Design Documentation: Design Analysis

Course Introduction

Assistant State Design Engineers
December 2021

Roger Millar, Secretary of Transportation

Amy Scarton, Deputy Secretary of Transportation

Safety Briefing

In Person

- Who is first aid trained?
- Who will call 911?
- Who will get the defibrillator?
- Who will call the safety officer?
- Address of this complex?

Teleworking

- Do you have trip hazards?
- How do you exit your workplace?
- Can 911 see your house address?
- Where can you go in an earthquake?
- Do your smoke detectors work?
- Do your CO2 detectors work?
- Do you have a first aid kit?

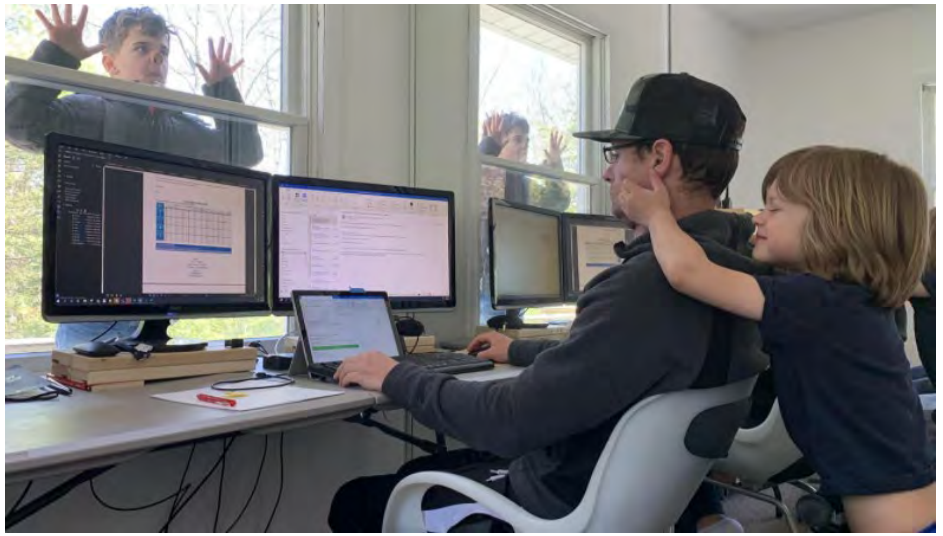
Logistics

Bathrooms

Breaks

Teleworking

Cell Phones



Introductions

- Region
- Years of Service

Participate

- Get OUT what you put IN
- Ask Questions

Attendee Background

- Mentimeter: Go to menti.com and type the code 1509 4630
- Mentimeter QR Code:

Course Outline

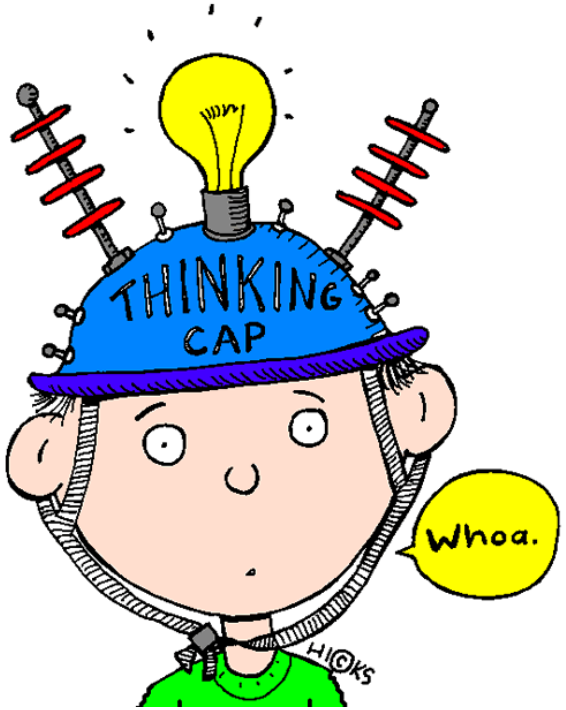
This training will cover:

- Introduction to a Design Analysis
- Design Analysis Template
- How to complete a Design Analysis
- Design Analysis Approval
- Design Analysis Filing

Class Goals and Objectives

After taking this course, you should understand:

- Why we write Design Analysis
- How to write a Design Analysis
- Design Analysis Approval
- Design Analysis Filing



You will also be provided with contact information and examples

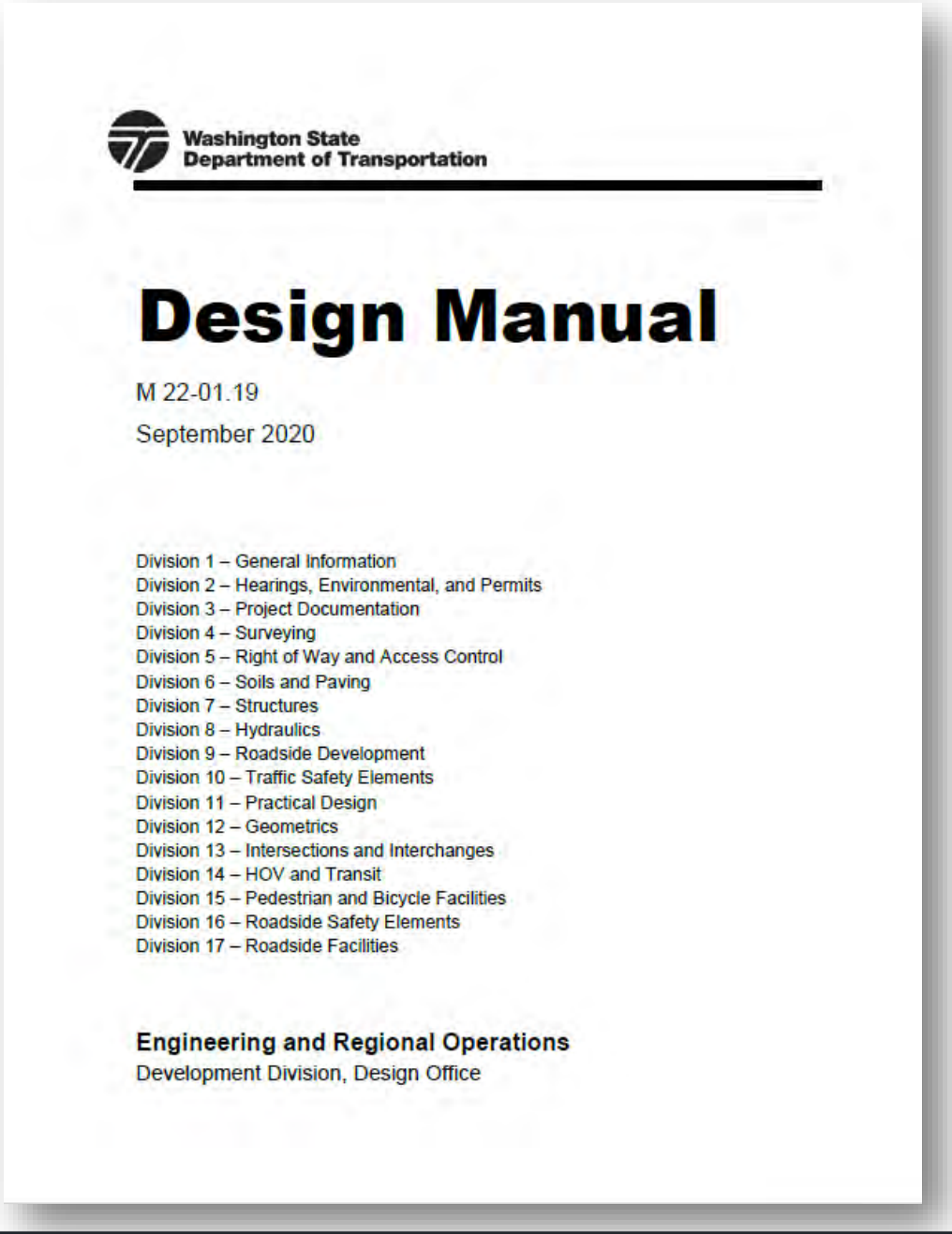
Design Analysis

Module 2

Introduction to Design Analyses

Design Manual

- Everything is from the Design Manual



Washington State
Department of Transportation

Design Manual

M 22-01.19

September 2020

Division 1 – General Information
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
Division 11 – Practical Design
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

What is a Design Analysis?

Design Manual 300.03(2)(a)

“A Design Analysis is a process and tool used to document important design decisions, summarizing information needed for an approving authority to understand and support the decision.”

Why do a Design Analysis?

- FHWA Stewardship and Oversight (S&O) Agreement
  - WSDOT must follow the S&O to receive federal funds
- Mitigate Liability Risk
  - Washington State is a Joint and Several Liability state
  - Washington State has no cap on the value of liability damages in a civil lawsuit
  - It is easier to defend a well documented decision than a good decision without documentation
- Demonstrate practical & logical decision making
  - It documents the RIGHT decision

Why do a Design Analysis?

- Standards may not be appropriate to all situations
  - Sometimes it is necessary to vary from a standard to do what works for your specific situation and your specific project
- Strictly following standards does not always equal good performance
- Others need to understand why you made your decision

Levels of Documentation

consider: To think carefully about, especially in order to make a decision. The decision to document a consideration is left to the discretion of the engineer.

Engineer of Record determines HOW or IF it is documented

document (verb): The act of including a short note to the DDP that explains a design decision.

Engineer of Record determines HOW it is documented

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.

A Design Decision is written. Use the Design Analysis Template.
Design Decisions follow the same process as a Design Analysis, but are only approved by the Engineer of Record.

Consider – Example

1310.02 Design Considerations

Consider all potential users of the facility in the design of an intersection. This involves addressing the needs of a diverse mix of user groups, including passenger cars, heavy vehicles of varying classifications, bicycles, and pedestrians. Often, meeting the needs of one user group results in a compromise in service to others. Intersection design balances these competing needs, resulting in appropriate levels of operation for all users.

In addition to reducing the number of conflicts, minimize the conflict area as much as possible while still providing for the design vehicle (see Chapter 1103). This is done to control the speed of turning vehicles and reduce the area of exposure for vehicles, bicycles, and pedestrians. For additional information on pedestrian needs, see Chapter 1510. For intersections with shared-use paths, see Chapter 1515. For bicycle considerations at intersections, see Chapter 1520.

Engineer of Record determines HOW or IF it is documented

Consider – Document

1310.03(2)(a)(4) Modifications to Left-Turn Designs

The left-turn lane designs discussed above and given in Exhibits 1310-10a through 10e may be modified when determined by design element dimensioning (see Chapter 1106.) 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.

Engineer of Record determines HOW it is documented

Consider – Justify

1040.07 Documentation

Justify and document any additional illumination in the Design Documentation Package (DDP).

The approval from maintenance to install median mounted luminaires can be an email or memo from the area maintenance superintendent and is kept in the design file.

Any areas in this section that says to “consider” a design element should have the logic of the consideration and decision documented in the design file for future reference.

Refer to Chapter 300 for design documentation requirements.

A Design Decision is written. Use the Design Analysis Template.

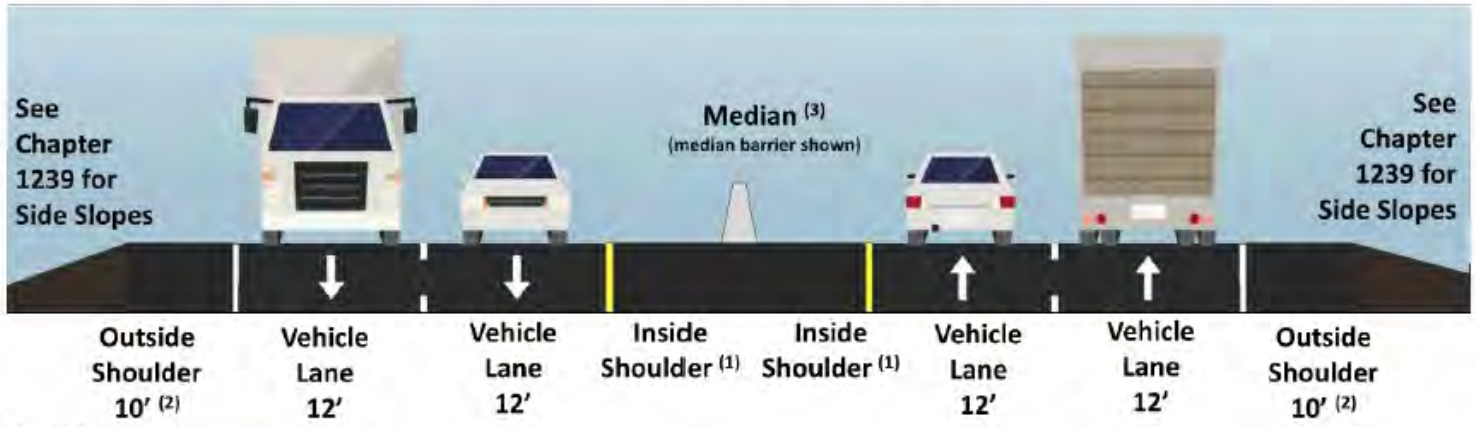
When do I need a Design Analysis?

- Required when specifically stated
- Required for design elements that do not meet a value or fall within a range of values

When do I need a Design Analysis?

Required when specifically stated:

Exhibit 1232-1 Geometric Cross Section - Interstate (4 lanes shown, can vary)



Notes:

See Chapter 1410 for HOV lane guidance.

Use of the shoulder on a freeway for transit only use or as an HOV lane requires a Design Analysis.

[1] 4 ft minimum on facilities up to 4 lanes, and 10 ft minimum on 6-lane facilities.
In mountainous terrain, inside shoulder may be reduced to 4 ft on facilities up to 6 lanes.

[2] In mountainous terrain, outside shoulders may be reduced to 8 ft on facilities up to 6 lanes.

[3] Overall median width and design will vary. See Chapter 1239 and 1610.

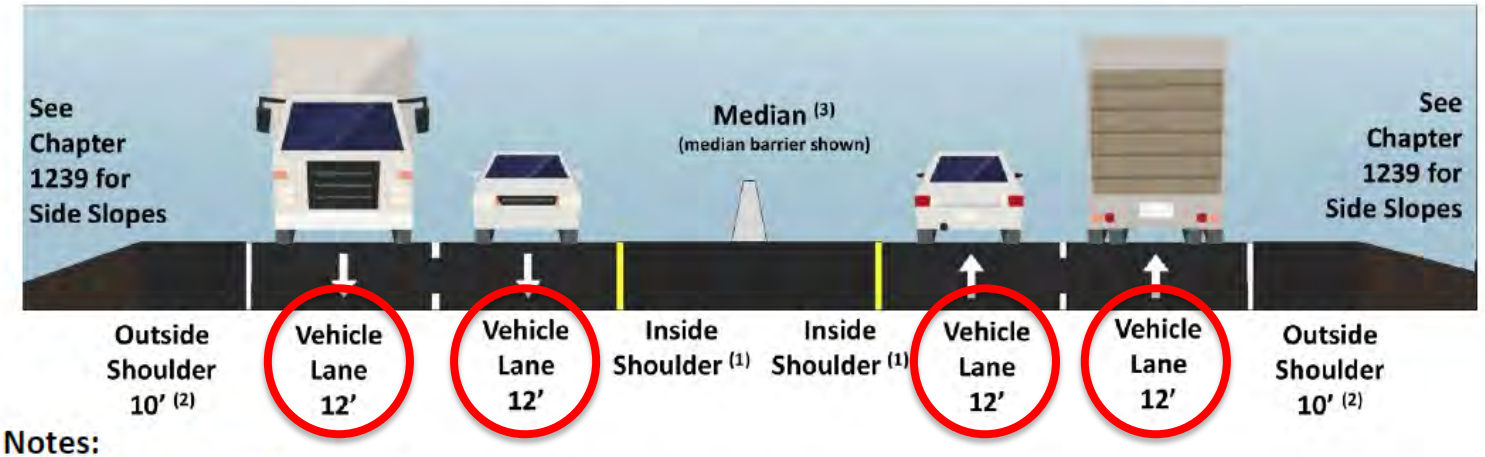
When do I need a Design Analysis?

Required when a chosen dimension does not meet the value or fall within the range of values

- Meet: Lane wide 12’ on Interstate

If a dimension is above specified range, a DA may not be warranted if said dimension is obligated by another DM chapter(s).

Exhibit 1232-1 Geometric Cross Section - Interstate (4 lanes shown, can vary)



Notes:

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[2] In mountainous terrain, outside shoulders may be reduced to 8 ft on facilities up to 6 lanes.

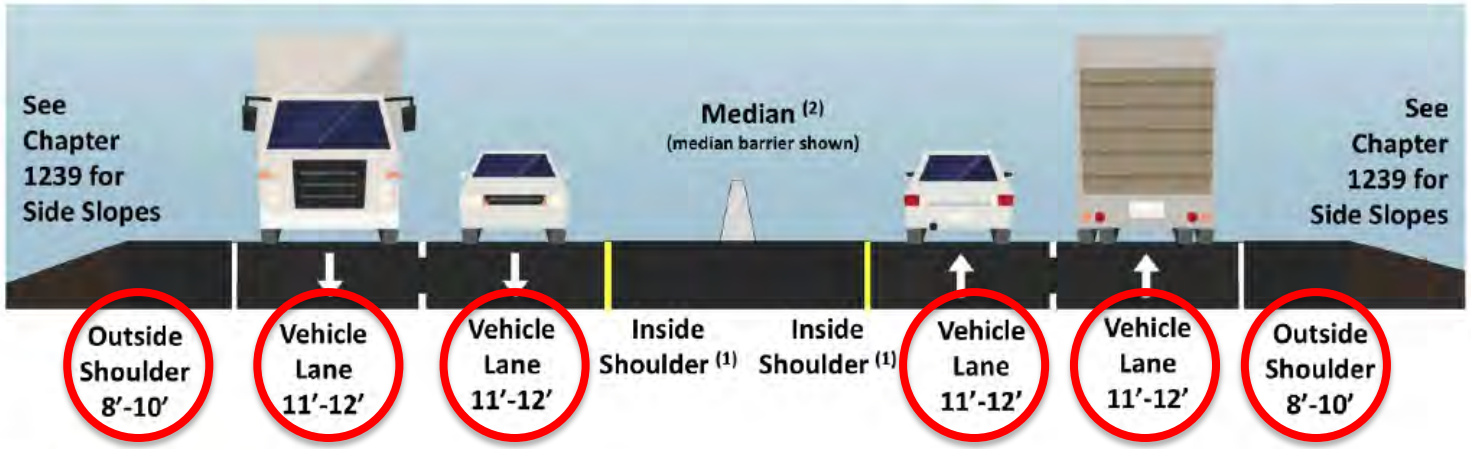
[3] Overall median width and design will vary. See Chapter 1239 and 1610.

When do I need a Design Analysis?

Required when a chosen dimension does not meet the value or fall within the range of values

- Range: 11-12’ lanes, 8-10’ shoulders

Exhibit 1232-2 Geometric Cross Section – Non-Interstate (4 lanes shown, can vary)



Notes:

See Chapter 1410 for HOV lane guidance.

Use of the shoulder on a freeway for transit only use or as an HOV lane requires a Design Analysis.

[1] 4 ft minimum on facilities up to 4 lanes, and 8 ft minimum on 6-lane facilities.
In mountainous terrain, inside shoulder may be reduced to 4 ft on facilities up to 6 lanes

[2] Overall median width and design will vary. See Chapter 1239 and 1610.

When do I need a Design Analysis?

- The direction may not use “hard” words like “require” or “shall” or “must”:
  - 1360.04(1)(a) Lane Balance and Entrances

    “At entrances, make the number of lanes beyond the merging of two traffic streams not less than the sum of all the lanes on the merging roadways less one (see Exhibit 1360-7a).”
  - 1610.03(5) Length of Need

    “Length of need refers to the total length of longitudinal barrier needed to shield a fixed feature.”

When do I need a Design Analysis?

- Sometimes the work “required” is associated with a process, not a roadway feature:
  - VE study *required* on projects over $25 Million
  - All projects are *required* to have a safety analysis for Design Approval
  - *Required* by law to perpetuate existing recorded monuments.
- Not following a “required” process must receive documented approval (e.g. email) from your Region Management and HQ, <u>but does not require a design analysis</u>

When do I need a Design Analysis?

- Sometime the constraint is found in the Exhibits

1515.02(2)(a) Shared-Use Path Widths

"Shared-use path shoulders are typically unpaved and 2 feet wide on either side. Exhibits 1515-3 through 1515-5 provide additional information and cross-sectional elements."

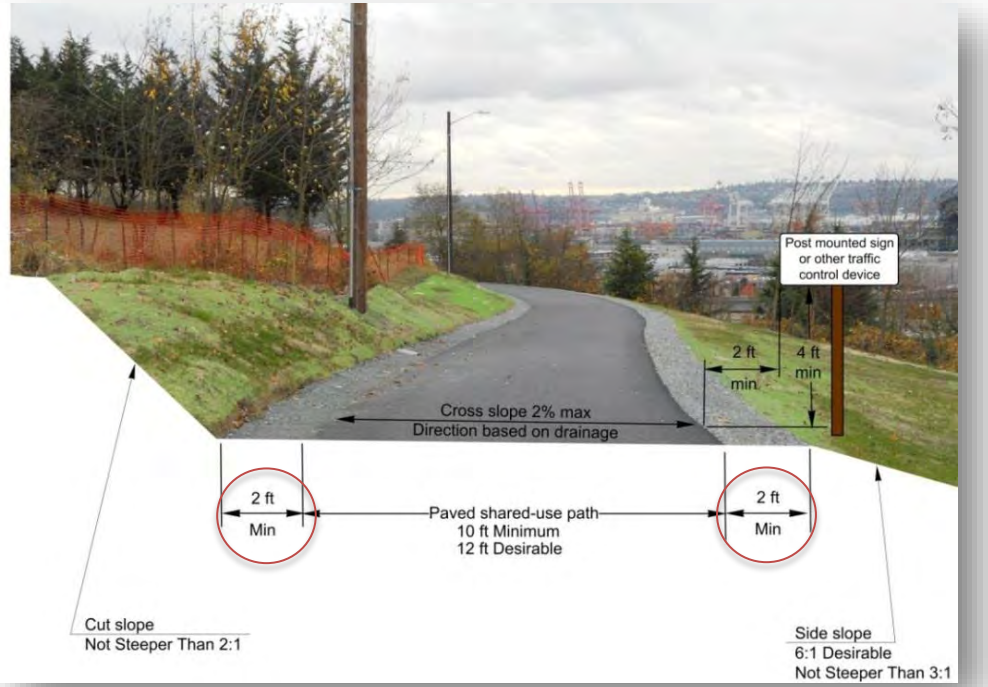


Exhibit 1515-3

CLASS EXERCISE – Is this a Design Analysis?

For the following elements, determine if you must write a Design Analysis.

Element	DM Reference	DM Guidance	AASHTO Guidance	Proposed	Design Analysis?
Distance from Ramp to Cross Street	Exhibit 530-1a	300’ min	N/A	200’	
Transportation Management Plan	1010.02	TMP required	N/A	No TMP	
Freeway Merge Lighting	Exhibit 1040-1b	200’ min	N/A	140’	
Low Speed Highway Lane Width	Exhibit 1231-5	10’-12’	11’-12’	10’	
High Speed Highway Outside Shoulder Width	Exhibit 1239-1	4’-10’	4’-10’	14’	

Design Analysis Approval

DM Exhibit 300-2
Approval Authorities

Project Type	Basis of Design (BOD) Approval	Design Analysis Approval [1]	Design Approval and Project Development Approval

- Approvals levels vary based on Project Type, Highway Classification, Local Jurisdiction, or the specific roadway element. Considerations include:
  - Project of Division Interest (PoDI)
  - Interstate

  FHWA / HQ Design
  - National Highway System (NHS)
  - Non-NHS: Improvement (I1, I2, I3, I4, etc.)

  HQ Design
  - Non-NHS: Preservation (P1, P2, P3, etc.)

  Region
  - Local Jurisdiction

  HQ Local Programs

FHWA Approval – Project of Divisional Interest (PoDI)

- **When do we have PoDIs?**
  - A PoDI Stewardship & Oversight Agreement is applied to projects that have an **elevated risk**, contain elements of higher risk, or present a **meaningful opportunity for FHWA involvement** to enhance meeting program or project objectives.
- **What does a PoDI do?**
  - It is an agreement of “FHWA Retained Approval or Action” for “Identified Risk Elements”
- **What does this mean to a Design Analysis**?
  - PoDI may grant FHWA additional DA approval authority.

FHWA Approval - Interstate

- All ***Interstate*** projects impacting ***mainline and ramps***
- Only design elements associated with the **10 Controlling Criteria**:

1. Design Speed
2. Lane Width
3. Shoulder Width
4. Horizontal Curve Radius
5. Superelevation Radius
6. Stopping Sight Distance*
7. Maximum Grade
8. Cross Slope
9. Vertical Clearance
10. Design Loading Structural Capacity

* Horizontal and vertical alignments except for sag vertical curves

- Approved by the FHWA Area Engineer
- Must also be approved by HQ Design - ASDE

FHWA Approval - NEPA

Instigates NEPA even though there is no FHWA Signature

A Design Analysis may instigate NEPA:

Route Type	Speed Limit	10 Controlling Criteria	Approval	NEPA
Interstate	All	Yes	FHWA	Yes
		No	WSDOT	No
NHS	≥ 50	Yes	WSDOT	Yes
		No	WSDOT	No
	<50	[1]	WSDOT	Yes
		No	WSDOT	No
non-NHS	All	N/A	WSDOT	No

[1] Only for two of the controlling criteria: Design Load Structural Capacity or Design Speed.

Region Approved

- Design Analysis on **non-NHS preservation projects** are only approved by the Region or HQ Local Programs
- Design Analysis for **design elements** that cannot meet Design Manual criteria, but can meet current AASHTO guidance adopted by FHWA … are only approved by the Region
  - AASHTO guidance adopted by FHWA is online
- **Send a PDF of Region Design Analysis to your ASDE**
  - *We are required to report to FHWA on a yearly basis*

CLASS EXERCISE – Is this a Design Analysis?

For the following elements, determine if you must write a Design Analysis.

Element	DM Reference	DM Guidance	AASHTO Guidance	Proposed	Design Analysis?
Distance from Ramp to Cross Street	Exhibit 530-1a	300’	N/A	200’	Yes
Transportation Management Plan	1010.02	TMP required	N/A	No TMP	No
Freeway Merge Lighting	Exhibit 1040-1b	200’	N/A	140’	Yes
Low Speed Highway Lane Width	Exhibit 1231-5	10’-12’	11’-12’	10’	No
High Speed Highway Outside Shoulder Width	Exhibit 1239-1	4’-10’	4’-10’	14’	Yes
Semi-Rigid Barrier Flare Rate (40 mph)	Exhibit 1610-4	9:1	8:1	8:1	Yes, Region Approved

City Streets as State Highways

RCW 47.24

Managed Access Control

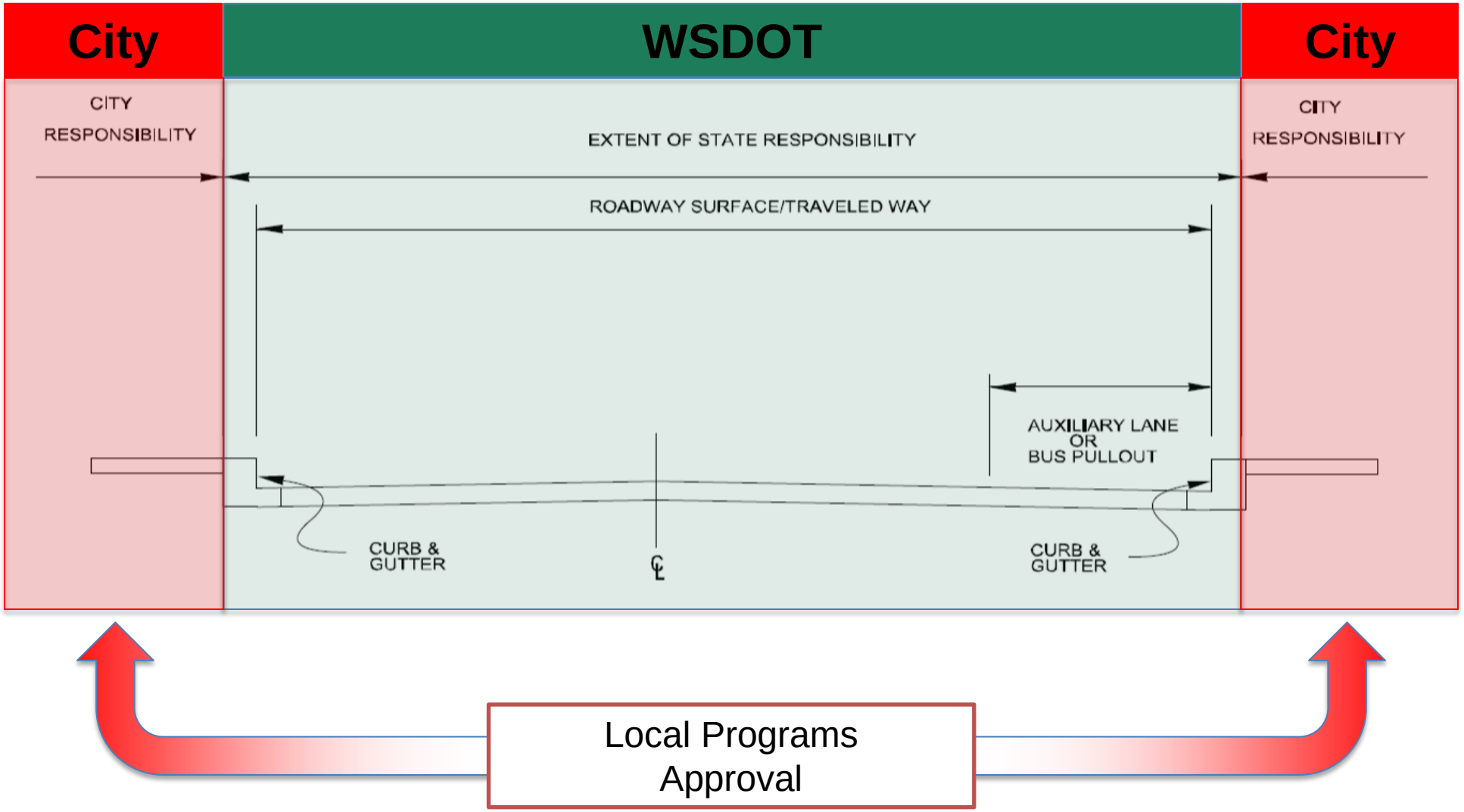
Cities shall exercise full responsibility for and control over any such street beyond the curbs

Limited Access Control

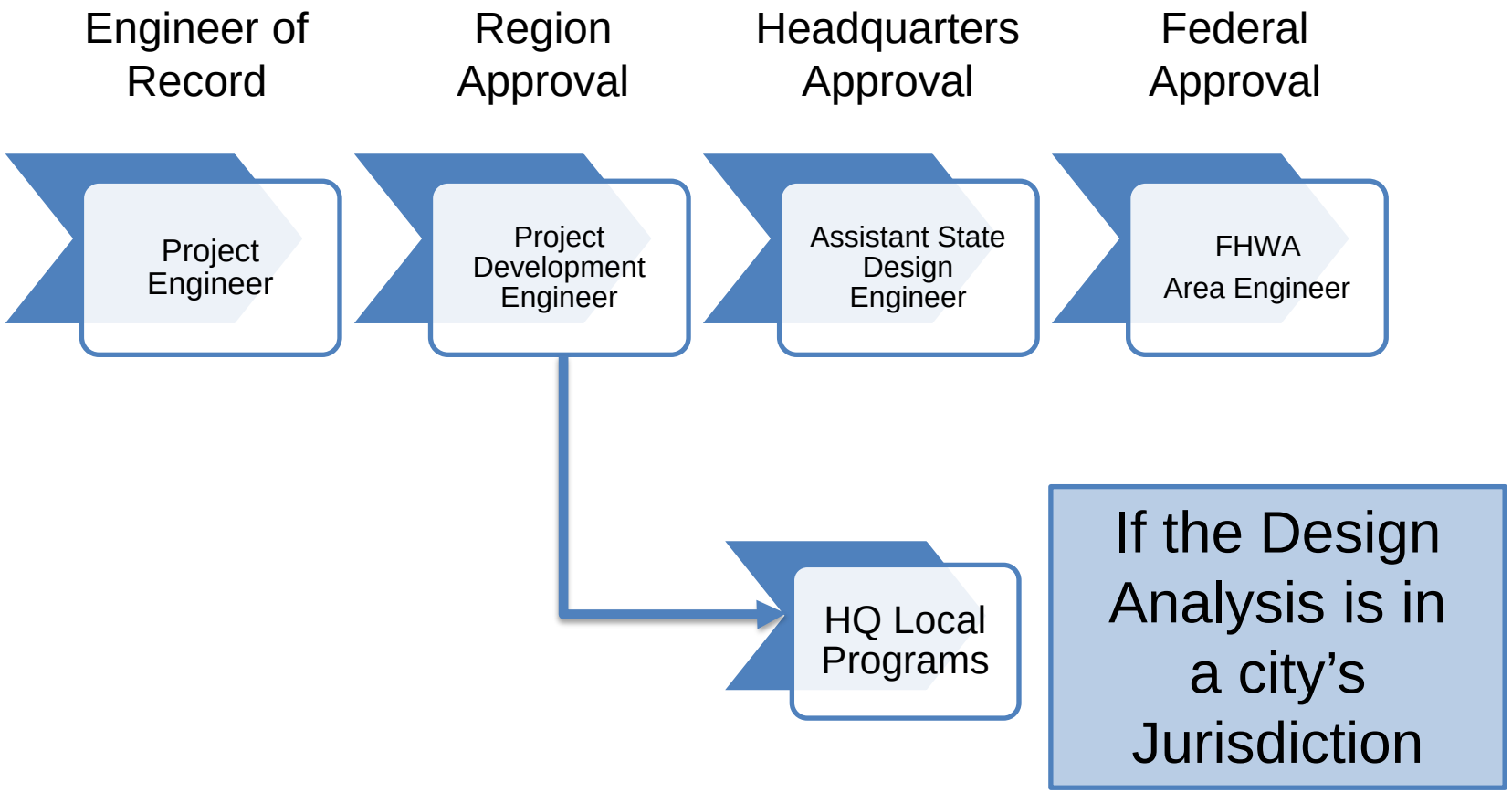
WSDOT has full jurisdiction, responsibility, and control

See City Streets as Part of State Highways agreement

Local Programs Approval



Approval Process



Design Analysis Approvers

WSDOT Projects

Classification	Project Type	Approver
Interstate & Projects of Division Interest	All	FHWA Area Engineer* & ASDE
National Highway System (NHS)	All	ASDE**
Non-NHS	Improvement	ASDE**
Non-NHS	Preservation	Region Project Development Engineer**

*FHWA approval is **only** required for elements related to controlling criteria (possible exception PoDI).
**Design Analysis for elements that are City responsibility must be approved by HQ Local Programs

Design Analysis Approvers

Local Agency & Developer Projects

Classification	Project Type	Approver
Interstate	All	FHWA Area Engineer* & ASDE
Limited Access NHS & non-NHS	All	ASDE
Managed Access NHS & non-NHS	All	ASDE**

*FHWA approval is **only** required for elements related to controlling criteria.

**Design Analysis for elements that are City responsibility must be approved by HQ Local Programs

CLASS EXERCISE – Approval

* I= Improvement, P = Preservation

For the following projects, determine the approver. Assume a WSDOT Project.

SR	Speed Limit	NHS	Access Type	Design Analysis	Project Type*	Approval
532	55	No	Managed	Shoulder Width	I	
167	55	No	Managed	Lane Width	P	
I-82	60	Yes	Limited	Guardrail Taper	P	
I-5	60	Yes	Limited	Shoulder Width	I	
12	35	Yes	Managed in City	S		
395	70	Yes	Limited	Design Speed	I	

Instigates NEPA

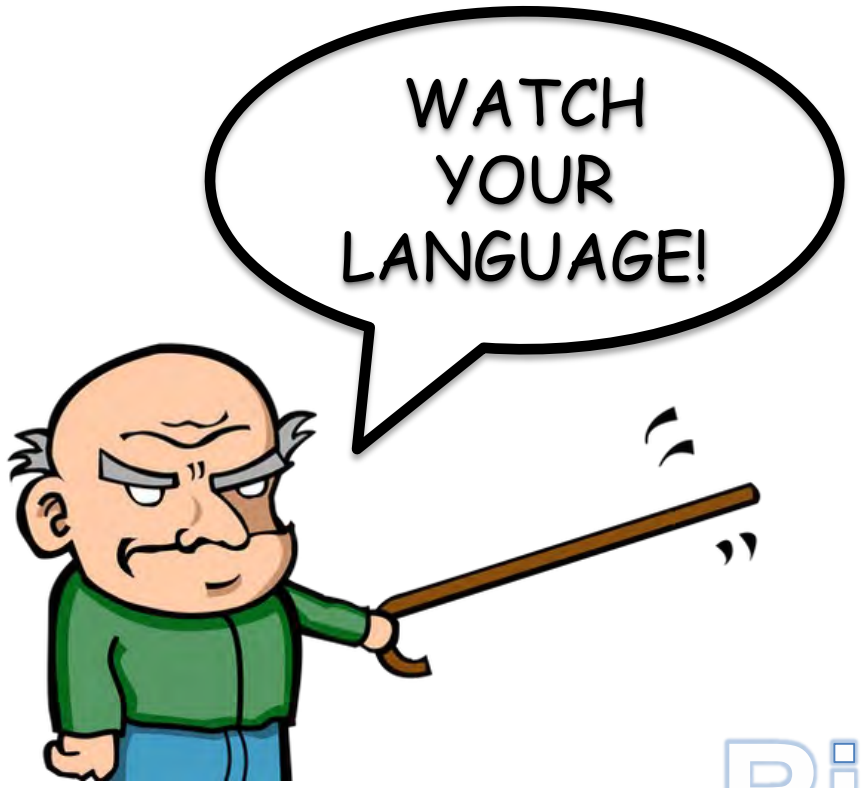
Design Analysis Tips

- Just the Facts: Consider it a court document
- The earlier they are found inside the design process the better
- Engage your ASDE early
- Use your ASDE as a sounding board
- Read your Design Manual
- Do not begin with a preferred alternative
- Find the RIGHT answer rather than meet the design criteria
- Be quantitative when possible
- Good data makes the process quicker

EXAMPLES

Design analyses examples can be found in ProjectWise.
Contact your ASDE for access.

Design Analysis Tips



Inadequate

Problem

Always

Required

Hazard

Assume

Deadly

Safe

Unsafe

Substandard

Risk

Must

Dangerous

Ensure

Death Trap

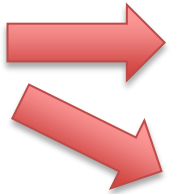
Guarantee

Design Analysis Template

Module 3

Template

YOU ARE HERE



Cover Sheet

Signatures and Metadata

1 - Background

2 – Decision Description

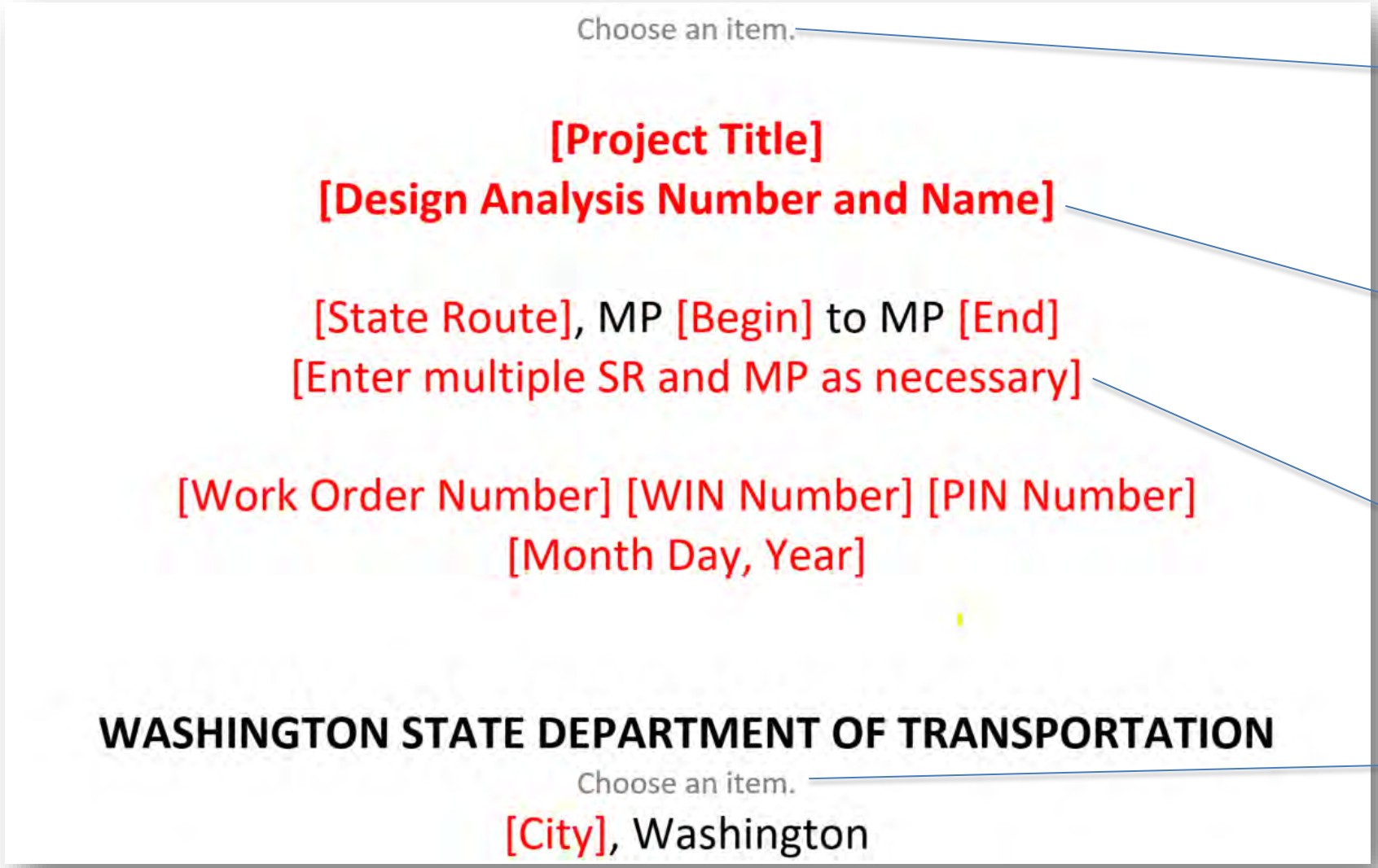
3 – Options Evaluation and Decision

4 – Attachments

Template available on the ASDE Website

DELETE RED TEXT AFTER USE.

Cover Sheet



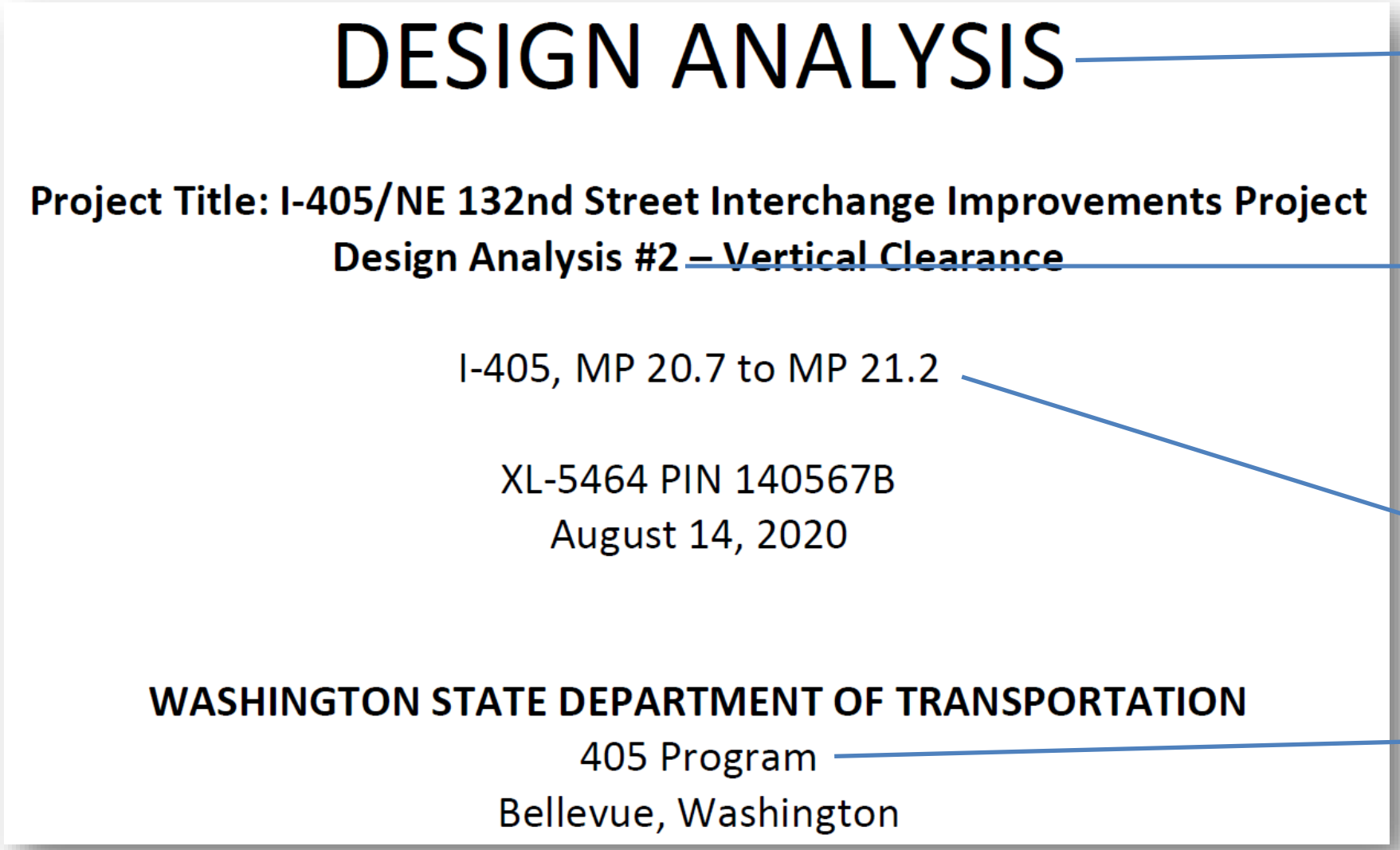
Choose Document Type:
- Design Analysis, or
- Design Decision

Design Analysis # is sequential for the project.

Begin and End MP of the actual Design Analysis location, **not** Project MP.

Choose your Region/Program

Cover Sheet - Example



Choose Document Type: Design Analysis

Design Analysis #2: Second Design Analysis for the project

Begin and End MP of the actual Design Analysis location, not Project MP

Selected their Program

Section 409

Include the Section 409 text at the bottom of the Cover Sheet

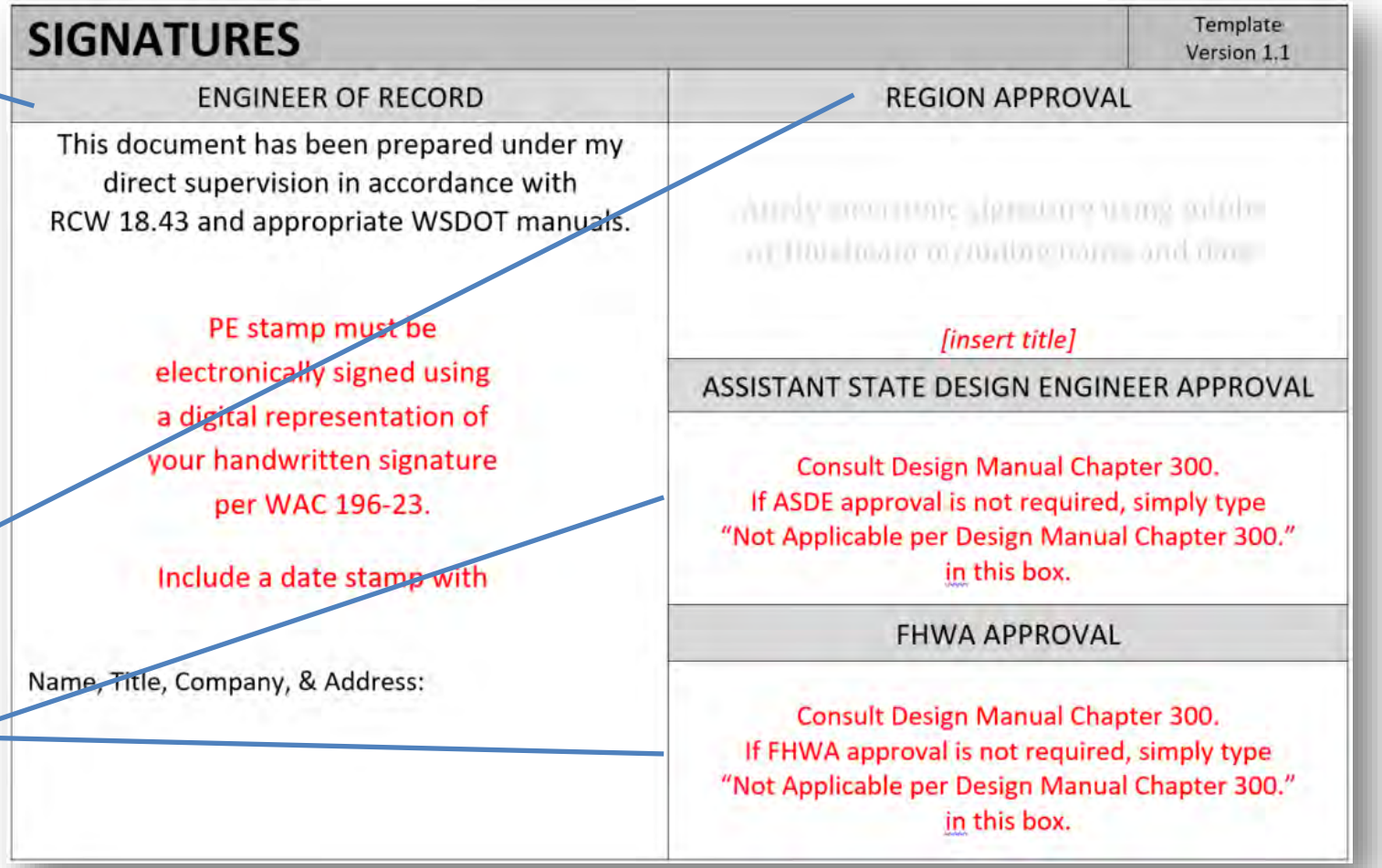
Under 23 U.S. Code § 409 and 23 U.S. Code § 148, safety data, reports, surveys, schedules, lists compiled or collected for the purpose of identifying, evaluating, or planning the safety enhancement of potential crash sites, hazardous roadway conditions, or railway-highway crossings are not subject to discovery or admitted into evidence in a Federal or State court proceeding or considered for other purposes in any action for damages arising from any occurrence at a location mentioned or addressed in such reports, surveys, schedules, lists, or data.

Signatures

Engineer of Record
- Professional Engineer stamping the document
- Who directed the development
- Often the WSDOT Project Engineer
- Consultants may call these Project Managers

Region Approval
- Project Development Engineer

ASDE and FHWA Approval
- As required
- See Exhibit 300-2



SIGNATURES	Template Version 1.1
ENGINEER OF RECORD	REGION APPROVAL
This document has been prepared under my direct supervision in accordance with RCW 18.43 and appropriate WSDOT manuals. PE stamp must be electronically signed using a digital representation of your handwritten signature per WAC 196-23. Include a date stamp with Name, Title, Company, & Address:	*[insert title]* ASSISTANT STATE DESIGN ENGINEER APPROVAL Consult Design Manual Chapter 300. If ASDE approval is not required, simply type "Not Applicable per Design Manual Chapter 300." in this box. FHWA APPROVAL Consult Design Manual Chapter 300. If FHWA approval is not required, simply type "Not Applicable per Design Manual Chapter 300." in this box.

Signatures - Example

Engineer of Record
- Professional Engineering Stamp
- Signed Digitally

Region Approval
- Engineering Manager
- Signed Digitally

ASDE and FHWA Approval
- See Exhibit 300-2
- Signed Digitally

SIGNATURES | Template Version 1.0

ENGINEER OF RECORD

This document has been prepared under my direct supervision in accordance with RCW 18.43 and appropriate WSDOT manuals.

CELSO G HERMOGENES STATE OF WASHINGTON 40051 REGISTERED PROFESSIONAL ENGINEER

Digitally signed by Celso Hermogenes
Date: 2020.08.14 12:12:01 -07'00'

Name, Title, Company, & Address:
Celso G. Hermogenes
Sr. Transportation Engineer
I-405/SR 167 MegaProgram
Bellevue, WA

REGION APPROVAL

Digitally signed by Chun-Ho Chen
Date: 2020.08.17 11:17:36 -07'00'

ASSISTANT STATE DESIGN ENGINEER APPROVAL

Digitally signed by James I. Mahugh
Date: 2020.08.26 14:32:13 -07'00'

FHWA APPROVAL

LINDSEY L HANDEL

Digitally signed by LINDSEY L HANDEL
Date: 2020.09.01 12:39:57 -07'00'

Metadata

Used when filing the Design Analysis

Add rows for SR and MP as necessary

Check all boxes necessary

If none apply, add yours at the bottom

DESIGN ANALYSIS (DA) METADATA							
PROJECT TITLE							
DA NAME						DA #	
REPORT TYPE	Choose an item.		REGION	Choose an item.		Report Date	5/5/2020
Work Order #		PIN #			WIN #		
SR		Begin MP		End MP			
SR		Begin MP		End MP			
SR		Begin MP		End MP			
Elements Considered in the Design Analysis (Check all that apply)							
☐	Acceleration Length	☐	Horizontal Sight Distance	☐	Reserve Area Width		
☐	Access	☐	HOV Elements	☐	Shoulder Width - Inside		
☐	BAT Lane Element	☐	Intersection Sight Distance	☐	Shoulder Width – Outside		
☐	Bridge Rail	☐	Lane Transition Rate	☐	Stopping Sight Distance		
☐	Buffer Width	☐	Lane Width	☐	Superelevation		
☐	Clear Zone	☐	Maximum Grade	☐	Superelevation Runoff		
☐	Design Speed	☐	Ramp Spacing	☐	Turning Roadway Width		
☐	Fill/Ditch Slope	☐	Ramp Width	☐	U-Turn Width		
☐	Gore Slope	☐	Ramp Width Shoulder	☐	Vertical Alignment		
☐	Horizontal Alignment	☐	Reserve Area Taper	☐	Vertical Sight Distance		
☐	[Insert Other Element]	☐	[Insert Other Element]	☐	[Insert Other Element]		

Metadata - Example

SR and MP of Design Analysis location

None of the above applied so “Vertical Clearance” was added

DESIGN ANALYSIS (DA) METADATA							
PROJECT TITLE	I-405/NE 132nd Street Interchange Improvements Project						
DA NAME	Limited Access					DA #	03
REPORT TYPE	Design Analysis	REGION	405 Program		Report Date	7/10/2020	
Work Order #	XL-5464	PIN #		WIN #			
SR	I-405	Begin MP	20.7	End MP	21.2		
SR		Begin MP		End MP			
SR		Begin MP		End MP			

Elements Considered in the Design Analysis (Check all that apply)					
☐	Acceleration Length	☐	Horizontal Sight Distance	☐	Reserve Area Width
☐	Access	☐	HOV Elements	☐	Shoulder Width - Inside
☐	BAT Lane Element	☐	Intersection Sight Distance	☐	Shoulder Width – Outside
☐	Bridge Rail	☐	Lane Transition Rate	☐	Stopping Sight Distance
☐	Buffer Width	☐	Lane Width	☐	Superelevation
☐	Clear Zone	☐	Maximum Grade	☐	Superelevation Runoff
☐	Design Speed	☐	Ramp Spacing	☐	Turning Roadway Width
☐	Fill/Ditch Slope	☐	Ramp Width	☐	U-Turn Width
☐	Gore Slope	☐	Ramp Width Shoulder	☐	Vertical Alignment
☐	Horizontal Alignment	☐	Reserve Area Taper	☐	Vertical Sight Distance
☐		☐		☒	Vertical Clearance

Metadata – Ramp Example

SR and Ramp Identifier

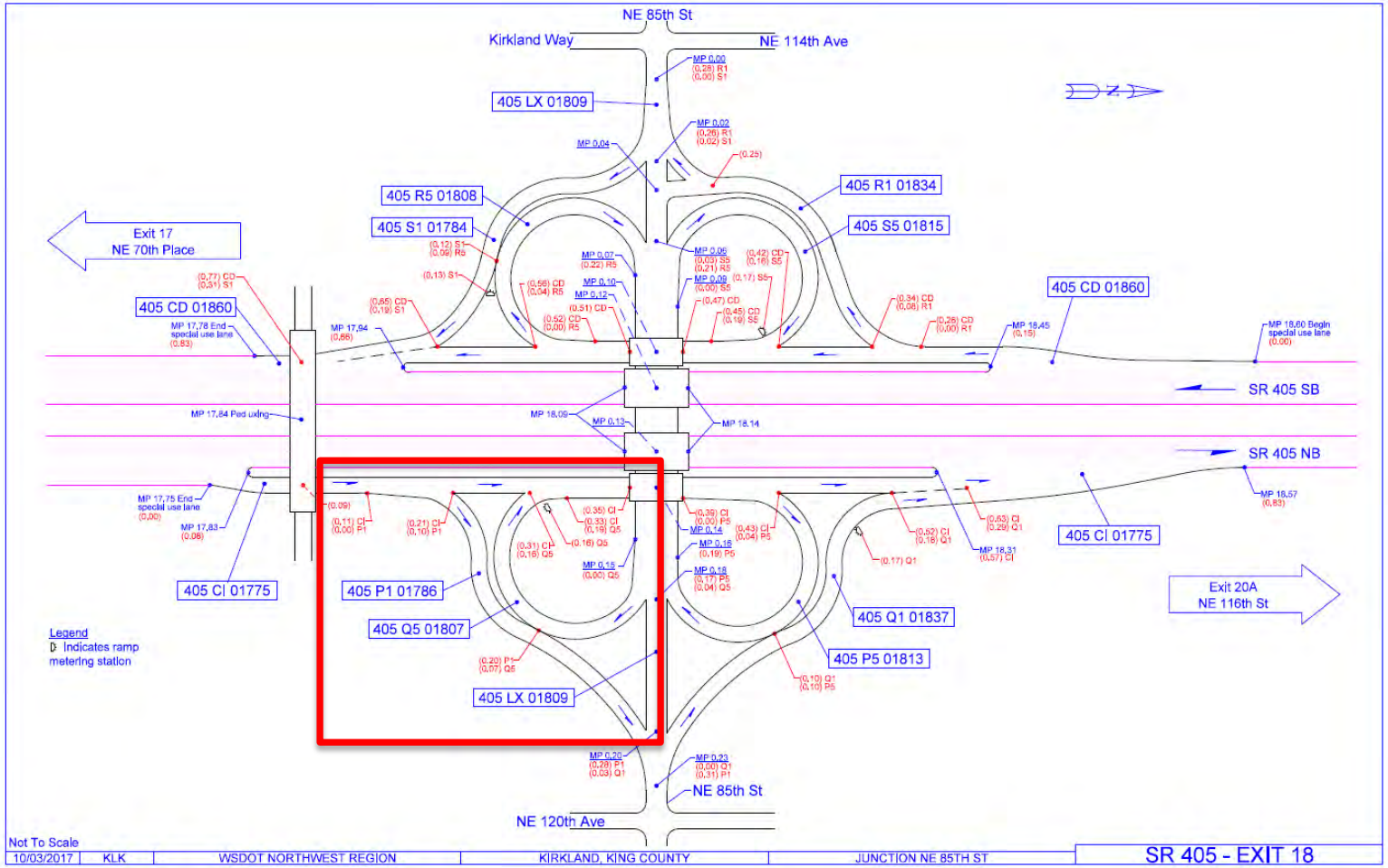
Ramp MP

Get Ramp Identifier and MP From Interchange Web Viewer

DESIGN ANALYSIS (DA) METADATA							
PROJECT TITLE	I-405/NE 85th Street Interchange Improvements Project						
DA NAME	Ramp Lane Width					DA #	99
REPORT TYPE	Design Analysis		REGION	405 Program		Report Date	5/5/2020
Work Order #	XL-1234		PIN #			WIN #	
SR	405, P101786		Begin MP	0.10		End MP	0.20
SR			Begin MP			End MP	
SR			Begin MP			End MP	

Elements Considered in the Design Analysis (Check all that apply)					
☐	Acceleration Length	☐	Horizontal Sight Distance	☐	Reserve Area Width
☐	Access	☐	HOV Elements	☐	Shoulder Width - Inside
☐	BAT Lane Element	☐	Intersection Sight Distance	☐	Shoulder Width – Outside
☐	Bridge Rail	☐	Lane Transition Rate	☐	Stopping Sight Distance
☐	Buffer Width	☐	Lane Width	☐	Superelevation
☐	Clear Zone	☐	Maximum Grade	☐	Superelevation Runoff
☐	Design Speed	☐	Ramp Spacing	☐	Turning Roadway Width
☐	Fill/Ditch Slope	☒	Ramp Width	☐	U-Turn Width
☐	Gore Slope	☐	Ramp Width Shoulder	☐	Vertical Alignment
☐	Horizontal Alignment	☐	Reserve Area Taper	☐	Vertical Sight Distance
☐		☐		☐	

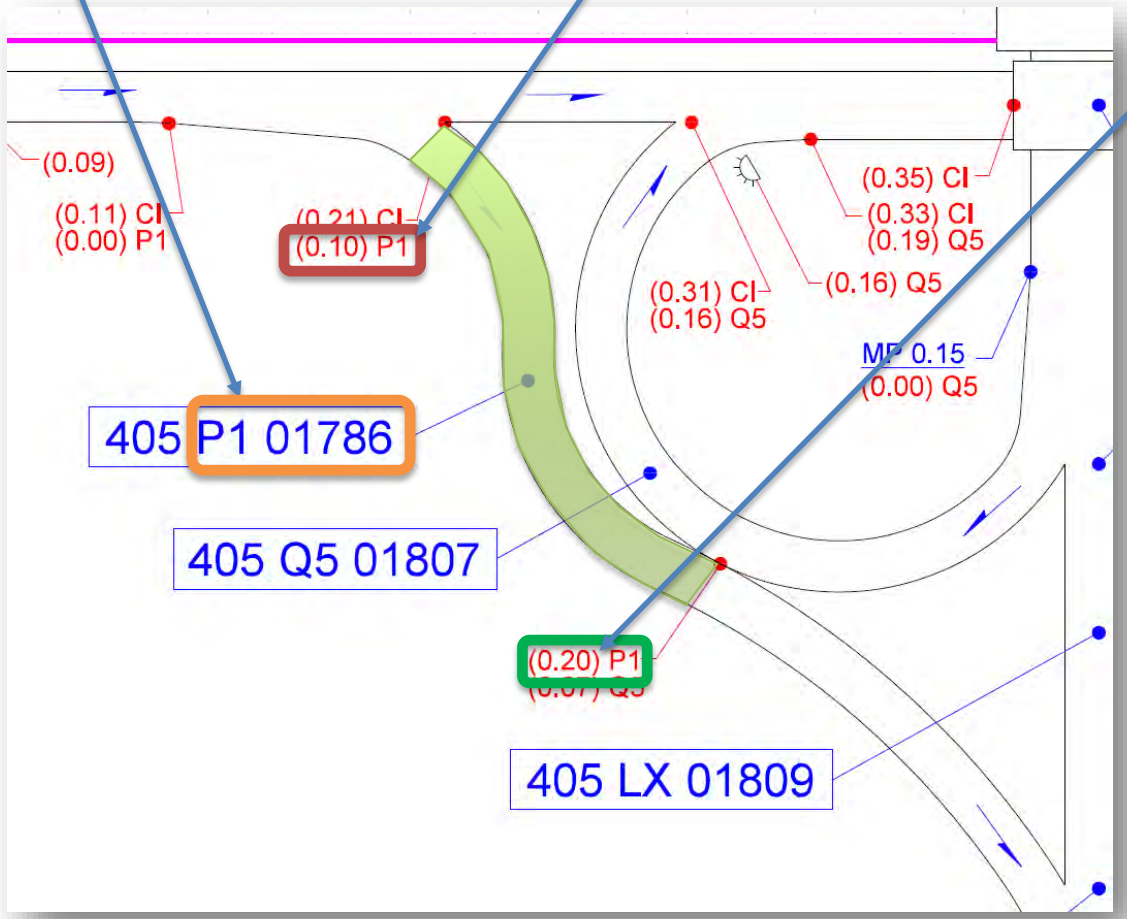
Metadata – Interchange Viewer



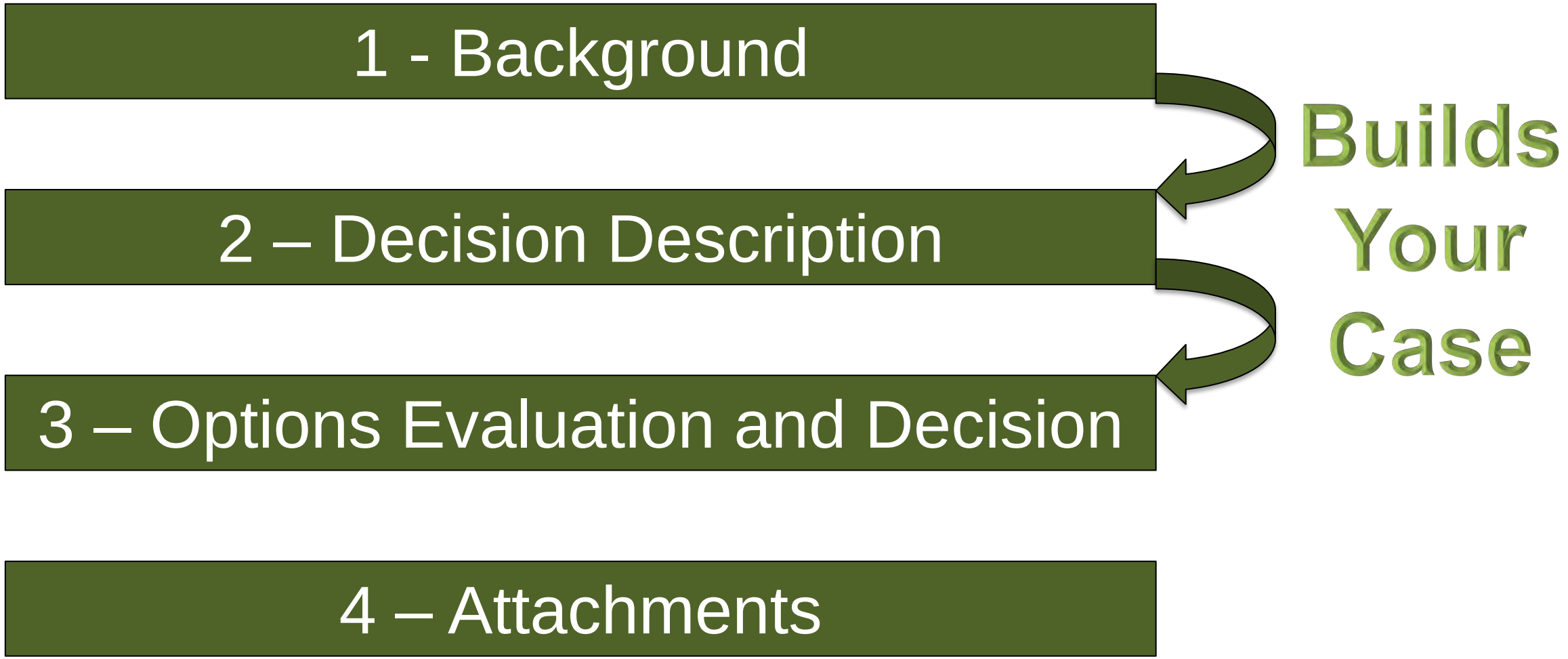
[WSDOT Interchange Web Viewer]

Metadata – Interchange Viewer

SR	405, P101786	Begin MP	0.10	End MP	0.20



Template Sections



Template Sections

1 - Background → Module 4

2 – Decision Description → Module 5

3 – Options Evaluation and Decision → Module 6

4 – Attachments → Module 7

Background

Module 4

Template

YOU ARE HERE 

Cover Sheet
Signatures and Metadata
1 - Background
2 – Decision Description
3 – Options Evaluation and Decision
4 – Attachments

Template available on the [ASDE Website]

DELETE RED TEXT AFTER USE.

Background Subsections

Project Description

Background Information

Related Documents

Project Description

Keep it Short and Concise

- Large projects a paragraph or two
- Small projects a sentence or two

Reference documents if necessary, but provide a summary

Project Description - Example

Good and concise … explains a nearly multi-million dollar project

The I-405, SR522 Vicinity to SR527 Express Toll Lanes Improvement Project includes I-405 improvements from just south of SR 522 to north of SR 527, a 5-mile length. This project will add an express toll lane (ETL) in each direction, extending the existing dual lane system to just north of SR 527. The resulting corridor will have two ETL lanes and two general purpose (GP) lanes in each direction plus auxiliary lanes in select locations. Interchange improvements at SR 522 and SR 527 will add Direct Access Ramps, connecting the ETL lanes to their respective state routes and adjacent transit facilities. This is an improvement and mobility project that supports the implementation of a Bus Rapid Transit (BRT) system along I-405. The project is funded and will be delivered as a Design Build Contract. Construction is anticipated to start in 2021. See Attachment A for Project Vicinity Map.

Project Description - Example

Good and concise … references the BOD for details

The "SR 167 / SR 410 to SR 18 - Congestion Management" project will add an HOV lane from MP 6.89 (Pierce Co.) and match into the existing HOV lane in the vicinity of MP 13.76 (King Co.) along with other associated major work. See Basis of Design for details.

WSDOT was awarded a Puget Sound Regional Council (PSRC) Grant with the intent to increase capacity on northbound SR 167 by rechannelizing the existing roadway. During the grant application process, it was determined an additional HOT/HOV lane would be added without major roadway widening, the PSRC grant was awarded

based on this design.

Project Description - Example

Good and concise … small project, small description

The project will widen the outside shoulder of the S 200th St on-ramp to SB I-5 and modify channelization on the ramp to provide one metered lane and one peak hour metered shoulder.

Background Information

Provide history necessary to understand the decision

- Make the history relevant

Describe the relevant context

- What is the area like?
- Set the stage
- What context is going to shape your decision

Do not get into the decisions

Background Information - Example

Provide any background information important to understanding the decision(s):

On April 2, 2018 WSDOT and the City of SeaTac met to discuss the current ramp meter operation and investigate a solution, agreeing to a metered shoulder.

Current Ramp Meter Operation: The Traffic Analysis Report (NWR Traffic, November 2018) indicates that the 2013 installation of the ramp meter (see below*) only provides 550 feet of lane storage versus the 900 feet recommended for peak hour volume of 720 vehicles (NWR ITS Design Guide, Exhibit 4.3.3.3, 601-900 vehicles). Queues in excess of 550 feet would block the signalized intersection of S 200th Street and Military Road S if the signal were not automatically giving a red signal to eastbound S 200th Street when an excessive queue is present. When the metering queues approach 550 feet, the signal cannot provide enough green time to eastbound S 200th Street to prevent its own lengthy queues, some occasionally reaching 26th Avenue S (1/2 mile).

In 2013 the WSDOT NWR Traffic Office installed ramp meters as an interim, best-fit, operational improvement on eight existing ramps, including five from a 2007 preliminary design (see below), largely without the associated widenings. The 2013 installation on the S 200th Street On-Ramp did not alter the existing ramp. It did not provide the metered shoulder, resulting in approximately half (550') of the 1000' of ramp metering storage explored in the 2007 preliminary design.*

***In July 2007 the SR 509 design office started a preliminary design for ramp meters and their necessary widenings on five existing ramps, including a metered shoulder on the Angle Lake (Military Road S) interchange southbound on-connection (aka "S 200th Street On-Ramp") with 1000' of storage (500' lane and 500' shoulder). The anticipated 2010 construction of these improvements did not occur.*

How a planned improvement at this location did not get built.

Background Information - Example

Provide any background information important to understanding the decision(s):

The subject "SR 520, I-5 Interchange – Improvements" project is one of several phases of the larger "SR 520, I-5 to Medina Bridge Replacement and HOV" mobility improvement project. See Basis of Design for corridor projects that have been completed or are under construction.

The subject project is one of two remaining projects that will complete the westerly portion of the SR 520 corridor rebuild (commonly referred to as "Rest of the West"). The latter of these two projects will include the "SR 520, Portage Bay Bridge Replacement" (PBB) project. The subject project and the PBB project include a significant amount of overlap such that many roadway elements of the subject project will be built in interim configurations to be forward compatible with the future PBB project while maintaining a connection to the existing Portage Bay Bridge (Br 520/3).

With regards to this Design Analysis, the EB SR 520 lanes and shoulders will be shifted to accommodate a new reversible HOV direct access ramp connection from the I-5 express lanes, including a new interim left-side HOV direct access ramp merge to EB SR 520. For documentation purposes, the portion of EB SR 520 between MP 0.00 to MP 0.24 is considered and documented as a "freeway to freeway" connector ramp as part of the NB I-5 to EB 520 and SB I-5 to EB SR 520 ramps. The portion of EB SR 520 located from MP 0.24 to MP 0.37 is addressed as part of this Design Analysis. MP 0.37 is where EB SR 520 proposed channelization modifications for the subject project will match existing channelization on the existing Portage Bay Bridge.

Construction of the subject project is planned to be completed by late 2022 to early 2023. The construction of PBB replacement is scheduled to begin between late 2022 and early 2023, resulting in sequential construction without significant gap between the two projects. The Portage Bay Bridge replacement project is fully funded.

Indicates construction phasing.

Background Information Example

Reflected how they measured clear zone and the posted speed

Provide any background information important to understanding the decision(s):

This Design Analysis considers how to apply clear zone guidance found in Design Manual Chapter 1600 in this project.

- There have been several written and verbal public requests not to remove vegetation on the north and south sides of SR 14 due to screening/noise considerations. The neighborhoods to the south have actively engaged WSDOT for many years over noise from SR 14. The noise study for this project found that not all neighborhoods qualified for a noise walls. The abutting neighborhoods have expressed concern about removal of vegetation along SR 14 necessary to establish the full clear zone. Most neighborhoods to the north qualified for a noise wall, but would still desire to leave as much vegetation as possible at the ends of the noise wall.
- Instead of widening the existing roadway section symmetrically about the existing centerline, which would add width on each side of the highway to meet standards for the additional lanes, the additional width is achieved through moving the barrier a minimal amount and widening on only one side of the highway. Besides cost savings, one of the key reasons why this method was chosen was the appeal of minimizing the changes due to widening eastbound. Although only a minimal amount of widening would be required eastbound to meet the standards for width, any amount of widening would require significant changes to the area between the existing pavement edge and the right of way line. The slope requirements would affect a large number of mature trees and would call for a major transformation of the area between eastbound SR 14 and the right of way line to the south. Eastbound widening would also require additional stormwater facilities. Since the project concept does not widen the pavement on the south side, the existing clear zone remains the same for some areas eastbound, where the striping is not changed.
- Some of the trees are at the edge of the clear zone line and/or are near the right of way line.
- The Safety Analysis describes that the number of crashes relating to hitting objects does not show an out-of-the-ordinary trend. These crashes include run-off-the-road collision history as well as median barrier collisions and being hit by debris. There are very few run-off-the road crashes in the areas where objects are planned to remain in the clear zone. The specific collision history for these areas is described in more detail in Section 3.
- The existing high-mast luminaires in the clear zone are planned for replacement
- The clear zone eastbound and westbound is measured from the fog line, except in the area designated as Peak Use Shoulder Lane. In the Peak Use Shoulder Lane, the clear zone is measured 11' north of the fog line, representing the edge of the peak use lane. Clear zone is based on a 60 mph speed.

Related Documents

List related project documents that shaped the decision:

- Basis of Design
- Environmental Impact Statement
- Local Agency Plans or Studies

Guidelines, Manuals, and Reports are listed later

Use Chicago Style referencing

- Doe, John. *Basis of Design: I-99 / NE 142nd St Interchange Improvements Project. NW Region:* WSDOT, 2019.

Decision Description

Module 5

Template

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Cover Sheet

Signatures and Metadata

1 - Background

2 – Decision Description

3 – Options Evaluation and Decision

4 – Attachments

Template available on the ASDE Website

DELETE RED TEXT AFTER USE.

Decision Description Subsections

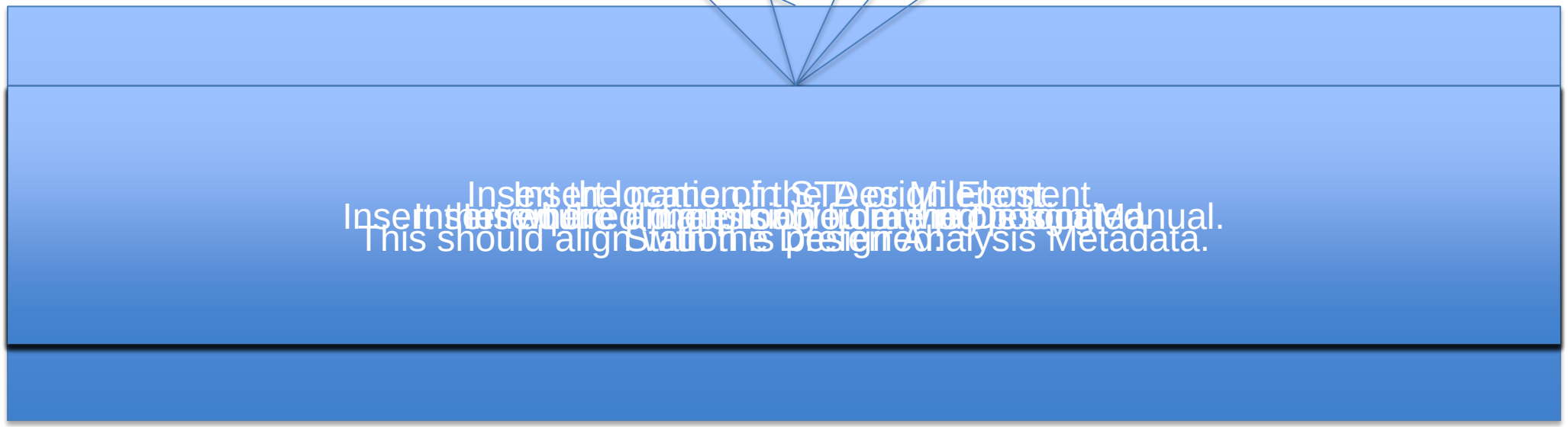
Design Element Table

Details

Other Guidance

Design Element Table

ID #	Design Element	Location	Guidance	Proposed	Shown on (Sheet #)
W1	Lane Width	LE-Line Sta. 123+45 to 130+00	12 ft	11 ft.	Appendix 1, pg. 5
W2	Lane Width	LE 130+00 to LE 150+00	12 ft	11.5 ft.	Appendix 1, pg. 6
SD1	Stopping Sight Distance	LW 50 +00 to 75+00	570 ft.	520 ft.	Appendix 1, pg. 1



Design Element Table - Example

ID #	Design Element	Location	Guidance	Proposed	Shown on (Sheet #)
L1	Bus Curb Loading Zone Length	A-Line Sta. 13+31 to 14+13	130 ft	82 ft.	Appendix 1, pg. 1

Guidance and Proposed simply noted

Design Element Table - Example

ID #	Design Element	Location	Guidance	Proposed	Shown on (Sheet #)
LW1	Lane Width	MRz 516+23.60 to MRz 522+85.54	Range = 11 to 12 Ft	11 Ft	CH8 – 9 (Appendix A)
SW1	Shoulder Width – Inside (Lt)	MRz 516+23.60 to MRz 522+85.54	4 Ft	2 to 5.4 Ft	CH8 – 9 (Appendix A)
SW2	Shoulder Width – Outside (Rt)	MRz 516+23.60 to MRz 522+85.54	Range = 8 to 10 Ft	2.8 to 8.6 Ft	CH8 – 9 (Appendix A)
LC1	Lateral Clearance – Inside Shoulder	MRz 516+23.60 to MRz 522+85.54	4 Ft	2 to 5.4 Ft	CH8 – 9 (Appendix A)
LC2	Lateral Clearance – Outside Shoulder	MRz 516+23.60 to MRz 522+85.54	4 Ft	2.8 to 8.6 Ft	CH8 – 9 (Appendix A)

SW = Shoulder Width, LC = Lateral Clearance
Two locations for each element: SW1 and SW2, LC1 and LC2

Design Element Table - Example

ID #	Design Element	Location	Guidance	Proposed	Shown on (Sheet #)
A	Horizontal Curve Radius	L-Line Sta. 783+95 to 796+12	700 ft. radius min.	572.9 ft. radius	Appendix 1
B	Turning Roadway Width	L-Line Sta. 783+95 to 796+12	29 ft.	24 ft.	Appendix 2
C	Horizontal Stopping Sight Distance (HSSD)	L-Line Sta. 790+00 to 792+50 This area is west of the existing bridge	350 ft. min HSSD for existing alignments	At least the existing HSSD of 279 feet	Appendix 3

This designer decided to call them by location A, B and C.
This worked with the way the remainder of the
Design Analysis was organized.

Design Element Table - Example

ID #	Design Element	Location	Guidance	Proposed	Shown on (Sheet #)
La1	Southbound Downstream Length of Pullout Lane (Acceleration Lane), La	664+36 LT to 670+09 LT	1200 ft.	573 ft.	See Pullout Lane exhibit
Ld2	Northbound Upstream Length of Pullout Lane (Deceleration Lane), Ld	664+41 RT to 669+16 RT	530 ft.	475 ft.	See Pullout Lane exhibit

This designer used La1 and Ld2.
La = Length of Acceleration
Ld = Length of Deceleration
The number simply was for location one and two.
Since there was only one location of each type,
they could have been La1 and Ld1.

Details

- Talk about each ID# separately
- Use the ID system you developed
- Cite specific DM Chapters and Exhibits
- State existing dimensions and/or context
- You MAY state proposed dimensions, but leave the details for the Options section.
- Set the stage for the Options section

Do Not discuss options here

Details - Example

Lane and Shoulder Width (LW1 & SW1/SW2) – The design for the EB SR 520 freeway has been developed in accordance with WSDOT's Practical Design policies per DM 1100 [July 2017] with alternative analysis developed in accordance with DM 1104 [July 2017]. Lane and shoulder width dimensions were developed and evaluated per DM 1232 [July 2017] and DM Exhibit1232-2 [July 2017] for non-interstate freeway criteria. Per DM Exhibit 1232-2, the allowable lane width ranges from 11 to 12 feet; the inside shoulder width on facilities up to 4 lanes is 4 feet, and the allowable outside shoulder width ranges from 8 to 10 feet.

This is the example where the Designers chose ID# SW1 and SW2.
This was carried through the entire analysis where they talked about items related to SW1 and SW2.

Details - Example

A. **Horizontal Curve Radius:** The existing spiral-curve-spiral has a degree of curvature of 10 degrees, which equates to a radius of 572 feet and utilizes a 10% superelevation table. The project proposes to utilize the existing alignment with no revisions to curve radius. The project design speed of 50 MPH requires at least a 700 foot radius utilizing a 10% super table (WSDOT DM Exhibit 1250-4a, July 2017) Using this table, the proposed design meets the criteria for a 45 MPH speed.

This is the example where the Designers chose ID# A, B, and C.
This worked because it aligned with the Design Element Table.

Details - Example

Ld2) The Design Manual (September 2020) Section 1350.06 Exhibit 1350-2 requires an upstream length for a pullout lane at a railroad crossing to be 530 feet for a design speed of 60 mph. The 530 ft. lane length includes a 4:1 taper transition area (48 ft. length taper for 12 ft. wide lane). The proposed dimension of 475 feet (48 ft. of taper transition and 427 ft. of deceleration lane) is the maximum upstream length that can be achieved without tapering the roadway in an approach and without widening Bridge 17/207 south of the railroad crossing (See Pullout Lane Exhibit)

This is the example where the Designers chose La1 and Ld2.
The details are given under the title Ld2 so you can align it with the Design Element Table.

Other Guidance

- List guidance other than Design Manual
  - AASHTO document
  - NCHRP report
  - TRB report
  - NACTO Guide
- List all guidance using Chicago Style
  - **Reference List:** *A Policy on Geometric Design of Highways and Streets.* Washington, DC: AASHTO, 2018.
  - **In-text*:*** *(*AASHTO *2018, 5-23)*

Options Evaluated and Decisions

Module 6

Template

Cover Sheet

Signatures and Metadata

1 - Background

2 – Decision Description

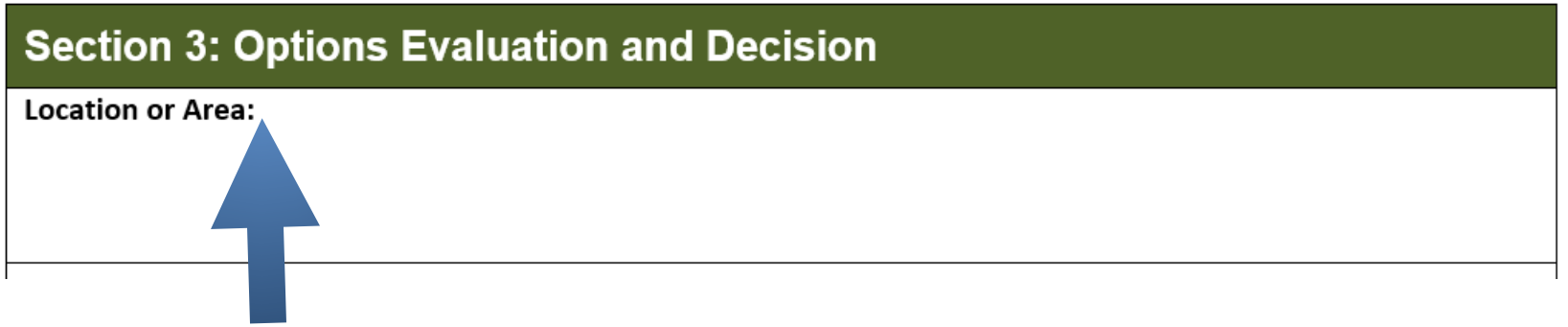
YOU ARE HERE  3 – Options Evaluation and Decision

4 – Attachments

Template available on the ASDE Website

DELETE RED TEXT AFTER USE.

Location or Area



- Delete if your document covers one location
- For multiple locations, talk about each section

Location or Area

Give each section a title LA1, LA2, etc. for future reference.

EXAMPLE

LA1, LA2, and LA3 used on I-405 NE 132nd Street Design Analysis. "LA1", "LA2", and "LA3" were used throughout the document to streamline the discussion about each location.

Location LA1 - NE 132nd Street @ NE132_WB 25+80:

Location LA1 is on the east leg of the roundabout for the northbound on-ramp, NE 132nd Street, and NE 116th Avenue intersection. Page 2 of Attachment C should be referenced while reading the discussion regarding location LA1.

Location LA2 - Totem Lake Blvd @ TLB_SB 50+20:

Location LA2 is on the south leg of the roundabout for the northbound on-ramp, NE 132nd Street, and NE 116th Avenue intersection. Page 2 of Attachment C should be referenced while reading the discussion regarding location LA2.

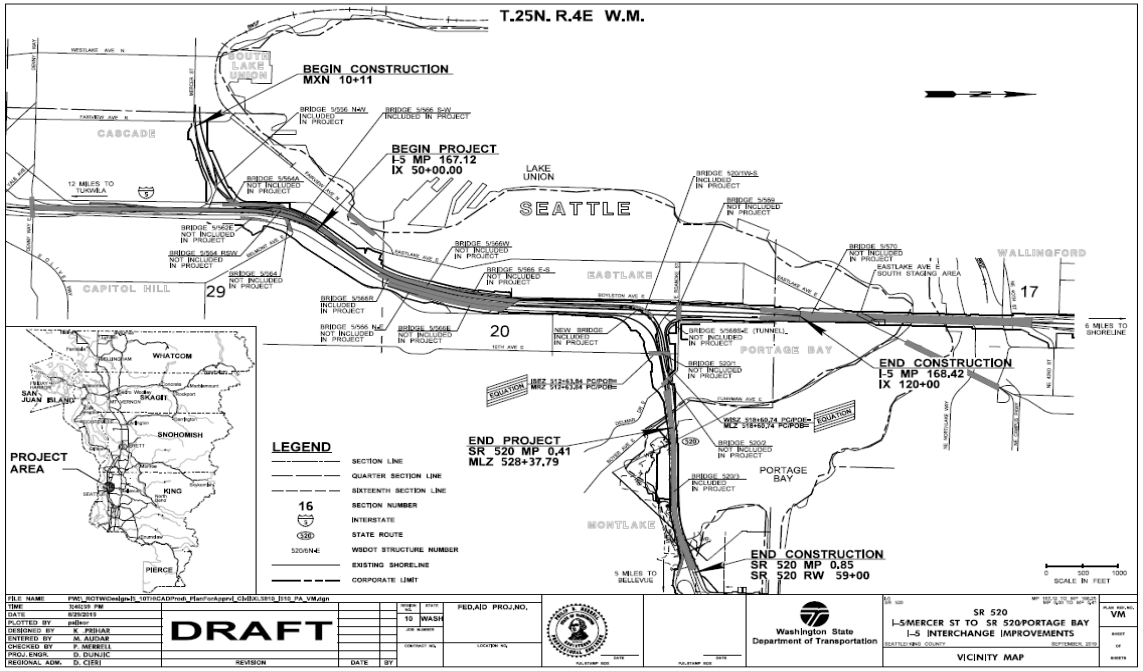
Location LA3 - NE 132nd Street @ NE132_WB 17+50:

Location LA3 is the north leg of the roundabout for the southbound off-ramp, NE 132nd Street, and 116th Way NE intersection. Page 1 of Attachment C should be referenced while reading the discussion regarding location LA3.

Location or Area

May need to use graphics/tables:

- Vicinity Map
- Informational Table
- Corresponding Graphic (e.g. Channelization Plans)



Evaluation Methodology

Section 3: Options Evaluation and Decision
Location or Area:
Discuss the evaluation methodology. Describe the metrics/considerations that will be used to choose between options. Describe methodology (quantitative or qualitative) and any performance targets. The performance metrics, methods and targets you choose will be part of your performance trade-offs "story"

So … how do I do that?

Required Metrics

1. Safety Performance
2. Operations and Mobility Performance

Safety Performance Metric

Safety Analysis Guide

- Provides guidance for safety analysis by funding program
- Focuses on Highway Safety Manual (HSM) predictive modeling
- There are limitations to predictive modeling
  - If HSM predictive modeling cannot be used, crash history can be used
- Resources: Contact your ASDE

Safety Analysis Guide – April 2020

Safety Analysis Methodology – Non-Preservation Projects

Safety Analysis Guide: Section 6.9

- Step 1: Determine appropriate scope and scale of analysis
- Step 2: Pull the crash data (if beneficial)
- Step 3: Review all fatal and serious injury crashes and any crashes involving people who walk or bike.
- Step 4: Analyze data to determine if there are any patterns or concentrations of crashes.
- Step 5: Conduct a safety performance analysis of each reasonable alternative.

Operations and Mobility Performance Metric

Use computer models if possible

- *Sidra, VISSIM, Synchro, HCS*

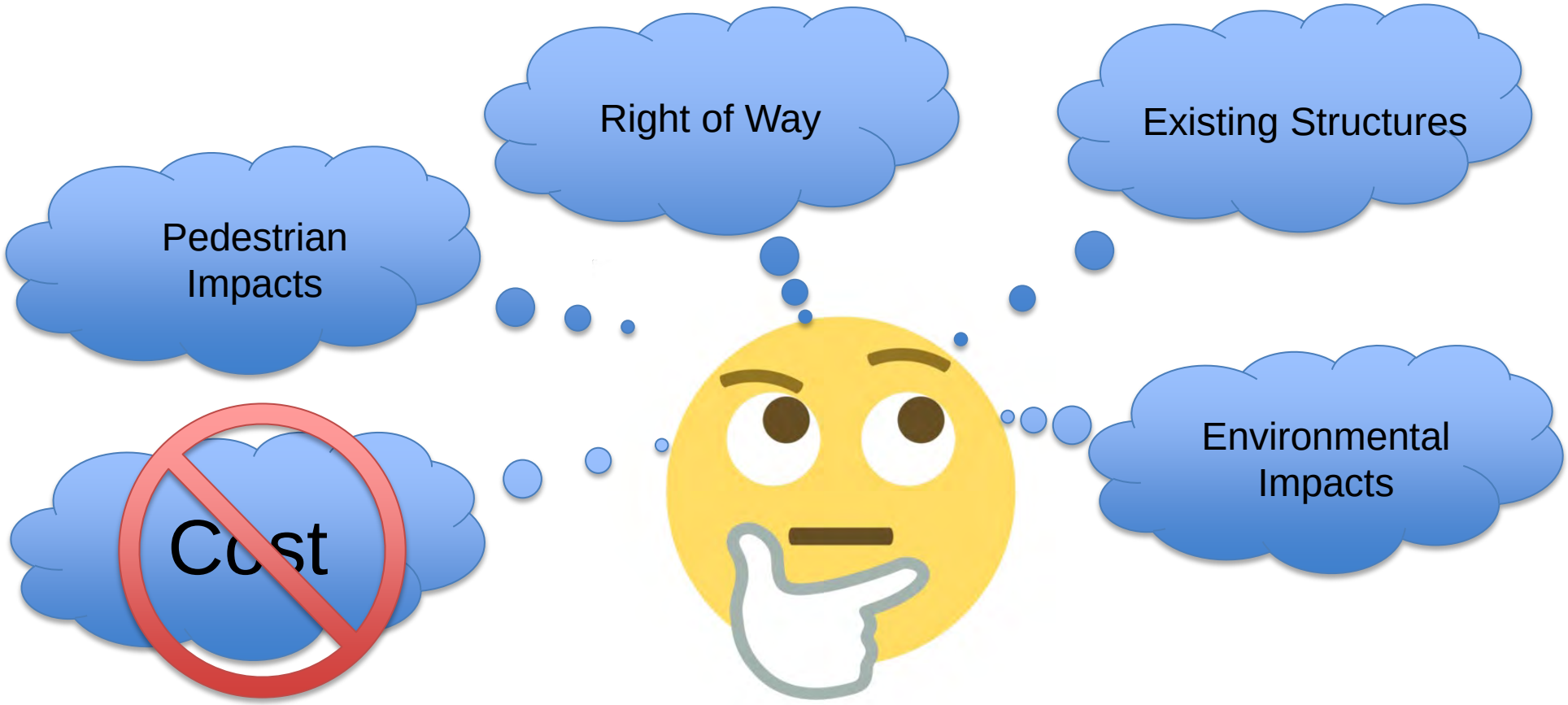
Try a Quantitative comparison

- *Delay*
- *Travel Time*
- *Level of Service*
- *Queue Length*
- *Volume/Capacity Ratio*

Talk to Region Traffic

Additional Metrics

Answer this question:
Why can't I build the full-build scenario?



Response to that question may be a metric or multiple metrics.

Additional Metric

- Cost is not a direct metric, but an indirect metric
  - Building to full dimension would require:
    - Additional Right of Way … Additional expense
    - Widen Existing Structures … Additional expense
- Consider Baseline and Contextual Needs
  - Often **NOT** a major player in the specific decision being documented on this template.
  - **ONLY** include project baseline or contextual needs if they are directly involved in the decision being discussed.

Additional Metrics

Avoid using temporary or schedule impacts to justify a permanent feature.

Additional Metrics

Think about your naming convention (i.e. Subject and Action):

- Impact to adjacent businesses
- Environmental impacts
- Right of way impacts
- Bicycle/pedestrian accommodation
- Stormwater Treatment

CLASS EXERCISE – Metrics

Your project is replacing an existing bridge. You are writing a Design Analysis to narrow the shoulders below the required dimension of 5 feet. You have a two lane highway with one lane in each direction. The location is a bridge that crosses over a creek with 2:1 slopes approaching the bridge.

CLASS EXERCISE – Metrics

You are considering three Options:

1. **OPTION 1: Full build.** 11’ Lanes, 5’ Shoulders on new alignment parallel and offset from the currently alignment. This Option allows for the existing bridge to remain intact while the new bridge is built.
2. **OPTION 2: Route Continuity.** 11’ Lanes, 2’ Shoulder on existing alignment. This Option requires a temporary shoe-fly bridge that is one-way alternating traffic for two construction seasons.
3. **OPTION 3: Practical Solution.** 10’ Lanes, 4’ Shoulders on existing alignment. This Option leaves the existing bridge in-place while constructing the new bridge and uses a one-way alternative traffic for two construction seasons. Option requires right-of-way acquisition.

CLASS EXERCISE – Metrics/Considerations

You desire to build Option 3: Practical Solution

Compile a list of Metrics/Considerations for your Design Analysis.

CLASS EXERCISE – Possible Answers

POSSIBLE METRICS:

- Operational Impact
- Safety Impact
- Bicycle Impact
- Pedestrian Impact
- Environmental Impact
- Right of Way Impact
- Tribal Impacts
- Route Continuity
- Project Constructability/Phasing
- Profile Impact

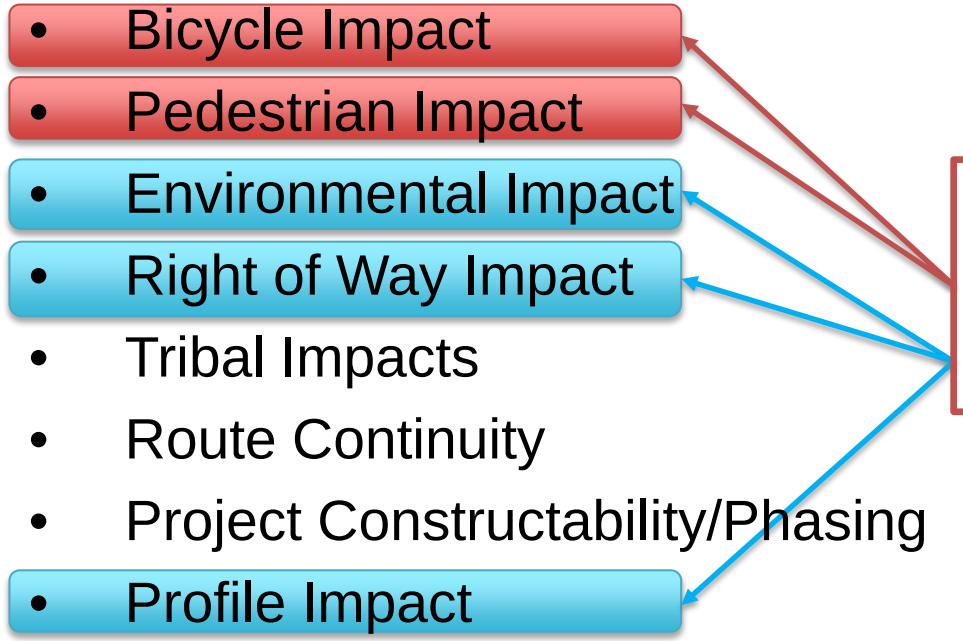
Subject = Blue
Action = Green

These are simple examples and the metric is communicated in very few words. You may use sentences to better explain the metric. Still try to keep the sentences simple.

CLASS EXERCISE – Possible Answers

POSSIBLE METRICS:

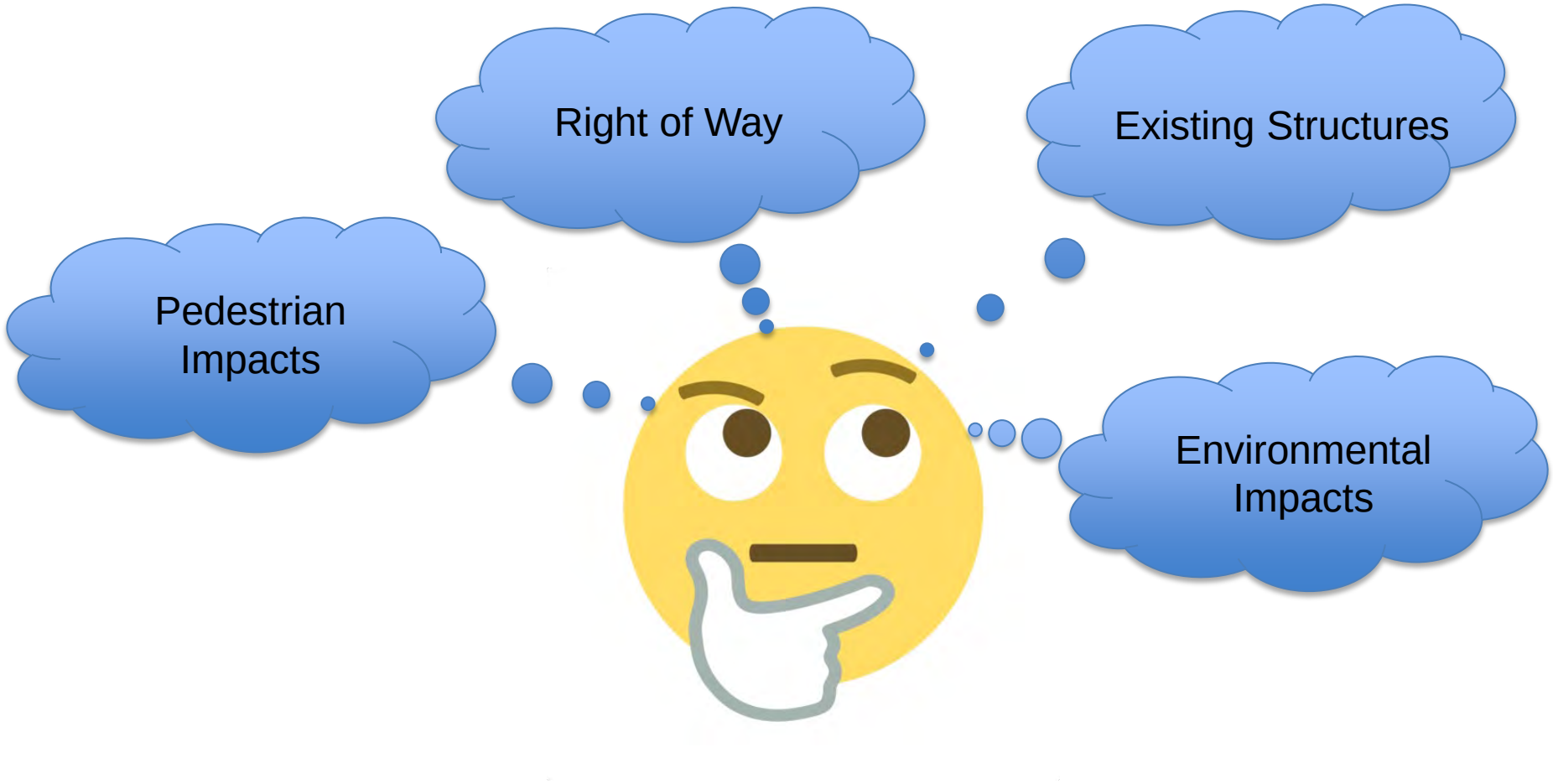
- Operational Impact (Required)
- Safety Impact (Required)
- Bicycle Impact
- Pedestrian Impact
- Environmental Impact
- Right of Way Impact
- Tribal Impacts
- Route Continuity
- Project Constructability/Phasing
- Profile Impact



Be careful that metrics don't overlap and cause double-counting.

Evaluation Methodology

How do I measure my metrics?



Evaluation Methodology

How do I measure my metrics?

QUANTITATIVE

VS

QUALITATIVE


Quantitative Methods
Only one in 30 take the free ice cream. Interesting...
free icecream
Qualitative Methods
What did you feel when you saw the free ice cream?
Excited. A little scared.
And why was that?

Qualitative Data	Quantitative Data
Overview: • Deals with descriptions. • Data can be observed but not measured. • Colors, textures, smells, tastes, appearance, beauty, etc. • Qualitative → Quality	**Overview:** • Deals with numbers. • Data which can be measured. • Length, height, area, volume, weight, speed, time, temperature, humidity, sound levels, cost, members, ages, etc. • Quantitative → Quantity
Example 1: ***Oil Painting***  **Qualitative data:** • blue/green color, gold frame • smells old and musty • texture shows brush strokes of oil paint • peaceful scene of the country • masterful brush strokes	**Example 1:** ***Oil Painting***  **Quantitative data:** • picture is 10" by 14" • with frame 14" by 18" • weighs 8.5 pounds • surface area of painting is 140 sq. in. • cost $300

Example 2: ***Latte***  **Qualitative data:** • robust aroma • frothy appearance • strong taste • burgundy cup	**Example 2:** ***Latte***  **Quantitative data:** • 12 ounces of latte • serving temperature 150° F. • serving cup 7 inches in height • cost $4.95
Example 3: ***Freshman Class***  **Qualitative data:** • friendly demeanors • civic minded • environmentalists • positive school spirit	**Example 3:** ***Freshman Class***  **Quantitative data:** • 672 students • 394 girls, 278 boys • 68% on honor roll • 150 students accelerated in mathematics

Quantitative

An analysis of a situation or event by means of numerical measurement.

- Operations numbers
  - *Sidra, VISSIM, Synchro, HCS*
- Safety numbers
  - *HSM, ISATe, IHSDM*
- Length of Horizontal Stopping Sight Distance (SSD) provided
  - Option #1 provides 495 ft of SSD, as required for 55 mph, for the entire curve with a 10 ft shoulder; and,
  - Option #2 provides 400 ft of SSD for 200 ft of the curve or 2.5 seconds of travel time (at 55 mph) with compromised SSD with a 6 ft shoulder.

Qualitative

An analysis that focuses on the relative impact of an option for a given metric as compared to the other options being assessed.

- Reduced Tribal Impacts
  - Option #1 will require less impact to tribal areas than Option #2 as it will not require rerouting the creek.
- Maintenance of Traffic Impacts
  - Option #1 should have less maintenance of traffic issues due to the fact that the culvert at STA 19+92 should not need to be replaced.

Qualitative Methodology

Answer these questions:

- What do you want from the Metric/Consideration?
- How does it effect project performance?

Use Qualitative Adjectives

• Additional	• Meets	• No Change
• Less	• Faster	• High
• None	• Slower	• Low
• No Impact	• More	• Similar
• Greater	• Fewer	• Better
• Reduce	• Increase	• Improve

Qualitative Methodology

You may use one of the Options as a baseline

Options Comparison Table	**Associated Issues (identified in Section 2)**	**Metrics / Considerations**						
		Safety Performance	*Operational and Mobility Performance*	*Environmental Impact*	Rights of Way *Impacts*	Maintenance Impacts	*Constructability & Phasing*	*Enforcement Impacts*
-- OPTION 1 -- 12' Lane 8' Right Shoulder 4' Left Shoulder	LW1 SW1	*0.67 FSI/Year*	*59 mph FFS*	*Worse*	*Worse*	*Same*	*Worse*	*Same*
-- OPTION 2 -- 11' Lane 8' Right Shoulder 4' Left Shoulder	LW1 SW1	*0.70 FSI/Year*	*58 mph FFS*	*Baseline*	*Baseline*	*Baseline*	*Baseline*	*Baseline*
-- OPTION 3 -- 11' Lane 4' Right Shoulder 4' Left Shoulder	LW1 SW1	*0.73 FSI/Year*	*56 mph FFS*	*Better*	*Worse*	*Worse*	*Better*	*Worse*

Baseline

CLASS EXERCISE – Measurement Adjectives

Take your list of Metrics/Considerations and add Qualitative Adjectives

CLASS EXERCISE – Possible Answers

POSSIBLE METRICS:

- Less Operational Impact
- Improve Safety Impact
- Reduce Bicycle Impact
- Less Pedestrian Impact
- No Environmental Impact
- Minimize Right of Way Impact
- Less Tribal Impacts
- Provide Route Continuity
- Ease of Project Constructability/Phasing
- Less Profile Impact

Noun = Blue
Verb = Green
Adjective = Red

CLASS EXERCISE – Methodology

Take four of your metrics. For each, come up with a measurement. State whether it is a ***quantitative*** or ***qualitative*** measure. If *quantitative*, state what is going to produce the number. If *qualitative*, state how you will compare them.

CLASS EXERCISE – Possible Answers

- No Environmental Impact: ***QUALITATIVE***. We can only surmise the actual impact to the environment at this stage in the game. We have not completed our hydraulics reports or preliminary engineering to know for certain. This comparison would be ***QUALITATIVE*** because it will be our opinion as to what the impacts would be.
- Provide Route Continuity: ***QUALITATIVE***. This will be a discussion on the route within the corridor and what that route may look like in the future. This comparison would be ***QUALITATIVE*** as it is our opinion on what the future of the roadway may be.
- Improve Safety Impact: **QUANTITIVE**. The shoulder and lane options will be analyzed using HSM equations.
- Reduce Bicycle Impact: ***QUALITATIVE***. Providing 5’ shoulders and 42” high barrier will improve bike accommodation for bicyclist utilizing this corridor.

Options Comparison Table

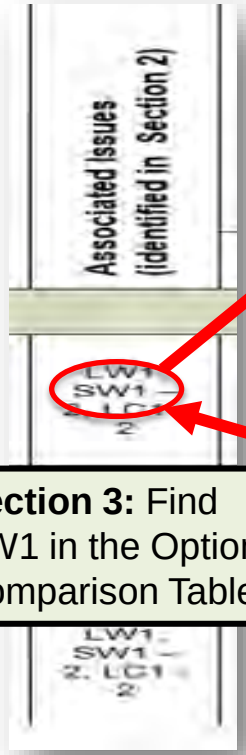
Place the Metrics in the Options Comparison Table

Options Comparison Table	**Associated Issues (identified in Section 2)**	**Metrics / Considerations**						
		Safety Performance	*Operational and Mobility Performance*	*Environmental Impact*	Route Continuity	Bicycle/Pedestrian Impact	*Ease of Construction*	
Full Build	LW1 SW1	*0.03 FSI/Year*	*58 mph FFS*	*Poor*	*Poor*	*Excellent*	*Excellent*	
Route Continuity	LW1 SW1	*0.10 FSI/Year*	*56 mph FFS*	*Moderate*	*Excellent*	*Poor*	*Good*	
Practical Solution	LW1 SW1	*0.06 FSI/Year*	*58 mph FFS*	*Moderate*	*Good*	*Good*	*Good*	

- One row for each Option, columns are metrics
- One of the Options must be full build
- Insert **quantitative** results in the cells if applicable
- Insert ***qualitative*** adjectives in the cells if ***qualitative*** analysis is used

Options Comparison Table

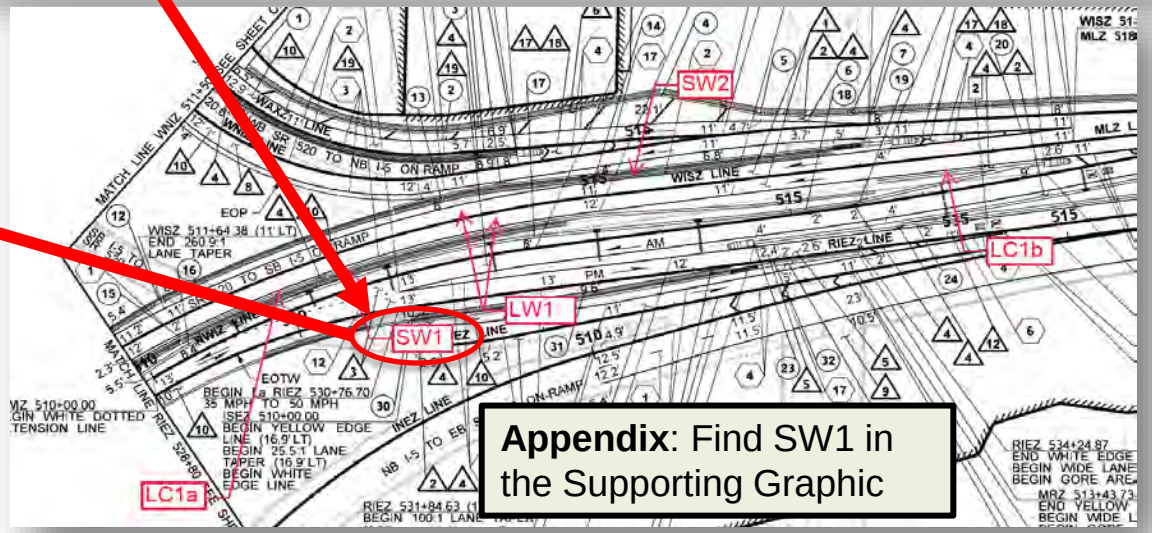
Notice the “Associated Issues” carried throughout the document



ID #	Design Element	Location	Guidance	Proposed	Shown on (Sheet #)
LW1	Lane Width	WISz 494+87.62 to WISz 518+60.74	Range = 23 to 25 Ft	22 to 23.5 Ft	CH06 - 08 (Appendix A)
SW1	Shoulder Width –	WISz 494+87.62 to .74	Range = 2 to 4 Ft	2 to 8 Ft	CH06 - 08 (Appendix A)
SW2	Shoul…	…62 to …0.74	Range = 4 to 8 Ft	2 to 15 Ft	CH06 - 08 (Appendix A)
LC1	Lateral … Inside Shoulder	…62 to …0.74	4 Ft	2 to > 4 Ft	CH06 - 08 (Appendix A)

Section 2: Find SW1 in the Design Element Table

Section 3: Find SW1 in the Options Comparison Table



Appendix: Find SW1 in the Supporting Graphic

Options Comparison Table

Example

Options Comparison Table	Associated Issues (identified in Section 2)	Metrics / Considerations							
		Safety Performance	Operational and Mobility Performance	Preservation	Construction Costs				
Option 1: Match Existing Profile Grade	SD1 & SD2	Lower	Higher	Higher	Lowest construction cost				
Option 2: Relocate Sag Off Proposed Structure with Increased Sight Distance	SD1 & SD2	Higher	Medium	Lower	Highest construction cost				
Option 3: Relocate Sag Off Proposed Structure	SD1 & SD2	Medium	Higher	Medium	Marginally higher construction cost than Option 1				

Which is better, Lower or Higher?

Options Comparison Table

Example

Options Comparison Table	Associated Issues (identified in Section 2)	Metrics / Considerations				
		Safety Performance no cross over collisions	*Operational and Mobility Performance (LOS)*	*Stopping Sight Distance*	*Safety Performance related to Stopping Sight Distance*	
OPTION 1 – No median barrier	SSD1&2	- -	*0*	*0*	++	
OPTION 2 – Build median barrier and lower the speed limit	SSD 1&2	++	-	*0*	+	
OPTION 3 – Build median barrier and maintain current speed limit	SSD 1&2	++	*0*	-	-	

Score (relative to other alternatives):
++ Optimal Performance
+ Benefit
0 Neutral
- Impact
- - Significant Impact

Options Comparison Table

Example

Options Comparison Table	**Associated Issues (identified in Section 2)**	**Metrics / Considerations**					
		BN2 Operational Performance – Travel Times & Reliability for I-5 Reversible Express Lanes		BN3 Safety Performance – Serious Injury & Fatal Crashes	CN3 – Minimize Impacts and Delays to the Traveling Public	CN4 – Improved Sustainability	Shoulder Width Functional Needs
		Effect on Travel Times	Effect on FFS				
Northbound I-5 Express Lanes							
Option A (3 lanes + aux lane) * [6' to 10', 12', 12', 12', 12', 6' to 10']	LW1, SW1 – 2, LC1 - 2	No increase in travel times	No reduction in FFS	0.05 (K) + 0.15 (A) = **0.20 (K + A) cpv**	Medium Impact. Reduces overall project duration by approximately 3 months as compared with Option B.	Rebuilds I-5 express lanes left shoulder	10-foot shoulders (typical)
Option B (4 lanes + aux lane) * [2' to 10', 11', 11', 11', 11', 11', 2' to 10']	LW1, SW1 – 2, LC1 - 2	No increase in travel times	- 3.2 mph reduction in FFS	0.10 (K) + 0.20 (A) = **0.30 (K + A) cpv**	High Impact. Increases overall project duration by approximately 3 months as compared with Option A.	Rebuilds I-5 express lanes left and right shoulders	2 to 4-foot shoulders (typical)
Option EX (Existing – 4 lanes) * [6' to 10', 12', 12', 12', 12', 6' to 10']	LW1, SW1 – 2, LC1 - 2	No increase in travel times	No reduction in FFS	0.05 (K) + 0.15 (A) = **0.20 (K + A) cpv**	No Impact	No consumption of construction materials or energy / Does not provide for new HOV DA connection	10-foot shoulders (typical)

Options Comparison Table

Example

Options Comparison Table	Design Elements	Metrics / Considerations					
		BN1 Traffic Operations	BN2 Access to ETL Lanes	BN3 Baseline Safety	CN1 Transit Reliability	CN3 Maintenance of Traffic	CN4* Environmental
OPTION 1 ***Design Manual Approach*** *Shoulder Width Outside: 10'* *Shoulder Width Inside: 10' or* *Shoulder Width Inside: 8' w/ 4' buffer* *Lane Width: 12'* *Buffer Width: 4'*		*Meets target*	*Meets target*	*Meets target*	*Meets target*	*Approximately 27 Additional Full I-405 Closures for Bridge Work.*	*Approximately 1.78 Additional Acres Wetland Impacts*
OPTION 2 ***Target Section Approach*** *Shoulder Width Outside: 10'* *Shoulder Width Inside: 10' or* *Shoulder Width Inside: 8' w/ 4' buffer* *Lane Width: 11'* *Buffer Width: 4'*	*LW*	*Meets target*	*Meets target*	*Meets target*	*Meets target*	*Approximately 27 Additional Full I-405 Closures for Bridge Work.*	*Approximately 0.24 Additional Acres Wetland Impacts*
OPTION 3 ***Practical Design Approach*** ***(Preferred)*** *Shoulder Width Outside: 2'-10'* *Shoulder Width Inside: 2'-10' or* *Shoulder Width Inside: 2'-8'w/ 4' buffer*	*LW/SW/ BW/LC*	*Meets target*	*Meets target*	*Meets target*	*Meets target*	*Baseline*	*Baseline*

Detailed Options Description

Options Comparison Table	**Associated Issues (identified in Section 2)**	**Metrics / Considerations**						
		Safety Performance	*Operational and Mobility Performance*	*Environmental Impact*	Route Continuity	Reduce Bicycle/Pedestrian Impact	*Ease of Construction*	
Full Build	LW1 SW1	*0.03 FSI/Year*	*58 mph FFS*	*Poor*	*Poor*	*Excellent*	*Excellent*	
Route Continuity	LW1 SW1	*0.10 FSI/Year*	*56 mph FFS*	*Moderate*	*Excellent*	*Poor*	*Good*	
Practical Solution	LW1 SW1	*0.06 FSI/Year*	*58 mph FFS*	*Moderate*	*Good*	*Good*	*Good*	

Detailed Description of the options evaluated as follows:

- Provide a short description of each option
- Don’t make them read a dissertation
- Don’t make the reader lookup everything in an attachment

Detailed Options Description

Example

Detailed Description of the options evaluated as follows:

Option 1: Match Existing Profile Grade (Attachment B & E)

This option matches the existing profile grade. The existing grade was analyzed for Stopping Sight Distance (SSD) and did not meet the Design Manual criteria of 534 feet, existing conditions produce a SSD of 363 feet. In addition, the sag location would fall within the limits of the proposed structure. This option accommodates a design speed of 40 MPH.

Option 2: Relocate Sag Off Proposed Structure with Increased Sight Distance (Attachment F & G)

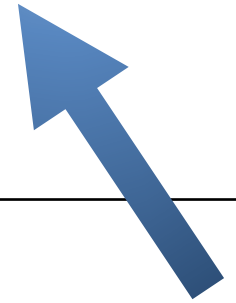
This option moves the sag location outside of the proposed structure location and exceeds the design criteria for stopping sight distance. In order to meet design criteria, the profile needed to shift west due to the existing infrastructure constraints from driveway accesses and the existing Eastbound US 101 structure. This option would bring the profile up to full design criteria for the posted speed of 55 MPH.

Option 3: Relocate Sag Off Proposed Structure (Attachment B, C & D)

This option moves the sag location outside of the proposed structure location. The roadway profile is raised at the proposed structure location and a second sag vertical curve is introduced due to the existing infrastructure constraints from the driveway accesses and the existing Eastbound 101 structure. This option either maintains or increases the available stopping sight distance in the sag vertical curves from existing conditions and accommodates a design speed of 40 MPH.

Performance Tradeoffs

Detailed Description of the options evaluated as follows:
Discuss the performance tradeoffs shown in the table, and compare the performance of the options:



Performance Tradeoffs

- Main section of a Design Analysis
- Discuss the trade-offs without reaching a conclusion on which option is best … that comes later …
- Explain your qualitative adjectives
  - Why did you say it was More/Greater/Best?
  - Why did you say it was Less/Fewer/Worse?
- Provide enough background so a reasonable person may reach the same conclusion

Performance Tradeoffs

This is your day in court

Use this section to present your case

Reference Your Statements

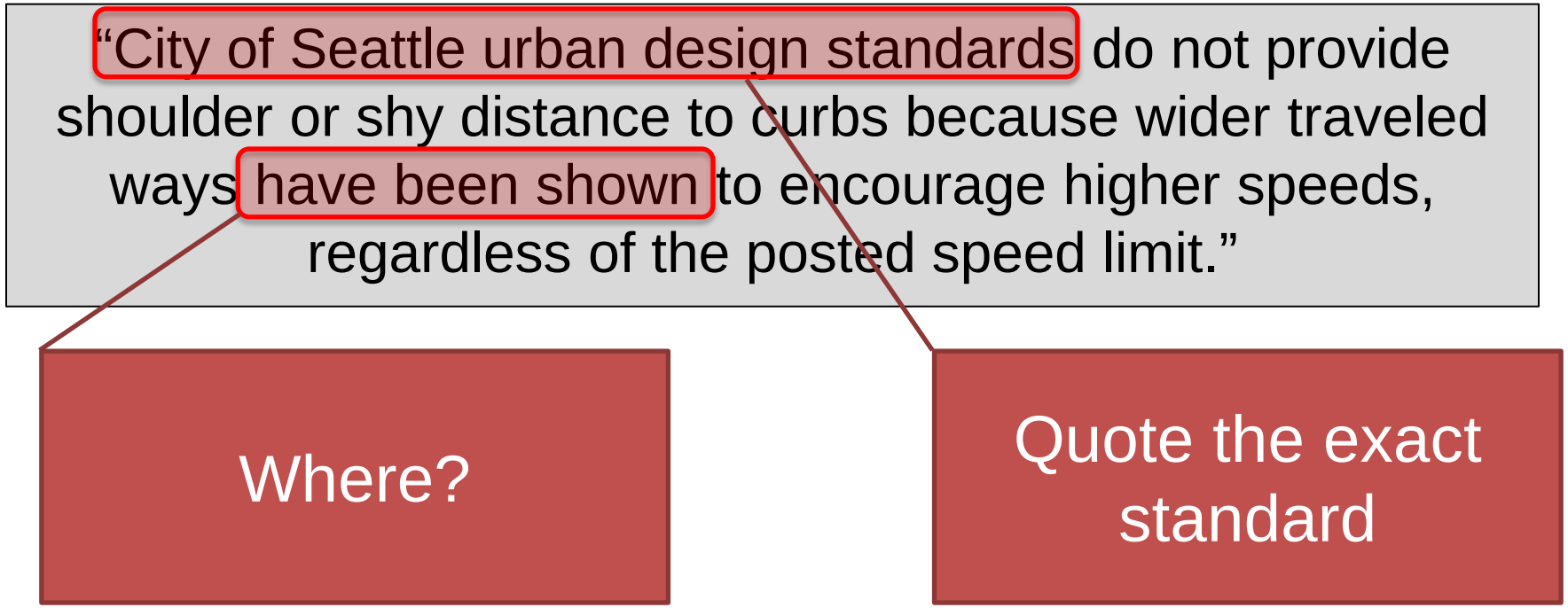
"Washington State laws and policies, along with City of Seattle ordinances, require that pedestrian utilization of transportation facilities be considered and explicitly encouraged by the design of roadway projects."

Quote the exact City Ordinance

Quote the exact Law (RCW or WAC) and Policy number

Treat it like a research paper from school …
include references

Reference Your Statements



Treat it like a research paper from school include references

Reference Your Statements

A ball-bank analysis was performed for the locations ER2, ET2, ET3, and ET6 to ET10. The ball-bank readings showed that the shorter superelevation transitions did not result in a lateral acceleration outside of the range for driver comfort. The resulting values were between 1.4 and 6.6 degrees. Per A Policy on Geometric Design of Highways and Streets, 6th Edition, AASHTO (2011), Section 3.3.2, curves that avoid driver discomfort are indicated by ball-bank readings of 14 degrees for speeds of 20 mph or less, 12 degrees for speeds of 25 to 30 mph, and 10 degrees for speeds of 35 through 50 mph, and by extrapolation for this analysis, 8 degrees for 60 mph.

Good,
Exact Reference

Good,
Exact Numbers

Reference Your Statements

Safety Performance: The existing alignment has had four crashes in the past five years; three were wildlife-related and one was an object in the roadway. The alignment has no history of run off the road type crashes typically associated with horizontal alignment, and no fatal and serious injury crashes in the previous five years. The performance metric of not increasing the risk of fatal and serious injury crashes is met by both options.

Good
Wraps back to the Metric

Good
Exact Numbers

CLASS EXERCISE –Performance Tradeoffs

Read the following statement. Is it good?

List one thing you would change or add to make it better?

Design Analysis: Bus pullout 130’ (required) to 82’

Metric: Impacts to Adjacent Properties

In all options, acquisition of additional right-of-way from private landowners is necessary. Options 2 and 3 are considered low impact, as there are no other impacts to adjacent properties, existing infrastructure, and/or critical areas.

Relocating the bus stop location west of Canyon Street (Option 1) would require significantly more right-of-way from a private landowner than Options 2 or 3. The land needed to accomplish Option 1 is currently a commercial property that utilized their land up to the right-of-way property line. For that reason, the impacts to adjacent properties for Option 1 is considered moderate.

CLASS EXERCISE – Performance Tradeoffs

Read the following statement. Is it good?

List one thing you would change or add to make it better?

Design Analysis: **Superelevation transition**

(270’ existing, 570’ required, 270’ proposed)

Metric: **Safety (HSM Equations not applicable)**

Southbound Super Transitions

There were zero fatal or serious injury crashes within the study Area. Since the runoff length exception occurs due to the outside edge of traveled way, the following existing crash summary details in the next paragraph are for the outside shoulder and two outside most lanes.

> Approximately 80% of the crashes for SB#1 through SB#3 were rear end crashes. Within this area, there were 2 fixed object and 5 angled/sideswipe crashes of which there were non-injury crashes. Approximately 85% of the fixed object and angled/sideswipe crashes occurred as result of inattention, following too close or not granting the right of way to vehicle.

Given these contributing factors for the crashes, it is likely the superelevation transition does not contribute to crashes. As a result, keeping the proposed equal to the existing should have similar positive safety performance.

CLASS EXERCISE – Performance Tradeoffs

Read the following statement. Is it good?

List one thing you would change or add to make it better?

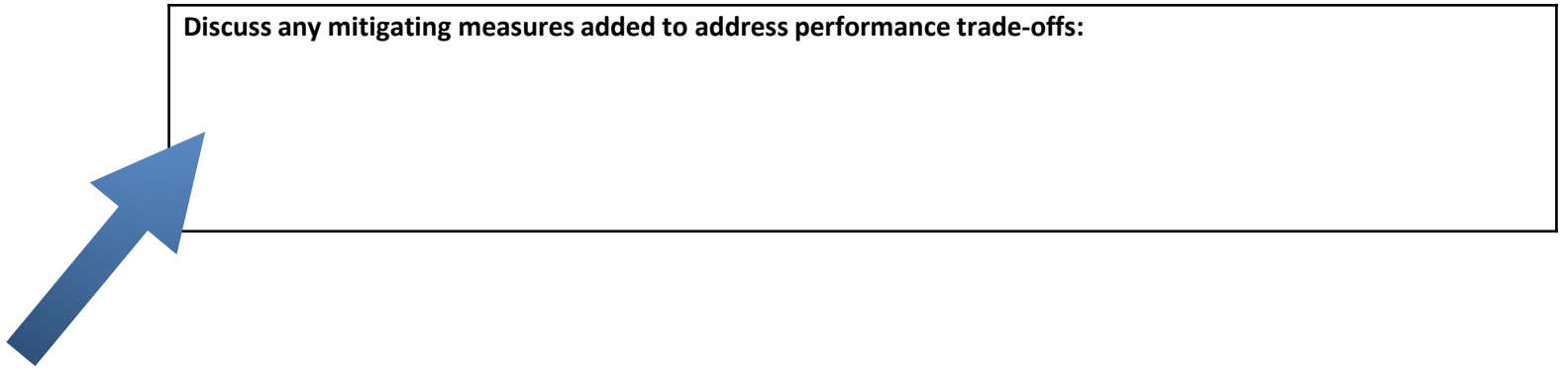
Design Analysis: Gap Acceptance Length (300' required, 136' proposed)

Metric: Impacts to the Traveling Public

Option A will require widening along the south side of the EB roadway including widening of the existing Beaverton Bridge. Widening will also require removing and replacing the existing Chicago Street undercrossing with a longer spanned temporary detour bridge. Note the detour bridge will be replaced by a large community enhancement lid as part of a future project. The approximate duration of traffic control lane and shoulder closures associated with widening the existing bridge is estimated at 12 months. The approximate duration for removing and replacing the existing Chicago Street undercrossing with a temporary detour bridge is estimated at 18 months. The combined duration for Option A impacts and delays to the traveling public are estimated at 24 months.

Option B and Option C will require restriping the existing NB to EB connector ramp and portion of EB mainline for the slightly modified two-lane parallel on-connection. Restriping the existing ramp will likely occur during nighttime hours, either by closing the ramp or by using single lane detours. The impact to the traveling public will be the same for Option B and Option C. Option D will not require any impacts or delays to the traveling public but does not meet the subject project purpose and need for adding a new HOV direct access ramp connection.

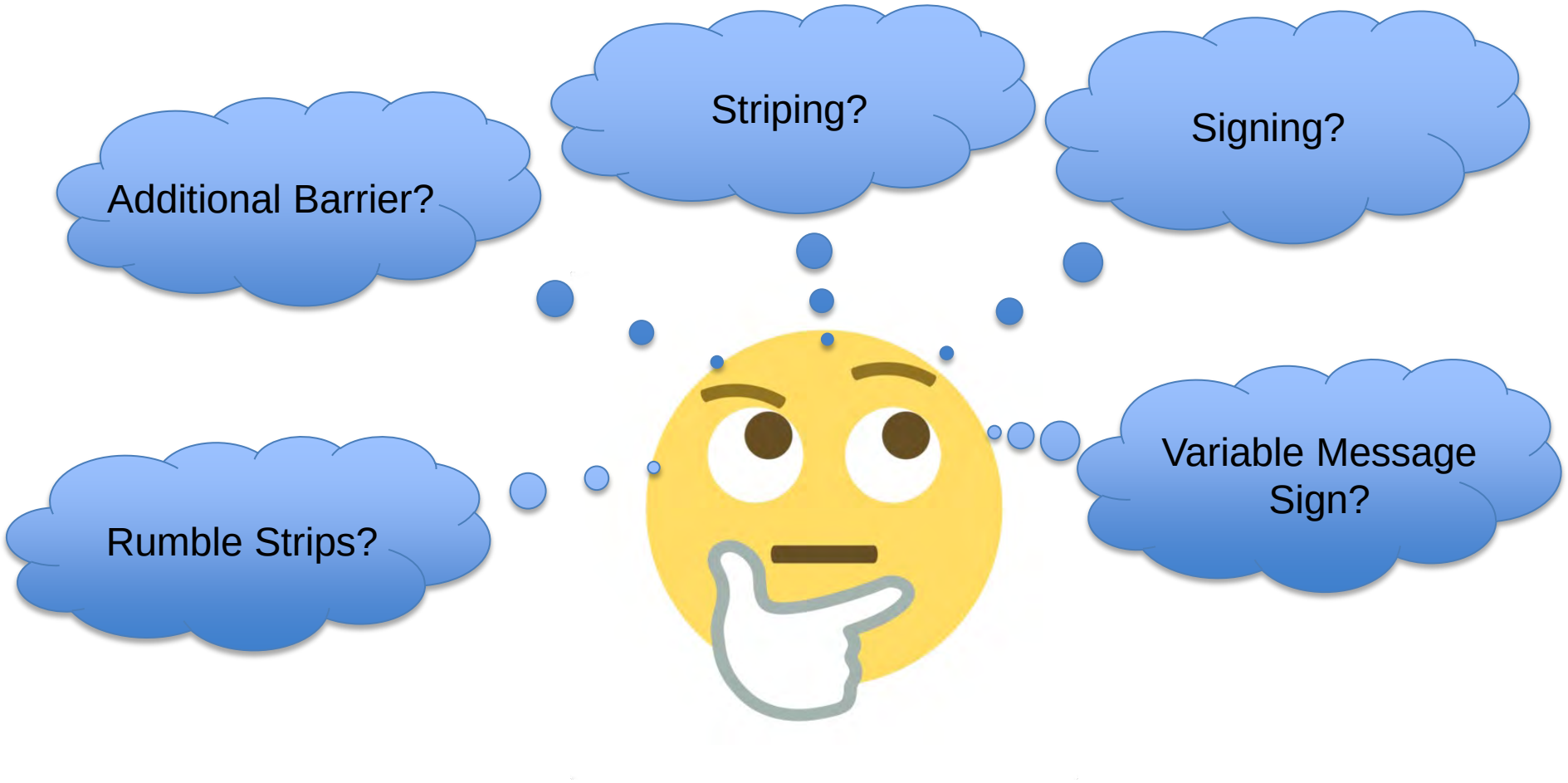
Mitigating Measures



- List items to help mitigate the location
  - Note ones that will be installed
- Consider low cost countermeasures such as:
  - Mitigation Strategies for Design Exemptions
  - TSMO
- Brainstorm with others outside of the project team

Mitigation Possibilities

How can I help?



CLASS EXERCISE – Mitigation

Select a partner and brainstorm five mitigation measures for the following Design Analyses

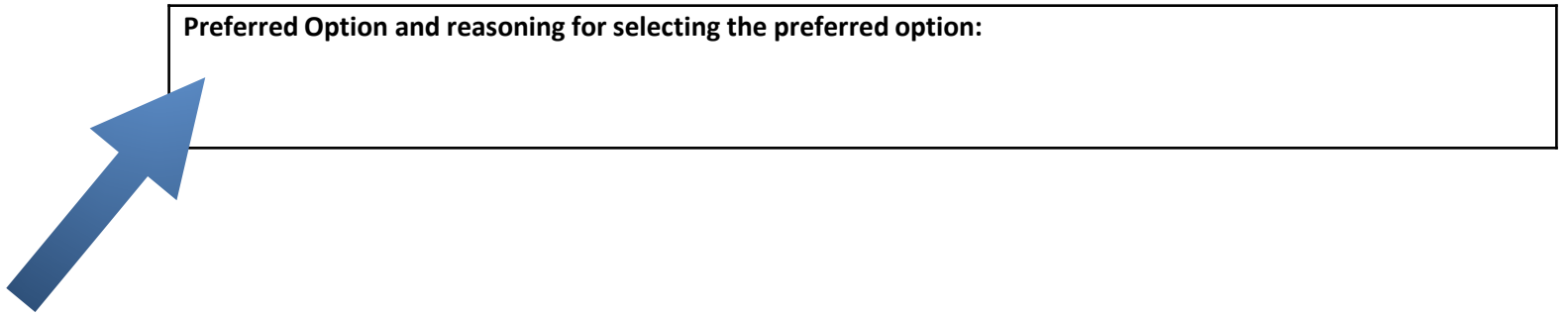
Horizontal Stopping Sight Distance

Intersection Sight Distance

Vertical Clearance

Lane and Shoulder Width

Preferred Option



- This is the conclusion of a Design Analysis
- State your preferred Option and why?
- No new information presented in this section
- Should be short … all of the details are in the prior sections

Preferred Option - Example

Option 2, Practical Design Approach, is selected as the Preferred Option.

Option 1 and Option 2 both meet the project's Baseline needs. When the project's Contextual Needs are considered, Option 2 out-performs Option 1 and best aligns with WSDOT's Practical Design policies by meeting the project's Baseline and Contextual needs at the lowest cost.

The preferred option is Option 1 that utilizes existing shoulder for ramp metering. The additional impacts of adding a new lane that is only required for a few hours each day is not a practical solution. Using the existing infrastructure to store vehicles entering the highway is the more economically viable solution that minimizes the impact to the environment and the surrounding area. For reasons detailed above, the preferred option is to use the shoulder for ramp meter storage instead of building a new lane.

Preferred Option - Example

Location #1: Sight Distance Looking North

Considering the three options discussed above, Option 3 is selected as the preferred option for the Sight Distance Setback on eastbound Grace Ave looking north. The option provides the AASHTO minimum sight distance setback for cars and busses.

Location #2: Sight Distance Looking South

Considering the three options discussed above, Option 3 is selected as the preferred option. Over the past five years, no crashes were associated with the limited sight distance looking south. This option increases the existing sight distance setback and exceeds the minimum distance allowed in the WSDOT Design Manual for situations where limited right of way constrains available options.

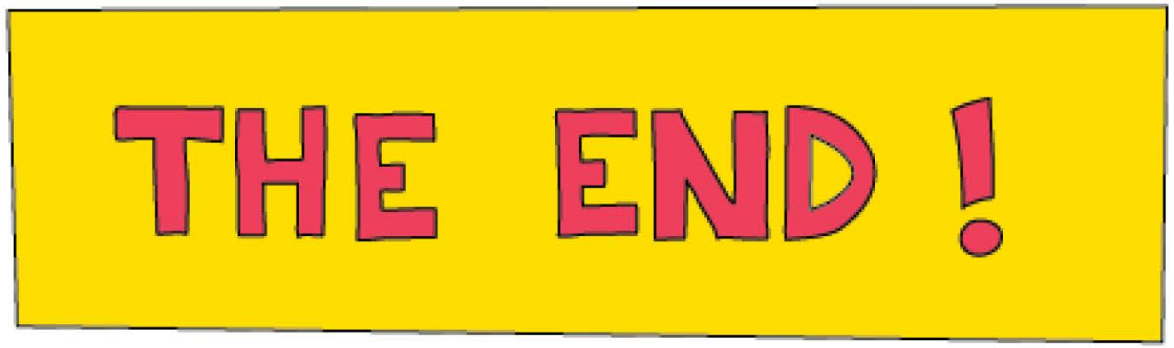
New information?

Preferred Option - Example

The preferred option is **Option 1**. Using the existing infrastructure to store vehicles entering the freeway is the most economically viable solution, minimizing the impact to the environment and the surrounding area. Option 1 is similar to the northbound SR 195 on-ramp to eastbound I-90 on the west side of Spokane where drivers form two lanes when metered. It is operating well and the driving public is able to understand and comprehend the striping and signing.

Option 2, while having similar cost and low impact, was not selected as it was determined this would be a new configuration for Spokane area drivers. Further, DM 1239.02(1)(a) states that “shoulder widths greater than 10 feet travel lane”. The on ramp is not a two lane ramp during non-metered operations and it is not desirable for drivers to have the idea that it is.

New information?


THE END !

Attachments and Filing

Module 7

Template

Cover Sheet

Signatures and Metadata

1 - Background

2 – Decision Description

3 – Options Evaluation and Decision

YOU ARE HERE 

4 – Attachments

Template available on the ASDE Website

DELETE RED TEXT AFTER USE.

Attachments

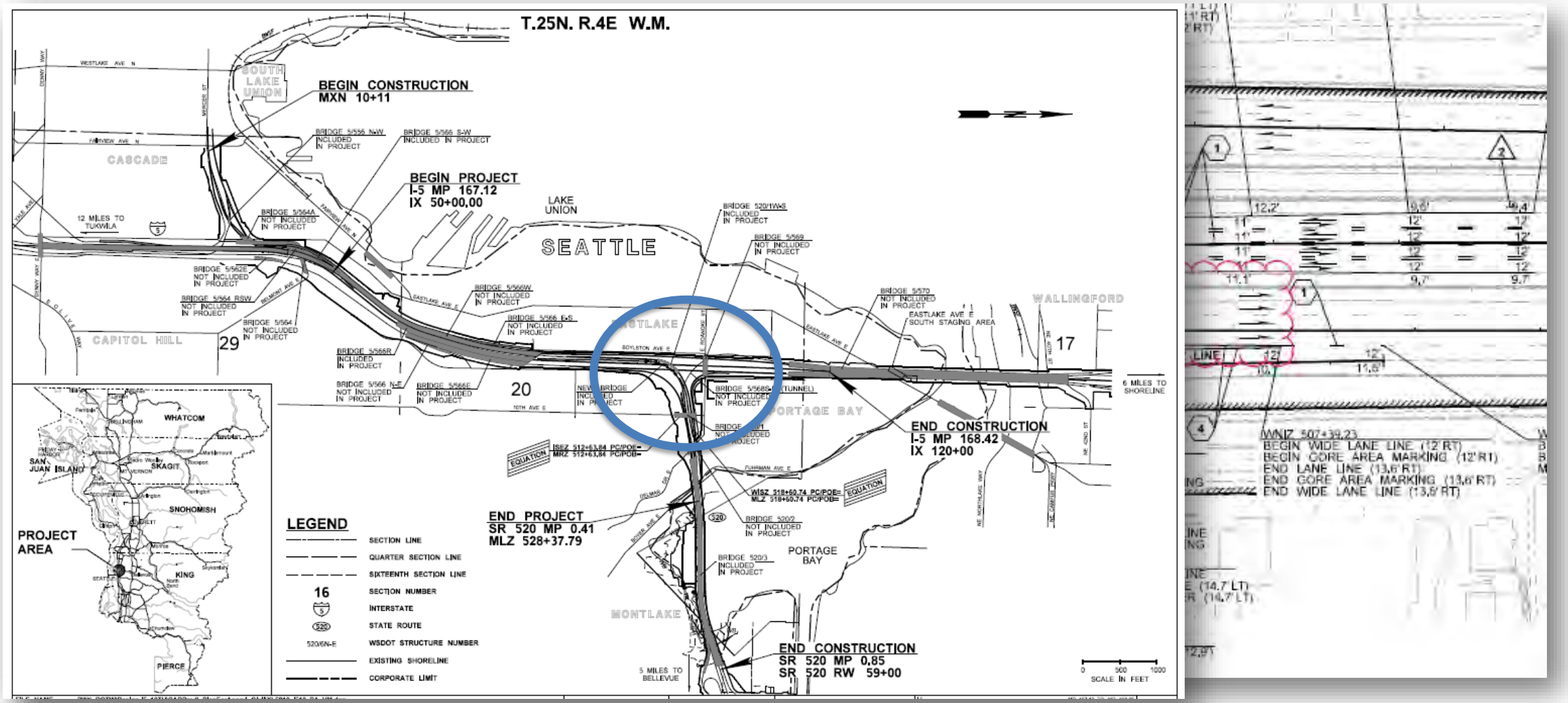
Possible attachments include:

- Vicinity Map
  - Not the Project Vicinity Map
  - Show the location of the Design Analysis
- Figures or Exhibits detailing the location
  - Cross Sections
- Safety Analysis Output
- Auto-Turn Exhibits

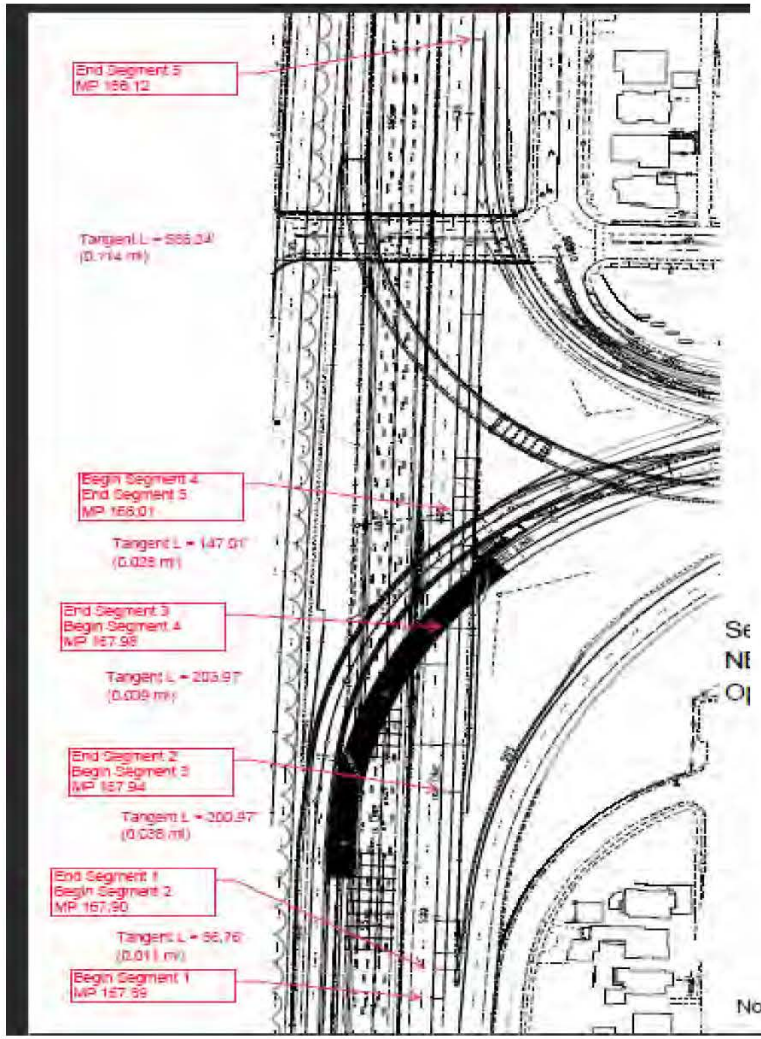
Don’t include other Design Documentation Package (DDP) items

- The Design Analysis is part of the DDP
- Other DDP items in the Design Analysis is duplicating effort

Vicinity Map



Safety Analysis



Output Summary

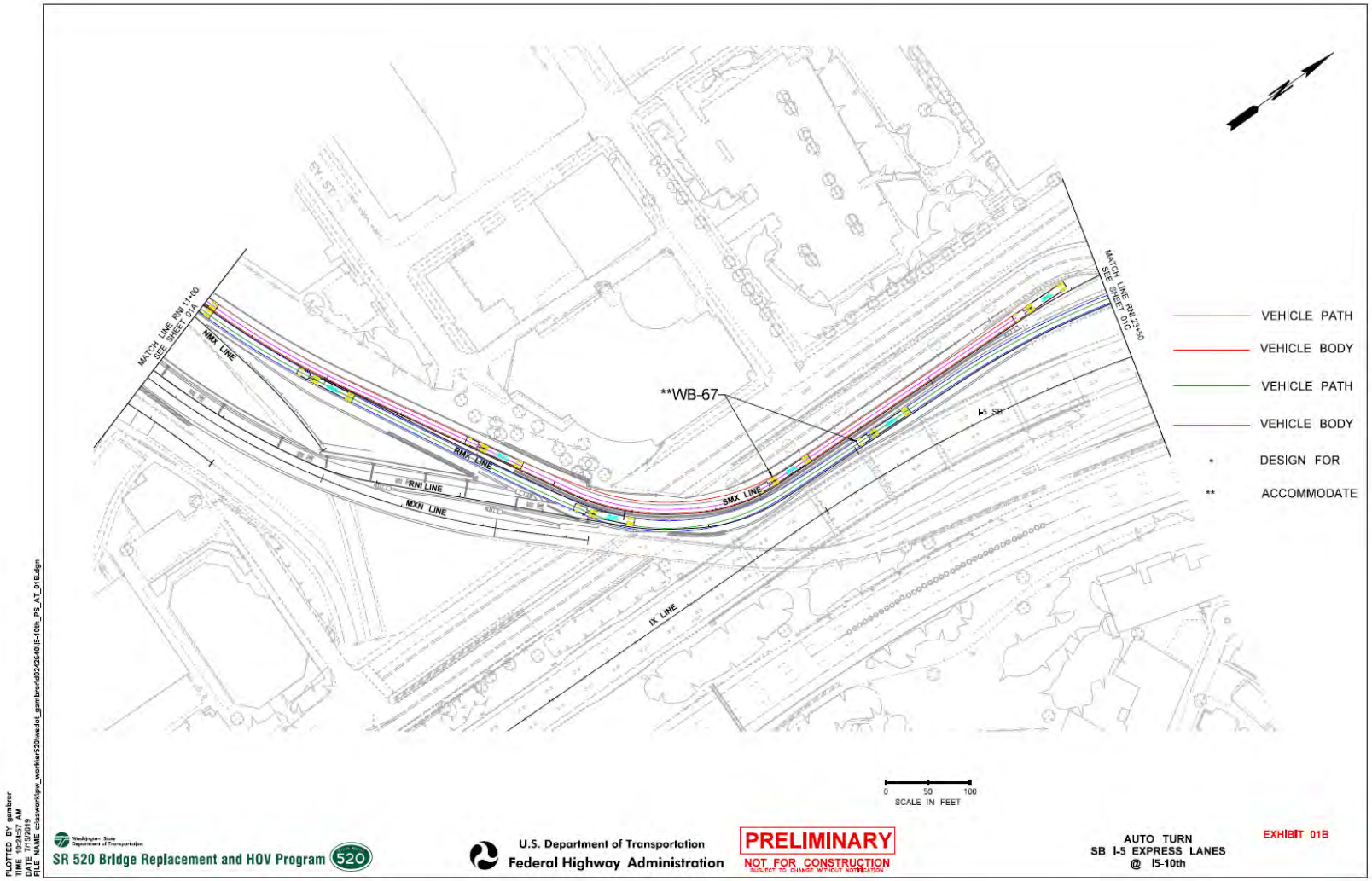
General Information						
Project description:	SR 520, I-5 Interchange Improvements - NB I-5 Mainline (Option B)					
Analyst:	jh	Date:	2/12/2020	Area type:	Urban	
First year of analysis:	2030					
Last year of analysis:	2030					
Crash Data Description						
Freeway segments	Segment crash data available?	No	First year of crash data:			
	Project-level crash data available?	No	Last year of crash data:			
Ramp segments	Segment crash data available?	No	First year of crash data:			
	Project-level crash data available?	No	Last year of crash data:			
Ramp terminals	Segment crash data available?	No	First year of crash data:			
	Project-level crash data available?	No	Last year of crash data:			

Estimated Crash Statistics							
Crashes for Entire Facility		Total	K	A	B	C	PDO
Estimated number of crashes during Study Period, crashes:		13.6	0.0	0.1	0.7	2.9	9.8
Estimated average crash freq. during Study Period, crashes/yr:		13.6	0.0	0.1	0.7	2.9	9.8
Crashes by Facility Component	Nbr. Sites	Total	K	A	B	C	PDO
Freeway segments, crashes:	5	13.6	0.0	0.1	0.7	2.9	9.8
Ramp segments, crashes:	0	0.0	0.0	0.0	0.0	0.0	0.0
Crossroad ramp terminals, crashes:	0	0.0	0.0	0.0	0.0	0.0	0.0
Crashes for Entire Facility by Year	Year	Total	K	A	B	C	PDO
Estimated number of crashes during the Study Period, crashes:	2030	13.6	0.0	0.1	0.7	2.9	9.8
	2031						
	2032						

	15	0	0.000	0			
	16	0	0.000	0			
Rumble strips	17	0	0.000	0			
	18	0	0.000	0			
	19	0	0.000	0			
	20	0	0.000	0			
Presence of ba	Ramp Segments						

1	Length of barrier ($L_{lb,1}$), mi:	0.011	0.038	0.039	0.028	0.114
	Distance from edge of traveled way to barrier face ($W_{off,in,1}$), ft:	10	10	4	4	10
2	Length of barrier ($L_{lb,2}$), mi:					
	Distance from edge of traveled way to barrier face ($W_{off,in,2}$), ft:					

Auto-Turn Exhibit



Where Are They Filed

- Project Engineer is responsible for filing of the original in ECM
- Original filed in the Design Approval or Project Development Approval
- Copy sent to HQ Design for filing
- Copy of Region Approved Design Analysis sent to HQ Design
- Enterprise Content Management (ECM)
- Records Retention

Review Process

PE draft DA

ASDE initial review

Address Comments

ASDE - FHWA reviews

Address Comments

Signatures

ASDE file DA in ProjectWise

PE file DA in ECM

1-2 Weeks

1-2 Weeks

1-2 Days*

Two weeks to a Month

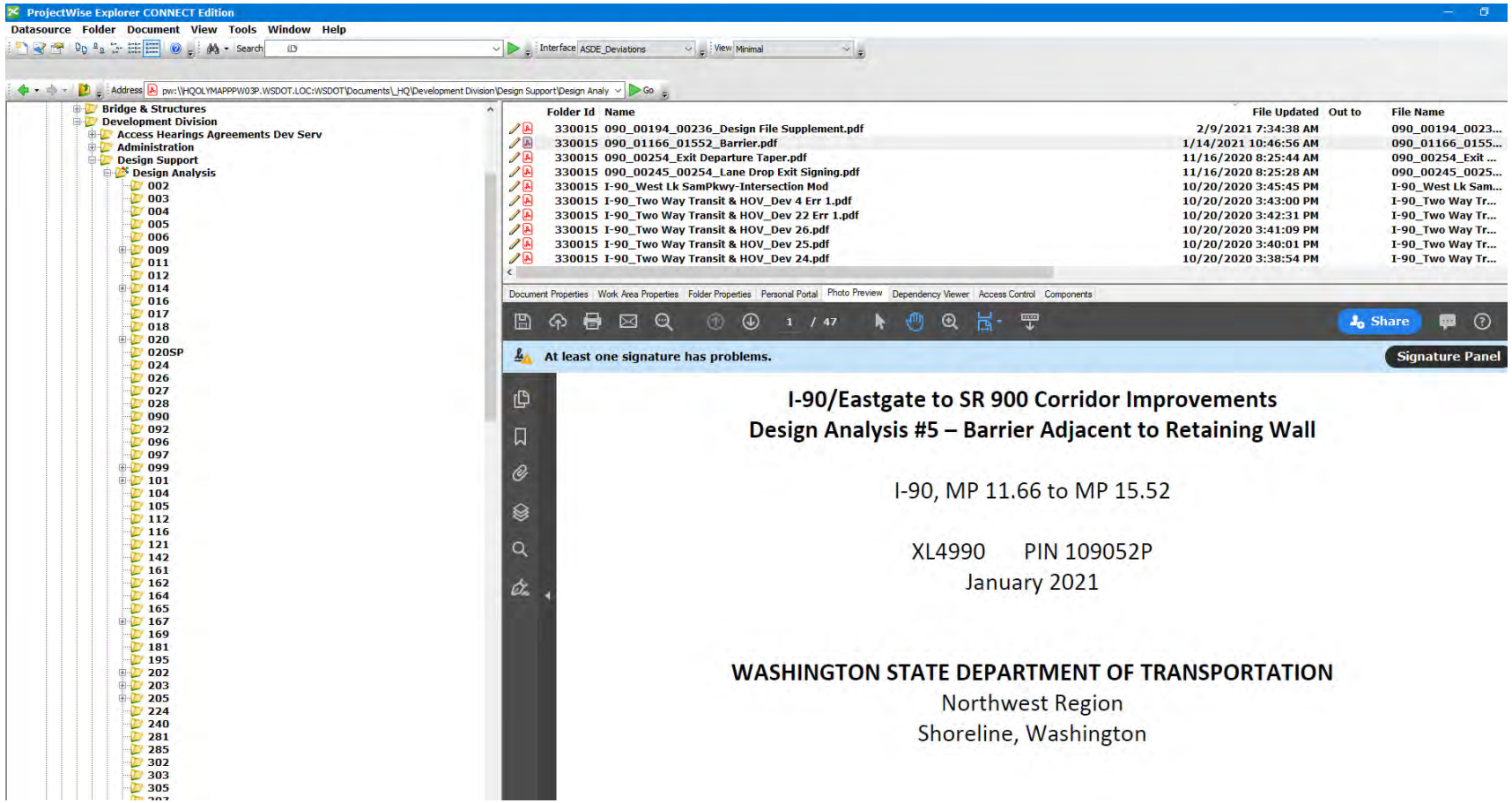
* Using Electronic Approval

Filing Design Analysis

- Design Analysis (DA) documents are filed by SR and milepost .
- They will be stored in ProjectWise. ProjectWise has the ability to collect metadata. The filename convention, file location, and ProjectWise metadata are described below.
- **Filename Convention**
  - DA file will be named as follows:
  - **AAA_BBBBB_EEEEE_DESCRIPTION.pdf**
  - AAA = *SR in three digit format* , Example: US 2 = 002, SR 20 = 020
  - BBBBB = *Beginning milepost in five digit format,* Example: MP 36.55 = 03655
    EEEEE = *Ending milepost in five digit format,* Example: MP 36.63 = 03663
    DESCRIPTION = *A short description of the item*
  - Example for DA: Lane Width, Shoulder Width
  - 002_03655_03663_Lane and Shoulder Width.pdf

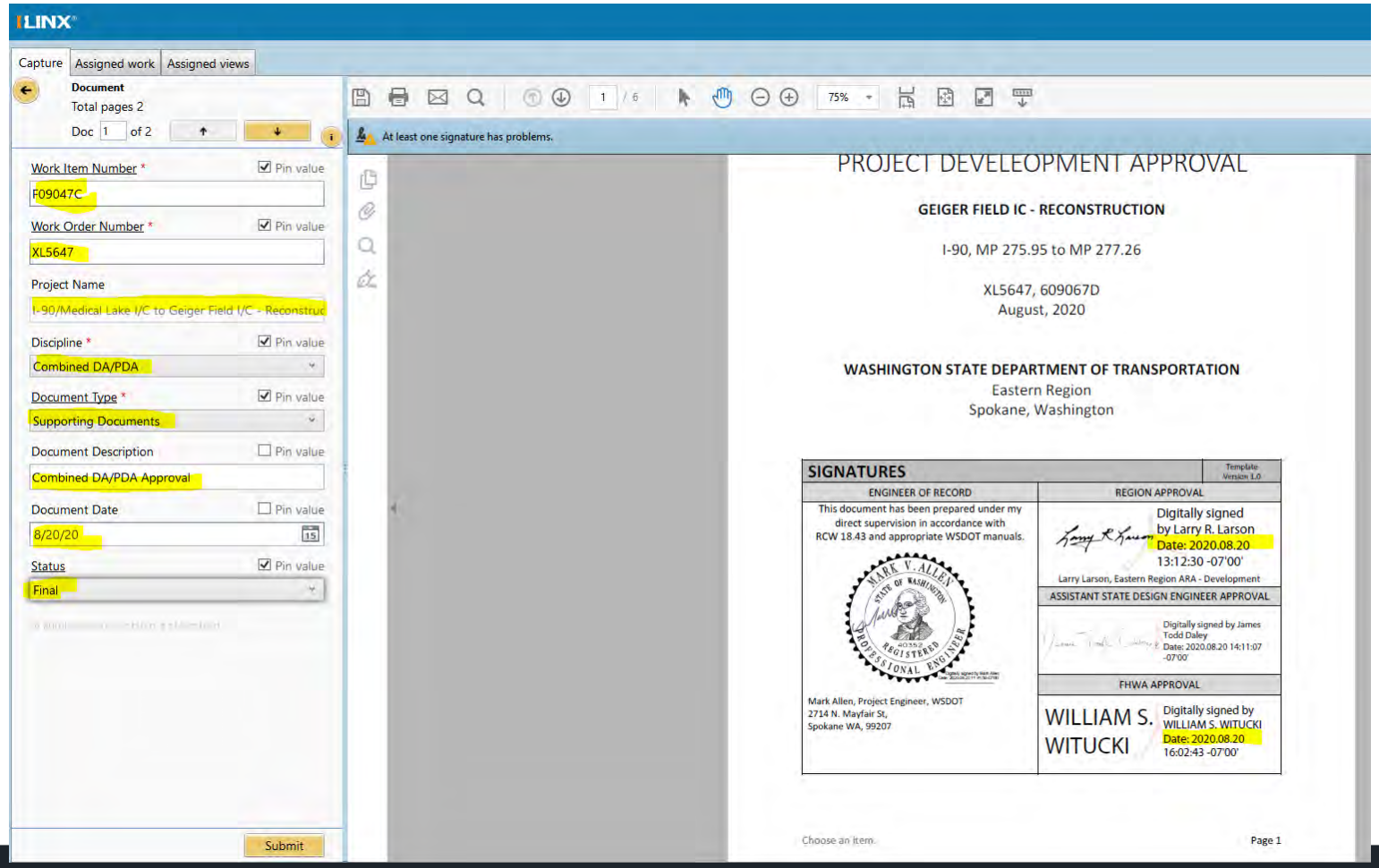
ProjectWise Example

090_01166_01552_Barrier.pdf



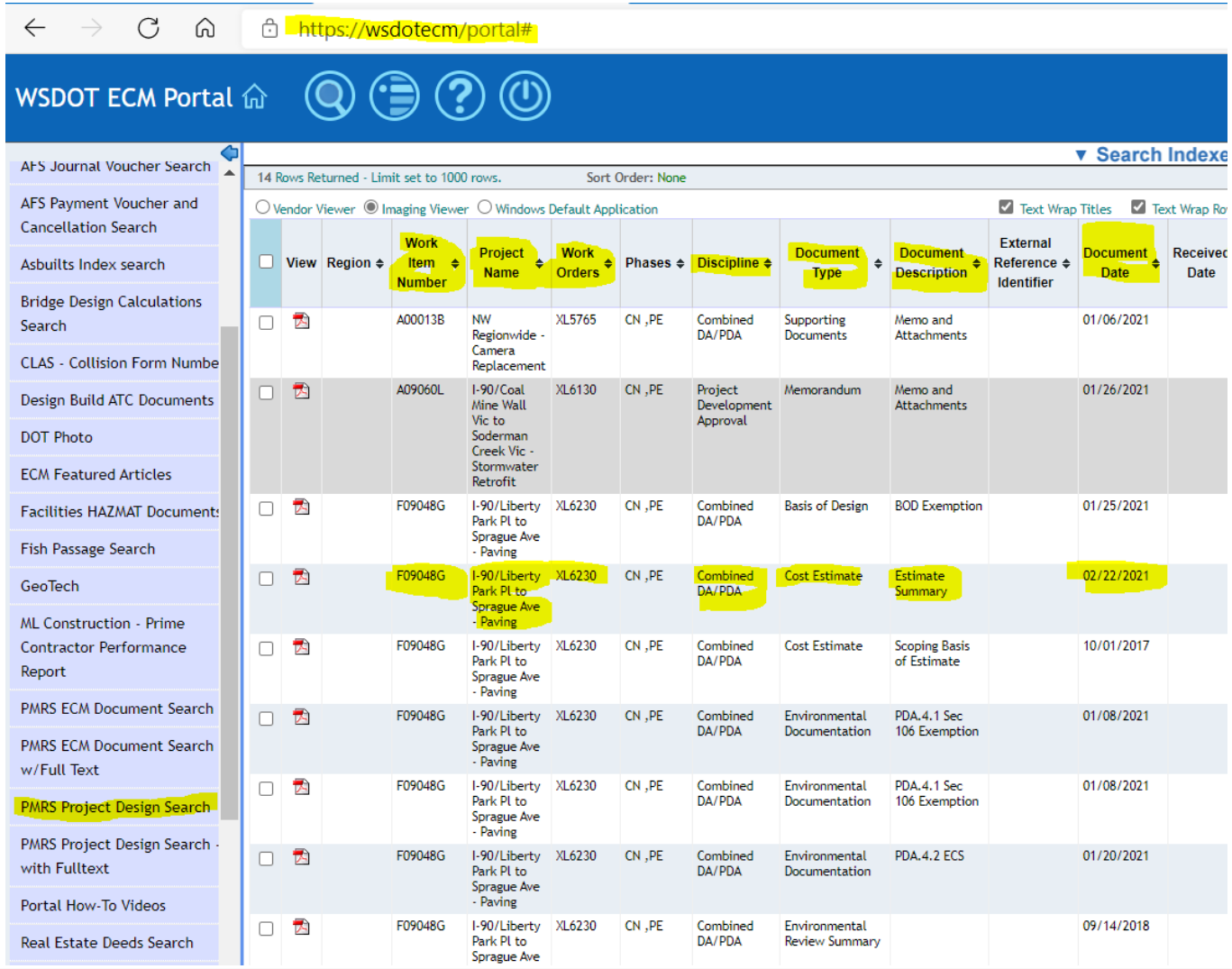
Data input in ECM Production

Coordinate with Region ECM power user to help you search and file documents. The power user will use https://wsdotecm/capture to file documents as shown below



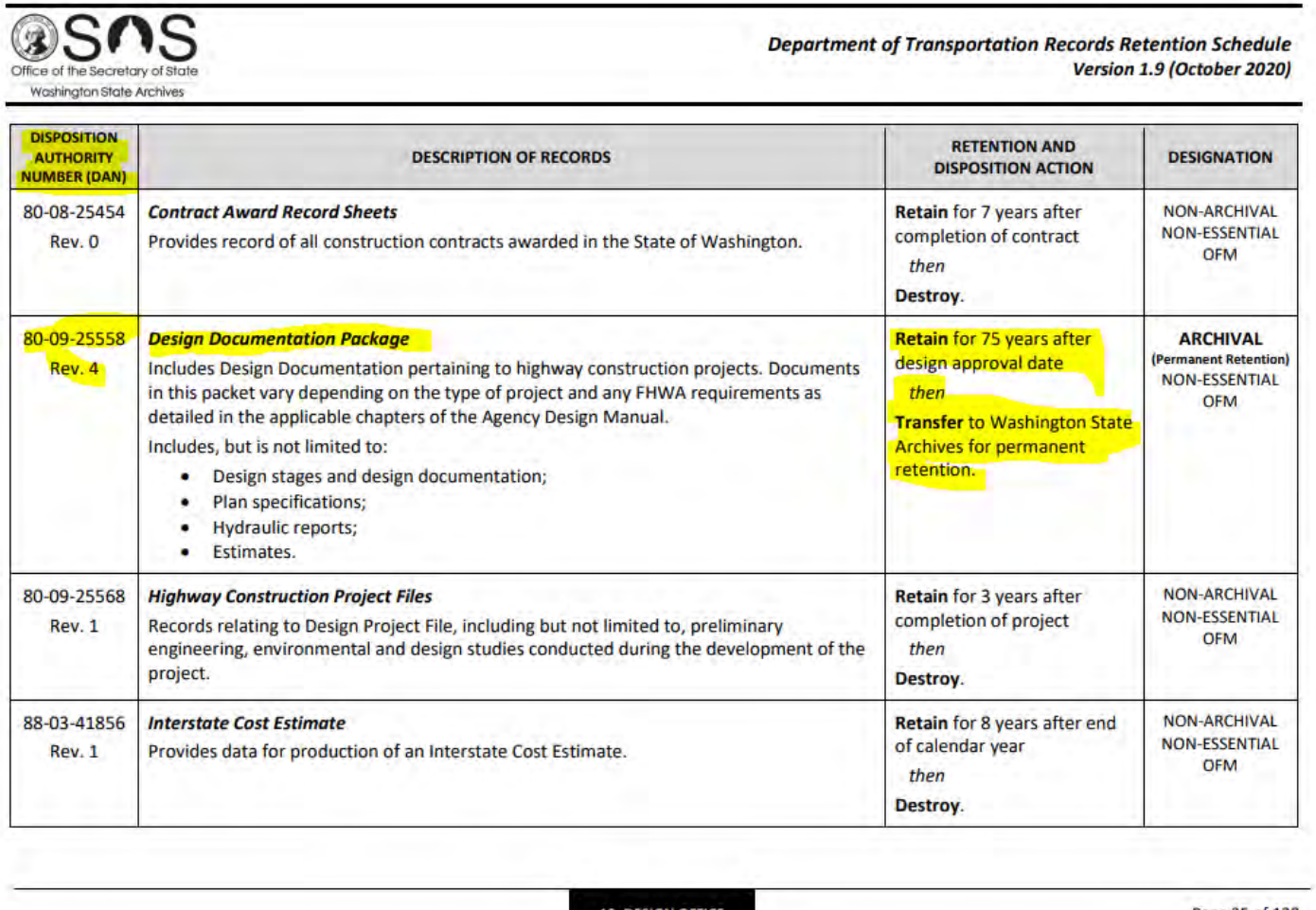
ECM Portal output

Use the following link https://wsdotecm/portal to search for a document in ECM.



Record Retention

Agency Unique Retention Schedule: https://www.sos.wa.gov/_assets/archives/recordsmanagement/department-of-transportation-records-retention-schedule-v.1.9-(october-2020).pdf



Office of the Secretary of State
Washington State Archives

Department of Transportation Records Retention Schedule
Version 1.9 (October 2020)

DISPOSITION AUTHORITY NUMBER (DAN)	DESCRIPTION OF RECORDS	RETENTION AND DISPOSITION ACTION	DESIGNATION
80-08-25454 Rev. 0	***Contract Award Record Sheets*** Provides record of all construction contracts awarded in the State of Washington.	**Retain** for 7 years after completion of contract *then* **Destroy**.	NON-ARCHIVAL NON-ESSENTIAL OFM
80-09-25558 Rev. 4	***Design Documentation Package*** Includes Design Documentation pertaining to highway construction projects. Documents in this packet vary depending on the type of project and any FHWA requirements as detailed in the applicable chapters of the Agency Design Manual. Includes, but is not limited to: • Design stages and design documentation; • Plan specifications; • Hydraulic reports; • Estimates.	**Retain** for 75 years after design approval date *then* **Transfer** to Washington State Archives for permanent retention.	**ARCHIVAL** (Permanent Retention) NON-ESSENTIAL OFM
80-09-25568 Rev. 1	***Highway Construction Project Files*** Records relating to Design Project File, including but not limited to, preliminary engineering, environmental and design studies conducted during the development of the project.	**Retain** for 3 years after completion of project *then* **Destroy**.	NON-ARCHIVAL NON-ESSENTIAL OFM
88-03-41856 Rev. 1	***Interstate Cost Estimate*** Provides data for production of an Interstate Cost Estimate.	**Retain** for 8 years after end of calendar year *then* **Destroy**.	NON-ARCHIVAL NON-ESSENTIAL OFM

10. DESIGN OFFICE

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