Alaskan Way Viaduct & Seawall Replacement Program

U.S. Department of Transportation Federal Highway Administration | WSDOT | King County | City of Seattle

SR 99 Bored Tunnel Alternative - Design Approval Package MP 29.83 TO MP 32.83

Submitted to:
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June 2009

The Alaskan Way Viaduct & Seawall Replacement Program

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Agreement No. Y-9715

Task CE.04

The Alaskan Way Viaduct & Seawall Replacement Program is a joint effort between the Federal Highway Administration (FHWA), the Washington State Department of Transportation (WSDOT), and the City of Seattle. To conduct this project, WSDOT contracted with:

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Washington State Department of Transportation

U. S. Department of Transportation
Federal Highway Administration

The Alaska Way Viaduct & Seawall Replacement Program
Design Approval Package
SR 99 Bored Tunnel Alternative
MP 29.89 to MP 32.83

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June 2009

WASHINGTON STATE DEPARTMENT OF TRANSPORTATION

Northwest Division
Seattle, Washington

Dawn McIntosh, P.E.
Project Engineer

Design Recommended for Approval:

Date _____

By _____, P.E.
Alec Williamson, Engineer Manager

Design Approval:

Date _____

By _____ , P.E.
Ed Barry, Assistant State Design Engineer for AWVRP

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1.0 Program Overview

The Alaskan Way Viaduct and Seawall Replacement Program (AWVSRP) design team has been working since 2001 to develop alternatives for the replacement of the Alaskan Way Viaduct. The team prepared and published a Draft Environmental Impact Statement (Draft EIS) in March 2004 and a Supplemental Draft Environmental Impact Statement (Supplemental Draft EIS) in September 2006. The team also prepared and submitted a Design Approval Package (DAP) to the Washington State Department of Transportation (WSDOT) for the preferred tunnel alternative in February 2007; however, the approval of that package was deferred while the project partners (City of Seattle, WSDOT, King County, and the U.S. Federal Highway Administration (FHWA)) re-evaluated the preferred configuration of State Route (SR) 99 in Seattle's central waterfront area.

On March 14, 2007, the Project Team was directed by WSDOT to advance portions of the program that would contribute to improving safety and mobility, and that have fundamental consensus among the project partners. The Governor and WSDOT then identified six "Moving Forward: Early Safety and Mobility Projects" that are currently being implemented while the preferred SR 99 configuration in the central waterfront area was re-evaluated. One of these projects is the South Holgate Street to South King Street Viaduct Replacement, which is currently under design and scheduled for construction in fall 2009.

In January 2009 a letter of agreement between WSDOT, King County, and the City of Seattle identified a four-lane, single-bore tunnel as the recommended alternative for replacing the Alaskan Way Viaduct. The Single-bore Tunnel Alternative (Tunnel Alternative) would connect to the South Holgate Street to South King Street Viaduct Replacement Project (South Project or H2K) at approximately S. Holgate Street Milepost (M.P. 29.89) in the south with a cut-and-cover section that extends to First Avenue and S. King Street. From this location, a tunnel boring machine would be used to construct the tunnel, following First Avenue to approximately Stewart Street, then veering east to the area of John Street and SR 99. The alternative includes another cut-and-cover section that connects to SR 99 near Mercer Street Milepost (M.P. 32.85) in the north. Interchange ramps would be provided at both the north and south sections. Additionally, a street connection between Alaskan Way and Elliott and Western Avenues is included (see Figure 1).

The AWVSRP is partially funded through a combination of state funds from the 2003 Nickel Funding Package and the 2005 Transportation Partnership Account Package. It has also received funding from FHWA and the City of Seattle.

This document and following appendices seek design approval by identifying key design aspects of the entire SR99 Bored Tunnel Project. Once Design Approval has been received, this document may be entered into the Design Documentation Package (DDP).

While this DDP for Design approval encompasses the entire project limits, separate DDP for project development approval will be completed for each construction contract. The ten contracts will all be Design-Bid-Build methodology, except for the single bored tunnel, which will be Design-Build. A breakdown of the planned construction projects, advertisement dates and budget is as follows:

Table 1. Contract Summary

Contract	Planned Ad Date[2]	Budget[1]
Contract Unit 01 - 1st. Ave Ground Replacement	Jan 2011	$71.1M
Contract Unit 02 – Tunnel Boring Machine Substation	May 2011	$14.1M
Contract Unit 03 - Tunnel and Tunnel Systems (Design-Build, 1 complete contract)	Jan 2011	$885M
Contract Unit 04 - South Access	Dec 2013	$208.2M
Contract Unit 05 - South End Surface Improvement	Sept 2015	$13.1M
Contract Unit 06 - North Portal Detour and Utility Relocation	May 2011	$53.5M
Contract Unit 07 - North Access.	Jan 2013	$181.9M
Contract Unit 08 - North End Surface Improvement	Sept 2015	$10M
Contract Unit 09 - Alaskan Way Demolition	Sept 2015	$132.9M
Contract Unit 10 – ITS Signage	Sept 2014	$24.9M
TOTAL		**$1.595 B**

[1] Budget taken from *Planning Level Cost Estimate June 2009* – Does not include escalation & contingency/risk

[2] Planned Ad Date assumes 3 month lead time to *AWV CEVP Tunnel Construction Flowchart June 2009*

Figure 1. Proposed Project Corridor

2.0 Project Overview

Functions and Operations:

The SR 99 Bored Tunnel Alternative (Tunnel Project) is located along the central waterfront of the AWVSRP area. The Tunnel Project would improve roadway efficiency and safety by providing a direct bypass under downtown for freight and vehicular traffic between S. King and Mercer Streets. The Tunnel Project would realign SR 99 away from the waterfront to a tunnel under and along First Avenue.

The Tunnel Project, especially the South and North Segments, lies within an area that supports a wide array of land uses, including the following:

- Qwest Field and Events Center, a professional football and soccer stadium with convention facilities
- Safeco Field, a professional baseball stadium
- Sundry industrial and commercial enterprises
- Retail enterprises
- Central Business District highrise offices
- Dense residential neighborhoods
- Other urban facilities and activities

Design Level:

Design Matrix 3, lines 3-7 (*WSDOT Design Manual,* Figure 325-5) is applicable to the project, which requires a full design level.

This Design Approval Package and subsequent DDP will encompass the entire SR 99 Bored Tunnel Project described below. However the DDP for Project Development Approval will be construction contract specific.

2.1 Existing SR 99 Roadway

The existing SR 99 urban route within the project vicinity is located along the waterfront between S. King Street and Pine Street before it turns northeast to the Battery Street Tunnel (BST) at First Avenue and Battery Street. It exits the BST at Denny Way and then turns north, crossing John, Thomas, Harrison, Republican, and Mercer Streets. The majority of the existing SR 99 runs along the waterfront and therefore parallels Alaskan Way directly to the west. To the east, the viaduct closely

shadows downtown buildings and Western Avenue with general parking directly underneath.

The existing SR 99 through the project vicinity is generally configured as a 40-foot-wide viaduct stacked structure. The number of existing lanes ranges from three to four in each direction, with lane widths varying from 9 to 12 feet and shoulder widths ranging from 0 to 3 feet. The SR 99 roadway width narrows to 25 feet with two lanes in each direction through the BST, and then widens to three to four lanes, each approximately 10 feet wide, north of the BST. WSDOT currently considers the BST a high accident location. The vertical alignment of the viaduct varies from 0 percent to 4 percent slope up to the BST, and then SR 99 adjusts to approximately -2 percent north of the BST to Mercer Street before transitioning to a positive slope northward. The rolling terrain between Union and Ward Streets has a posted speed of 40 miles per hour (mph), while the southern portion of the route from S. Royal Brougham Way to Union Street is level and posted as 50 mph.

The average daily traffic (ADT) peaks along the existing central waterfront mainline at 52,500 for the northbound direction and 50,500 for the southbound direction. In this area, the level-of-service (LOS) for northbound and southbound mainline traffic varies between LOS D and LOS E. At LOS D and E, SR 99 is approaching the worst case classification is LOS F with speeds at nearly zero. Existing ADT truck traffic volumes are approximately 3 percent to 5 percent of total traffic. At the northern end of the project corridor, two existing High Accident Locations have been identified at northbound MP 31.9 to 32.1 and southbound MP 32.0 to 32.4 (see *SR 99 Corridor Analysis, June 2009 in* Appendix C).

Many aspects of the existing horizontal and vertical curves do not meet today's roadway design standards for the posted speed limit. When compared to current design standards for stopping sight distance, horizontal curve radius, and vertical curve length, about two-thirds of the horizontal and vertical curves would coincide with a design speed of less than 40 mph.

A number of on- and off-ramps are located along the corridor. A northbound on-ramp and southbound off-ramp are located at Railroad Way S.; a southbound on-ramp is located at Columbia Street; and a northbound off-ramp is located at Seneca Street. A northbound on-ramp and southbound off-ramp occur near the BST's South Portal at Elliott and Western Avenues and Bell Street. A northbound on-ramp and southbound off-ramp is located at Denny Way, and a northbound off-ramp and southbound off-ramp are located at Broad Street. A number of "right turn only" intersections are located north of the BST that function more like city street intersections rather than highway ramps. All ramps are on the right side of traffic, with the exception of the southbound on-ramp at Columbia Street and the southbound off-ramp at Railroad Way S.

The SR 99 roadway for the SR 99 Bored Tunnel Project has been assigned the functional classification of Principal Arterial Highway by WSDOT; its geometric

design classification is that of an Urban Principal Arterial P-1, per the current *WSDOT Design Manual,* Figure 440-6 (see approved *SR 99 Corridor Analysis, June 2009*). 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 the roadway as a Major Truck Street.

2.2 Proposed SR 99 Roadway

The SR 99 Bored Tunnel Alternative would replace the existing viaduct and Battery Street Tunnel (BST) with a single bored tunnel east of the existing alignment. This project is comprised of a bored tunnel containing two stacked roadway decks with cut-and-cover sections at both the north and south ends. The tunnel would be constructed with an approximately 55-foot diameter TBM. Southbound traffic would be on the top deck, and northbound traffic would be on the bottom deck. Enclosed roadways would meet or exceed current fire, life, and safety codes. The inside of the tunnel would be lined with an approximately 2-foot-thick concrete liner. The alignment would consist of a minimum of two northbound and two southbound lanes with shoulders varying on the left from 2 to 4 feet, and on the right at a fixed 8 feet. Both the South and North Segments of the project would contain fully directional interchange movements connecting with the City's surface street grid. See Figure 1 for SR 99 Bored Tunnel alignment and segments.

2.2.1 South Segment

In the south, the alignment would match the S. Holgate Street to S. King Street Project structure, which is to be built to accommodate both a northbound off-ramp and a southbound on-ramp. The SR 99 mainline would include two lanes northbound and two lanes southbound with standard shoulder widths of 4 feet on the left and 10 feet on the right. An additional northbound on-ramp and southbound off-ramp would connect S. Holgate Street to the mainline in the cut-and-cover section. Three of the four ramps would follow the typical right-side configuration, as shown in the *WSDOT Design Manual*, Figure 930-4, with one ramp (the southbound off-ramp) being a left-side ramp. No ramps would extend into the central tunnel segment of the project.

Access to and from the north would be provided via an interchange at S. Royal Brougham Way and the Alaskan Way frontage road. The northbound on-ramp would enter a retained cut section north of S. Royal Brougham Way and merge with the two SR 99 northbound lanes from the right side. The southbound off-ramp would diverge from the left side of SR 99 and enter a retained cut section as it approaches S. Royal Brougham Way from the north.

Access to and from the south would be provided via an interchange at Alaskan Way north of S. Royal Brougham Way. The southbound on-ramp would enter the two SR 99 southbound lanes from a retained fill section as an added third southbound lane. The northbound off-ramp would exit SR 99 as a right-side drop lane with two

lanes remaining on the mainline SR 99, and would approach Alaskan Way on a retained fill section.

Ramp design speeds, grades, and cross-sections for the South Segment are within *WSDOT Design Manual* guidelines. The south segment left of traveled way off-ramp will require deviation approval.

2.2.2 Central Segment

The bored tunnel's diameter of 55 feet was determined by setting two stacked roadway widths at 35 feet southbound and 34 feet northbound, with 16 feet of vertical clearance each (to the bottom of the sign clearance), and building out structurally from there. Any additional clearance requirements would likely have a direct impact on the tunnel bore's outside diameter. The roadway cross-section is designed with a wall-to-wall width of 34 feet in the northbound and 35 feet in the southbound direction (See Figure 2). Two 12-foot lanes take up 24 feet, leaving 10 to 11 feet for shoulders and possible barriers. There is ongoing discussion with regards to the need of barrier shape within the tunnel. Currently the project is assuming the use of a barrier shape with a width of 9 inches for each barrier, the remaining area in the northbound direction allows for approximately 1 feet-3 inches for left shoulder and 7 feet-3 inches for right shoulders and in the southbound direction approximately 2 feet-3 inches for the left shoulder and 7 feet-3 inches for the right shoulders. Southbound traffic would be on the top roadway deck, and northbound traffic would be on the lower roadway deck.

As part of the fire and life safety requirements, emergency egress locations would be located at approximately 500-foot intervals. To provide sufficient space for safe egress, the current design would require the northbound roadway to be offset from center throughout the tunnel design.

The horizontal and vertical design speed is 50 mph, per *WSDOT Design Manual* guidelines. There would be no on- or off-ramps in the Central Segment.

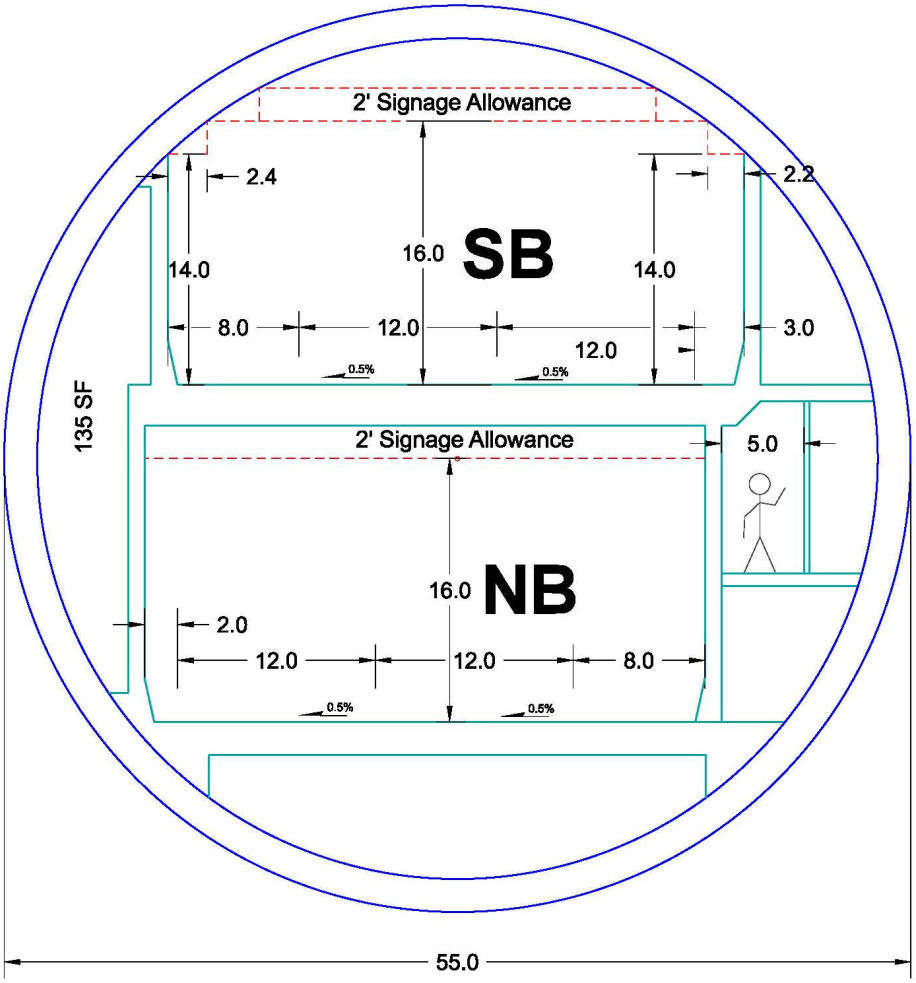

Figure 2. Proposed Tunnel Typical Cross-Section (wall-to-wall dimensions)

2.2.3 North Segment

The stacked roadways of the bored tunnel section would begin to unstack north of John Street, entering a cut-and-cover section between John and Harrison Streets, and a retained cut section north of Harrison Street. Northbound and southbound SR 99 would meet the existing vertical grade between Republican and Mercer Streets. SR 99 would match the existing grade and alignment between Mercer and Ward Streets.

The existing SR 99 north of Mercer Street consists of three southbound lanes and three northbound lanes, with a fourth northbound auxiliary lane ending north of Aloha Street. The existing lane width varies from 10.5 feet to 11 feet, and there are

no existing shoulders. A gore stripe adjacent to a curb and a 6-foot sidewalk are provided. The existing posted speed is 40 mph.

In the north, the alignment would connect to the existing SR 99 south of Mercer Street. This cut-and-cover section would provide on- and off-ramps for both the northbound and southbound directions. The northbound on-ramp and southbound off-ramp would be left-side connections that provide service to surface streets centered on the SR 99 alignment.

Access to and from north SR 99 would be provided via ramps at Harrison Street. A northbound on-ramp would join the two SR 99 mainline lanes as an additional third lane from the left side at Republican Street. A southbound off-ramp would exit from SR 99 as a left-side drop lane near Republican Street, leaving two southbound mainline lanes.

Access to and from the south would be via ramps at Republican Street. A southbound on-ramp would merge via an acceleration lane to the two SR 99 mainline lanes from the right side of SR 99 in a retained cut section. A northbound off-ramp would diverge from the two SR 99 mainline lanes into a deceleration lane approaching Republican Street in a cut section.

The SR 99 mainline design speed is 50 mph per *WSDOT Design Manual* guidelines. Ramp design speeds range from 10 to 45 mph depending on the requirements of each location. The north segment left off and on-ramps will require deviation approval.

3.0 Status of Major Design Elements

The current status of the major design elements is described in the following sections.

3.1 Construction Sequencing and Durations

The Tunnel Project will be designed and constructed in a series of separate contract packages, or phases as described in the following sections and listed in section 1.0. Furthermore construction dates provided below assume a Spring 2011 Record of Decision.

3.1.1 South Segment (South Tunnel Portal Entry) Spring. 2011 – March 2015

A cut-and-cover structure would be constructed beneath First Avenue S. between S. King Street and the Washington Oregon Shippers Cooperative Association (WOSCA) site just south of Railroad Way S. The current concept includes placing 10-foot-diameter secant piles along each side of First Avenue S., excavating to a depth of 8 feet, decking across to open the street temporarily, and hanging utilities from the braces/struts before completing any below-deck excavation. This work also includes a shored excavation located at the WOSCA site, with sufficient length to fit the tunnel boring machine (TBM) and all required trailing gear. Utilities along the cut-and-cover alignment would either be supported in place or temporarily relocated and later replaced.

Initially, utilities within the secant pile alignment will be relocated during a two-month period. Following utility relocation, the secant pile installation along First Avenue S. would be constructed in two phases, with the Railroad Way S. ramps acting as the demarcation line. The shoring installation for the WOSCA site would occur simultaneously as the Phase 1 shoring installation along First Avenue S. A drilling contractor would mobilize two crews to begin installation of the secant pile shoring system at First Avenue S. between S. King Street and Railroad Way S., which is projected to be five months of work, and at the WOSCA site, which is projected to have a seven-month duration.

At the completion of shoring installation along First Avenue, the contractor would excavate down 8 feet and re-open the street to traffic. Prior to transitioning into the second phase of the secant pile installation and initial excavation along First Avenue S., the existing Railroad Way S. ramps would need to be removed to enable the shoring operation to continue to the WOSCA site. Once the Railroad Way S. ramps are removed, the second phase of the shoring installation can begin. This phase would take four months to complete and necessitate a full closure of First Avenue S. within the shoring footprint.

At the conclusion of the second phase of shoring installation, First Avenue S. would be re-opened to traffic and all construction activities related to the tunnel would be

performed from the WOSCA site. Mass excavation and placement of internal shoring would then commence, and in seven months the subgrade would be lowered to the planned elevation. The final activity in the construction of the South Portal is the placement of the concrete slab, which would provide the work surface during construction of the tunnel. This activity would take three months to complete.

3.1.2 Central Segment (Bored Tunnel with Stacked Roadways) Nov 2012 – Dec 2015

The 55-foot-diameter bored tunnel, which is to be located under First Avenue, would be accessed from the south near Qwest and Safeco Fields, and would connect to Aurora Avenue in the north. The tunnel would be built in a stacked configuration, with the southbound lanes on the upper level and the northbound lanes on the lower level. Fire and life safety features included in the tunnel are power, lighting, ventilation, fire alarm, deluge sprinkler system, signals, and communication.

The bored tunnel contract is divided into five parts:

1) Procurement of the tunnel boring machine (18-month duration)

2) Setup of the tunnel staging area, which includes establishment of a slurry processing plant, track infrastructure for transport of material into and out of the tunnel, power facilities for the TBM, and lay down space for the precast tunnel liners

3) Tunnel boring

4) Construction of the concrete stacked tunnel configuration

5) Installation of the tunnel fire and life-safety systems

The WOSCA site is designated as the staging area for the tunnel contractor. Preparation for the WOSCA site would take three months.

The launching pit for the tunnel bore would be from the south, beneath First Avenue S., with a bulkhead located near S. King Street. The duration of the drive is estimated to be 11 months, with an assumed productivity rate of 30 feet per day. At the completion of the tunnel drive, the support equipment would be dismantled and removed from the tunnel. Planned to run concurrently with the tunnel excavation, installation of the internal walls and roadway deck would be staged from a specially fabricated moving rig and working platform called a "jumbo."

After completion of the bored tunnel's excavation and removal of the TBM, precast panels for the lower roadway deck would be installed, concurrently loaded from the north and south ends and working toward the middle. This operation would be followed by installation of other precast elements, some for the tunnel's side walls,

some for its emergency staircase enclosures, and some for the precast panels for the upper roadway deck. All such elements would be concurrently loaded from the north and south ends, working toward the middle. After these internal structures have been completely installed, components relating to mechanical, electrical, and control instrumentation systems (but not otherwise embedded into precast structural elements) would be installed throughout the bored tunnel and portals. Both activities would run nearly concurrently and would extend for 19 months.

3.1.3 North Segment (North Portal Tunnel Entry) Aug 2011 – Mar 2015

A cut-and-cover structure would be constructed beneath Aurora Avenue N., extending from the TBM relief shaft to the point where the new roadway grade would match the existing SR 99 roadway grade north of Mercer Street. The portal structure would incorporate a transition structure that unstacks the upper and lower roadways and brings them together on a single common grade at the match point.

Prior to construction of the TBM recovery shaft and the cut-and-cover structure, all utilities within Denny Way, John Street, Thomas Street, Harrison Street, Sixth Avenue, and First Avenue would need to be relocated. A temporary detour would be constructed approximately six months into the utility relocation phase. The existing SR 99 traffic would then be diverted onto the detour alignment.

Following construction of the detour alignment and utility relocation work, construction of the TBM recovery shaft would begin. Secant or tangent piles are planned for shoring both the recovery shaft and the cut-and-cover North Portal entry. Once shoring is completed for the TBM recovery shaft, the drilling contractor would construct the shoring for the North Portal entry.

The recovery shaft must be completed prior to completion of the tunnel drive in order to dismantle and remove the TBM from the tunnel and to provide access into the tunnel from the north for the interior tunnel structure and systems construction. The North Portal entry shoring system would be identical to that of the TBM recovery shaft; the excavation would be internally braced and the portal would be a cut-and-cover concrete structure.

The duration for construction of the TBM recovery shaft is estimated to be 12 months, while the North Portal cut-and-cover structure is estimated to be 15 months. There is a six-month lag time estimated between the start of shoring installation of the TBM recovery shaft and the shoring installation of the North Portal entry.

Further construction activities, durations, and sequencing are available in the Construction Flowchart included as an attachment in Section I of this DAP.

3.2 Work Zone Traffic Control (WZTC) Strategy

The Tunnel Project must coordinate with the constraints of the S. Holgate Street to S. King Street Viaduct Replacement Project in the south and the transition section of the viaduct and Aurora Avenue in the north to develop an effective strategy for Maintenance of Traffic (MOT) during construction. The main advantage of the Tunnel Project is that construction of the tunnel itself would largely not affect MOT. However the south and north segments that connect to H2K and the existing Aurora Avenue, respectively, would require extensive phasing to successfully manage traffic through the work zones.

The main constraints for the South Portal relate to the H2K Project. A goal is to maintain at least two lanes of SR 99 traffic in each direction (northbound and southbound) through the corridor during the construction period. However additional South Portal conflicts include the northbound on-ramp at S. Royal Brougham Way to the transition structure, the northbound Alaskan Way surface detour, and maintaining the northbound Railroad Way S. ramp off of First Avenue S. The MOT strategy will rely upon newly constructed detours and temporary structures to mitigate closures. Likewise, the project team will work closely with WSDOT and SDOT traffic engineers to ensure that surface street traffic for freight, autos, bikes, and pedestrians will be maintained through the corridor during construction.

3.3 Environmental

The environmental documentation for this project will be a National Environmental Policy Act/State Environmental Policy Act (NEPA/SEPA) Supplemental Draft EIS, which anticipates a Final Record of Decision (ROD) in early 2011. All discipline reports (technical supporting documents) for the Supplemental Draft EIS are expected to be completed by early December 2009 and the Supplemental Draft EIS is expected to be issued in early March 2010. Public hearings on the Supplemental Draft EIS are expected in late March 2010.

3.4 Right-of-Way

Preliminary right-of-way exhibits for this document are based on the plan set developed for the EIS, which constitutes a design level of less than 5 percent. The *SR 99 Bored Tunnel Alternative – Draft Right-of-Way Needs and Boundaries Summary* contains a description of possible property impacts and summary tables that identify possible property acquisitions, temporary construction easements, and subsurface tunnel easements are found in Section G of this DAP. Initial right-of-way plans are underway, and an acquisition program is currently progressing with expected completion in June 2010. For general location information, please refer to the alignment/right-of-way plans also found in Section G of this DAP.

3.5 Project Design Decisions

The AWVSRP employs a formal process, the Trend Program, for developing and documenting major project decisions. The Trend Program, through a Change Control Board, brings changes to senior management's attention for review and adjudication. It is an internal tool that identifies and formally documents changes to scope, cost and schedule of the AWV Projects over the biennial and entire project lifecycle. The response of the Change Control Board, with representation from WSDOT and the Seattle Department of Transportation (SDOT), formalizes the decisions on project changes.

A trend not only evaluates scope, cost, and/or schedule impacts to the SR 99 Tunnel Project, but also evaluates secondary impacts to other projects as well. When a trend is 'Fully Approved,' it initiates an update to baseline budgets and schedules, as well as contract task orders or task order amendments. If Capital Program Management System (CPMS) information (budget or schedule milestones) is changed by a "Fully Approved" trend, then a Project Control Request Form (PCRF) and/or a 603 Form will be initiated through appropriate channels at WSDOT Urban Corridors and Headquarters.

The trends (approved and unapproved) also serve as a history and record of key project decisions for the AWVSRP. These documents are available in the project file and summarized in the Project Summary Documents and Deviations in Appendix A and D of this DAP.

3.6 Deviations

Design deviations are being discussed with FHWA and WSDOT and final approvals are expected in late 2009. Following approvals, the deviations will be recorded in the Design Variance Inventory System (DVIS). Copies of the approved deviation packages and the DVIS output are included in Section D of this DAP. The identified deviations for WSDOT facilities include the following:

SR 99:

1. Shoulder Width – Inside & Outside
2. Left Off/On-Ramp
3. Length of Grade
4. Turning Roadway/Ramp Width
5. Superelevation (max. 8 percent)
6. Vertical Clearance within the Tunnel (16 foot traveled way, 14 foot shoulder)
7. Sag Vertical Curve
8. 0.5 percent single slope crown

Design deviations from City of Seattle standards have been drafted for local access streets that are reconstructed as part of the Tunnel Project. These deviations are covered by this DAP; consequently, a list is included in this package (See Appendix D). The design team continues to work toward elimination or resolution of these design variances with SDOT. Final local street deviations will be prepared in conformance with the *Seattle Right-of-Way Improvements Manual* and will be approved by SDOT prior to issuance of street use permits.

3.7 Permits

For the SR 99 Bored Tunnel Project, the following is a list of the permits anticipated for the contracts.

City of Seattle Street Use Permits

City of Seattle Shoreline Exemption

City of Seattle Noise Variances

King County Industrial Waste Discharge Permit

Department of Ecology Construction Stormwater General NPDES Permit

Permits have yet to be attained; however each construction contract will be required to pursue the permits as part of the final design and PS&E process. The most common are listed above and will be filled in as documentation becomes available.

3.8 Cost Estimate/Overall Program Schedule

A cost estimate is currently being developed for the program. Governor Gregoire and the Washington State Legislature have approved a $2.8 Billion Viaduct Bill as of May 12th, 2009 and an estimated $1.9 Billion will go towards the bored tunnel portion of the project.

Table 2. WSDOT Financial Responsibility

Fund Type	Preliminary Engineering	Right of Way	Construction	Total
Legislative Final 2009	$118.9M	$163.3M	$1.208B	$1.491B
CPMS	$118.9M	$163.3M	-	$282.2M
Estimated Cost to Complete	$237M	$165.1M	$1.8B	$2.20B

An additional $1.4 Billion has been committed by King County, the City of Seattle, and the Port of Seattle for other roadway elements and non-roadway elements that compliment the bored tunnel project.

Table 3. City of Seattle and King County Financial Responsibility

Projects	City of Seattle	King County
Alaska Way Surface Street and Promenade	$100M	-
Central Seawall	$255M	-
Public Utility Relocation	$250M	-
City Streets and Transit Pathways	$190M	$25M
Transit Infrastructure and Services	$135M	$115M
Construction Mitigation		$50M
TOTAL	**$930M**	**$190M**

Table 4. Overall Program Schedule

Milestone	Date
Design Approval	Fall 2009
Record of Decision	Spring 2011
Begin Construction	Spring 2011
Tunnel Construction Complete	Fall 2015
Open to Public	Winter 2015
Begin Demolition of Viaduct	Spring 2016
AWVRP Complete	Fall 2017

For future reference, the program is currently planned to be constructed under ten separate construction contracts listed in section 1.0. Backup data for this cost estimate and schedule will be included in Section H of this DAP.

3.9 Geotechnical

Most of the existing soil in the South Portal area is fill with a significant amount of old pilings and miscellaneous debris. Much of the soil is contaminated. As a result, it is assumed that a significant portion of the existing soil would be unsuitable for backfill.

The WSDOT Geotechnical Services Division is overseeing the geotechnical studies for this project. Geotechnical data, recommendations, and studies completed for the Project from 2001 through 2005 are summarized in the *Executive Summary Geotechnical and Environmental Studies 2001 – 2005* (Shannon & Wilson, June 2006). Since then, an additional report has been prepared for the south segment of the corridor: *Geotechnical and Environmental Data Report – S. Holgate Street to S. King Street Viaduct Replacement Project* (Shannon & Wilson, Dec 2008). The 2008 report includes additional geotechnical data and results of analyses related to deep foundations for

bridges; ground settlement and stability for retained fills (earth embankments); earthquake considerations; and recommendations for strengthening the ground near the bridges.

Central Waterfront Tunnel project data collection is currently set to start July of 2009 and a formal geotechnical report will be developed in November of 2009. The latest Central Waterfront documentation report is the *Geotechnical Considerations for Proposed Twin Highway Tunnel Report, Oct 2008*. .The expected *2009 Geotechnical and Environmental Data Report* will be provided in Appendix F when it becomes available

More recent geotechnical findings for the north segment of the corridor were summarized in *Geotechnical and Environmental Data Report Aurora Section, Jan 2007*.

It is anticipated that continuing geotechnical analyses will be summarized in a series of interim letters from the geotechnical team. These interim letters will provide geotechnical and environmental recommendations for final design. See Appendix F for any changes

3.10 Hydraulics

Because this is a multi-agency project, it is necessary to consider multiple policies when designing the stormwater drainage system. The City and King County own and maintain existing gravity systems (sewer and storm drainage) within the project area. Ownership of the downstream infrastructure dictates which National Pollution Discharge Elimination System (NPDES) permit, issued by the Washington State Department of Ecology (Ecology), applies and what operational methods will be used to maintain the system.

Sanitary sewer and combined sewer flows, including some runoff from the project area, are conveyed through the Elliott Bay Interceptor to the West Point Wastewater Treatment Plant, which are both owned and operated by King County. Stormwater tributary to the separated stormwater drainage system is governed by Ecology and Seattle Public Utilities (SPU) policy. Runoff generated on SR 99 is subject to WSDOT policy. Department of Ecology policy is used for water quality purposes only.

WSDOT and SPU stormwater policies and requirements were used. Both agencies have stormwater policies designed to meet NPDES requirements. NPDES permitting requirements for this project were initially discussed in detail in the *Environmental Permits and Approvals Guide* (Parametrix, April 2006). City drainage requirements are documented in Seattle Municipal Code Chapters 22.800-22.808, the Stormwater, Grading, and Drainage Control Code (issued July and November 2000). Specific technical requirements resulting from the code are implemented by Director's Rules technical requirements manuals. WSDOT design standards used include the Hydraulics Manual, M23-03 (WSDOT, March 2007) and the Highway

Runoff Manual, M31-16 (WSDOT, May 2006). The City is currently updating its Stormwater Grading and Drainage Code.

Stormwater runoff from the Project area will be treated prior to discharge to the existing storm drain system, and detention will be provided for project area runoff that discharges to the combined sewer system unless other agreements are made. Except at the portals, the tunnel will be located underground in areas that will not be impacted by rainfall, or consequently generate stormwater runoff. Runoff will only be generated on underground surfaces by the fire suppression system during testing or emergency events, so stormwater quality treatment for the tunnel's underground surface area is not necessary. Runoff produced during fire suppression system testing will be discharged to the combined sewer system. In previous conceptual designs for AWV tunnels, oil/water separators were proposed to treat water pumped from tunnels; this may also be a feature of the bored tunnel drainage system, but it is not a requirement for discharge to the combined sewer system.

For surface streets and the tunnel portals, stormwater quality treatment is required prior to discharge to the existing storm drain system. Placement of stormwater quality treatment facilities is constrained by the urban environment, specifically by the amount of space available. Stormwater quality treatment types, or BMPs, considered for this Project include: bioswales and cartridge media filtration vaults. Natural Drainage Systems (NDS) should also be considered, when possible, for this project.

Stormwater conveyance for pass-through areas must be maintained throughout the Project, including during construction. For additional details see the *SR 99 Bored Tunnel Summary Level Stormwater Report* in Appendix G of this DAP.

The Project is vested under the current code. The design standards are based on both WSDOT and SPU practices; where the two agencies differ, the more stringent criteria have been selected for the Project.

3.11 Utility Impact

It is anticipated that the North and South Portals of the bored tunnel would be constructed using a combination techniques, some of which include cut-and-cover that could include a secant or tangent pile shoring wall system. Regardless of the technique selected, significant impacts to public and private utilities are expected.

Utility impacts are expected because the South Portal would require excavation that is nearly the width of First Avenue S. for an area that extends approximately 1,200 feet south of S. King Street to the south intersection of S. King Street. All utilities in First Avenue S. in this vicinity would be affected and would require some form of mitigation during construction. The South Portal would impact the following services: Seattle City Light electrical transmission lines, Seattle Public Utilities 16-inch and 24-inch cast iron with leaded joints (CILJ) water line, sanitary and combined

sewers, storm drainage, telecommunications, cable television, and Puget Sound Energy natural gas.

Utility impacts also are expected because the North Portal would require excavation that is approximately the width of SR 99 for an area that extends from approximately John to Broad Streets. All utilities in SR 99 in this vicinity would be affected and would require some form of mitigation during construction. The identified impacts to utilities in the North Portal are 115Kv transmission line, ductbanks on the east side of SR 99, Seattle Public Utilities 12-inch CILJ water line, sanitary and combined sewers under the center of SR 99, telecommunication DoIT line, cable television, and Puget Sound Energy natural gas.

A more complete description of maintenance issues and agreements for the Project is available in the *SR 99 Bored Tunnel Alternative – Draft Utility Impact Report, April 2009*.

3.12 Bridge and Structure Coordination

The WSDOT Bridge and Structures Office is overseeing the structural design for the bridges and walls for the Project and meets with the Project Team regularly. The South Project would include construction of nine new structures, including retained-cut-and-fill structures, two cut-and-cover systems, and the tunnel assembly. Among these structures, one is a temporary retained cut that would serve as a detour bridge to maintain northbound and southbound SR 99 traffic to the Battery Street Tunnel during construction. Table 3 summarizes the major structures that would be constructed as part of the Project.

Table 5. Summary of Major Structures to be Constructed

Structure Number	Description	Permanent or Temporary
1	Mainline Tunnel SR 99 – Northbound and Southbound	Permanent
2	South Portal – Mainline Cut-and-Cover	Permanent
3	South Portal – Retained Cut	Permanent
4	South Portal – Retained Fill	Permanent
5	North Portal – Mainline Cut-and-Cover	Permanent

Structure Number	Description	Permanent or Temporary
6	North Portal – Mainline Retained Cut	Permanent
7	North Portal – Retained Fill (Harrison Street Ramp)	Permanent
8	North Portal – Retained Cut (Republican Street NB and SB Ramps)	Permanent
9	Retained Cut Mainline Detour to Battery Street Tunnel	Temporary

3.13 Maintenance Coordination

WSDOT Maintenance has provided input on a variety of design issues. WSDOT Maintenance has met regularly with the Project Team as part of the Fire and Life Safety Subcommittee and will participate in the 30% Constructability Review.

The Project includes facilities owned and operated by the City and WSDOT. In general, WSDOT standards will be used for SR 99 administration of the construction contract, and City details and standards will be used for features that are to be maintained by the City.

A more complete description of maintenance issues and agreements for the Project is available in the following reports:

- *SR 99 Bored Tunnel Alternative – Draft Constructability, Construction Engineering, and Construction Impacts,* April 2009
- *PB/Jacobs Memorandum Documenting Maintenance Concerns,* June 2008

3.14 Traffic

All traffic activities have been coordinated with WSDOT Northwest Region Traffic, WSDOT Urban Corridors Office Traffic, and SDOT Traffic. Plans for signals, signing, Intelligent Transportation Systems, and illumination are under development.

A more complete description of traffic issues and operations for the Project is provided in the *2009 Corridor Analysis* located in Appendix C of this DAP.

3.15 Fire/Life/Safety Requirements

The National Fire Protection Association (NFPA) 502 standard establishes the minimum requirements for tunnel fire protection and fire life safety requirements, as well as the authority having jurisdiction, namely the Seattle Fire Department, which shall determine the application of the standard for the Project. The following should be noted:

- The Project will use the 2008 NFPA 502 Standard. The next version of the NFPA 502 Standard will be published in 2011. The Project shall evaluate the upcoming changes for the 2011 version of the code for inclusion as part of the project requirements.

- The City of Seattle (Ordinance 122491) currently adopts the 2006 Seattle Fire Code and by reference adopts the 2004 NFPA 502 standard. The City has amendments to the 2004 edition of NFPA 502. It is expected that the City will adopt the 2008 NFPA 502 standard in 2009.

- While it is not the intent of this report to repeat the requirements of the NFPA 502 standard, many of the key requirements of NFPA 502 are summarized in Section 5.0 of the *March 2009 Tunnel Systems Design Criteria Report*.