Its overall length of 17 feet allowed it to be used where space was not available for a guardrail transition and terminal. The system is very similar to the QuadTrend 350 in both appearance and function except that it uses three beam fender panels instead of the quadruple corrugated panels. This system needs a transition when used to terminate rigid barriers.



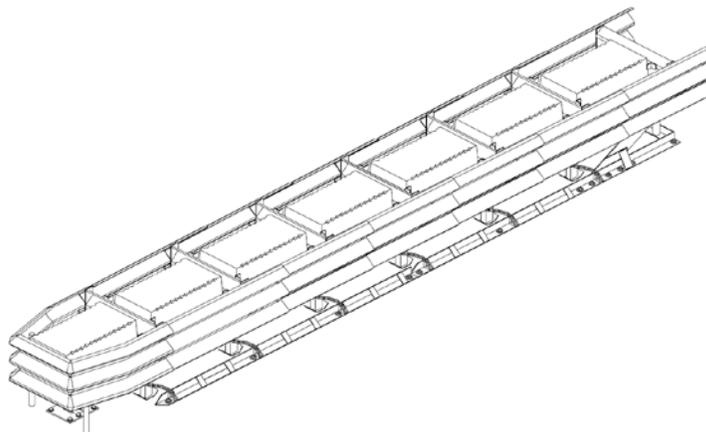
**Sentre**

**1620.04(3)(b) TREND**

The TREND is an end treatment with a built-in transition and was used at the end of rigid barriers including bridge rails. The system is similar to the QuadTrend 350 except that it uses three beam fender panels.

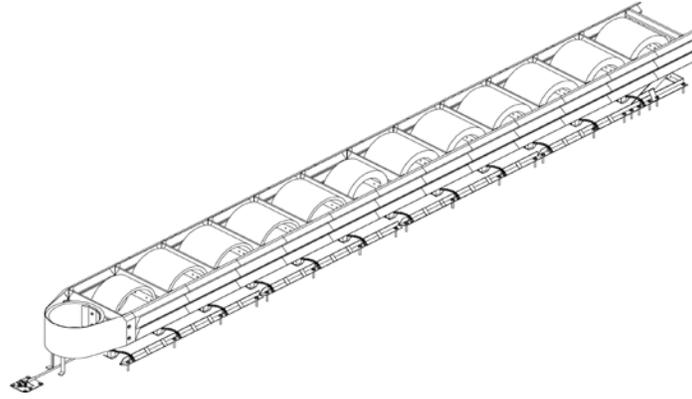
**TREND****1620.04(3)(c) Guard Rail Energy Absorption Terminal (G-R-E-A-T)**

This system was primarily used as an end treatment for concrete barrier. It is similar to the QuadGuard except that it uses three beam fender panels.

**GREAT**

**1620.04(3)(d) Low-Maintenance Attenuator System (LMA)**

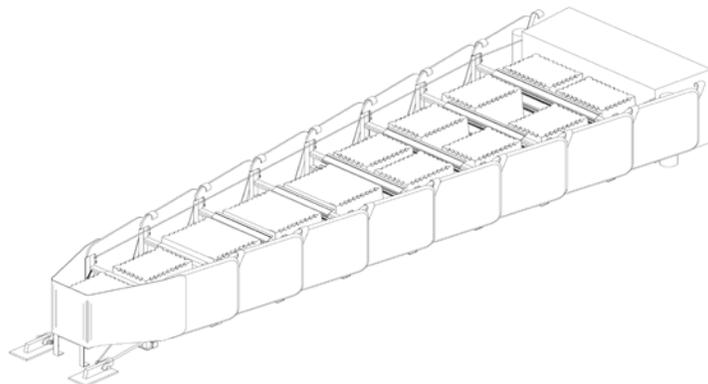
The LMA is an end treatment for concrete barrier and beam guardrail and was used for fixed objects up to 3 feet wide. The system is similar to the QuadGuard Elite except that it uses three beam fender panels and rubber cylinders.



**LMA**

**1620.04(3)(e) Hex-Foam Sandwich**

The Hex-Foam Sandwich system is an end treatment for beam guardrail and concrete barrier and was also used for fixed objects 3 feet or more in width. This system consists of a number of Hex-Foam cartridges containing an energy absorption material separated by a series of diaphragms and restrained by anchor cables. It is installed on a concrete slab. Impact energy is absorbed by the internal shearing of the cartridges and crushing of the energy absorption material. The lapped panels on the perimeter serve to redirect vehicles for side impacts. If the site has grade or cross slope in excess of 5%, additional site preparation or modification to the units in accordance with the manufacturer's literature is needed.



**Hex-Foam Sandwich**

Exhibit 1620-1a Impact Attenuator System Comparison

System <sup>(1)</sup>	Permanent (P), Temporary (T), or Both (B)	Posted Speed (mph) <sup>(4)</sup>	Approximate Outside Width	Maximum Shielded Object Width	Approximate System Length <sup>(10)</sup>	Distance Beyond Length of Need (See Exhibit 1620-2)	Initial Cost Category <sup>(11)</sup>
Brakemaster 350 <sup>(2)</sup>	P	≥ 60	2.1	2	31.5	15.8	A
CAT 350 <sup>(2)</sup>	P	≥ 60	2.5	2	31.3	18.8	A
QuadTrend 350 <sup>(6)</sup>	P	≥ 60	1.3	2	20	10.5	A
Universal Tau-II <sup>(7)</sup>	P	See Note 7	4.4 to 8.9	3.9 to 8.4	14.5 to 27.1	3	C,D <sup>(7)</sup>
QuadGuard <sup>(7)</sup>	B	See Note 7	2.5 to 10.5	2.0 to 10	13.1 to 22.1	3.3	B,C <sup>(7)</sup>
QuadGuard II <sup>(7)</sup>	B	See Note 7	2.5 to 8.0	2.0 to 7.5	10.0 to 19.1	3.3	B,C <sup>(7)</sup>
QuadGuard Elite <sup>(7)</sup>	B	See Note 7	2.5 to 8.0	2.0 to 7.5	18 to 27.1	3.3	C <sup>(7)</sup>
QuadGuard M10 <sup>(7)</sup>	B	See Note 7	2.5 to 8.0	2.0 to 7.5	13.1 to 22.1	3.3	C,D <sup>(7)</sup>
HEART	B	≥ 60	3	2	26	5	D
REACT 350 (9-Bay)	B	≥ 60	4	3	30.5	4.3	D
REACT 350 (6-Bay)	B	≤ 55	4	3	20	4.3	D
REACT 350 (4-Bay)	B	≤ 45	4	3	15.5	4.3	D
REACT 350 Wide TL-3 (60"/96"/120" widths)	B	≥ 60	5.2/8.2/10.2	5.0/8.0/10.0	32.8/36.8/36.8	4.3	D
REACT 350 Wide TL-2 (60"/96" widths)	B	≤ 45	5.2/8.2/10.2	5.0/8.0/10.0	21	4.3	D
Compressor	B	≥ 60	4.1	3.0	21.3	3	D
SCI100GM	B	≥ 60	3.1	2.0/2.5/3.0	21.5/24.4/25.9	3	C
SCI70GM	B	≤ 45	2.8	2.0/2.5/3.1	13.5/15.4/16.9	3	C
INERTIAL BARRIERS	B	See Note 5	See Note 5	See Note 5	See Note 5	See Note 3	A
ABSORB 350 TL-3 <sup>(8)</sup>	T	≥ 60	2	2	32	See Note 3	B
ABSORB 350 TL-2	T	≤ 45	2	2	19.3	See Note 3	B
ADIEM 350	T	≤ 45	2.7	2	30	14.1	B
QuadGuard CZ <sup>(7)</sup>	T	See Note 7	2.5 to 8.0	2.0 to 7.5	13 to 22.1	3.3	C,D <sup>(7)</sup>
N-E-A-T	T	≤ 45	1.9	2	10	See Note 3	B
TRACC	T <sup>(9)</sup>	≥ 60	2.6	2	21.3	8	B
ShorTRACC	T <sup>(9)</sup>	≤ 45	2.6	2	14.3	8	B
Triton CET TL-3 <sup>(8)</sup>	T	≥ 60	1.8	2	40	See Note 3	A
Triton CET TL-2	T	≤ 45	1.8	2	40	See Note 3	A
QUEST TL-3 (24"/30"/36" widths)	T	≥ 60	3.0/3.5/4.0	2.0/2.5/3.0	28	3.5	B
QUEST TL-2 (24"/30"/36" widths)	T	≤ 45	3.0/3.5/4.0	2.0/2.5/3.0	22	3.5	B
ACZ-350 TL-3 <sup>(8)</sup>	T	≥ 60	1.7	2	31.6	See Note 3	A
ACZ-350 TL-2	T	≤ 45	1.7	2	18.4	See Note 3	A
SLED TL-3 <sup>(8)</sup>	T	≥ 60	2	2	26	See Note 3	B
SLED TL-2	T	≤ 45	2	2	19	See Note 3	B

For table notes, see the following page.

**Exhibit 1620-1a Impact Attenuator System Comparison (continued)****Notes:**

- [1] See system descriptions in [1620.04](#) for additional information regarding slopes, transitions, and other factors that may influence the appropriateness of an attenuator selection for a specific site.
- [2] Generally for use with double-sided beam guardrail
- [3] The N-E-A-T, Inertial Barriers, Triton CET, ACZ 350, SLED and ABSORB 350 may only be used beyond the length of need.
- [4] It is acceptable to use an attenuator rated for a higher posted speed on a roadway with a lower posted speed. For example: an attenuator rated for  $\geq 60$  mph may be used on a roadway with posted speed of 50 mph (see [1620.03](#)).
- [5] Varies; see the [Standard Plans](#).
- [6] See manufacturer's requirements for slope and clear area behind the device.
- [7] Numerous speed, length, and width combinations are available (see [Exhibit 1620-1b](#)).
- [8] Test Level 3 version on high-speed facilities should be limited to locations where the likelihood of being hit is low.
- [9] May be considered for permanent installations with concurrence of the Area Maintenance Superintendent.
- [10] The given dimension is the approximate system length. The effective length may vary depending on such factors as the physical design and type of anchorage used. To verify the total length needed, refer to the manufacturer's specifications and drawings.
- [11] A (\$5,000 to \$10,000); B (\$10,000 to \$15,000); C (\$15,000 to \$25,000); D (\$25,000 to \$50,000). These are rough initial cost estimates; verify actual costs through manufacturers/suppliers. Some products are priced very close to the margin between cost categories.

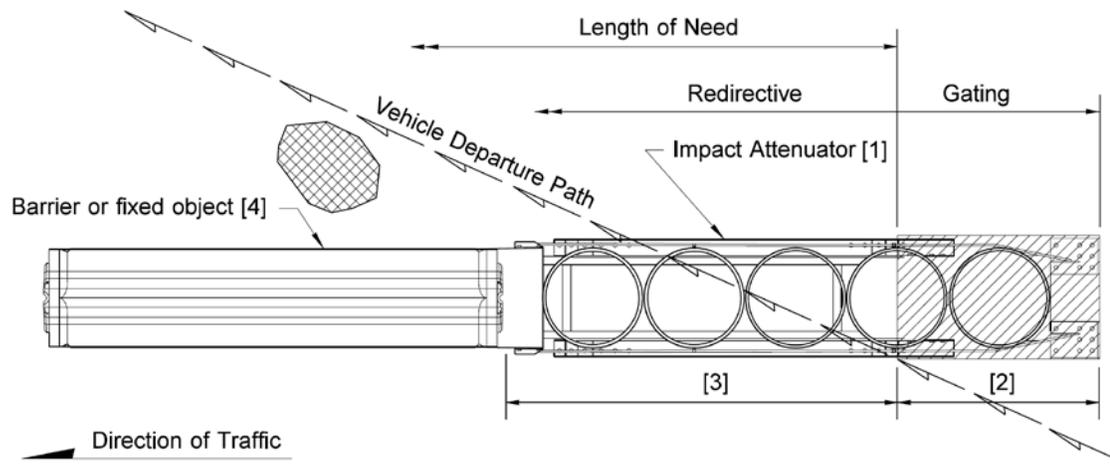
Exhibit 1620-1b Impact Attenuator Systems: Universal TAU II and QuadGuard Configurations

System <sup>(1)</sup>	Permanent (P), Temporary (T), or Both	Posted Speed (mph) <sup>(2)</sup>	Approximate Outside Width	Maximum Shielded Object Width	Approximate System Length <sup>(3)</sup>	Initial Cost Category <sup>(4)</sup>
Universal Tau-II (8-Bay, 30" width)	P	≥ 60	2.9	2.5	25.4	D
Universal Tau-II (8-Bay, 42"/48"/54"/60" widths)	P	≥ 60	4.4/4.9/5.4/5.9	3.9/4.4/4.9/5.4	27.1	D
Universal Tau-II (7-Bay, 66"/72"/78"/84"/90"/96" widths)	P	≥ 60	6.4/6.9/7.4/7.9/8.4/8.9	5.9/6.4/6.9/7.4/7.9/8.4	24.2	D
Universal Tau-II (7-Bay, 30" width)	P	≤ 55	2.9	2.5	22.7	C
Universal Tau-II (7-Bay, 42"/48"/54"/60" widths)	P	≤ 55	4.4/4.9/5.4/5.9	3.9/4.4/4.9/5.4	24.2	D
Universal Tau-II (5-Bay, 72"/78"/84"/90"/96" widths)	P	≤ 55	6.9/7.4/7.9/8.4/8.9	6.4/6.9/7.4/7.9/8.4	18.6	D
Universal Tau-II (5-Bay, 30" width)	P	≤ 50	2.9	2.5	16.9	C
Universal Tau-II (5-Bay, 42"/48"/54"/60" widths)	P	≤ 50	4.4/4.9/5.4/5.9	3.9/4.4/4.9/5.4	18.6	D
Universal Tau-II (4-Bay, 66"/72"/78"/84"/90"/96" widths)	P	≤ 50	6.4/6.9/7.4/7.9/8.4/8.9	5.9/6.4/6.9/7.4/7.9/8.4	16	D
Universal Tau-II (4-Bay, 30" width)	P	≤ 45	2.9	2.5	14.5	C
Universal Tau-II (4-Bay, 42"/48"/54"/60" widths)	P	≤ 45	4.4/4.9/5.4/5.9	3.9/4.4/4.9/5.4	16	C
QuadGuard (6-Bay, 24"/30"/36"/90"/120" widths)	B	≥ 60	2.5/3.0/3.5/8.0/10.5	2.0/2.5/3.0/7.5/10	22.1	C
QuadGuard (5-Bay, 24"/30"/36"/90" widths)	B	≤ 55	2.5/3.0/3.5/8.0	2.0/2.5/3.0/7.5	19.1	C
QuadGuard (4-Bay, 24"/30"/36"/69"/90" widths)	B	≤ 50	2.5/3.0/3.5/6.3/8.0	2.0/2.5/3.0/5.7/7.5	16.1	C
QuadGuard (3-Bay, 24"/30"/36"/69"/90" widths)	B	≤ 45	2.5/3.0/3.5/6.3/8.0	2.0/2.5/3.0/5.7/7.5	13.1	B
QuadGuard II (5-Bay, 24"/30"/36"/90" widths)	B	≥ 60	2.5/3.0/3.5/8.0	2.0/2.5/3.0/7.5	19.1	C
QuadGuard II (4-Bay, 24"/30"/36"/69"/90" widths)	B	≤ 55	2.5/3.0/3.5/6.3/8.0	2.0/2.5/3.0/5.8/7.5	16.1	C
QuadGuard II (3-Bay, 24"/30"/36"/69"/90" widths)	B	≤ 50	2.5/3.0/3.5/6.3/8.0	2.0/2.5/3.0/5.8/7.5	13.1	B
QuadGuard II (2-Bay, 24"/30"/36" widths)	B	≤ 45	2.5/3.0/3.5	2.0/2.5/3.0	10	B
QuadGuard Elite (8-Bay, 24"/30"/36"/69"/90" widths)	B	≥ 60	2.5/3.0/3.5/6.3/8.0	2.0/2.5/3.0/5.8/7.5	27.1	C
QuadGuard Elite (5-Bay, 24"/30"/36"/69"/90" widths)	B	≤ 45	2.5/3.0/3.5/6.3/8.0	2.0/2.5/3.0/5.8/7.5	18	C
QuadGuard M10 (6-Bay, 24"/30"/36"/69"/90" widths)	B	≥ 60	2.5/3.0/3.5/6.3/8.0	2.0/2.5/3.0/5.8/7.5	22.1	D
QuadGuard M10 (3-Bay, 24"/30"/36"/69"/90" widths)	B	≤ 45	2.5/3.0/3.5/6.3/8.0	2.0/2.5/3.0/5.8/7.5	13.1	C
QuadGuard CZ (6-Bay, 24"/30"/36" widths)	T	≥ 60	2.5/3.0/3.5	2.0/2.5/3.0	22.1	D
QuadGuard CZ (5-Bay, 24"/30"/36" widths)	T	≤ 55	2.5/3.0/3.5	2.0/2.5/3.0	19.1	D
QuadGuard CZ (4-Bay, 24"/30"/36" widths)	T	≤ 50	2.5/3.0/3.5	2.0/2.5/3.0	16.1	C
QuadGuard CZ (3-Bay, 24"/30"/36" widths)	T	≤ 45	2.5/3.0/3.5	2.0/2.5/3.0	13.1	C

**Notes:**

- [1] See system descriptions in [1620.04](#) for additional information regarding slopes, transitions, and other factors that may influence the appropriateness of an attenuator selection for a specific site.
- [2] It is acceptable to use an attenuator rated for a higher posted speed on a roadway with a lower posted speed. For example, an attenuator rated for ≥ 60 mph may be used on a roadway with posted speed of 50 mph (see [1620.03](#)).
- [3] The given dimension is the approximate system length. The effective length may vary depending on such factors as the physical design and type of anchorage used. To verify the total length needed, refer to the manufacturer's specifications and drawings.
- [4] A (\$5,000 to \$10,000); B (\$10,000 to \$15,000); C (\$15,000 to \$25,000); D (\$25,000 to \$50,000). These are rough initial cost estimates; verify actual costs through manufacturers/suppliers. Some products are priced very close to the margin between cost categories.

Exhibit 1620-2 Impact Attenuator Distance Beyond Length of Need

**Notes:**

- [1] Impact attenuator type and manufacturer varies with application (see [Exhibit 1620-1a](#)).
- [2] Distance beyond the length of need (see [Exhibit 1620-1a](#)). This portion is nonredirective (gating).
- [3] This portion is redirective (nongating) and can be included as part of the barrier needed to satisfy length of need.
- [4] Concrete barrier shown for illustration purposes only. Type of object varies.

**1620.05 Documentation**

Refer to [Chapter 300](#) for design documentation requirements.



[Acronyms](#)

[ADA / Pedestrian Terms](#)

[Main Glossary of Terms](#)

# Acronyms

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<b>AADT</b>	Annual average daily traffic	<b>HSS</b>	Highways of Statewide Significance
<b>ACCT</b>	Agency Council on Coordinated Transportation	<b>ICA</b>	Intersection Control Analysis
<b>ADA</b>	Americans with Disabilities Act of 1990	<b>ICD</b>	Inscribed circle diameter
<b>ADT</b>	Annual daily traffic	<b>IJR</b>	Interchange Justification Report
<b>ADT</b>	Average daily traffic	<b>ISTEA</b>	Intermodal Surface Transportation Efficiency Act of 1991
<b>ALJ</b>	Administrative law judge	<b>ITS</b>	Intelligent transportation systems
<b>AOS</b>	Apparent opening size	<b>L/A</b>	Limited access
<b>APS</b>	Accessible pedestrian signal	<b>LOS</b>	Level of service
<b>ARB</b>	Agency Request Billing	<b>MEF</b>	Maximum extent feasible
<b>AWDVTE</b>	Average weekday vehicle trip ends	<b>MOU</b>	Memorandum of Understanding
<b>BAT</b>	Business access transit	<b>MPO</b>	Metropolitan Planning Organization
<b>B/C</b>	Benefit/Cost	<b>MTIP</b>	Metropolitan Transportation Improvement Program
<b>BLM</b>	Bureau of Land Management	<b>MUTCD</b>	Manual on Uniform Traffic Control Devices
<b>BRT</b>	Bus rapid transit	<b>NEPA</b>	National Environmental Policy Act
<b>BST</b>	Bituminous surface treatment	<b>NHS</b>	National Highway System
<b>CE</b>	Categorical Exemption (SEPA)	<b>PAR</b>	Pedestrian access route
<b>CE</b>	Categorical Exclusion (NEPA)	<b>PATS</b>	Priority Array Tracking System
<b>CFR</b>	Code of Federal Regulations	<b>PC&amp;R</b>	Project Control and Reporting
<b>CIPP</b>	Capital Improvement and Preservation Program	<b>PCPH</b>	Passenger cars per hour
<b>CLB</b>	Current Law Budget	<b>PD</b>	Project Definition
<b>CMP</b>	Corridor Management Plan	<b>PE</b>	Preliminary engineering
<b>CPMS</b>	Capital Program Management System	<b>PF</b>	Project File
<b>CRT</b>	Controlled releasing terminal post	<b>PPH</b>	Persons per hour
<b>CSS</b>	Context sensitive solutions	<b>PS</b>	Project Summary
<b>CTR</b>	Commute Trip Reduction	<b>PS&amp;E</b>	Plans, Specifications, and Estimates
<b>CVISN</b>	Commercial Vehicle Inf. System and Networks	<b>PSRC</b>	Puget Sound Regional Council
<b>DCE</b>	Documented Categorical Exclusion (NEPA)	<b>RCW</b>	Revised Code of Washington
<b>DD</b>	Design Decisions	<b>RFP</b>	Request for Proposal
<b>DE</b>	Design exception	<b>ROD</b>	Record of Decision
<b>DDHV</b>	Directional design hour volume	<b>RTID</b>	Regional Transportation Investment District
<b>DDP</b>	Design Documentation Package	<b>RTIP</b>	Regional Transportation Improvement Program
<b>DHV</b>	Design hourly volume	<b>RTPO</b>	Regional Transportation Planning Organization
<b>DNS</b>	Determination of Nonsignificance (SEPA)	<b>RV</b>	Recreational vehicle
<b>DS</b>	Determination of Significance (SEPA)	<b>R/W</b>	Right of way
<b>DVI</b>	Design Variance Inventory	<b>SEPA</b>	[Washington] State Environmental Policy Act
<b>DVIS</b>	Design Variance Inventory System	<b>SIMMS</b>	Signal Maintenance Management System
<b>EA</b>	Environmental Assessment (NEPA)	<b>SOV</b>	Single-occupant vehicle
<b>ECS</b>	Environmental Classification Summary	<b>SRA</b>	Safety rest area
<b>E&amp;EP</b>	Environmental & Engineering Programs Division	<b>STIP</b>	Statewide Transportation Improvement Program
<b>EIS</b>	Environmental Impact Statement	<b>STP</b>	Surface Transportation Program
<b>ERS</b>	Environmental Review Summary	<b>TIP</b>	Transportation Improvement Program
<b>EU</b>	Evaluate upgrade	<b>TMA</b>	Transportation Management Area
<b>FAST</b>	Freight Action Strategy	<b>TMP</b>	Transportation management plan
<b>FGTS</b>	Freight and Goods Transportation System	<b>TRIPS</b>	Transportation Information and Planning Support
<b>FHWA</b>	Federal Highway Administration	<b>TWLT</b>	Two-way left-turn lane
<b>FONSI</b>	Finding of No Significant Impact (NEPA)	<b>UPO</b>	[Central Puget Sound] Urban Planning Office
<b>FTA</b>	Federal Transit Administration	<b>USC</b>	United States Code
<b>GIS</b>	Geographic Information System	<b>VE</b>	Value engineering
<b>GLO</b>	General Land Office	<b>VECP</b>	Value Engineering Change Proposal
<b>GMA</b>	Growth Management Act	<b>VIC</b>	Visitor Information Center
<b>HCP</b>	Highway Construction Program	<b>VPH</b>	Vehicles per hour
<b>HMA</b>	Hot mix asphalt	<b>WAC</b>	Washington Administrative Code
<b>HOT</b>	High-occupancy toll	<b>WIM</b>	Weigh in motion
<b>HOV</b>	High-occupancy vehicle	<b>WSDOT</b>	Washington State Department of Transportation
<b>HQ</b>	WSDOT's Headquarters in Olympia	<b>WSPMS</b>	Washington State Pavement Management System
<b>HSP</b>	Highway System Program (also SHSP)	<b>WTP</b>	Washington Transportation Plan

## ADA / Pedestrian Terms

**Note:** This grouping of terms is used primarily in Chapters [1510](#) and [1515](#).

ADA / Pedestrian Terms	
<b>accessible</b>	Usable by persons with disabilities (ADA compliant).
<b>accessible pedestrian signal (APS)</b>	A device that communicates information about the “WALK” phase in audible and vibrotactile (vibrating surface that communicates information through touch, located on the accessible pedestrian signal button) formats.
<b>accessible route</b>	See <a href="#">pedestrian access route</a> .
<b>ADA</b>	An abbreviation for the Americans with Disabilities Act of 1990. The ADA is a civil rights law that identifies and prohibits discrimination based on disability. Title II of the ADA requires public entities to design new pedestrian facilities or alter existing pedestrian facilities to be accessible to and usable by people with disabilities.
<b>alternate pedestrian access route</b>	A temporary accessible route to be used when the existing pedestrian access route is blocked by construction, alteration, maintenance, or other temporary condition(s).
<b>alteration</b>	<p>A change to a facility in the public right of way that affects or could affect access, circulation, or use.</p> <p>Alterations include, but are not limited to: renovation; rehabilitation; reconstruction; historic restoration; resurfacing of circulation paths or vehicular ways; or changes or rearrangement of structural parts or elements of a facility.</p> <p>Alterations <i>do not</i> include: Spot pavement repair; liquid-asphalt sealing, chip seal (bituminous surface treatment), or crack sealing; or lane restriping that does not alter the usability of the shoulder.</p>
<b>buffer</b>	A space measured from the back of the curb to the edge of the sidewalk that could be treated with plantings or alternate pavement, or be used for needs such as drainage treatment or utility placement.
<b>clear width</b>	The unobstructed width within a pedestrian circulation path. The clear width within a pedestrian circulation path must meet the accessibility criteria for a pedestrian access route.
<b>construction impact zone</b>	The area in which an alteration to an existing facility takes place (also known as the project footprint). If a crosswalk (marked or unmarked) will be reconstructed, paved (overlay or inlay), or otherwise altered as part of a project, then the curb ramps that serve that crosswalk are within the construction impact zone.
<b>counter slope</b>	The slope of the gutter or roadway at the foot of a curb ramp or landing where it connects to the roadway, measured along the axis of the running slope extended.
<b>cross slope</b>	The slope measured perpendicular to the direction of travel.
<b>crosswalk</b>	A marked or unmarked pedestrian crossing, typically at an intersection, that connects the pedestrian access routes on opposite sides of a roadway. A crosswalk must meet accessibility criteria.

ADA / Pedestrian Terms	
	<p>A crosswalk is also defined as:</p> <ul style="list-style-type: none"> <li>• "...the portion of the roadway between the intersection area and a prolongation or connection of the farthest sidewalk line or in the event there are no sidewalks then between the intersection area and a line ten feet therefrom, except as modified by a marked crosswalk" (<a href="#">RCW 46.04.160</a>).</li> <li>• "(a) That part of a roadway at an intersection included within the connections of the lateral lines of the sidewalks on opposite sides of the highway measured from the curbs or in the absence of curbs, from the edges of the traversable roadway, and in the absence of a sidewalk on one side of the roadway, the part of the roadway included within the extension of the lateral lines of the sidewalk at right angles to the center line; (b) any portion of a roadway at an intersection or elsewhere distinctly indicated as a pedestrian crossing by lines on the surface, which might be supplemented by contrasting pavement texture, style, or color" (<a href="#">MUTCD, 2003</a>; <i>Guide for the Planning, Design, and Operation of Pedestrian Facilities</i>, AASHTO, 2004).</li> </ul>
<b>curb extension</b>	A curb and sidewalk bulge or extension out into the parking lane used to decrease the length of a pedestrian crossing and increase visibility for the pedestrian and driver.
<b>curb ramp</b>	<p>A combined ramp and landing to accomplish a change in level at a curb. This element provides street and sidewalk access to pedestrians with mobility impairments.</p> <ul style="list-style-type: none"> <li>• <b>parallel curb ramp</b> A curb ramp design where the sidewalk slopes down to a landing at road level with the running slope of the ramp in line with the direction of sidewalk travel</li> <li>• <b>perpendicular curb ramp</b> A curb ramp design where the ramp path is perpendicular to the curb and meets the gutter grade break at a right angle.</li> </ul>
<b>detectable warning surface</b>	A tactile surface feature of truncated dome material built into or applied to the walking surface to alert persons with visual impairments of vehicular ways. Federal yellow is the color used on WSDOT projects to achieve visual contrast. Colors other than federal yellow that meet the light-on-dark/dark-on-light requirement may be used on projects where cities have jurisdiction. (Detectable warning surfaces are detailed in the <a href="#">Standard Plans</a> .)
<b>flangeway gap</b>	The gap for the train wheel at a railroad crossing. The space between the inner edge of a rail and the pedestrian crossing surface.
<b>grade break</b>	The intersection of two adjacent surface planes of different grade.
<b>landing</b>	A level paved area, within or at the top and bottom of a stair or ramp, designed to provide turning and maneuvering space for wheelchair users and as a resting place for pedestrians.
<b>maximum extent feasible (MEF)</b>	<p>From the U.S. Department of Justice, <a href="#">28 CFR Part 36.402</a>, Alterations. The phrase "to the maximum extent feasible" applies to "the occasional case where the nature of an existing facility makes it virtually impossible to comply fully with applicable accessibility standards through a planned alteration."</p> <p>This phrase also refers to a stand-alone piece of design documentation that WSDOT uses to record its reasons for not being able to achieve full ADA compliance in alteration projects (called a Maximum Extent Feasible document).</p>
<b>midblock pedestrian crossing</b>	A marked pedestrian crossing located between intersections.

ADA / Pedestrian Terms	
<b>passenger loading zone</b>	An area provided for pedestrians to board/disembark a vehicle.
<b>pedestrian</b>	Any person afoot or using a wheelchair (manual or motorized) or means of conveyance (other than a bicycle) propelled by human power, such as skates or a skateboard.
<b>pedestrian access route (PAR)</b> (synonymous with <a href="#">accessible route</a> )	A continuous, unobstructed walkway within a pedestrian circulation path that provides accessibility. Pedestrian access routes consist of one or more of the following pedestrian facilities: walkways/sidewalks, curb ramps (excluding flares), landings, crosswalks, pedestrian overpasses/underpasses, access ramps, elevators, and platform lifts.  Note: Not all transportation facilities need to accommodate pedestrians. However, those that do accommodate pedestrians need to have an accessible route.
<b>pedestrian circulation path</b>	A prepared exterior or interior way of passage provided for pedestrian travel. Includes independent walkways, shared-use paths, sidewalks, and other types of pedestrian facilities. All pedestrian circulation paths are required to contain a continuous pedestrian access route that connects to all adjacent pedestrian facilities, elements, and spaces that are required to be accessible.
<b>pedestrian facilities</b>	Walkways such as sidewalks, walking and hiking trails, shared-use paths, pedestrian grade separations, crosswalks, and other improvements provided for the benefit of pedestrian travel. Pedestrian facilities are intended to be accessible routes.
<b>pedestrian overpass or underpass</b>	A grade-separated pedestrian facility, typically a bridge or tunnel structure over or under a major highway or railroad that allows pedestrians to cross.
<b>pedestrian refuge island</b>	An island in the roadway that physically separates the directional flow of traffic, provides pedestrians with a place of refuge, and reduces the crossing distance.  Note: Islands with cut-through paths are more accessible to persons with disabilities than are raised islands with curb ramps.
<b>pedestrian signal</b>	An adaptation of a conventional traffic signal installed at established pedestrian crossings. It is used to provide a protected phase for pedestrians by terminating the conflicting vehicular movements to allow for pedestrian crossings.
<b>person with disability</b>	An individual who has an impairment, including a mobility, sensory, or cognitive impairment, that results in a functional limitation in access to and use of a building or facility.
<b>raised median</b>	A raised island in the center of a road used to restrict vehicle left turns and side street access. Note: Islands with cut-through paths are more accessible to persons with disabilities than are raised islands with curb ramps.
<b>ramp</b>	A walking surface with a running slope steeper than 20H:1V (5%).
<b>running slope</b>	A slope measured in the direction of travel, normally expressed as a percent.
<b>sidewalk</b>	A walkway along a highway, road, or street intended for use by pedestrians.
<b>site</b>	A parcel of land bounded by a property line or a designated portion of a public right of way.
<b>street furniture</b>	Sidewalk equipment or furnishings, including garbage cans, benches, parking meters, and telephone booths.

<b>ADA / Pedestrian Terms</b>	
<b>traffic calming</b>	Design techniques that have been shown to reduce traffic speeds and unsafe maneuvers. These techniques can be stand-alone or used in combination, and they include lane narrowing, curb extensions, surface variations, and visual clues in the vertical plane.
<b>transitional segments</b>	Segments of a pedestrian circulation path that blend between existing undisturbed pedestrian facilities and newly altered pedestrian facilities. Use of transitional segments may permit the work of the alteration to more nearly meet the new construction standards. At a later time, when other segments of the pedestrian circulation path are altered, the noncomplying transitional segments can be removed and replaced with pedestrian facilities that meet the accessibility criteria.
<b>universal access</b>	Access for all persons regardless of ability or stature.
<b>walk interval</b>	That phase of a traffic signal cycle during which the pedestrian is to begin crossing, typically indicated by a WALK message or the walking person symbol and its audible equivalent.
<b>walkway</b>	The continuous portion of the pedestrian access route that is connected to street crossings by curb ramps.

## Main Glossary of Terms

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A B C D E F G H I J K L M N O P Q R S T U V W Y

### A

**access** A means of entering or leaving a public road, street, or highway with respect to abutting property or another public road, street, or highway.

**access break** Any point from inside or outside the state limited access right of way limited access hachures that crosses over, under, or physically through the plane of the limited access, is an access break or “break in access,” including, but not limited to, locked gates and temporary construction access breaks.

**access connection** An access point, other than a public road/street, that permits access to or from a managed access highway on the state highway system.

**access connection permit** A written authorization issued by the permitting authority for a specifically designed access connection to a managed access highway at a specific location; for a specific type and intensity of property use; and for a specific volume of traffic for the access connection based on the final stage of the development of the applicant’s property. The actual form used for this authorization is determined by the permitting authority.

**access control** The limiting and regulating of public and private access to Washington State’s highways, as required by state law.

**Access Control Tracking System Limited Access and Managed Access Master Plan** A database list, related to highway route numbers and mileposts, that identifies either the level of limited access or the class of managed access: [www.wsdot.wa.gov/design/accessandhearings](http://www.wsdot.wa.gov/design/accessandhearings)

**access deviation** A deviation (see [Chapter 300](#)) that authorizes deferring or staging acquisition of limited access control, falling short of a 300-foot requirement, or allowing an existing access point to stay within 130 feet of an intersection on a limited access highway. Approval by the Director & State Design Engineer, Development Division, is required (see [Chapter 530](#)).

**access hearing plan** A limited access plan prepared for presentation at an access hearing.

**access point** Any point that allows private or public entrance to or exit from the traveled way of a state highway, including “locked gate” access and maintenance access points.

**access point revision** A new access point or a revision of an existing interchange/ intersection configuration. Locked gates and temporary construction breaks are also access point revisions.

**access point spacing** On a managed access highway, the distance between two adjacent access points on one side of the highway, measured along the edge of the traveled way from one access point to the next (see also [corner clearance](#)).

**access report plan** A limited access plan prepared for presentation to local governmental officials at preliminary meetings before preparation of the access hearing plan.

**access rights** Property rights that allow an abutting property owner to enter and leave the public roadway system.

**adaptive lighting system** A lighting system with a control system connected, allowing for dimming, on/off operation by time of night, and independent scheduling of individual lights for select hours of operation during nighttime hours.

**affidavit of publication** A notarized written declaration stating that a *notice of hearing* (or *notice of opportunity for a hearing*) was published in the legally prescribed manner.

**affidavit of service by mailing** A notarized written declaration stating that the limited access hearing packet was mailed at least 15 days prior to the hearing and entered into the record at the hearing.

**alternatives** Possible solutions to accomplish a defined purpose and need. These include local and state transportation system mode and design options, locations, and travel demand management and transportation system management-type improvements such as ramp metering, mass transit, and high-occupancy vehicle (HOV) facilities.

**ancillary services** Those secondary services, also considered amenities, provided at safety rest areas that include, but are not limited to, vending machines, picnic areas, interpretive signing, telephones, recreational vehicle (RV) sanitary disposal facilities, trails, scenic viewpoints, commercial and public information displays, and visitor information centers.

**annual average daily traffic (AADT)** The total volume of traffic passing a point or segment of a highway facility in both directions for one year divided by the number of days in the year.

**annual daily traffic (ADT)** The volume of traffic passing a point or segment of a highway, in both directions, during a period of time, divided by the number of days in the period, and factored to represent an estimate of traffic volume for an average day of the year.

**application for an access connection** An application provided by the permitting authority to be completed by the applicant for access to a managed access highway.

**approach** An access point, other than a public road/street, that allows access to or from a limited access highway on the state highway system.

**approach and access connection** These terms are listed under the specific access section to which they apply. The first section below is for limited access highways and uses the term *approach*. The second section below is for managed access highways and uses the term *access connection*. Approaches and access connections include any ability to leave or enter a highway right of way other than at an intersection with another road or street.

(a) **limited access highways: approach** An access point, other than a public road/street, that allows access to or from a limited access highway on the state highway system. There are five types of approaches to limited access highways that are allowed:

- **Type A** An off and on approach in a legal manner, not to exceed 30 feet in width, for the sole purpose of serving a single-family residence. It may be reserved by the abutting owner for specified use at a point satisfactory to the state at or between designated highway stations. This approach type is allowed on partial and modified control limited access highways.
- **Type B** An off and on approach in a legal manner, not to exceed 50 feet in width, for use necessary to the normal operation of a farm, but not for retail marketing. It may be reserved by the abutting owner for specified use at a point satisfactory to the state at or between designated highway stations. This approach type is allowed on partial and modified control limited access highways. This approach type may be used for wind farms when use of the approach is limited to those vehicles necessary to construct and maintain the farm for use in harvesting wind energy.

- **Type C** An off and on approach in a legal manner, for a special purpose and width to be agreed upon. It may be specified at a point satisfactory to the state at or between designated highway stations. This approach type is allowed on partial and modified control limited access highways and on full control limited access highways where no other reasonable means of access exists, as solely determined by the department.
  - **Type D** An off and on approach in a legal manner, not to exceed 50 feet in width, for use necessary to the normal operation of a commercial establishment. It may be specified at a point satisfactory to the state at or between designated highway stations. This approach type is allowed only on modified control limited access highways.
  - **Type E** This type is no longer allowed to be constructed because of the requirements that there be only one access point per parcel on a limited access state highway.
  - **Type F** An off and on approach in a legal manner, not to exceed 30 feet in width, for the sole purpose of serving a wireless communication site. It may be specified at a point satisfactory to the state at or between designated highway stations. This approach type is allowed only on partial control limited access highways. (See [WAC 468-58-080\(vi\)](#) for further restrictions.)
- (b) **managed access highways: access connection** An access point, other than a public road/street, that permits access to or from a managed access highway on the state highway system. There are five types of access connection permits:
- **conforming access connection** A connection to a managed access highway that meets current WAC and WSDOT location, spacing, and design criteria.
  - **grandfathered access connection** Any connection to the state highway system that was in existence and in active use on July 1, 1990, and has not had a significant change in use.
  - **joint-use access connection** A single connection to a managed access highway that serves two or more properties.
  - **nonconforming access connection** A connection to a managed access highway that does not meet current WSDOT location, spacing, or design criteria, pending availability of a future conforming access connection.
  - **variance access connection** A connection to a managed access highway at a location not normally allowed by current WSDOT criteria.
- (c) **managed access connection category** There are four access connection permit categories for managed access connections to state highways: Category I, Category II, Category III, and Category IV (see [Chapter 540](#)).

**approach design speed** The design speed of the roadway leading into the roundabout.

**approach lanes** The lane or set of lanes for traffic approaching the roundabout (see [Chapter 1320](#)).

**area of influence** The area that will be directly impacted by the proposed action: freeway main line, ramps, crossroads, immediate off-system intersections, and state and local roadway systems.

**articulated bus** A two-section bus that is permanently connected at a joint.

**auxiliary aids and services** (1) Qualified interpreters, notetakers, transcription services, written materials, telephone handset amplifiers, assistive listening devices, assistive listening systems, telephones compatible with hearing aids, open and closed captioning, telecommunications devices for deaf persons (TDDs), videotext displays, or other effective methods for making aurally delivered materials available to individuals with hearing limitations; (2) Qualified readers, taped texts, audio recordings, Brailled materials, large print materials, or other effective methods for making visually delivered materials available to individuals with visual impairments; (3) Acquisition or modification of equipment or devices; (4) Other similar services and actions; and (5) Providing and disseminating information, written materials, and notices in languages other than English, where appropriate.

**auxiliary lane** The portion of the roadway adjoining the through lanes for parking, speed change, turning, storage for turning, weaving, truck climbing, and other purposes supplementary to through-traffic movement.

**average daily traffic (ADT)** The total volume during a given time period (in whole days): greater than one day and less than one year, divided by the number of days in that time period.

**average light level** The average of all light intensities within the design area.

**average weekday vehicle trip ends (AWDVTE)** The estimated total of all trips entering plus all trips leaving a road approach on a weekday for the final stage of development of the property served by the road approach.

## **B**

**backslope** A sideslope that goes up as the distance increases from the roadway (cut slopes).

**barrier terminal** A crash-tested end treatment for longitudinal barriers that is designed to reduce the potential for spearing, vaulting, rolling, or excessive deceleration of impacting vehicles from either direction of travel. Barrier terminals include applicable anchorage.

**baseline** The existing transportation system configuration and traffic volumes for a specific year against which to compare possible alternative solutions.

**basic number of lanes** The minimum number of general purpose lanes designated and maintained over a significant length of highway.

**benefit cost (b/c) ratio** A method for prioritizing highway improvement projects. The b/c ratio is determined by dividing measurable benefits (based on improvement in performance) by measurable costs for a specific time period.

**bicycle** Any device propelled solely by human power upon which a person or persons may ride, having two tandem wheels, either of which is 16 inches or more in diameter, or three wheels, any one of which is more than 20 inches in diameter.

**bicycle route** A system of facilities that is used or has a high potential for use by bicyclists or that is designated as such by the jurisdiction having the authority. A series of bicycle facilities may be combined to establish a continuous route and may consist of any or all types of bicycle facilities.

**bike lane** A portion of a highway or street identified by signs and pavement markings as reserved for bicycle use.

**break** See [access break](#).

**bridge project** A bridge project shall include any project where the primary purpose is to construct, reconstruct, rehabilitate, resurface, or restore a bridge ([23 CFR 636.103](#)). Notes:

- A VE analysis must be conducted on all federally funded bridge projects with an estimated total cost of \$20 million or more.
- WSDOT's policy is also to conduct a VE analysis for any bridge project with an estimated total cost of \$20 million or more.

**buffer-separated HOV lane** An HOV lane that is separated from the adjacent same direction general-purpose freeway lanes by a designated buffer.

**bus** A rubber-tired motor vehicle used for transportation, designed to carry more than ten passengers.

**business access transit (BAT) lanes** A transit lane that allows use by other vehicles to access abutting businesses.

**bus pullout** A bus stop with parking area designed to allow transit vehicles to stop wholly off the roadway.

**bus rapid transit (BRT)** An express rubber tired transit system operating predominantly in roadway managed lanes. It is generally characterized by separate roadway or buffer-separated HOV lanes, HOV direct access ramps, and a high-occupancy designation (3+ or higher).

**bus shelter** A facility that provides seating and protection from the weather for passengers waiting for a bus.

**bus stop** A place designated for transit vehicles to stop and load or unload passengers.

## C

**capacity** The maximum sustainable flow rate at which vehicles or persons can reasonably be expected to traverse a point or uniform segment of a lane or roadway during a specified time period under given roadway, geometric, traffic, environmental, and control conditions. Capacity is usually expressed as vehicles per hour (vph), passenger cars per hour (pcph), or persons per hour (pph).

**Capital Improvement and Preservation Program (CIPP)** WSDOT's program of projects developed each biennium that delivers capital investments in highway, marine, and rail facilities that have been funded in part or in whole by the state Legislature. The CIPP is submitted to the Governor and, ultimately, by the Governor to the Legislature.

**Capital Program Management System (CPMS)** A computer database used to develop and manage the highway and marine construction programs. The CPMS allows users to establish and maintain project data and is used to manage and deliver statewide construction programs.

**capture trips** Trips that do not enter or leave the traveled ways of a project's boundary within a mixed-use development.

**carpool/vanpool** A group of people who share the use and cost of a car or van for transportation on a regular basis.

**Categorical Exclusion (CE) (NEPA) or Categorical Exemption (CE) (SEPA)** Actions that do not individually or cumulatively have a significant effect on the environment.

**central island** The area of the roundabout, including the truck apron, surrounded by the circulating roadway.

**central island diameter** The diameter of the central island, including the truck apron (see [Chapter 1320](#)).

**circulating lane** A lane used by vehicles circulating in the roundabout.

**circulating roadway** The traveled lane(s) adjacent to the central island and outside the truck apron, including the entire 360° circumference of the circle.

**circulating roadway width** The total width of the circulating lane(s) measured from inscribed circle to the central island (see [Chapter 1320](#)).

**clear run-out area** The area beyond the toe of a nonrecoverable slope available for use by an errant vehicle.

**clear zone** The total roadside border area, available for use by errant vehicles, starting at the edge of the traveled way and oriented from the outside or inside shoulder (in median applications) as applicable. This area may consist of a shoulder, a recoverable slope, a nonrecoverable slope, and/or a clear run-out area. The clear zone cannot contain a critical fill slope, fixed objects, or water deeper than 2 feet.

**climbing lane** An auxiliary lane used for the diversion of slow traffic from the through lane.

**coefficient of retroreflection ( $R_s$ )** A measure of retroreflection.

**collector-distributor road (C-D road)** A parallel roadway designed to remove weaving from the main line and reduce the number of main line entrances and exits.

**collector system** Routes that primarily serve the more important intercounty, intracounty, and intraurban travel corridors; collect traffic from the system of local access roads and convey it to the arterial system; and on which, regardless of traffic volume, the predominant travel distances are shorter than on arterial routes ([RCW 47.05.021](#)).

**collision rate** Collisions per one million vehicle miles traveled and fatal rates per one hundred million vehicle miles.

**Commercial Vehicle Information Systems and Networks (CVISN)** A network that links intelligent transportation systems (ITS) to share information on commercial vehicles. When in operation at a weigh site, it can enable commercial vehicles to clear the facility without stopping.

**complex ramp alignment and grade** The exit advisory speed is 35 mph or lower than the posted main line speed, or there is a 6% or greater change in grade from existing main line grade to the ramp grade.

**conflict** An event involving two or more road users in which the action of one user causes the other user to make an evasive maneuver to avoid a collision.

**conflict point** A point where traffic paths cross, merge, or diverge.

**connection** See [approach and access connection](#).

**consider** To think carefully about, especially in order to make a decision. No backup documentation is required.

**context sensitive solutions (CSS)** A collaborative, interdisciplinary approach that involves all stakeholders to develop a transportation facility that fits its physical setting and preserves scenic, aesthetic, historic, and environmental resources while maintaining safety and mobility. CSS is an approach that considers the total context within which a transportation improvement project will exist.

**contiguous parcels** Two or more pieces of real property, under the same ownership, with one or more boundaries that touch and have similarity of use.

**continuous load** The electrical load on a circuit that lasts for a duration of three or more hours on any day.

**controlled releasing terminal (CRT) post** A standard-length guardrail post that has two holes drilled through it so it might break away when struck.

**conventional traffic signal** A permanent or temporary installation providing alternating right of way assignments for conflicting traffic movements. At least two identical displays are required for the predominant movement on each approach.

**corner clearance** On a managed access highway, the distance from an intersection of a public road or street to the nearest access connection along the same side of the highway. The minimum corner clearance distance (see [Chapter 540](#)) is measured from the closest edge of the intersecting road or street to the closest edge of the traveled way of the access connection, measured along one side of the traveled way (through lanes) (see also [access point spacing](#)).

**corridor analysis** Documentation that justifies a change in design level and/or decisions to include, exclude, or modify design elements. A corridor analysis addresses needs and design solutions within a substantial segment of roadway. A corridor analysis is useful beyond a specific project contained within it, and it is an appropriate document to address design speed.

**court reporter** A person with a license to write and issue official accounts of judicial or legislative proceedings.

**crash-accepted device** A feature that has been proven acceptable for use under specified conditions, either through crash testing or in-service performance.

**critical fill slope** A slope on which a vehicle is likely to overturn. Slopes steeper than 3H:1V are considered critical fill slopes.

**crossroad** The minor roadway at an intersection. At a stop-controlled intersection, the crossroad has the stop.

**curb section** A roadway cross section with curb and sidewalk.

## D

**decision sight distance** The distance needed for a driver to detect an unexpected or difficult-to-perceive condition, recognize the condition, select an appropriate maneuver, and complete the maneuver based on design conditions and design speed.

**deflection** (in respect to roundabouts) The change in the path of a vehicle imposed by the geometric features of a roundabout resulting in a slowing of vehicles.

**delineation** Any method of defining the roadway operating area for the driver.

**departure lanes** The lane or set of lanes for traffic leaving the roundabout (see [Chapter 1320](#)).

**Design Approval** Documented approval of the design criteria, which becomes part of the Design Documentation Package. This approval is an endorsement of the design criteria by the designated representative of the approving organization as shown in [Chapter 300](#).

**design-bid-build** The project delivery method where design and construction are sequential steps in the project development process ([23 CFR 636.103](#)).

**design-build contract** An agreement that provides for design and construction of improvements by a consultant/contractor team. The term encompasses design-build-maintain, design-build-operate, design-build-finance, and other contracts that include services in addition to design and construction. Franchise and concession agreements are included in the term if they provide for the franchisee or concessionaire to develop the project that is the subject of the agreement ([23 CFR 636.103](#)).

**design-builder** The firm, partnership, joint venture, or organization that contracts with WSDOT to perform the work.

**Design Clear Zone** The minimum clear zone target value used in highway design.

**Design Documentation Package (DDP)** See [Project File](#).

**designer** This term applies to WSDOT design personnel. Wherever “designer” appears in this manual, design-build personnel shall deem it to mean: Engineer of Record, Design Quality Assurance Manager, design-builder, or any other term used in the design-build contract to indicate design-build personnel responsible for the design elements of a design-build project, depending on the context of information being conveyed.

**design exception (DE)** A method to document a geometric feature that has been preauthorized to exclude improvement of an existing design element for various types of projects, as designated in the design matrices (see [Chapter 1100](#)). A DE designation indicates that the design element is normally outside the scope of the project type (see [Chapter 300](#)). Some design exceptions require justification.

**design hourly volume (DHV)** Computed by taking the annual average daily traffic times the K-factor. It can only be accurately determined in locations where there is a permanent traffic recording device active 365 days of the year. It correlates to the peak hour (see [peak hour](#)), but it is not equivalent. In some circumstances, it is necessary to use the peak hour data instead of DHV because peak hour can be collected using portable traffic recorders.

**design speed** The speed used to determine the various geometric design features of the roadway.

**design variance** A recorded decision to differ from the design level specified in the *Design Manual*, such as an evaluate upgrade (EU) not upgraded, a DE, or a deviation. EUs leading to an upgrade are documented but are not considered to be variances. A project or corridor analysis may also constitute a design variance if that analysis leads to a decision to use a design level or design classification that differs from what the *Design Manual* specifies for the project type.

**Design Variance Inventory (DVI)** A list of design elements that will not be improved in accordance with the *Design Manual* criteria designated for the project. Only approved variances should be included on this list.

**Design Variance Inventory System (DVIS)** A database application developed to generate the DVI form. The DVIS also provides query functions, giving designers an opportunity to search for previously granted variances. The DVIS was started in the early 2000s and does not identify prior variances. The *Design Manual* is constantly being refined and guidelines change over time. What may have been a design variance previously may not be a deviation today. Previously approved design variances do not carry forward and must be revisited as described in [Chapter 300](#). The DVIS database is intended for internal WSDOT use only, and WSDOT staff access it from the left margin of this website:

<http://wwwi.wsdot.wa.gov/design/>

**design vehicle** A vehicle used to establish the intersection geometry.

**design year** 20 years from the beginning of construction.

**desirable** Design criteria that are recommended for inclusion in the design.

**Determination of Nonsignificance (DNS) (SEPA)** The written decision by the Regional Administrator that a proposal will not have a significant impact and no EIS is required.

**Determination of Significance (DS) (SEPA)** A written decision by the Regional Administrator that a proposal could have a significant adverse impact and an EIS is required.

**deviation** A documented decision granting approval at project-specific locations to differ from the design level specified in the *Design Manual* (see Chapters [1100](#) and [300](#)).

**directional design hour volume (DDHV)** The traffic volume for the design hour in the peak direction of flow, in vehicles per hour. For example, if during the design hour, 60% of the vehicles traveled eastbound and 40% traveled westbound, then the DDHV for the eastbound direction would be the DHV x 0.60.

**divided multilane** A roadway with two or more through lanes in each direction and a median that physically or legally prohibits left turns, except at designated locations.

**document** (verb) The act of including a short note to the Design Documentation Package that explains a design decision.

**double-lane roundabout** A roundabout with a two-lane circulating roadway and one or more entry or exit legs with two lanes.

**driveway** A vehicular access point that provides access to or from a public roadway.

**drop and ride** An area of a park & ride lot or other multimodal facility where patrons are dropped off or picked up by private auto or taxi.

**durability** A measure of a traffic line's resistance to the wear and deterioration associated with abrasion and chipping.

## E

**easement** A documented right, as a right of way, to use the property of another for designated purposes.

**element** An architectural or mechanical component or design feature of a space, site, or public right of way.

**emergency escape ramp** A roadway leaving the main roadway designed for the purpose of slowing and stopping out-of-control vehicles away from the main traffic stream.

**emergency vehicle signal** A special adaptation of a conventional traffic signal installed to allow for the safe movement of authorized emergency vehicles. Usually, this type of signal is installed on the highway at the entrance into a fire station or other emergency facility. The signal ensures protected entrance onto the highway for the emergency vehicle. When not providing for this movement, the signal either operates continuously (consistent with the requirements for a conventional traffic signal) or displays continuous green, which is allowed at non-intersection locations only. At least two identical displays are required per approach.

**enforcement observation point** A place where a law enforcement officer may park and observe traffic.

**entry angle** The angle between the entry roadway and the circulating roadway measured at the yield point (see [Chapter 1320](#)).

**entry curve** The curve of the left edge of the roadway that leads into the circulating roadway (see [Chapter 1320](#)).

**entry width** The width of an entrance leg at the inscribed circle measured perpendicular to travel (see [Chapter 1320](#)).

**Environmental Assessment (EA)** (NEPA) A document prepared for federally funded, permitted, or licensed projects that are not categorical exclusions (CE), but do not appear to be of sufficient magnitude to require an EIS. The EA provides enough analysis to determine whether an EIS or a FONSI should be prepared.

**Environmental Classification Summary (ECS)** A form used to evaluate and classify projects for the construction program. The ECS supports a decision of a documented CE.

**Environmental Impact Statement (EIS)** A detailed written statement of a proposed course of action, project alternatives, and possible impacts of the proposal.

**Environmental Review Summary (ERS)** (see [Project Summary](#)) Part of the Project Summary document, the ERS identifies environmental permits and approvals. It is prepared in the region and is required for Design Approval.

**evaluate upgrade (EU)** A decision-making process to determine whether or not to upgrade an existing design element as designated in the design matrices. Documentation is required (see [Chapter 300](#)).

**exit curve** The curve of the left edge of the roadway that leads out of the circulating roadway (see [Chapter 1320](#)).

**exit width** The width of an exit leg at the inscribed circle (see [Chapter 1320](#)).

**expressway** A divided highway that has a minimum of two lanes in each direction for the exclusive use of traffic and that may or may not have grade separations at intersections.

**extrude** A procedure for applying marking material to a surface by forcing the material through a die to give it a certain shape.

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**F**

**facility** All or any portion of buildings, structures, improvements, elements, and pedestrian or vehicular routes located in a public right of way.

**feature** A component of a pedestrian access route, such as a curb ramp, driveway, crosswalk, or sidewalk.

**Federal Highway Administration (FHWA)** The division of the U.S. Department of Transportation with jurisdiction over the use of federal transportation funds for state highway and local road and street improvements.

**Federal Transit Administration (FTA)** The division of the U.S. Department of Transportation with jurisdiction over the use of federal funds for financial assistance to develop new transit systems and improve, maintain, and operate existing systems.

**feeder service** Bus service that provides connections with other bus or rail services.

**final design** Any design activities following preliminary design; expressly includes the preparation of final construction plans and detailed specifications for the performance of construction work ([23 CFR 636.103](#)). Final design is also defined by the fact that it occurs *after* NEPA/SEPA approval has been obtained.

**Finding of No Significant Impact (FONSI) (NEPA)** A federal document indicating that a proposal will not significantly affect the environment and an EIS is not required.

**findings and order** A document containing the findings and conclusions of a limited access hearing approved by the Assistant Secretary, Engineering & Regional Operations (see [Chapter 210](#)).

**findings and order plan** A limited access plan, prepared after a limited access hearing, which is based on the hearing record.

**fixed feature (object to be mitigated)** A fixed object, a side slope, or water that, when struck, can result in impact forces on a vehicle's occupants that may result in injury or place the occupants in a situation that has a high likelihood of injury. A fixed feature can be either constructed or natural.

**flare** The widening of the approach to the roundabout to increase capacity and facilitate natural vehicle paths.

**flasher warning assembly** Flashing beacons that are used only to supplement an appropriate warning or regulatory sign or marker. The displays consist of two alternating flashing yellow indications.

**flyer stop** A transit stop inside the limited access boundaries.

**footcandle (fc)** The illumination of a surface one square foot in area on which a flux of one lumen is uniformly distributed. One footcandle equals one lumen per square foot.

**foreslope** A sideslope that goes down as the distance increases from the roadway (fill slopes and ditch inslopes).

**freeway** A divided highway that has a minimum of two lanes in each direction for the exclusive use of traffic and with full control of access.

**frontage road** An auxiliary road that is a local road or street located beside a highway for service to abutting property and adjacent areas and for control of access.

**functional classification** The grouping of streets and highways according to the character of the service they are intended to provide.

## G

**geocomposites** Prefabricated edge drains, wall drains, and sheet drains that typically consist of a cusped or dimpled polyethylene drainage core wrapped in a geotextile. The geotextile wrap keeps the core clean so that water can freely flow through the drainage core, which acts as a conduit. Prefabricated edge drains are used in place of shallow geotextile-wrapped trench drains at the edges of the roadway to provide subgrade and base drainage. Wall drains and sheet drains are typically placed between the back of the wall and the soil to drain the soil retained by the wall.

**Geographic Information System (GIS)** A computerized geographic information system used to store, analyze, and map data. Data may be used with GIS if the data includes the Accumulated Route Mile (ARM) or State Route Milepost (SRMP) programs. Global Positioning System (GPS) technology provides a means of collecting data and is an alternative to ARM and SRMP. WSDOT's primary desktop tool to view and analyze GIS data is ArcGIS software. GIS is used to gather and analyze data to support the purpose and need as described in the Project Summary (<http://wwwi.wsdot.wa.gov/gis/supportteam/default.asp>).

**geogrids** A polymer grid mat constructed either of coated yarns or a punched and stretched polymer sheet. Geogrids usually have high strength and stiffness and are used primarily for soil reinforcement.

**geomembranes** Impervious polymer sheets that are typically used to line ponds or landfills. In some cases, geomembranes are placed over moisture-sensitive swelling clays to control moisture.

**geonets** Similar to geogrids, but typically lighter weight and weaker, with smaller mesh openings. Geonets are used in light reinforcement applications or are combined with drainage geotextiles to form a drainage structure.

**geosynthetic erosion control** The minimizing of surficial soil particle movement due to the flow of water over the surface of bare soil or due to the disturbance of soil caused by construction activities under or near bodies of water. This is the primary function of geotextiles used as silt fences or placed beneath riprap or other stones on soil slopes. Silt fences keep eroded soil particles on the construction site, whereas geotextiles placed beneath riprap or other stones on soil slopes prevent erosion from taking place at all. In general, the permanent erosion control methods described in [Chapter 630](#) are only used where more natural means (like the use of biodegradable vegetation mats to establish vegetation to prevent erosion) are not feasible. These functions control some of the geosynthetic properties, such as apparent opening size (AOS) and permittivity, and in some cases load-strain characteristics. The application will also affect the geosynthetic installation conditions. These installation conditions influence the remaining geosynthetic properties needed, based on the *survivability* level required.

**geosynthetic filtration** The passage of water through the geosynthetic relatively unimpeded (permeability or permittivity) without allowing passage of soil through the geosynthetic (retention). This is the primary function of geotextiles in underground drainage applications.

**geosynthetic survivability** The ability of the geosynthetic to resist installation conditions without significant damage, such that the geosynthetic can function as intended. Survivability affects the strength properties of the geosynthetic required.

**geotextiles (nonwoven)** A sheet of continuous or staple fibers entangled randomly into a felt for needle-punched nonwovens and pressed and melted together at the fiber contact points for heat-bonded nonwovens. Nonwoven geotextiles tend to have low-to-medium strength and stiffness with high elongation at failure and relatively good drainage characteristics. The high elongation characteristic gives them superior ability to deform around stones and sticks.

**geotextiles (woven)** Slit polymer tapes, monofilament fibers, fibrillated yarns, or multifilament yarns simply woven into a mat. Woven geotextiles generally have relatively high strength and stiffness and, except for the monofilament wovens, relatively poor drainage characteristics.

**glass beads** Small glass spheres used in highway pavement markings to provide the necessary retroreflectivity.

**gore** The area downstream from the intersection of the shoulders of the main line and exit ramp. Although generally referring to the area between a main line and an exit ramp, the term may also be used to refer to the area between a main line and an entrance ramp.

**gore nose** At an exit ramp, the point at the end of the gore area where the paved shoulders of the main line and the ramp separate (see [Chapter 1360](#)) or the beginning of traffic barrier, not including any impact attenuator. Also, the similar point at an entrance ramp.

## H

**hearing** An assembly to which the public is invited and at which participation is encouraged. Types of hearings include:

- **administrative appeal hearing** A formal process whereby a property owner may appeal WSDOT's implementation of access management legislation. The appeal is heard by an administrative law judge (ALJ), who renders a decision. (See [Chapter 540](#) for administrative appeal hearing procedures.)
- **combined hearing** A hearing held when there are public benefits to be gained by combining environmental, corridor, design, and/or limited access subjects.
- **corridor hearing** A formal or informal hearing that presents the corridor alternatives to the public for review and comment before a commitment is made to any one route or location. This type of hearing is beneficial for existing corridors with multiple Improvement projects programmed over a long duration.
- **design hearing** A formal or informal hearing that presents the design alternatives to the public for review and comment before the selection of a preferred alternative.
- **environmental hearing** A formal or informal hearing documenting that social, economic, and environmental impacts have been considered and that public opinion has been solicited.
- **formal hearing format** A hearing conducted by a moderator using a formal agenda, overseen by a hearing examiner, and recorded by a court reporter, as required by law. Limited access hearings require the use of the formal hearing format (see [Chapter 210](#)).
- **informal hearing format** A hearing where oral comments are recorded by a court reporter, as required by law. An informal hearing often uses the "open house" format (see [Chapter 210](#)). A formal agenda and participation by a hearing examiner are optional.
- **limited access hearing** A formal hearing that gives local public officials, owners of abutting properties, and other interested persons an opportunity to be heard about the limitation of access to the highway system.

**hearing agenda** An outline of the actual public hearing elements, used with formal hearings. (See [Chapter 210](#) for contents.)

**Hearing Coordinator** The Development Services & Access Manager within the HQ Access and Hearings Section: (360) 705-7251.

**hearing examiner** An administrative law judge from the Office of Administrative Hearings, or a WSDOT designee, appointed to moderate a hearing.

**hearing script** A written document of text to be presented orally by department representatives at a hearing.

**hearing summary** Documentation prepared by the region and approved by Headquarters that summarizes environmental, corridor, and design hearings. (See [Chapter 210](#) for content requirements.)

**hearing transcript** A document prepared by the court reporter that transcribes verbatim all oral statements made during the hearing, including public comments. This document becomes part of the official hearing record.

**high-occupancy toll (HOT) lane** A managed lane that combines a high-occupancy vehicle lane and a toll lane.

**high-occupancy vehicle (HOV)** A vehicle that meets the occupancy requirements of the facility as authorized by [WAC 468-510-010](#).

**high pavement type** Portland cement concrete pavement or hot mix asphalt (HMA) pavement on a treated base.

**high-speed roadway** A roadway with a posted speed of 45 mph or higher.

**highway** A general term denoting a street, road, or public way for the purpose of vehicular travel, including the entire area within the right of way.

**Highway Construction Program (HCP)** A comprehensive multiyear program of highway Improvement and Preservation projects selected by the Legislature.

**Highway System Plan (HSP)** A WSDOT planning document that addresses the state highway system element of the Washington Transportation Plan (WTP). The HSP defines the service objectives, action strategies, and costs to maintain, operate, preserve, and improve the state highway system for 20 years. The HSP is the starting point for the state highway element of the CIPP and the state Highway Construction Program. It is periodically updated to reflect completed work and changing transportation needs, policies, and revenues. It compares highway needs to revenues, describes the “constrained” costs of the highway programs, and provides details of conceptual solutions and performance in the improvement program.

**Highways of Statewide Significance (HSS)** Highways of Statewide Significance include interstate highways and other principal arterials that are needed to connect major communities in the state. The designation helps assist with the allocation and direction of funding. The HSS was mandated by the 1998 Legislature through enactment of House Bill 1487 and codified into [RCW 47.06.140](#). In 1999, the Legislature passed House Joint Memorial 4006 requesting that WSDOT, with the assistance of Regional Transportation Planning Organizations, update the HSS at least every five years.

The HSS was designated by the Transportation Commission through Resolution #660 on January 21, 2004. The Legislature concurred and adopted the HSS, including a map and route list through Engrossed House Bill 1433 on March 31, 2004. In 2006, the Legislature adopted House Bill 3266, adding SR 169 to the route list of highways of statewide significance. In 2009, the Legislature adopted SB 5642, adding SR 164 to the route list of highways of statewide significance.

**HOV direct access ramp** An on- or off-ramp exclusively for the use of HOVs that provides access between a freeway HOV lane and a street, transit support facility, or another freeway HOV lane without weaving across general-purpose lanes.

**HOV facility** A priority treatment for HOVs.

## I

**impact attenuator system** A device that acts primarily to bring an errant vehicle to a stop at a deceleration rate tolerable to the vehicle's occupants or to redirect the vehicle away from a fixed feature.

**incorporated city or town** A city or town operating under [RCW 35](#) or [35A](#).

**inscribed circle** The outer edge of the circulating roadway.

**inscribed circle diameter (ICD)** The diameter of the inscribed circle (see [Chapter 1320](#)).

**intelligent transportation systems (ITS)** An integrated system of advanced sensor, computer, electronics, and communication technologies and management strategies, used to increase the safety and efficiency of the surface transportation system.

**interchange** A system of interconnecting roadways, in conjunction with one or more grade separations, providing for the exchange of traffic between two or more intersecting highways or roadways.

**Interchange Justification Report (IJR)** The document used to propose a revision to limited access freeways.

**intermediate pavement type** Hot mix asphalt pavement on an untreated base.

**intersection** An at-grade access point connecting a state highway with a road or street duly established as a public road or public street by the local governmental entity.

**intersection angle** The angle between any two intersecting legs at the point the centerlines intersect.

**intersection area** The area of the intersecting roadways bounded by the edge of traveled ways and the area of the adjacent roadways to the farthest point: (a) the end of the corner radii, (b) through any marked crosswalks adjacent to the intersection, (c) to the stop bar, or (d) 10 feet from the edge of shoulder of the intersecting roadway (see [Chapter 1310](#)).

**intersection at grade** The general area where a roadway or ramp terminal is met or crossed at a common grade or elevation by another roadway.

- **four-leg intersection** An intersection formed by two crossing roadways.
- **split tee** A four-leg intersection with the crossroad intersecting the through roadway at two tee intersections offset by at least the width of the roadway.
- **tee (T) intersection** An intersection formed by two roadways where one roadway terminates at the point it meets a through roadway.
- **wye (Y) intersection** An intersection formed by three legs in the general form of a "Y" where the angle between two legs is less than 60°.

**intersection control beacon** (also flashing beacon) A secondary control device, generally suspended over the center of an intersection, that supplements intersection warning signs and stop signs. One display per approach may be used; however, two displays per approach are desirable. Intersection control beacons are installed only at intersections that control two or more directions of travel.

**intersection leg** Any one of the roadways radiating from and forming part of an intersection.

- **entrance leg** The lanes of an intersection leg for traffic entering the intersection.
- **exit leg** The lanes of an intersection leg for traffic leaving the intersection.

**Note:** Whether an intersection leg is an entrance leg or an exit leg depends on which movement is being analyzed. For two-way roadways, each leg is an entrance leg for some movements and an exit leg for other movements.

**intersection sight distance** The length of roadway visible to the driver of a vehicle entering an intersection.

**Interstate System** A network of routes designated by the state and the Federal Highway Administration (FHWA) under terms of the federal-aid acts as being the most important to the development of a national system. The Interstate System is part of the principal arterial system.

**island** A defined area within an intersection, between traffic lanes, for the separation of vehicle movements or for pedestrian refuge.

## J

**justify** Preparing a memo to the DDP identifying the reasons for the decision: a comparison of advantages and disadvantages of all options considered. A more rigorous effort than *document*.

## K

**K-factor** The proportion of AADT occurring in the analysis hour is referred to as the K-factor, expressed as a decimal fraction (commonly called “K,” “K30,” or “K100”). The K30 is the thirtieth (K100 is the one-hundredth) highest peak hour divided by the annual average daily traffic. Normally, the K30 or K100 will be in the range of 0.09 to 0.10 for urban and rural areas. Average design hour factors are available on the web in the Statewide Travel and Collision Data Office’s Annual Peak Hour Report.

## L

**lamp lumens** The total light output from a lamp, measured in lumens.

**lane** A strip of roadway used for a single line of vehicles.

**lane control signal** (reversible lanes) A special overhead signal that permits, prohibits, or warns of impending prohibition of lane use.

**lane width** The lateral design width for a single lane, striped as shown in the [Standard Plans](#) and the [Standard Specifications](#). The width of an existing lane is measured from the edge of traveled way to the center of the lane line or between the centers of adjacent lane lines.

**lateral clearance** The distance from the edge of traveled way to a roadside object.

**lead agency** The public agency that has the principal responsibility for carrying out or approving a project.

**legal road approach** A road approach that complies with the requirements of [Chapter 530](#) for limited access facilities and [Chapter 540](#) for managed access facilities.

**length of need** The length of a traffic barrier used to shield a fixed feature.

**level of service (LOS)** LOS is based on peak hour, except where noted. LOS assigns a rank (A – F) to facility sections based on traffic flow concepts like density, delay, and/or corresponding safety performance conditions. (See the *Highway Capacity Manual* and AASHTO's *Geometric Design of Highways and Streets* ["Green Book"] for further details.)

**life cycle cost** The total cost of a project or item over its useful life. This includes all of the relevant costs that occur throughout the life of a project or item, including initial acquisition costs (such as right of way, planning, design, and construction), operation, maintenance, modification, replacement, demolition, financing, taxes, disposal, and salvage value as applicable.

**light emitting diode (LED)** A two-lead semiconductor light source.

**limited access (L/A)** Full, partial, or modified access control is planned and established for each corridor and then acquired as the right to limit access to each individual parcel (see [Chapter 520](#)).

- **acquired limited access control** Access rights have been purchased.
- **established limited access control** An access hearing has been held and the Assistant Secretary, Engineering & Regional Operations, has adopted the findings and order, which *establishes* the limits and level of control.
- **planned limited access control** Limited access control is planned for some time in the future; however, no access hearing has been held.

**Limited Access and Managed Access Master Plan** A map of Washington State that shows established and planned limited access highways: [www.wsdot.wa.gov/design/accessandhearings](http://www.wsdot.wa.gov/design/accessandhearings)

**limited access highway** All highways listed as “Established L/A” on the Limited Access and Managed Access Master Plan and where the rights of direct access to or from abutting lands have been acquired from the abutting landowners.

- **full access control** This most restrictive level of limited access provides access, using interchanges, for selected public roads/streets only, and prohibits highway intersections at grade.
- **partial access control** The second most restrictive level of limited access. At-grade intersections with selected public roads are allowed, and there may be some crossings and some driveway approaches at grade. Direct commercial access is not allowed.
- **modified access control** The least restrictive level of limited access. Characteristics are the same as for partial access control except that direct commercial access is allowed.

**local roads** Non-state highways that are publicly owned.

**long tunnel** A tunnel, lid, or underpass that is greater than 80' in length and has a length to vertical clearance ratio greater than 10:1.

**low pavement type** Bituminous surface treatment (BST).

**low-speed roadway** A roadway with a posted speed of lower than 45 mph.

**lumen** The unit used to measure luminous flux.

**luminaire** A complete lighting unit comprised of a light bulb or light emitting Diode (LED) module, wiring, and a housing unit.

**luminance** The quotient of the luminous flux at an element of the surface surrounding the point and propagated in directions defined by an elementary cone containing the given direction, by the product of the solid angle of the cone and area of the orthogonal projection of the element of the surface on a plane perpendicular to the given direction. The luminous flux may be leaving, passing through, and/or arriving at the surface.

**luminous flux** The time rate of the flow of light.

## M

**Major Project** A project receiving federal financial assistance (1) with an estimated cost of \$500 million or more, or (2) that has been identified by the Secretary as being "Major" as a result of special interest (23 U.S.C 106 (h)).

**managed access highway** Highways where the rights of direct access to or from abutting lands have not been acquired from the abutting landowners.

**managed lane** A lane that increases efficiency by packaging various operational and design actions. Lane management operations may be adjusted at any time to better match regional goals.

**maximum** The highest design value allowed without a deviation.

**maximum uniformity ratio** The average light level within the design area divided by the minimum light level within the design area (see [Chapter 1040](#)).

**maximum veiling luminance ratio** The maximum veiling luminance divided by the average luminance over a given design area for an observer traveling parallel to the roadway centerline (see [Chapter 1040](#)).

**mcd/m<sup>2</sup>/lux** Pavement marking retroreflectivity is represented by the coefficient of retroreflected luminance ( $R_L$ ) measured in millicandelas per square meter.

**Measures of Effectiveness (MOEs)** In the context of [Chapter 320](#), examples are: speed, delay, density, LOS, QOS, person or vehicle throughput, cost vs. benefit, and queue. (See FHWA's MOE List.)

**median** The portion of a divided highway separating vehicular traffic traveling in opposite directions.

**median opening** An opening in a continuous median for the specific purpose of allowing vehicle movement.

**Memorandum of Understanding (MOU)** There is one MOU (*Highways Over National Forest Lands*) between the United States Forest Service (USFS) and WSDOT that requires the USFS to obtain a road approach permit for new access to a state highway that is crossing Forest Service land.

**metering signal** A signal used to control the predominant flow rate of traffic at an at-grade facility.

**Methods and Assumptions Document** A mandatory document developed at the beginning of the IJR phase to record IJR assumptions, methodologies, criteria, and decisions (see [Chapter 550](#)).

**Metropolitan Planning Organization (MPO)** A lead agency designated by the Governor to administer the federally required transportation planning process in a metropolitan area with a population over 50,000. The MPO is responsible for the 20-year long-range plan and Transportation Improvement Program (TIP).

**mil** Unit of measurement equivalent to 0.001 inches.

**minimum** The lowest design value allowed without a deviation.

**minimum average light level** The average of all light intensities within the design area, measured just prior to relamping the system (see [Chapter 1040](#)).

**minimum light level** The minimum light intensity of illumination at any single point within the design area measured just prior to relamping the system (see [Chapter 1040](#)).

**minor arterial system** A rural network of arterial routes linking cities and other activity centers that generate long distance travel and, with appropriate extensions into and through urban areas, form an integrated network providing interstate and interregional service ([RCW 47.05.021](#)).

**minor operational enhancement projects** These projects usually originate from the Q2 component of the Q Program and are quick responses to implement low-cost improvements. They are typically narrow in scope and focus on improvements to traffic operations and modifications to traffic control devices. Guidance on the type of work included in the Q subprograms is in the *Chart of Accounts*.

**monument** As defined in [Chapter 410](#), a monument is any physical object or structure that marks or references a survey point. This includes, but is not limited to, a point of curvature (P.C.), a point of tangency (P.T.), a property corner, a section corner, a General Land Office (GLO) survey point, a Bureau of Land Management (BLM) survey point, and any other permanent reference set by a governmental agency or private surveyor.

**monument removal or destruction** The physical disturbance or covering of a monument such that the survey point is no longer visible or readily accessible.

**mounting height – luminaire** The vertical distance between the surface of the design area and the center of the light source of the luminaire. Note: This is not to be confused with pole height (H1), but is the actual distance that the luminaire is located above the roadway edge line.

**movable bridge signal** (also drawbridge signal) A signal installed to notify traffic to stop when the bridge is opened for waterborne traffic. Movable bridge signals display continuous green when the roadway is open to vehicular traffic.

**multilane approach** An approach that has two or more lanes, regardless of the lane use designation.

**multimodal connection** The point where multiple types of transportation activities occur; for example, where transit buses and van pools drop off or pick up passengers (including passengers with bicycles).

## N

**National Highway System (NHS)** The NHS was developed by the U.S. Department of Transportation (DOT) in cooperation with the states, local officials, and metropolitan planning organizations (MPOs).

The NHS includes the following subsystems of roadways (note that a specific highway route may be on more than one subsystem):

- **Interstate:** The Eisenhower Interstate System of highways retains its separate identity within the NHS.
- **Other Principal Arterials:** These are highways in rural and urban areas that provide access between an arterial and a major port, airport, public transportation facility, or other intermodal transportation facility.
- **Strategic Highway Network (STRAHNET):** This is a network of highways that are important to the United States' strategic defense policy and that provide defense access, continuity, and emergency capabilities for defense purposes.
- **Major Strategic Highway Network Connectors:** These are highways that provide access between major military installations and highways that are part of the Strategic Highway Network.
- **Intermodal Connectors:** These highways provide access between major intermodal facilities and the other four subsystems making up the National Highway System.

**natural vehicle path** The natural path that a driver navigates a vehicle given the layout of the intersection and the ultimate destination.

**need** A statement that identifies the transportation problem(s) that the proposal is designed to address and explains how the problem will be resolved. An existing or anticipated travel demand that has been documented through a study process to require a change in access to the state's limited access freeway system.

**negative illumination** Lighting the background and leaving the object dark to contrast with the light behind it as the driver views it.

**nighttime** The period of time from one-half hour after sunset to one-half hour before sunrise and any other time when persons or objects may not be clearly discernible at a distance of 500 feet ([RCW 46.04.200](#)).

**no-build condition** The baseline, plus state transportation plan and comprehensive plan improvements, expected to exist, as applied to the year of opening or the design year.

**nonconforming road approach** A road approach that does not meet current requirements for location, quantity, spacing, sight distance, or geometric elements.

**nonrecoverable slope** A slope on which an errant vehicle might continue until it reaches the bottom, without having the ability to recover control. Fill slopes steeper than 4H:1V, but not steeper than 3H:1V, are considered nonrecoverable.

**nonseparated HOV lane** An HOV lane that is adjacent to and operates in the same direction as the general-purpose lanes with unrestricted access between the HOV lane and the general-purpose lanes.

**notice of appearance** A form provided by WSDOT for anyone wanting to receive a copy of the findings and order and the adopted *limited access plan* (see [Chapter 210](#)).

**notice of hearing (or hearing notice)** A published advertisement that a public hearing will be held.

**notice of opportunity for a hearing** An advertised offer to hold a public hearing.

## O

**occupancy designation** The minimum number of occupants required for a vehicle to use the HOV facility.

**operating speed** The speed at which drivers are observed operating their vehicles during free-flow conditions. The 85<sup>th</sup> percentile of the distribution of observed speeds is most frequently used.

**order of hearing** The official establishment of a hearing date by the Director & State Design Engineer, Development Division.

**outer separation** The area between the outside edge of traveled way for through traffic and the nearest edge of traveled way of a frontage road or collector-distributor (C-D) road.

**overlapped displays** Overlapped displays allow a traffic movement to operate with one or more nonconflicting phases. Most commonly, a minor street's exclusive right-turn phase is overlapped with the nonconflicting major street's left-turn phase. An overlapped display can be terminated after the parent phase (the main phase the overlap is associated with) terminates. An overlapped display programmed for two or more parent phases continues to display until all of the parent phases have terminated. An overlap is made up of two or more phases—not one phase controlling two movements.

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**P**

**painted nose** The point where the main line and ramp lanes separate.

**“pass-by” trips** Pass-by trips are intermediate stops between an origin and a primary trip destination; for example, home to work, home to shopping.

**passenger loading zone** An area provided for pedestrians to board/disembark a vehicle.

**passing lane** An auxiliary lane on a two-lane highway used to provide the desired frequency of passing zones.

**passing sight distance** The distance (on a two-lane highway) needed for a vehicle driver to execute a normal passing maneuver based on design conditions and design speed.

**pavement marking** A colored marking applied to the pavement to provide drivers with guidance and other information.

**peak hour** The 60-minute interval that contains the largest volume of traffic during a given time period. If a traffic count covers consecutive days, the peak hour can be an average of the highest hour across all of the days. An a.m. peak is simply the highest hour from the a.m., and the p.m. peak is the highest from the p.m. The peak hour correlates to the DHV, but is not the same. However, it is close enough on items such as intersection plans for approval to be considered equivalent.

**permit holder** The abutting property owner or other legally authorized person to whom an access connection permit is issued by the permitting authority.

**permitted access connection** A connection for which an access connection permit has been issued by a permitting authority.

**permitting authority** The agency that has legal authority to issue managed access connection permits. For access connections in unincorporated areas, the permitting authority is WSDOT; for access connections within corporate limits, the permitting authority is a city or town.

**physical nose** The point, upstream of the gore, with a separation between the roadways of 16 to 22 feet (see [Chapter 1360](#)).

**planning** Transportation planning is a decision-making process required by federal and state law used to solve complex, interrelated transportation and land use problems (see [Chapter 120](#)).

**Plans, Specifications, and Estimates (PS&E)** The project development activity that follows Project Definition and culminates in the completion of contract-ready documents and the engineer’s cost estimate.

**pole height (H1)** The vertical distance from the light source to the pole base. This distance is specified in contracts and used by the pole manufacturers to fabricate the light standard.

**policy point** There are eight policy points addressed in the IJR:

- Need for the Access Point Revision
- Reasonable Alternatives
- Operational & Collision Analyses
- Access Connections & Design
- Land Use & Transportation Plans
- Future Interchanges
- Coordination
- Environmental

**portable traffic signal** A type of conventional traffic signal used in work zones to control traffic. This signal is most commonly used on two-way two-lane highways where one lane has been closed for roadwork. This signal is most commonly operated in pairs, with one signal at each end of the work zone. This eliminates the need for 24-hour flagger control. The traffic signal provides alternating right of way assignments for conflicting traffic movements. The signal has an adjustable vertical support with two three-section signal displays and is mounted on a mobile trailer with its own power source.

**positive illumination** Lighting the surface of the object as the driver views it.

**posted speed** The maximum legal speed as posted on a section of highway using regulatory signs.

**prehearing packet** A concise, organized collection of all necessary prehearing data, prepared by the region and approved by the HQ Development Services & Access Manager prior to the hearing (see [Chapter 210](#)).

**preliminary engineering (PE)** A term used to describe the Project Delivery process from project scoping through PS&E review.

**principal arterial system** A connected network of rural arterial routes with appropriate extensions into and through urban areas, including routes designated as part of the Interstate System, that serves corridor movements with travel characteristics indicative of substantial statewide and interstate travel ([RCW 47.05.021](#)).

**priority array** A collection of similar needs identified in the HSP, prioritized based on the methodology adopted by WSDOT to meet the requirements of [RCW 47.05](#).

**Priority Array Tracking System (PATS)** A database that allows tracking of highway needs and their solutions. The system is designed to ensure WSDOT addresses the highest-ranked transportation needs. Deficiencies are tracked for each strategy in the HSP.

**product or service** Any element of a project from concept through maintenance and operation. In all instances, the required function should be achieved at the lowest life cycle cost based on requirements for performance, maintainability, safety, environment, and aesthetics.

**project** A portion of a highway that WSDOT or a public authority proposes to construct, reconstruct, or improve as described in the preliminary design report or applicable environmental document. A project is roadway/highway improvement within the logical termini identified in the environmental document and may consist of several contracts, or phases of a project or contract, that are implemented over several years.

**Project Analysis** Documentation that justifies a change in design level and/or decisions to include, exclude, or modify design elements specific to a project only (see also [Chapter 1100](#)).

**Project Change Request Form** A form used to document and approve revisions to project scope, schedule, or budget from a previously approved Project Definition (see [Project Summary](#)). Include copies in the Design Documentation Package.

**Project Control and Reporting (PC&R)** The Headquarters (HQ) Project Control and Reporting Office is responsible for monitoring, tracking, and reporting delivery of the Highway Construction Program in coordination with the Program Management offices in each of the six WSDOT regions and the Urban Corridors Office.

**Project Definition** (see [Project Summary](#))

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**Project Development Approval** Final approval of all project development documents by the designated representative of the approving organization prior to the advertisement of a capital transportation project (see [Chapter 300](#)).

**Project Engineer** This term applies to WSDOT personnel. Wherever “Project Engineer” appears in this manual, the design-builder shall deem it to mean “Engineer of Record.”

**Project File (PF)** A file containing all documentation and data for all activities related to a project (see [Chapter 300](#)).

- **Design Documentation Package (DDP)** The portion of the Project File, including Design Approval and Project Development Approval, that will be retained long term in accordance with WSDOT document retention policies. Depending on the scope of the project, it contains the Project Summary and some or all of the other documents discussed in [Chapter 300](#). Technical reports and calculations are part of the Project File, but they are not designated as components of the DDP. Include estimates and justifications for decisions made in the DDP (see Chapter 300). The DDP explains how and why the design was chosen and documents approvals.

**project management plan** A formal, approved document that defines how the project is executed, monitored, and controlled. It may be in summary or detailed form and may be composed of one or more subsidiary management plans and other planning documents. For further information, see the *Project Management Online Guide*:

🔗 <http://www.wsdot.wa.gov/projects/projectmgmt/onlineguide/preconstruction.htm>

**Project Scoping** See [Chapter 300](#).

**Project Summary** A set of documents consisting of the Design Decisions (DD), Environmental Review Summary (ERS), and Project Definition (PD). The Project Summary is part of the design documentation required to obtain Design Approval and is ultimately part of the design documentation required for Project Development Approval (see [Chapter 300](#)).

- **Design Decisions (DD)** A document that records major design decisions regarding roadway geometrics, roadway and roadside features, and other issues that influence the project scope and budget.
- **Environmental Review Summary (ERS)** A document that records the environmental classification (class of action) and considerations (consequences of action) for a specific project.
- **Project Definition (PD)** A document that records the purpose and need of the project, along with program level and design constraints.

**proposal** The combination of projects/actions selected through the study process to meet a specific transportation system need.

**public art** An enhancement to a functional element, feature, or place within a transportation facility to provide visual interest. The enhancement could be an addition to a functional element, integrated into a design, or for purely aesthetic purposes. An element is considered “public art” if it is beyond WSDOT standard practice for architectural treatment.

**public involvement plan** A plan to collaboratively involve the public in decision making, tailored to the specific needs and conditions of a project and the people and communities it serves. It is often part of a broader communications plan.

**public transportation** Passenger transportation services available to the public, including buses, ferries, rideshare, and rail transit.

**purpose** General project goals such as improve safety, enhance mobility, or enhance economic development.

## Q

**Quality of Service (QOS)** Defined by the *Highway Capacity Manual* or by agreement. Intended to describe how well a facility or service operates or functions from the perspective of the user.

**queue cutter traffic signal** A traffic signal used at highway-rail grade crossings where the queue from a downstream traffic signal is expected to extend within the Minimum Track Clearance Distance. It is used to keep vehicles from an adjacent signalized intersection from queuing on the railroad tracks.

## R

**ramp connection** The pavement at the end of a ramp, connecting to a main lane of a roadway.

**ramp (in relation to a roadway)** A short roadway connecting a main lane of a highway with another facility, such as a road, parking lot, or transit stop, for vehicular use.

**ramp meter** A traffic signal at a freeway entrance ramp that allows a measured or regulated amount of traffic to enter the freeway.

**ramp terminal** An intersection at the end of a ramp.

**Record of Decision (ROD)** Under the National Environmental Policy Act, the Record of Decision accompanies the Final Environmental Impact Statement; explains the reasons for the project decision; discusses alternatives and values considered in selection of the preferred alternative; and summarizes mitigation measures and commitments that will be incorporated in the project.

**recoverable slope** A slope on which the driver of an errant vehicle can regain control of the vehicle. Slopes of 4H:1V or flatter are considered recoverable.

**recovery area** The minimum target value used in highway design when a fill slope between 4H:1V and 3H:1V starts within the Design Clear Zone.

**Recreational Vehicle Account** In 1980 the RV account was established for use by the department of transportation for the construction, maintenance, and operation of recreational vehicle sanitary disposal systems at safety rest areas ([RCW 46.68.170](#)). A recreational vehicle sanitary disposal fee is required for registration of a recreational vehicle ([RCW 46.17.375](#)). Adjustments to the recreational vehicle fee by the department of transportation may be implemented after consultation with the citizens' representatives of the recreational vehicle user community ([RCW 47.01.460](#)).

**Regional Transportation Planning Organization (RTPO)** A planning organization authorized by the Legislature in 1990 as part of the Growth Management Act. The RTPO is a voluntary organization with representatives from state and local governments that are responsible for coordinating transportation planning activities within a region.

**relocation assistance program** A program that establishes uniform procedures for relocation assistance that will ensure legal entitlements and provide fair, equitable, and consistent treatment to persons displaced by WSDOT-administered projects, as defined in the [Right of Way Manual](#).

**Request for Proposal (RFP)** The document package issued by WSDOT requesting submittal of proposals for the project and providing information relevant to the preparation and submittal of proposals, including the instructions to proposers, contract documents, bidding procedures, and reference documents.

**rest area** An area to the side of a path.

**résumé** An official notification of action taken by WSDOT following adoption of a findings and order (see [Chapter 210](#)).

**retroreflection** The phenomenon of light rays striking a surface and being returned directly back to the source of light.

**retroreflectometer** An instrument used to measure retroreflectivity.

**right of way (R/W)** A general term denoting land or interest therein, acquired for or designated for transportation purposes. More specifically, lands that have been dedicated for public transportation purposes or land in which WSDOT, a county, or a municipality owns the fee simple title, has an easement devoted to or required for use as a public road/street and appurtenant facilities, or has established ownership by prescriptive right.

**right of way and limited access plan (R/W and L/A plan)** A right of way plan that also shows limited access control details.

**road approach** An access point, other than a public road/street, that allows access to or from a limited access highway on the state highway system.

**road approach design template** The design geometric criteria for a road approach based on the usage, types of vehicles, and traffic volume.

**roadside park** A roadside user facility for safe vehicular parking off the traveled way and separated from the highway by some form of buffer. These sites might be equipped with features or elements such as points of interest, picnic tables, and/or vault toilet buildings. Unlike a safety rest area, a roadside park does not always provide a permanent restroom building.

**roadway** The portion of a highway, including shoulders.

**roadway luminance** The light projected from a luminaire that travels toward a given area, represented by a point on the pavement surface, and then back toward the observer, opposite to the direction of travel. The units of roadway luminance are footcandles.

**roundabout** A circular intersection at grade with yield control of all entering traffic, channelized approaches with raised splitter islands, counter-clockwise circulation, and appropriate geometric curvature to force travel speeds on the circulating roadway generally to less than 25 mph.

**rumble strips** Rumble strips are grooves or rows of raised pavement markers placed perpendicular to the direction of travel to alert inattentive drivers.

**rural design area** An area that meets none of the conditions to be an urban design area.

**rural intersection** An intersection in a rural design area (see [Chapter 1140](#)).

## S

**safety rest area (SRA)** A roadside facility equipped with permanent restroom building(s), a parking area, picnic tables, refuse receptacles, illumination, and other ancillary services. SRAs typically include potable water and might include traveler information and telephones.

**Safety Rest Area Strategic Plan** Developed in 2008 under a stakeholder-coordinated effort of executive and advisory team members, this plan provides guidance for current and future management of the SRA program.

**sawtooth berth** A series of bays that are offset from one another by connecting curb lines, constructed at an angle from the bus bays. This configuration minimizes the amount of space needed for vehicle pull in and pull out.

**scoping phase** The first phase of project development for a specific project, the scoping phase follows identification of the need for a project and precedes detailed project design. It is the process of identifying the work to be done and developing a cost estimate for completing the design and construction. The Project Summary, engineering and construction estimates, and possibly several technical reports (geotechnical, surfacing, bridge condition, and so on) are developed during this phase.

**security lighting** A minimal amount of lighting used to illuminate areas for public safety or theft reduction. Security lighting for walkways is the lighting of areas where shadows and horizontal and vertical geometry obstruct a pedestrian's view.

**"select zone" analysis** A traffic model run, where the related project trips are distributed and assigned along a populated highway network. This analysis isolates the anticipated impact on the state highway network created by the project.

**separated HOV facility** An HOV roadway that is physically separated from adjacent general-purpose lanes by a barrier or median, or is on a separate right of way.

**service life** The service life of a pavement marking is the time or number of traffic passages required for its retroreflectivity to decrease from its initial value to a minimum threshold value indicating that the marking needs to be refurbished or replaced.

**shared roadway** A roadway that is open to both bicycle and motor vehicle travel. This may be a new or existing roadway/highway, a street with wide curb lanes, or a road with paved shoulders.

**shared-use landing** A level (0 to 2% grade cross slope and running slope) paved area within the shared-use path, designed to provide turning and maneuvering space for wheelchair users and as a resting place for pedestrians.

**shared-use path** A facility physically separated from motorized vehicular traffic within the highway right of way or on an exclusive right of way with minimal crossflow by motor vehicles. Shared-use paths are primarily used by bicyclists and pedestrians, including joggers, skaters, and pedestrians with disabilities, including those who use nonmotorized or motorized wheeled mobility devices. With appropriate design considerations, equestrians may also be accommodated by a shared-use path facility.

**short tunnel** A tunnel, lid, or underpass that is shorter than 80' in length and has a length to vertical clearance ratio of 10:1 or less.

**shoulder** The portion of the roadway contiguous with the traveled way, primarily for accommodation of stopped vehicles, emergency use, lateral support of the traveled way, and where allowed, use by pedestrians and bicycles.

**shoulder width** The lateral dimension of the shoulder, measured from the edge of traveled way to the edge of roadway or the face of curb.

**shy distance** The distance from the edge of the traveled way beyond which a roadside object might not be perceived by a typical driver as an immediate feature to be avoided to the extent that the driver will change the vehicle's placement or speed.

**sight distance** The length of highway visible to a driver.

**Signal Maintenance Management System (SIMMS)** A database used for traffic signals, illumination, and Intelligent Transportation Systems (ITS). SIMMS is used to establish an inventory base, enter work reports, print timesheets, and store maintenance records for electrical/electronics systems within WSDOT right of way.

**signed shared roadway** A shared roadway that has been designated by signing as a route for bicycle use.

**single-lane roundabout** A roundabout having single-lane entries at all legs and one circulating lane.

**single-occupant vehicle (SOV)** Any motor vehicle other than a motorcycle carrying one occupant.

**site** A parcel of land bounded by a property line or a designated portion of a public right of way.

**slip base** A mechanical base designed to allow the light standard to break away from the fixed foundation when hit by a vehicle traveling at the design speed and traveling at a departure angle less than or equal to the design departure angle.

**slip lane** A lane that separates heavy right-turn movements from the roundabout circulating traffic (see [Chapter 1320](#)).

**slip ramp** A connection between legs of an intersection that allows right-turning vehicles to bypass the intersection or a connection between an expressway and a parallel frontage road. These are often separated by an island.

**slow-moving vehicle turnout** A shoulder area widened to provide room for a slow-moving vehicle to pull out of the through traffic, allow vehicles to pass, and then return to the through lane.

**spacing** The distance in feet measured on centerline between adjacent luminaires.

**speed limit sign beacon** A beacon installed with a fixed or variable speed limit sign. The preferred display is two flashing yellow indications.

**splitter island** The raised island at each two-way leg between entering and exiting vehicles, designed primarily to control the entry and exit speeds by providing deflection. They also discourage wrong-way movements, and provide pedestrian refuge.

**spraying** A procedure for applying marking material to a surface as a jet of fine liquid particles.

**state highway system** All roads, streets, and highways designated as state routes in compliance with [RCW 47.17](#).

**Statewide Transportation Improvement Program (STIP)** A planning document that includes all federally funded projects and other regionally significant projects for a three-year period.

**static scale** A scale that requires a vehicle to stop for weighing.

**stopping sight distance** The distance needed for a driver to stop a vehicle traveling at design speed based on design conditions.

**stop sign beacon** A beacon installed above a stop sign. The display is a flashing red indication.

**study area** The transportation system area to study in the study process and for an IJR. The study area is a minimum of one interchange upstream and downstream from the proposal. The study area shall also include the intersecting roadway in the area to the extent necessary to ensure its ability to collect and distribute traffic to and from the interchange. The study area should be expanded as necessary to capture operational impacts of adjacent interchanges in the vicinity that are, or will be, bottlenecks or chokepoints that influence the operations of the study interchange.

**study plan** A term associated with environmental procedures, this plan proposes an outline or “road map” of the environmental process to be followed during the development of a project that requires complex NEPA documentation (see [Chapter 210](#) and the [Environmental Manual](#)).

**suburban area** A term for the area at the boundary of an urban design area. Suburban settings may combine higher speeds common in rural design areas with activities more common to urban settings.

**superelevation** The rotation of the roadway cross section in such a manner as to overcome part of the centrifugal force that acts on a vehicle traversing a curve.

**superelevation runoff** The length of highway needed to accomplish the change in cross slope from a section with adverse crown removed (level) to a fully superelevated section, or vice versa.

**superelevation transition length** The length of highway needed to change the cross slope from normal crown or normal pavement slope to full superelevation.

**support team** An integral part of the IJR process consisting of an assemblage of people from the regions, FHWA (for Interstates), WSDOT HQ Access and Hearings, and other representatives organized to develop and analyze alternatives to meet the need of a proposal, including approval authorities.

**Surface Transportation Program (STP)** A federal program established by Congress in 1991 that provides a source of federal funding for highway and bridge projects.

## T

**tangent runoff** The length of highway needed to change the cross slope from normal crown to a section with adverse crown removed (level).

**temporary traffic signal** A conventional traffic signal used during construction to control traffic at an intersection while a permanent signal system is being constructed. A temporary traffic signal is typically an inexpensive span-wire installation using timber strain poles.

**Total Project Costs** The costs of all phases of a project, including environmental, design, right of way, utilities, and construction.

**traffic barrier** A longitudinal barrier, including bridge rail or an impact attenuator, used to redirect vehicles from fixed features located within an established Design Clear Zone, help mitigate median crossovers, reduce the potential for errant vehicles to travel over the side of a bridge structure, or (occasionally) protect workers, pedestrians, or bicyclists from vehicular traffic.

**traffic barrier/longitudinal barrier** A device oriented parallel or nearly parallel to the roadway whose primary function is to contain or safely redirect errant vehicles away from fixed features or to (occasionally) protect workers, pedestrians, or bicyclists from vehicular traffic. Beam guardrail, cable barrier, bridge rail, concrete barrier, and impact attenuators are barriers, and they are categorized as rigid, rigid anchored, unrestrained rigid, semirigid, and flexible. They can be installed as roadside or median barriers.

**traffic calming** Design techniques that have been shown to reduce traffic speeds and unsafe maneuvers. These techniques can be stand-alone or used in combination, and they include lane narrowing, curb extensions, surface variations, and visual clues in the vertical plane.

**Traffic Impact Analysis (TIA) (sometimes called Traffic Impact Study (TIS))** If a traffic analysis is not an IJR, it is a TIA. TIAs are used for environmental reviews and developer projects (see [Chapter 320](#)).

**traffic paint** A pavement marking material that consists mainly of a binder and a solvent. The material is kept in liquid form by the solvent, which evaporates upon application to the pavement, leaving the binder to form a hard film.

**transit** A general term applied to passenger rail and bus service used by the public.

**transit facility** A capital facility that improves the efficiency of public transportation or encourages the use of public transportation.

**transit flyer stop** A multimodal connection located within the boundaries of a limited access facility.

**transition** A section of barrier used to produce the gradual stiffening of a flexible or semirigid barrier as it connects to a more rigid barrier or fixed object.

**transit lane** A lane for the exclusive use of transit vehicles.

**transit stop** A facility for loading and unloading passengers that is set aside for the use of transit vehicles only.

**transit vehicle** A bus or other motor vehicle that provides public transportation (usually operated by a public agency).

**Transportation Improvement Program (TIP)** A three-year transportation improvement strategy required from MPOs by Congress, which includes all federally funded or regionally significant projects.

**Transportation Information and Planning Support (TRIPS)** A mainframe computer system designed to provide engineering, maintenance, planning, and accounting staff with highway inventory, traffic, and accident data.

**Transportation Management Area (TMA)** Urbanized areas with populations of 200,000 or greater are federally designated as Transportation Management Areas.

**transportation management plan (TMP)** A set of traffic control plans, transportation operations plans, and public information strategies for managing the work zone impacts of a project. A TMP is required for all projects to address work zone safety and mobility impacts.

**Transportation Planning Studies** These studies identify the current functions of a corridor and forecast future demands on the system. Data collection and public involvement are used to forecast future needs that will improve the function of a state route.

**travel demand** The demand travelers will make on the system based on the number and types of trips they will take and the mode and routes they will use. Local travel demand represents short trips that should be made on the local transportation system, such as intracity roads and streets. Regional travel demand represents long trips that are made on the regional transportation system, such as Interstate, regional, and/or intercity/interregional roads, streets, or highways.

**traveled way** The portion of the roadway intended for the movement of vehicles, exclusive of shoulders and lanes for parking, turning, and storage for turning.

**traveler information** Commercial and noncommercial information that informs and orients the traveling public. This includes access information for food, gas, lodging, local attractions, regional tourist attractions, roadway conditions, and construction schedules.

**traveling public** Motorists, motorcyclists, bicyclists, pedestrians, and pedestrians with disabilities.

**trips** Short trips are normally local. Long trips are normally interstate, regional, or interregional.

**truck apron** The optional mountable portion of the central island of a roundabout between the raised nontraversable area of the central island and the circulating roadway (see [Chapter 1320](#)).

**turning radius** The radius that the front wheel of the design vehicle on the outside of the curve travels while making a turn (see [Chapter 1320](#)).

**turning roadway** A curve on an open highway, a ramp, or the connecting portion of the roadway between two intersecting legs of an intersection.

**two-way left-turn lane (TWLTL)** A lane, located between opposing lanes of traffic, to be used by vehicles making left turns from either direction, from or onto the roadway.

## U

**undivided multilane** A roadway with two or more through lanes in each direction on which left turns are not controlled.

**uniformity ratio** The ratio of the minimum average light level on the design area to the minimum light level of the same area (see [Chapter 1040](#)).

**urban area** An area designated by the Washington State Department of Transportation (WSDOT) in cooperation with the Transportation Improvement Board (TIB) and Regional Transportation Planning Organizations (RTPO), subject to the approval of the Federal Highway Administration (FHWA).

**urban design area** An area where urban design criteria are appropriate, that is defined by one or more of the following:

- An urban area.
- An area within the limits of an incorporated city or town.
- An area characterized by intensive use of the land for the location of structures, that receives urban services such as sewer, water, and other public utilities, as well as services normally associated with an incorporated city or town. This may include an urban growth area defined under the Growth Management Act (see [RCW 36.70A](#), Growth management – Planning by selected counties and cities), but outside the city limits.
- An area with not more than 25% undeveloped land.

**urban intersection** An intersection in an urban design area (see [Chapter 1140](#)).

**urbanized area** An urban area with a population of 50,000 or more.

**usable shoulder** The width of the shoulder that can be used by a vehicle for stopping.

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**V**

**Value Engineering (VE) Analysis** The systematic process of reviewing and assessing a project, during the planning and design phases, by a multidisciplinary team not directly involved in the planning and design phases of the project, that follows the VE Job Plan and is conducted to provide recommendations for:

- Providing the needed functions, considering community and environmental commitments, safely, reliably, efficiently, and at the lowest overall life cycle cost.
- Improving the value and quality of the project.
- Reducing the time to develop and deliver the project.

**Value Engineering Change Proposal (VECP)** A construction contract change proposal submitted by the construction contractor based on a VECP provision in the contract. The intent of these types of proposals is to (1) improve the project's performance, value, and/or quality, (2) lower construction costs, or (3) shorten the delivery time, while considering their impacts on the project's overall life-cycle cost and other applicable factors.

**Value Engineering (VE) Job Plan** A systematic and structured action plan (see [Chapter 310](#)) for conducting and documenting the results of the VE analysis. While each VE analysis shall address each phase in the VE Job Plan, the level of analysis conducted and effort expended for each phase should be scaled to meet the needs of each individual project. The VE Job Plan shall include and document the following seven phases:

1. Information Phase: Gather project information, including project commitments and constraints.
2. Function Analysis Phase: Analyze the project to understand the required functions.
3. Creative Phase: Generate ideas on ways to accomplish the required functions, which improve the project's performance, enhance its quality, and lower project costs.
4. Evaluation Phase: Evaluate and select feasible ideas for development.
5. Development Phase: Develop the selected alternatives into fully supported recommendations.
6. Presentation Phase: Present the VE recommendation to the project stakeholders.
7. Resolution Phase: Evaluate, resolve, document, and implement all approved recommendations.

Post-analysis Job Plan activities include the implementation and evaluation of the outcomes of the approved recommendations. These post-analysis phases are conducted in accordance with the policies stated below and as described in paragraph 4f of FHWA Order 1311.1A, FHWA Value Engineering Policy.

**veiling luminance** The stray light produced within the eye by light sources produces a veiling luminance that is superimposed on the retinal image of the objects being observed. This stray light alters the apparent brightness of an object within the visual field and the background against which it is viewed, thereby impairing the ability of the driver to perform visual tasks. Conceptually, veiling luminance is the light that travels directly from the luminaire to the observer's eye.

**viewpoint** A roadside stopping opportunity with a view of some point of interest or area scenery. This area is not typically separated from the traveled way by some form of highway buffer.

**violation rate** The total number of violators divided by the total number of vehicles on an HOV facility.

**Visitor Information Center (VIC)** A staffed or nonstaffed booth or separate building that displays and dispenses free tourist travel maps and brochures. These are typically located at border-entry SRAs to provide travel information to highway users as they enter the state.

## W

**warning beacon** A beacon that supplements a warning or regulatory sign or marking. The display is a flashing yellow indication. These beacons are not used with STOP, YIELD, or DO NOT ENTER signs or at intersections that control two or more lanes of travel. A warning identification beacon is energized only during those times when the warning or regulation is in effect.

**warrant** A minimum condition for which an action is authorized. Meeting a warrant does not attest to the existence of an unsafe or undesirable condition. Further justification is required.

**Washington State Pavement Management System (WSPMS)** A computer system that stores data about the pavement condition of all the highways in the state. Information available includes the latest field review and past contracts for every main line mile of state highway. Calculations are used to determine whether a given section of pavement is a past due, due, or future due preservation need.

**Washington Transportation Plan (WTP)** A WSDOT planning document developed in coordination with local governments, regional agencies, and private transportation providers. The WTP addresses the future of transportation facilities owned and operated by the state as well as those the state does not own but in which it has an interest. It identifies needed transportation investments, which are defined by service objectives and specific desired outcomes for each transportation mode.

**weaving section** A length of highway over which one-way traffic streams cross by merging and diverging maneuvers.

**weigh in motion (WIM)** A scale facility capable of weighing a vehicle without the vehicle stopping.

**wet film thickness** Thickness of a pavement marking at the time of application without glass beads.

**work zone** An area of a highway with construction, maintenance, or utility work activities. A work zone is identified by the placement of temporary traffic control devices that may include signs, channelizing devices, barriers, pavement markings, and/or work vehicles with warning lights. It extends from the first warning sign or high-intensity rotating, flashing, oscillating, or strobe lights on a vehicle to the END ROAD WORK sign or the last temporary traffic control device ([MUTCD](#)).

**work zone impact** Highway construction, maintenance, or utility work operations in the traveled way, adjacent to the traveled way, or within the highway's right of way that creates safety and mobility concerns for workers or the traveling public.

**work zone traffic control** The planning, design, and preparation of contract documents for the modification of traffic patterns due to work zone impacts.

**wye (Y) connection** An intersecting one-way roadway, intersecting at an angle less than 60°, in the general form of a "Y."

## Y

**yield-at-entry** The requirement that vehicles on all entry lanes yield to vehicles within the circulating roadway.

**yield point** The point at which entering traffic must yield to circulating traffic before entering the circulating roadway (see [Chapter 1320](#)).