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# 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 \_\_\_\_\_

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

Date \_\_\_\_\_



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1 **Deviation revision**

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

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

5 **Project Overview**

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

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

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

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

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

27 In January 2009, the Governor, King County, and the City of Seattle agreed to recommend replacing  
28 the existing Viaduct through downtown Seattle with a 55’ diameter single bore tunnel that will  
29 include stacked roadways consisting of two northbound lanes ~~with left and right~~ shoulders, above  
30 two southbound lanes ~~with left and right~~ shoulders. The south portal to the tunnel will start at Royal  
31 Brougham Way S. (MP 30.32) and travel north under First Ave until reaching Mercer St (MP 32.78)  
32 where the north portal will emerge and connect to the existing SR 99 route near Ward St. (MP  
33 33.08). ~~There will~~ be fully directional interchanges ~~at the north and south portals~~ (currently in the  
34 design phase) that will ~~provide~~ access to the city’s Central Business District (CBD). Once the tunnel  
35 has been opened to traffic, and the existing Viaduct and detours are removed, the ~~City~~ of Seattle will  
36 construct new surface streets and urban design features ~~along~~ the waterfront.

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

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Deleted: while construction for the deep bored tunnel takes place

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

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

## 18 Existing Conditions though the Project Limits

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

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

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

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?

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

4 The project team is coordinating with the SR 519/I-90 to SR 99 Intermodal Access Project—I/C  
 5 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.

## 6 Proposed Roadway Configuration in Vicinity of S. Holgate 7 Street

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

- Deleted: along
- Deleted: alignment
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- Comment [KS8]:** What happens to SR 99 north of RBW?
- Deleted: full standard mainline
- Deleted: proposed

14 The roadway lane and shoulder layout consists of a 4-foot left shoulder, three 12-foot lanes, and a  
 15 10-foot-wide right shoulder for both the northbound and southbound roadways. The northbound  
 16 and southbound left and right shoulders will vary along the S. Holgate Curve in order to maximize  
 17 the stopping sight distance (SSD) and accommodate existing site constraints.

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

- Comment [KS9]:** This should be 50, 55 mph was not agreed to for the SB direction.
- Comment [KS10]:** MP??
- Deleted: n

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

- Deleted: anticipated
- Deleted: At S. Royal Brougham Way, the design speed is reduced to 40 mph
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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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27 Table 1 summarizes those geometric design elements that are proposed for deviations on SR 99 in  
 28 the vicinity of S. Holgate Street. The station limits of the deviations are listed in Tables 2 and 3.

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

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

**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?

<u>Deviation #2 - Shoulder Width</u> (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)
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**Comment [KS13]:** Use same terminology as documentation below (left and right).

**Deleted:** Horizontal Stopping Sight Distance<sup>¶</sup>  
(Figure 650-2 January 2009 & Figure 650-3, Ma... [1])

## 1 Deviation Description

2 This document requests deviations for horizontal stopping sight distance and left and right shoulder  
3 widths for both the northbound and southbound SR 99 mainline near S. Holgate Street (MP 29.90  
4 vic.). The following sections define the proposed roadway deviations between MP 29.89 and MP  
5 30.78. The requested shoulder deviations are required to match existing conditions at the beginning  
6 of the project where the proposed roadway section matches the existing roadway section.

## 7 Stopping Sight Distance

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

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13 The project team proposes designing the northbound outside lane at this location for a HSSD of  
14 443 ft. The line of sight will be inside the right side barrier face. The roadway cross-section through  
15 the curve from left to right, ahead on stationing, will consist of a barrier, 4-foot left shoulder, two  
16 12-foot lanes, one 13-foot right lane, a 10-foot right shoulder and a right side barrier. The 13-foot  
17 right lane is provided in order to accommodate the turning roadway width criteria per the WSDOT  
18 Design Manual.

**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?

19 The project team proposes designing the southbound inside lane at this location for a HSSD of 465  
20 ft. The line of sight will be inside the left side barrier face. The roadway cross-section through the  
21 curve consists of an inside left shoulder that varies between 4 and 21 feet, a 13-foot left lane, two  
22 12-foot lanes, and a 10-foot right shoulder. The inside shoulder was widened from 4 feet to 21 feet  
23 to provide adequate clearance for the construction sequencing and maintenance of traffic while the  
24 project is under construction. The widened part of the shoulder also increases the HSSD through  
25 the curve to provide standard sight distance for a vehicle traveling at 50 miles per hour, which is the  
26 posted speed through the curve (the design speed of the curve is 55 mph). WSDOT's Northwest  
27 Region Traffic has created a striping plan clearly delineating the widened shoulder to prevent drivers  
28 from using it as a pull-out parking location.

**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.

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

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

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

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

2

3 **Shoulder Width**

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

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8 **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

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

9 The transition from existing shoulder widths to proposed shoulder width along both the  
 10 northbound and southbound roadways generally occurs south of the Holgate curve as seen in Figure  
 11 1A - D. Through the Holgate curve the left and right shoulder widths vary, particularly the left  
 12 shoulder in the southbound direction of travel, which increases horizontal sight distance without  
 13 increasing the radius of the preferred curve or traveled way width. Through this area, SR 99  
 14 generally remains within the existing roadway footprint between the rail yards.

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

15

## 1 Alternatives Considered

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

### 6 Alternative 1: Preferred alternative – Nonstandard Stopping 7 Sight Distance and Shoulder Width

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

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

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Deleted: The following constraints have been determined through preliminary design and discussion with the SR 99 South End Subcommittee, the Port of Seattle, the BNSF railroad and the Union Pacific Railroad:

Comment [KS22]: Please also spell this out

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

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

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Comment [KS23]: relocation??

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

## 4 **Alternative 2: Full Design Standards Alternative**

5 Alternative 2 provides an alignment that meets horizontal stopping sight distance requirements for a  
6 55 MPH design speed. This alternative requires the removal of the Whatcom RR Yard and all  
7 associated constraints to facilitate a westerly shift of SR 99 and larger radii for the northbound and  
8 southbound roadways. This alternative would also allow simpler solutions to construction staging  
9 and maintenance of traffic for the project.

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

### 16 **Justifications**

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

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

25 The justifications for this recommendation are:

- 26 1. There exists insufficient right-of-way to accommodate a roadway with full standard roadway  
27 design elements, with very low probability of being able to acquire additional right-of-way  
28 due to uses of regional importance on adjoining properties;
- 29 2. Application of full standard roadway design would result in significant adverse impacts to  
30 existing rail operations, which are considered highest and best use of the property on which  
31 these operations occur, and are not easily moved to, nor are viable on, other properties in  
32 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 completely eliminated?

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

**Deleted:** As mentioned above, the shoulder widths must be deviated to match into the existing SR 99 facility at the beginning of the project.

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

**Deleted:** . Removal of these RR constraints would

**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???

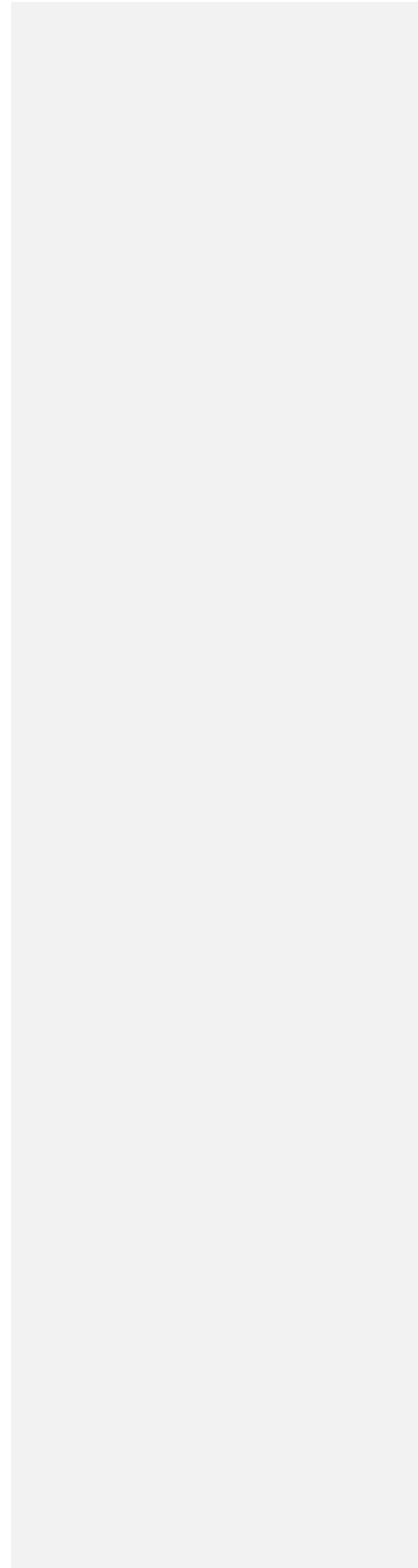
**Comment [KS31]:** Should this be deleted as it is found in the Justification #4?

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



- 1 3. The proposed shoulder widths must match back into existing shoulder widths at the end of  
2 the project limits, which requires that a portion of the shoulder widths within the project  
3 limits be tapered down to match the non-standard shoulder widths of the existing roadway;
- 4 4. The horizontal stopping sight distances that are provided meet standards for a 50-mph  
5 design speed, which matches the posted speed limit for the facility.

6



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