DESIGN DEVIATION NOs. 1 & 2

Supersedes Deviation #1 & #2 Approved on December 18, 2008

Horizontal Stopping Sight Distance and Shoulder Width Reduction

SR 99 S. Holgate St to S. King St. Viaduct Replacement Stage 2

MP 29.89 TO MP 30.78

XL-3237 PIN-809936D

June 2009

WASHINGTON STATE DEPARTMENT OF TRANSPORTATION

Alaskan Way Viaduct and Seawall Replacement Program
Seattle, Washington

Mark Anderson, PE
Project Engineer

Design Approval:

By _____ , P.E.
Susan Everett, PE Program Design Engineer

Date _____

By _____ , P.E.
Ed Barry, PE WSDOT Assistant State Design Engineer

Date _____

Washington State Department of Transportation

By _____ , P.E.
Randy Everett, PE FHWA Urban Area Engineer

Date _____

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Deviation revision

This document "Design Deviation Nos. 1 &2 Horizontal Stopping Sight Distance and Shoulder Width Reduction" supersedes the project's Design Deviation #1 & 2 "Horizontal Stopping Sight Distance (HSSD) and Shoulder Width Reduction near S Holgate Curve", approved Dec. 18, 2008.

Comment [KS1]: Briefly document what changes occurred to the original.

Project Overview

The Alaskan Way Viaduct & Seawall Replacement Program (AWVSRP) is located in an urban area within the City of Seattle in King County. The program limits extend along SR 99 from north of the S. Spokane Street Bridge (Milepost [MP] 29.29) to Mercer Street vicinity (MP 32.78) and underneath First Ave in downtown Seattle.

SR 99 is functionally classified as an Urban Principal Arterial Highway by Washington State Dept. of Transportation (WSDOT) and is currently classified as an M1 Managed Access Highway from S. Spokane St (MP 28.61) to Thomas St (MP 32.58). Speed limits are posted between 40-50mph.

It is also a designated National Highway System (NHS) route and a Highway of Statewide Significance, per WSDOT classification. The project corridor has a WSDOT freight tonnage designation of T-1 (more than 10 million tons per year), and the City of Seattle classifies it as a Major Truck Street.

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The AWVSRP is partially funded through a combination of state funds from the 2003 Nickel Funding Package and the 2005 Transportation Partnership Account (TPA) Package. It has also received funding from the U.S. Federal Highway Administration (FHWA) and the City of Seattle.

On March 14, 2007, the Project Team was directed by WSDOT to advance portions of the project that would contribute to improving safety and mobility, and have fundamental consensus among the project partners. One of the six Moving Forward: Early Safety and Mobility Projects (ESMP) is the South Holgate Street to South King Street Viaduct Replacement Project (H2K). This project has been divided into three stages and each stage will be released as a separate construction contract. Stage one involves relocating existing utilities; stage 2 involves reconstructing SR 99 from S. Holgate to King St; and stage 3 involves demolishing the existing viaduct and roadside restoration.

In January 2009, the Governor, King County, and the City of Seattle agreed to recommend replacing the existing Viaduct through downtown Seattle with a 55' diameter single bore tunnel that will include stacked roadways consisting of two northbound lanes with left and right shoulders, above two southbound lanes with left and right shoulders. The south portal to the tunnel will start at Royal Brougham Way S. (MP 30.32) and travel north under First Ave until reaching Mercer St (MP 32.78) where the north portal will emerge and connect to the existing SR 99 route near Ward St. (MP 33.08). There will be fully directional interchanges at the north and south portals (currently in the design phase) that will provide access to the city's Central Business District (CBD). Once the tunnel has been opened to traffic, and the existing Viaduct and detours are removed, the City of Seattle will construct new surface streets and urban design features along the waterfront.

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The removal and replacement limits for bridge structures within the H2K Stage 2 Project extend from approximately S. Holgate Street (MP 29.89) to S. Dearborn Street (MP 30.66). Other required improvements for SR 99 and city surface streets extend the project construction work as far north as Lenora Street (MP 31.79 vic.) and as far south as S. Spokane Street (MP 29.20). This project includes demolishing the existing viaduct and reconstructing infrastructure elements, including portions of many local streets and portions of SR 99. Near S. Holgate Street, SR 99 will transition from an at-grade roadway to a bridge structure over the existing railroad tracks and S. Atlantic Street, returning to at-grade near S. Royal Brougham Way. While construction for the deep bored tunnel takes place an interim transition bridge structure, expected to be in place for 4 to 5 years, will be built to connect the ultimate bridge structure spanning S Atlantic Street to the existing Viaduct near the Railroad Way Ramps (MP 30.78). After the tunnel is opened to traffic, this interim bridge structure and the existing Viaduct will be removed.

Design Matrix 3, line 3-7 (*WSDOT Design Manual* Figure 325-5, January 2009) applies to this project. This roadway is being designed to P-1 design class criteria.

This document requests deviation approval for horizontal stopping sight distance (HSSD) and Shoulder Width Reduction within the project limits for the SR 99 S. Holgate St. to S. King St Stage 2 project.

Existing Conditions though the Project Limits

On SR 99 within the program corridor limits, existing Average Daily Traffic (ADT) ranges from approximately 32,400 to 56,100 in the northbound direction and from 31,000 to 55,000 in the southbound direction. Ingress and egress on SR 99 from just north of S. Spokane Street (MP 29.26) to Thomas St. (MP 32.58) is currently limited to on- and off-ramps connecting to First Ave. S, Columbia Street, Seneca Street, Elliot Ave, Western Ave, and Denny Way.

The terrain in the S Holgate Street vicinity is mostly level. The posted speed limit is 50 mph in this segment for both the northbound and southbound roadways.

Within the project limits, SR 99 existing lane widths range from 9.5 to 12 feet and shoulder widths range from 0 to 3 feet. Near S Holgate Street (MP 29.89 vic.), the existing lane widths are 12 feet and the shoulder widths are approximately 1 foot. The existing transition between the six-lane surface highway and the viaduct occurs near S. Holgate Street. The existing curve near S. Holgate Street is built on separate elevated structures for both northbound and southbound. The northbound roadway has a radius of 920 feet, and the southbound roadway has a radius of 1040 feet, with a superelevation rate of 6% for both roadways. The existing roadway design speed is 50 mph when these existing horizontal geometrics are compared against the 6% maximum superelevation rate table (*WSDOT Design Manual* Figure 642-4c, November 2007) based on current design guidelines. The vertical curve lengths in this area for both northbound and southbound roadways are 350 feet. The grade for both roadways in this area is 5 percent. Figure 650-11 from the WSDOT Design Manual (May 2008) indicates these existing sag curves meet 50 mph design criteria.

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Comment [KS2]: Please define what the limits are for the project.

Comment [KS3]: Should there be a note that briefly discusses that this section of SR 99 was originally designed using design criteria for a UMA-1 design classification which allows using the 6% table superelevation rate?

Suggest revising: To confirm the existing roadway design speed of 50 mph, a check was made based upon current design guidelines using existing horizontal geometrics and the 6% maximum superelevation rate table (*WSDOT Design Manual* Figure 642-4c, November 2007).

Comment [KS4]: What are the grades for N & S (can the profiles be included)?

Comment [KS5]: Not sure where the "area" is, and how does this relate to the vertical curves identified in the previous sentence?

Comment [KS6]: Is this the correct reference?

The Seattle International Gateway (SIG) Rail Yard lies immediately east of SR 99 along the entire length of the SR 99 project limits, and the Whatcom Rail Yard is immediately west of SR 99 in the vicinity of S. Holgate Street. In some areas the closest rail tracks are within 12 feet of the roadway.

The project team is coordinating with the SR 519/I-90 to SR 99 Intermodal Access Project—I/C Improvements (SR 519 Phase 2) and the SR 99 Deep Bore Tunnel Project.

Comment [KS7]: This seems out of place in the "existing" section. Suggest moving this to the "Project Overview" section.

Proposed Roadway Configuration in Vicinity of S. Holgate Street

The H2K Stage 2 Project will reconstruct the existing SR 99 facility to a new alignment in the south portion of the project with at-grade, retained fill, and elevated roadways. The new SR 99 alignment begins major roadwork to the south near S. Walker Street (MP 29.89) with a six-lane, at-grade roadway that transitions to an elevated structure near S. Holgate Street. SR 99 continues to traverse over the railroad tracks and South Atlantic Street before returning to an at-grade roadway in the vicinity of S. Royal Brougham Way, MP???.

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Comment [KS8]: What happens to SR 99 north of RBW?

The roadway lane and shoulder layout consists of a 4-foot left shoulder, three 12-foot lanes, and a 10-foot-wide right shoulder for both the northbound and southbound roadways. The northbound and southbound left and right shoulders will vary along the S. Holgate Curve in order to maximize the stopping sight distance (SSD) and accommodate existing site constraints.

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The SR 99 Corridor Analysis established the design speed for SR 99 as 50 mph in the northbound direction and 55mph in the southbound direction from the southern project limit to the vicinity of S. King Street, with a posted speed of 50 mph along this roadway segment (*SR 99 Corridor Analysis,* (month 2009)).

Comment [KS9]: This should be 50, 55 mph was not agreed to for the SB direction.

Comment [KS10]: MP??

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The design speed for this project is 50 mph from the southern project limits to the vicinity of S. Royal Brougham Way. The design speed is reduced to 40 mph north of S. Royal Brougham Way through the transition section (SR 99 transitions from an at-grade side-by-side roadway to an aerial stacked structure) to where SR 99 re-connects onto the existing Viaduct structure just north the Railroad Way ramps, MP??.

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Comment [b11]: State that this is documented in the approved Construction Corridor Analysis and is only temporary. State that the permanent design speed will be documented in the Corridor Report.

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Table 1 summarizes those geometric design elements that are proposed for deviations on SR 99 in the vicinity of S. Holgate Street. The station limits of the deviations are listed in Tables 2 and 3.

Table 1: Proposed Deviated Geometric Elements in Vicinity of S. Holgate St. Curve

Geometric Element	Standard Design	Proposed SR 99 Design
Deviation #1 - Horizontal Stopping Sight Distance (Figure 650-2, January 2009 & Figure 650-3, May 2008)	Northbound 495' Southbound 542'	Northbound 443' Southbound 465'

Comment [KS12]: Identify what this value is based upon. Should the standard be for design speed of 60 mph (Figure 440-6)? How was Alternative#2 design speed of 55 mph arrived at found on pg 7, line 6?

Deviation #2 - Shoulder Width (Figure 440-6, May 2008)	10 foot (inside) 10 foot (outside)	NB: varies 1 to 5.5 feet (inside) varies 6 to 10 feet (outside) SB: varies 1 to 21 feet (inside) varies 6 to 10 feet (outside)

Deviation Description

This document requests deviations for horizontal stopping sight distance and left and right shoulder widths for both the northbound and southbound SR 99 mainline near S. Holgate Street (MP 29.90 vic.). The following sections define the proposed roadway deviations between MP 29.89 and MP 30.78. The requested shoulder deviations are required to match existing conditions at the beginning of the project where the proposed roadway section matches the existing roadway section.

Stopping Sight Distance

WSDOT Design Manual Fig. 650-2 and 650-3 defines the required minimum stopping sight distance based on design speed and vertical grade. The project team is requesting a deviation for the horizontal stopping sight distance (HSSD) for the northbound outside (right side direction of travel) lane and southbound inside (left side in direction of travel) lane roadways between approximate stations 149+50 and 159+50, as shown on Figures 1A-D.

The project team proposes designing the northbound outside lane at this location for a HSSD of 443 ft. The line of sight will be inside the right side barrier face. The roadway cross-section through the curve from left to right, ahead on stationing, will consist of a barrier, 4-foot left shoulder, two 12-foot lanes, one 13-foot right lane, a 10-foot right shoulder and a right side barrier. The 13-foot right lane is provided in order to accommodate the turning roadway width criteria per the WSDOT Design Manual.

The project team proposes designing the southbound inside lane at this location for a HSSD of 465 ft. The line of sight will be inside the left side barrier face. The roadway cross-section through the curve consists of an inside left shoulder that varies between 4 and 21 feet, a 13-foot left lane, two 12-foot lanes, and a 10-foot right shoulder. The inside shoulder was widened from 4 feet to 21 feet to provide adequate clearance for the construction sequencing and maintenance of traffic while the project is under construction. The widened part of the shoulder also increases the HSSD through the curve to provide standard sight distance for a vehicle traveling at 50 miles per hour, which is the posted speed through the curve (the design speed of the curve is 55 mph). WSDOT's Northwest Region Traffic has created a striping plan clearly delineating the widened shoulder to prevent drivers from using it as a pull-out parking location.

Table 2 summarizes the minimum stopping sight distance required and the proposed stopping sight distance near S. Holgate Street, which meets a 50 mph stopping sight distance design guideline.

Comment [KS13]: Use same terminology as documentation below (left and right).

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Comment [KS14]: Could reference a typical roadway section (new a figure for both the N & S roadways)

Comment [KS15]: Should the DM reference be provided?

Comment [KS16]: Is this for the Stage 2 project and all of the traffic shifting needed to construct the structures? Please provide a brief description of what is included in the "maintenance"

Comment [KS17]: This speed was not agreed to. Please revise.

Table 2: Stopping Sight Distance in S. Holgate St. Curve Vicinity

Direction	Grade	Required Minimum Stopping Sight Distance for 55 mph (Design Manual Figure 650-2&3, May 2008)	Required Minimum Stopping Sight Distance for 50 mph (Design Manual Figure 650-2&3, May 2008	Proposed Minimum Stopping Sight Distance
Northbound	0%	495 feet	425 feet	443 feet
Southbound	-5%	542 feet	465 feet	465 feet

Shoulder Width

A deviation for shoulder width is proposed along the new SR 99 alignment between the stations as shown in Table 3 and on Figures 1A-D. Table 3 lists the current design standard and proposed left and right shoulder widths for the mainline curves near the beginning and ending of the project, as well as the minimum shoulder width.

Table 3: Shoulder Widths

Direction	Left Shoulder Width (feet)		Right Shoulder Width (feet)	
	Standard (Design Manual Figure 440-6, May 2008)	Proposed	Standard (Design Manual Figure 440-6, May 2008	Proposed
Northbound	10	141+94.95 to 177+70 Varies 1 to 5.5	10	141+93 to 146+92 Varies 6 to 10
Southbound	10	141+92.78 to 177+64 Varies 1 to 21	10	141+94 to 149+80 Varies 6 to 10

The transition from existing shoulder widths to proposed shoulder width along both the northbound and southbound roadways generally occurs south of the Holgate curve as seen in Figure 1A - D. Through the Holgate curve the left and right shoulder widths vary, particularly the left shoulder in the southbound direction of travel, which increases horizontal sight distance without increasing the radius of the preferred curve or traveled way width. Through this area, SR 99 generally remains within the existing roadway footprint between the rail yards.

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Comment [KS18]: The 55 mph speed was not agreed to, so this column is not applicable.

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Comment [KS19]: Without the Figures to look at, how does the Stationing and MP correlate?

Comment [KS20]: Please discuss standing water ponding along the shoulder and impacts to the traveled way. State that the hydraulic design will keep water out of the travelled way during the design storm event.

Comment [b21]: Attach the figure

Alternatives Considered

The project team developed and assessed alternate alignments to best meet WSDOT design standards, minimize impacts to adjacent rail facilities, and allow for efficient staging of the construction of the project's south end. The alignment alternatives for the mainline roadway are summarized in the following sections.

Alternative 1: Preferred alternative – Nonstandard Stopping Sight Distance and Shoulder Width

Alternative 1 provides an alignment that maximizes horizontal stopping sight distance while minimizing railroad and right-of-way impacts. The preferred roadway configuration is illustrated in Figures 1A-D. The preferred alternative includes deviations for the stopping sight distance and shoulder width identified in the previous sections. The following justifications are provided for these deviations.

Through preliminary design and discussions with the SR 99 South End Subcommittee, the Port of Seattle, the BNSF railroad and the Union Pacific Railroad it was identified that there would be a significant negative impact on the region, particularly the industrial port area, if the railroads were unable to continue operating at a capacity that ensures their viability. Additionally, significant growth in both port and rail usage is anticipated and requires that these facilities function at an increased level of activity. The following constraints have been identified:

- There is insufficient right-of-way between the Whatcom Rail Yard and SIG Rail Yard for full SR 99 mainline geometric guidelines to be met without impacting rail yard configuration and capacity;
- Track relocation/reconfiguration cannot be accommodated within the existing SIG Yard due to space constraints;
- Throughput of the rail yard is anticipated to increase significantly, requiring that current and future rail operations work efficiently within the constrained rail yard;
- Track length is a key consideration in the assembly and staging of trains and is essential to maintaining the efficiency and capacity of rail yard operations.

The proposed design of the SR 99 roadway avoids adversely impacting rail operations because the design does not require major reconfiguration of the SIG Rail Yard, and has minor permanent impacts to the Whatcom Yard. These stopping sight distance and shoulder width deviations avoid major reconfigurations to the SIG Rail Yard and reduce the amount of reconfiguration of the Whatcom Rail Yard. The shoulder width deviation at this location also allows for the transition between the overall narrower existing SR 99 roadway south of the project, and the overall wider proposed roadway to the north without requiring further westward movement of the Whatcom Rail Yard. Moving the Whatcom Rail Yard farther west would impact the existing East Marginal Way surface street at the south end of the Holgate curve. The October 2005 CEVP 90% level cost estimate for reconfiguring the Whatcom Rail Yard was approximately $15 million.

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Comment [KS23]: relocation??

In addition, a deviation is necessary for the shoulder widths at the southern project limits because of the required roadway width transitioning between the overall narrower existing SR 99 roadway to the south, and the overall wider proposed roadway to the north.

Alternative 2: Full Design Standards Alternative

Alternative 2 provides an alignment that meets horizontal stopping sight distance requirements for a 55 MPH design speed. This alternative requires the removal of the Whatcom RR Yard and all associated constraints to facilitate a westerly shift of SR 99 and larger radii for the northbound and southbound roadways. This alternative would also allow simpler solutions to construction staging and maintenance of traffic for the project.

This alternative does not rely on the acquisition of additional right-of-way, however, the project would have to acquire the rights to property that is currently occupied by the Union Pacific and Burlington Northern Santa Fe railroads. The cost and schedule impacts associated with acquisition of these rights are prohibitive. A formal Project Decision process to reject this alternative was conducted and documented in April, 2008 (decision documented in *AWVSR Program Trend Number SS005 for Issues Relating to Lead Railroad Track for BNSF and UPRR and the Whatcom Yard*).

Justifications

Alternative 1 (Preferred Alternative) proposes nonstandard design elements for the curve near S. Holgate Street which are:

- Minimum horizontal stopping sight distance: 443 feet in the northbound direction and 465 feet in the southbound direction, which meets the requirements for a 50 mph design speed (but does not meet required 55mph design speed for area in question).
- Northbound shoulder width: Varies 1 foot to 5.5 feet (left), and varies 6 feet to 10 feet (right).
- Southbound shoulder width: Varies 1 foot to 21 feet (left), and varies 6 feet to 10 feet (right).

The justifications for this recommendation are:

1. There exists insufficient right-of-way to accommodate a roadway with full standard roadway design elements, with very low probability of being able to acquire additional right-of-way due to uses of regional importance on adjoining properties;

2. Application of full standard roadway design would result in significant adverse impacts to existing rail operations, which are considered highest and best use of the property on which these operations occur, and are not easily moved to, nor are viable on, other properties in the area;

Comment [KS24]: How was this design speed selected, per 440-6, min is 60 mph

Comment [KS25]: Would the rail yard have to be replaced or is it completed eliminated?

Comment [KS26]: Please ensure consistency in naming conventions (see pg 7, line 37)

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Comment [KS27]: Provide a brief explanation on what these are.

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Comment [KS28]: Please provide more detail on how.

Comment [KS29]: Was this approved by anyone or was there an agreement of some type reached and who was involved??

Comment [b30]: Where is the mitigation? Illumination, signing, delineation, ect???

Comment [KS31]: Should this be deleted as it is found in the Justification #4?

Comment [KS32]: Please provided a brief explanation why they are not.

3. The proposed shoulder widths must match back into existing shoulder widths at the end of the project limits, which requires that a portion of the shoulder widths within the project limits be tapered down to match the non-standard shoulder widths of the existing roadway;

4. The horizontal stopping sight distances that are provided meet standards for a 50-mph design speed, which matches the posted speed limit for the facility.

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Horizontal Stopping Sight Distance (Figure 650-2 January 2009 & Figure 650-3, May 2008)	Northbound 495’ Southbound 542’	Northbound 443’ Southbound 465’