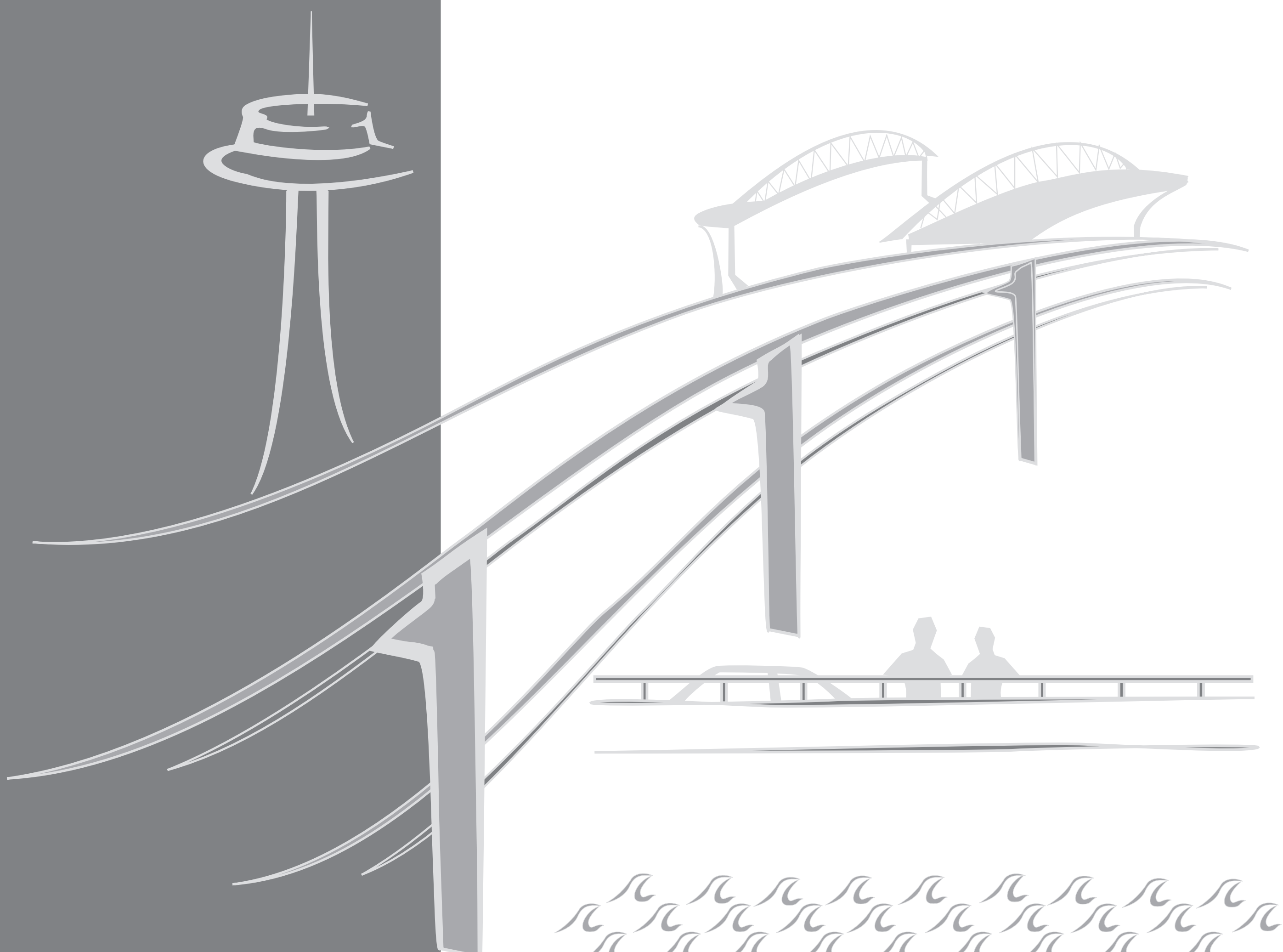
SR 99: ALASKAN WAY VIADUCT &
SEAWALL REPLACEMENT PROJECT

Draft Environmental Impact Statement
Appendix O
Public Services and Utilities Technical Memorandum



MARCH 2004

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U.S. Department of Transportation
Federal Highway Administration

Washington State
Department of Transportation

City of Seattle

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SR 99: ALASKAN WAY VIADUCT & SEAWALL REPLACEMENT PROJECT

Public Services and Utilities Technical Memorandum Draft EIS

AGREEMENT NO. Y-7888

FHWA-WA-EIS-04-01-D

Submitted to:

Washington State Department of Transportation
Alaskan Way Viaduct and Seawall Replacement Project Office
999 Third Avenue, Suite 2424
Seattle, WA 98104

The SR 99: Alaskan Way Viaduct & Seawall Replacement Project is a joint effort between the Washington State Department of Transportation (WSDOT), the City of Seattle, and the Federal Highway Administration (FHWA). To conduct this project, WSDOT contracted with:

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In association with:

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List of Exhibits

ACRONYMS

AASHTO	American Association of State Highway and Transportation Officials
AWV	Alaskan Way Viaduct
BMP	Best Management Practice
BNSF	Burlington Northern Santa Fe Railway Company
BP	British Petroleum
BST	Battery Street Tunnel
CBD	Central Business District
CDL	construction, demolition, and land clearing waste
CFR	Code of Federal Regulations
CSO	combined sewer system overflow
DoIT	Seattle Department of Information Technology
EBI	Elliott Bay Interceptor
FHWA	Federal Highway Administration
HP	high-pressure
IP	intermediate-pressure
kV	kilovolt
LF	lineal feet
LOS	level of service
MW	megawatts
MSE	mechanically stabilized earth
NEPA	National Environmental Policy Act
PSE	Puget Sound Energy
RCW	Revised Code of Washington
SDOT	Seattle Department of Transportation
SEM	Seattle Emergency Management
SFD	Seattle Fire Department
SPD	Seattle Police Department
SPU	Seattle Public Utilities
SR	State Route
SSO	sanitary sewer overflow
USPS	United States Postal Service
WAC	Washington Administrative Code
WSDOT	Washington State Department of Transportation

Chapter 1 SUMMARY

This section describes the existing conditions for public services and utilities along the alignment of the proposed Alaskan Way Viaduct and Seawall Replacement Project. In addition, the potential construction and operation impacts and their mitigation measures are discussed. The topics covered in this report include methodology, studies and coordination, affected environment, operational impacts and benefits, construction impacts, secondary and cumulative impacts, and mitigation measures.

In general, public services and utilities within three to five blocks of existing or proposed facilities are identified as being within the study area of potential construction or operational impacts (see Exhibit 4-2). There are exceptions to this rule, however; some facilities (such as hospital emergency rooms) are located outside of the study area, but are included in this analysis because they offer critical services to the project area. Public services and facilities analyzed include police, fire suppression, emergency medical response, public schools, disaster preparedness, and solid waste collection. Several federal government facilities are also located in downtown Seattle, including postal services. The primary public service providers in the study area include Seattle Police Department (SPD), Seattle Fire Department (SFD), and Seattle Solid Waste Division. Other public service providers in the study area include Seattle Emergency Management, Washington State Ferries, and the Port of Seattle.

A number of utility providers within the study area (including municipal agencies and private companies) provide electricity, water, wastewater and stormwater collection, natural gas, steam, oil/petroleum, and telecommunications services. The construction and operation of the Alaskan Way Viaduct (AWV) alternatives will be largely within the public street rights-of-way, where utilities are also generally located. The primary public utility providers in the study area include Seattle Public Utilities (SPU) for the water and sanitary sewer system, King County for stormwater, and Seattle City Light (City Light) for the electrical power system. The private utilities include Puget Sound Energy, Seattle Steam, Qwest, Comcast, BP (British Petroleum, doing business as Olympic Pipeline), Waste Management, and a number of other private communications companies (see Chapter 5, Utilities).

The AWV project boundaries generally follow the State Route (SR) 99 alignment from approximately S. Spokane Street on the south to Ward Street on the north. The study area includes areas within three to five blocks of the proposed Build Alternatives, including the seawall to approximately Fourth

Avenue from west to east. Five Build Alternatives are proposed for the AWV study area. Each corridor alternative is named according to the type of roadway proposed through the central section of the study area. These alternatives are Rebuild, Aerial, Tunnel, Bypass Tunnel, and Surface. The five Build Alternatives all include building replacement structures for both the Alaskan Way Viaduct and the Alaskan Way Seawall. No changes are proposed to the seawall between Blanchard and Battery Streets for any of the Build Alternatives.

For the Rebuild, Aerial, and Surface Alternatives, the seawall would be rebuilt by constructing concrete drilled shafts in combination with a continuous block of jet-grouted soil improvements behind the existing seawall. The jet grout would be used to stabilize the liquefiable soils behind the seawall and under the timber relieving platform. The Tunnel and Bypass Tunnel Alternatives include replacing the existing seawall from S. King Street to Myrtle Edwards Park. The western wall of the tunnel would serve as both the outer tunnel wall and the new seawall. In most cases, the new seawall/outer tunnel wall would be constructed behind the existing seawall. However, from S. Washington Street to Yesler Way, the new seawall/tunnel would extend into Elliott Bay from its current location. North of Pike Street, the seawall would be rebuilt, as described under the Rebuild Alternative. An option to rebuilding the seawall for the Aerial Alternative would be to construct a frame of continuous secant pile wall behind the existing seawall, similar to that discussed for the Tunnel Alternative.

General overviews for each of the Build Alternatives are provided below. See Appendix B, Alternatives Description and Construction Methods Technical Memorandum for more information.

Rebuild Alternative Overview

The Rebuild Alternative includes a combination of new construction, rebuild and retrofit[1] of the Alaskan Way Viaduct, and a rebuild of the seawall. The alignment for the Rebuild Alternative generally follows the existing SR 99 alignment from south of S. Holgate Street to the Battery Street Tunnel (BST). The proposed work along the Alaskan Way Seawall runs from S. Washington Street to Myrtle Edwards Park.

[1] Rebuild means replacing most of the existing structure in approximately the same location. Retrofit means strengthening the existing structural members and adding new seismic resisting elements.

Aerial Alternative Overview

The Aerial Alternative includes constructing an aerial structure between S. Walker Street and the existing BST, upgrading the BST for fire/life safety, constructing improvements north of the BST, and rebuilding the existing seawall.

Tunnel Alternative Overview

The proposed Tunnel Alternative would replace the existing SR 99 Alaskan Way Viaduct with a new six-lane roadway (three lanes each way) from S. Hanford Street to Pike Street, located generally along the alignment of the existing SR 99. At Pike Street, the mainline would diverge from the seawall with a new four-lane (two lanes each way) connection to the existing BST with connection to Aurora Avenue N. At Pike Street, one-lane northbound and southbound ramps would surface into Alaskan Way along the north waterfront seawall.

Bypass Tunnel Alternative Overview

The Bypass Tunnel Alternative would replace the existing SR 99 Alaskan Way Viaduct with an at-grade roadway combined with a bypass tunnel through midtown. The alignment is located generally along the alignment of the existing SR 99, with project limits extending from S. Hanford Street in the south to Valley Street in the north. Interbay traffic would be directed along the north waterfront on Alaskan Way.

Surface Alternative Overview

The Surface Alternative would replace the existing SR 99 Alaskan Way Viaduct with a six-lane roadway (three lanes each way) from S. Hanford Street to Pike Street, located generally within the existing SR 99 right-of-way. At Pike Street, the mainline would diverge from the seawall on a new four-lane (two lanes each way) aerial structure connecting to the existing BST with a connection to Aurora Avenue N.

In addition, the corridor has been broken into four segments for the purposes of analysis. Within each Build Alternative, the following segments will be discussed:

- South – S. Spokane Street to S. King Street
- Central – S. King Street to the Battery Street Tunnel West Portal
- North Waterfront – Pike Street north to Broad Street
- North – Battery Street Tunnel to approximately Ward Street

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Chapter 2 METHODOLOGY

The objective of this memorandum is to describe the conditions of the public services and utilities along the study area and identify impacts (and benefits) that the proposed alternatives could have on these resources. Information about the public services and utilities along the AWV study area was evaluated by reviewing existing available utility drawings and technical reports. The information collected from these studies was used to develop a description of the affected environment, location of critical utilities, and the general setting. Based on the proposed alternatives and options, public services and utilities impacts related to construction and operation were assessed. Mitigation measures for these impacts were also identified.

Potential construction and operational impacts on public services were determined by reviewing the traffic analysis prepared for the project (refer to Appendix C, Transportation Discipline Report), and the level of service (LOS) results for the No Build (Existing Conditions) Alternative and Build Alternatives. LOS reductions due to lane closures and related congestion during construction could affect response times for fire, police, and emergency medical services, as well as mobility and access in the corridor. Factors considered during operation were the added demands placed on public services from implementation of the proposed alternatives, and the potential risks imposed by the Build Alternatives on public services.

Potential impacts to utilities were determined by engineering review of utility placement and preliminary project design. The analysis of impacts produced planning level comparative ratings by alternative, based on the number, size, and lineal feet of the utilities affected, as well as feasibility of relocating or protecting existing utilities, and the risk factors associated with potential relocation. Where cost or difficulty of relocation is found to be prohibitive, project design modifications will be explored in close consultation with the utility purveyors to minimize utility impacts. The planning level estimates reflected in this analysis will be refined once a Preferred Alternative is selected and additional information is known regarding project design and funding. In addition, this analysis will be modified, if necessary, as additional information is acquired from local utility purveyors.

2.1 Literature Review

The following steps have been taken to analyze the potential impacts to public services and utilities related to the Build Alternatives:

- Review of the digital computer-aided design and drafting (CADD) and geographic information system (GIS) data and utility maps provided by utility purveyors compared to the Build Alternatives.
- Review of web sites (and printed materials as available) of utility purveyors and public services agencies.
- Follow-up discussions with purveyors and service providers as necessary to provide clarification or further information.
- Review of City, County, state, and federal regulations and codes.
- Review of conceptual engineering drawings and utility relocation estimates.

2.2 Regulatory Guidelines

The following regulations and guidelines provided information that was considered in developing public services and utilities-related impacts:

- National Environmental Policy Act (NEPA)/State Environmental Policy Act (SEPA)
- Code of Federal Regulations (CFR) Title 23 – Reimbursement for Utility Relocation
- CFR Title 40 – 1500-1508 Environmental Protection Agency Council on Environmental Quality
- DOH Design Manual
- Revised Code of Washington (RCW) 47.44: Franchises on State Highways
- Washington Administrative Code (WAC) 468.34: Utility Franchises and Permits
- WAC 173-201A: Water Quality Standards for Surface Waters of the State of Washington
- WAC 173-204: Sediment Management Standards
- WAC 173-221: Discharge Standards and Effluent Limitations for Domestic Wastewater Facilities
- WAC 173-226: Waste Discharge General Discharge Program
- WAC 173-245: Submission of Plans and Reports for Construction and Operation of Combined Sewer Overflow Reduction Facilities
- WAC 173-270: Puget Sound Highway Runoff Program
- WAC 246-290
- City of Seattle Ordinances

- City of Seattle Franchise Agreements with Other Agencies
- Institute of Electrical and Electronics Engineers (IEEE) Standards (electrical design criteria)
- Seattle City Light Overhead and Underground Construction Guidelines
- National Electric Safety Code (NESC) and the National Electric Code (NEC)
- Washington State Department of Transportation (WSDOT) Environmental Procedures Manual (M31-11)
- WSDOT Design Manual (M22-01)
- WSDOT Franchises
- WSDOT Utilities Accommodation Policy
- WSDOT Utility Manual (M 22-86)
- WSDOT Standard Specifications for Road, Bridge, and Municipal Construction 2004 (M41-10)
- City of Seattle Standard Plans and Specification for Road, Bridge, and Municipal Construction (most current version)
- Federal Highway Administration (FHWA) Standard Specifications for Construction of Roads and Bridges on Federal Highway Projects (1992)
- FHWA Technical Advisory T6640.8A
- Sections 21 and 22 of the Seattle Municipal Code

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Chapter 3 STUDIES AND COORDINATION

This section describes the coordination and studies that were used to identify existing facilities and providers of public services and utilities in the AWV study area. Many resources were used to prepare the affected environment section, including various documents, regulations, municipal plans, Internet and Web page information, literature review, and discussions with public service and utility providers. Additional resources have been identified in the References section at the end of this report. Coordination with authors of other AWV technical reports has also been conducted to maintain accuracy of the information and analysis for this report. The AWV technical reports referenced for this analysis include:

- Appendix B, Alternatives Description and Construction Methods Technical Memorandum
- Appendix C, Transportation Discipline Report
- Appendix F, Noise and Vibration Discipline Report
- Appendix I, Social Resources Technical Memorandum
- Appendix U, Hazardous Materials Discipline Report
- Appendix V, Energy Technical Memorandum
- Appendix T, Geology and Soils Discipline Report
- Appendix K, Relocations Technical Memorandum
- Appendix L, Historic Resources Technical Memorandum

3.1 Previous Studies

Public services and utilities existing conditions data from previous studies and reports were reviewed as part of this memorandum. These studies were used to supplement the analysis. Data was collected from the following sources, and these documents are incorporated by reference:

Public Services

- City of Seattle Comprehensive Plan, Capital Facilities Appendices (2003)
- City of Seattle Comprehensive Plan, Utilities Element (2001)
- Prevention and Control of Highway Tunnel Fires, U.S. Department of Transportation, Federal Highway Administration (2000)
- Seattle Police Department Annual Report (2002)
- Seattle All-Hazards Draft Mitigation Plan (2003)
- Seattle Central Waterfront Plan (2003)

Utilities

- Alaskan Way Viaduct and Seawall Project, Conceptual Plans for Build Alternatives, Volumes 1–4 (March 2003)
- Post-CEVP Cost Estimates and Utility Relocations – Electrical Power. SR 99: Alaskan Way Viaduct Project. BJT Associates. November 2003.
- Final Utilities Design Criteria and Standards, Rosewater Engineering, Inc.
- Alaskan Way Viaduct and Seawall Replacement Project, Public Utilities Workshop PowerPoint Presentation, Rosewater Engineering (October 2003)
- Draft Drainage Technical Memorandum, Rosewater Engineering, Inc.
- City of Seattle Comprehensive Plan, Utilities Element (2001)
- Existing Utilities Technical Memorandum. SR 99: Alaskan Way Viaduct Project. Rosewater Engineering, Inc. April 2002.
- Draft Utilities Design Criteria and Standards. SR 99: Alaskan Way Viaduct Project. Rosewater Engineering, Inc. April 2002.
- Final Drainage Technical Memorandum. SR 99: Alaskan Way Viaduct Project. Rosewater Engineering, Inc. April 2002.
- Final Existing Utilities Technical Memorandum. SR 99: Alaskan Way Viaduct Project. Rosewater Engineering, Inc. August 2002.
- Conceptual Design Maps. SR 99: Alaskan Way Viaduct Project. Rosewater Engineering, Inc. April 2002.
- Post-CEVP Cost Estimates and Utility Relocations – Water, Sewer, Storm, and Private Utilities. SR 99: Alaskan Way Viaduct Project Rosewater Engineering, Inc. November 2003.
- City of Seattle Comprehensive Plan, Utilities Element (2001).
- Design Criteria for Relocation of Electrical Transmission and Distribution Facilities. PB Power. 2002.
- DWW Systems/Alaskan Way Viaduct Alternatives. Brown & Caldwell/Seattle Public Utilities. October 2002.
- Activity Durations For Project Construction. SR 99: Alaskan Way Viaduct Project PB. 2003.

3.2 Coordination

Public agencies and service purveyors or their Web sites consulted for information on the facilities or services in the AWV study area include the following:

- Seattle Fire Department (SFD)
- Seattle Police Department (SPD)
- Seattle Public Schools
- Seattle Public Schools, Transportation Office
- Seattle Public Utilities (SPU)
- Seattle Department of Information Technology (DoIT)
- Seattle City Light (City Light)
- Seattle Department of Transportation (SDOT) Street Use and Utilities Franchises
- Seattle Emergency Management
- WSDOT
- Washington State Ferries
- Port of Seattle
- King County Wastewater Treatment Division
- King County Solid Waste Management
- King County Metro
- United States Postal Service (USPS)

Private organizations or their Web sites consulted for information on the facilities or services in the AWV study area include the following:

- Puget Sound Energy
- Seattle Steam
- BP
- Qwest
- Rabanco

360 Networks, AT&T Broadband, City of Seattle Fiber Optics, ComCast (formerly TCI/AT&T), CNI Locates, Electric Lightwave, Inc., Global Crossing, Time Warner (formerly GST), Level 3, Looking Glass Network, Metromedia Fiber Network Services, MCI WorldCom (formerly MFS), Sprint, Millennium Digital Media (formerly Summit), Terrabeam, US Crossings, Nextira One (formerly Williams & Staples), Williams Communications, XO Communications, and Yipes Communications.

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Chapter 4 PUBLIC SERVICES

Public services and facilities analyzed for this report include fire suppression and emergency medical services, law enforcement services, hospitals and medical clinics, public schools, postal services, disaster preparedness, and solid waste and recycling. Some facilities (such as hospital emergency rooms) are located outside of the study area, but are included in this analysis as they provide critical services to the project area. This chapter includes narrative descriptions of each of these services, followed by potential impacts to services and mitigation of impacts. Other community services are discussed in Appendix I, Social Resources Technical Memorandum.

4.1 Affected Environment

Existing conditions within the AWV study area that could be substantially changed by the project have been identified in the conceptual development stage of the project. Information has been collected to provide a description of existing baseline conditions for use in the discussion of potential impacts and benefits.

4.1.1 Fire Suppression and Emergency Medical Services

Fire Suppression

The Seattle Fire Department provides fire suppression and emergency medical services to a metropolitan urban population of over 560,000 people within a land area of approximately 83.9 square miles and approximately 193 miles of waterfront (U.S. Census Bureau 2000). The department employs more than 1,100 uniformed and non-uniformed personnel serving Seattle at 35 fire stations and other facilities located throughout the city. At its disposal are 33 fire engines, 11 ladder trucks, 5 aid units (basic life support), and 7 medic units (advanced life support), 2 air trucks, 2 fireboats, 2 hose wagons, and 1 foam trailer. Miscellaneous special equipment is also used by the following specializations: command and control unit, marine unit, hazardous materials unit, multiple casualty incident unit (MCI Van), urban search and rescue (USAR Tractor/Trailer), metropolitan medical strike team (MMST Tractor/Trailer), weapons of mass destruction (WMD) Decon Trailer, and technical rescue unit (high angle, confined space, trench and dive rescue) (SFD 2003a).

At least seven Seattle Fire Department stations are available for first response to fire and medical emergencies within the AWV study area (Exhibit 4-1). The Seattle fire alarm center is located at Fire Station No. 2, at Fourth Avenue and

Battery Street in downtown Seattle. Emergency fire and medical units are generally dispatched from the station nearest the call site, although units can be dispatched from other stations as well. The Seattle Fire Department's average 2002 response times (from the time units were dispatched following a 911 call to their arrival at the site) are as follows: 4.24 minutes for fire and hazardous materials responses, 3.75 minutes for basic life support responses (fire and aid cars), and 4.01 minutes for advanced life support (Medic One) (SFD 2003a). Seattle fire stations serving the AWV study area are shown in Exhibit 4-1 and mapped in Exhibit 4-2.

Exhibit 4-1. Seattle Fire Stations in or Adjacent to Alaskan Way Viaduct Study Area

Station	Location	Segment Served	Equipment
14	3224 Fourth Avenue S.	South	Aid unit, ladder, and rescue unit
10	301 Second Avenue S.	Central/South	Aid unit, ladder, engine, Deputy Chief/shift commander, hazardous materials unit, and staff coordinator
25	1300 E. Pine Street	Central	Aid unit, ladder, engine, Battalion Chief, hose wagon, and power/CO2 unit
2	2334 Fourth Avenue	North/Central	Aid unit, ladder, engine, and Safety Chief
Harborview Medical Center	325 Ninth Avenue (Harborview)	All	Two medic units

Source: SFD (2003).

Of the stations listed above in Exhibit 4-1, Fire Station No. 5 is located at the seawall, in the immediate vicinity of the Alaskan Way Viaduct. Fire Station No. 5 currently houses one marine company that operates the fireboat (Engine 4) and one land-based company that operates Engine 5 and acts as marine back-up. Current response constraints for Engine 5 are primarily linked to ferry and/or other normal special event traffic delays on Alaskan Way. SFD reports that the current delays due to the trolley are not significant given the normally quick progression of the trolleys through the intersections (Nelsen 2003).

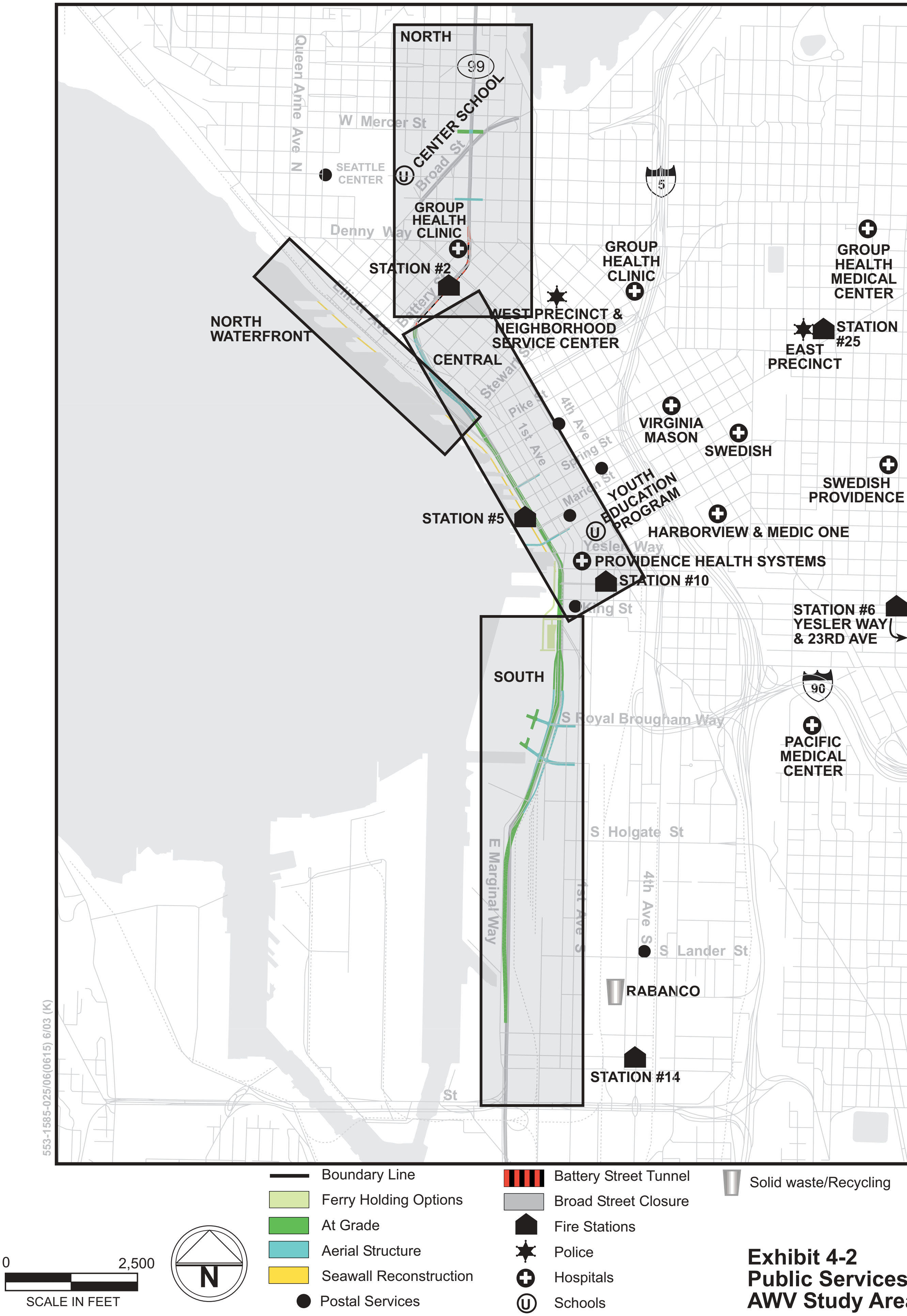

Exhibit 4-2
Public Services in the AWV Study Area

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Emergency Medical Services

Several hospitals provide emergency medical services to the AWV study area. These hospitals include Harborview Medical Center (325 Ninth Avenue), Swedish Medical Center (747 Broadway), Group Health Cooperative (201 16th Avenue E.), Virginia Mason Medical Center (925 Seneca Street), and Swedish Medical Center, Providence (500 17th Avenue). Their service locations are listed in Exhibit 4-3 and shown on the map in Exhibit 4-2. Numerous outpatient facilities and clinics are also located in the project vicinity as listed in Exhibit 4-3.

Exhibit 4-3. Hospitals and Clinics in AWV Study Area

Hospital/Clinic	Location	Segment Served
Pacific Medical Center	1101 Madison, Suite #301	South
Providence Health Systems	506 Second, #1200	South/Central
Harborview Medical Center	325 Ninth Avenue	Central/South
Swedish Medical Center	747 Broadway	Central/South
Swedish Medical Center @ Providence	500 17th Avenue	Central
Group Health Clinic	1730 Minor	Central
Virginia Mason	925 Seneca Street	Central
First Hill Care Center	1334 Terry Avenue	Central
RegenceCare & Clinical Options	1800 Ninth Avenue	Central
Heritage House at the Market	1533 Western Avenue	Central
U.S. Vietnam Veteran's Center	2030 Ninth Avenue	Central
Group Health Medical Center	201 16th Avenue E.	Central/North
Group Health Clinic	521 Wall Street	North

Source: Helplinedatabase.com.

4.1.2 Law Enforcement Services

The Seattle Police Department (SPD) provides law enforcement and responds to 911 emergency calls in and throughout Seattle and the AWV study area. SPD has more than 1,250 sworn personnel and nearly 700 civilian personnel (SPD 2000 Annual Report) in five main bureaus: Operations Bureaus I & II, Investigations, Information Resources, and Community Services & Support (SPD Functional Organizational Chart, November 2001).

SPD is divided into five precincts, which include South Precinct (3001 S. Myrtle Street), a new Southwest Precinct (2300 S.W. Webster Street) that opened in 2003, East Precinct (1519 12th Avenue), West Precinct (810 Virginia

Avenue), and North Precinct (10049 College Way N.). Additionally, the Seattle Police Headquarters shares the Seattle Justice Center at 610 Fifth Avenue with the Seattle Municipal Court. This office was opened in 2002 and does not function as a precinct (SPD 2003a).

In 2001, SPD dispatched patrol units in response to nearly 300,000 calls for service and responded to a total of over 550,000 events (SPD 2002). The AWV study area falls within portions of both the West and East Precincts. In 2001, there were 73,756 dispatches from the West Precinct and 57,185 dispatches from the East Precinct. In addition, there is a Downtown Neighborhood Service Center located at 820 Virginia Avenue. Seattle police precinct locations in the study area and vicinity are listed in Exhibit 4-4 and shown on the map in Exhibit 4-2.

Exhibit 4-4. Seattle Police Stations/Neighborhood Center in AWV Study Area

Precinct/Neighborhood Center	Location	Nearest Segment
East Precinct	1519 12th Avenue	Central
West Precinct	810 Virginia Avenue	Central/North
Downtown Neighborhood Service Center	820 Virginia Avenue	Central

Source: SPD (2003).

The Port of Seattle Police also maintain jurisdiction in the AWV Corridor along the central waterfront and Elliott Bay. The Port Police provide law enforcement response and patrol services for the commercial properties located at the piers and terminals in this geographic area. In addition, crime prevention for the Burlington Northern Santa Fe (BNSF) Railroad in the vicinity of the Alaskan Way Viaduct is provided by BNSF's own Police Solutions Team. The Police Solutions Team coordinates with other law enforcement agencies to investigate crimes committed on railroad property (Stairs 2003).

For the central waterfront, the Port of Seattle Police provide the primary law enforcement response (within the Port's geographical boundaries), including the piers and terminals. The container terminals are located in the south harbor area, and crimes related to container cargo unloading and loading include the smuggling of people, drugs, and equipment into the U.S. and shipping out stolen cars (Watts 2003). In addition, containers are often poorly secured, leaving them vulnerable to theft by trespassers.

The expanding cruise ship industry (on Port property) experiences similar crime problems. Bell Street Pier 66 provides moorage for Norwegian Cruise Lines, and Terminal 30 has been redeveloped to provide moorage for Holland America and Princess Cruises. Typical crimes affecting cruise lines include drug smuggling, theft aboard ship during transit, and people traveling who have outstanding warrants for their arrest. There are no reports of arriving or departing tourists being targeted by pickpocket activities (Watts 2003).

For the BNSF Railroad, typical crimes involve cargo as containers are being offloaded from ships and loaded onto railcars and during transit. Most containers are not locked, and have only aluminum or cable seals that indicate tampering if broken but generally offer little theft protection. Vandalism, including the shooting out of signals or rock throwing at railcars, and tagging (spreading graffiti on railcars) is also prevalent. Trespassing is another serious problem, and one that often results in injury from people crossing BNSF tracks (Stairs 2003).

Crime Data

The City of Seattle maintains statistics related to crime in its jurisdiction. Crimes are typically divided into Part I and Part II crimes. In general, Part I crimes (also known as the "Crime Index") are more serious and include felony crimes such as homicide, rape, robbery, aggravated assault, burglary, theft, auto theft, and arson. Part II crimes include all other crimes, such as simple assault, vandalism, forgery, prostitution, weapons offenses, drug and liquor violations, disorderly conduct, loitering, and other offenses.

In 2001, SPD reported 46,091 Index crimes, representing a 1.7 percent increase from 2000. In general, crime rates in Seattle have been slowly declining since the early 1990s. All categories of violent crime dropped in 2001, for a combined decrease of 4.2 percent from 2000. Property crimes, however, rose by 2.3 percent, while auto-theft was up 4.4 percent (SPD 2002).

The AWV study area is within the region of the city listed as "Considerably Above the Median" (i.e., includes approximately 15 percent of census tracts with most offenses) for both violent crimes and property crimes (SPD 2002).

4.1.3 Postal Services

A number of postal facilities are located within the AWV study area. Those facilities east of Fourth Avenue, and within the project area, are identified in Exhibit 4-5. Each of the primary post offices distributes mail to their respective surrounding areas and has counter service for residents wishing to purchase stamps and mail parcels.

Exhibit 4-5. Postal Services in the AWV Study Area

Precinct/ Neighborhood Center	Location	Nearest Segment	Services
Terminal Station	2420 Fourth Avenue S.	South	Mail drop off and distribution
Pioneer Square Drop-Off Station	91 S. Jackson Street	Central	Mail drop off only
Federal Finance Facility	909 First Avenue	Central	Mail drop off and service counter; no mail distribution
Bank of America Drop-Off Station	1001 Fourth Avenue	Central	Mail drop off only
Main Post Office	301 Union Street	Central	Mail drop off and distribution
Queen Anne Post Office	415 First Avenue N.	North	Mail drop off and distribution

Source: Nguyen (2003); Jenkins (2003).

The Pioneer Square and Bank of America drop-off stations are overseen by the International Station Post Office at 414 Sixth Avenue S., at Sixth and Jackson, which is outside the project area.

4.1.4 Disaster Preparedness

Seattle Emergency Management

Seattle Emergency Management (SEM) is an Emergency Preparedness Bureau of the Seattle Police Department devoted to citywide disaster preparedness, response, recovery, and mitigation (SEM 2003). The unit consists of a staff of nine people whose principal responsibilities involve encouraging individual and community preparedness and providing a key liaison function between the City and its state and federal emergency management counterparts (SEM 2002). The official emergency management function originated in the Seattle Fire Department in 1991. In 1997, emergency management functions were moved to the Seattle Police Department.

The primary functions of SEM include (1) maintaining the City's command center, (2) developing disaster plans, (3) educating the public, (4) protecting and repairing City infrastructure, (5) coordinating mitigation projects and managing recovery processes, (6) managing outside assistance, and (7) planning and running emergency exercises and training.

Washington State Ferry System

Washington State Ferries has an operations center located at Colman Dock, within the AWV study area. The Operations Center was initiated in the 1995–1997 biennium and consists of approximately 50 employees, including a watch supervisor, dispatchers, and customer information agents. The center operates 24 hours per day, 365 days per year. The Operations Center's primary role is to respond in times of crisis, such as bomb threats, severe regional weather, emergency vehicle transport coordination, and vessel/terminal accidents. The center also serves an administrative function by coordinating, monitoring, and gathering performance data for Washington State Ferries in 26 different areas such as cancelled trips, non-scheduled trips, non-revenue trips, employee injuries, customer injuries, and sick leave (Washington State Ferries 1999 Annual Report).

Port of Seattle

The Port of Seattle maintains an emergency response plan for all facilities, including their marine and seaport facilities within the AWV study area. In the Central Harbor area, these facilities include Pier 69, which accommodates the Port of Seattle headquarters and the terminal for the Victoria Clipper, and Piers 64, 65, and 66, home to a cruise ship terminal, conference center, and marina. In the South Harbor area, Terminals 3, 5, 15, 18, and 46/47 handle containerized cargo; Terminal 37, break bulk cargo; and Terminal 30, a second cruise ship terminal, opened in May of 2003. An estimated 140 cruise ship calls serving more than 500,000 passengers are expected for 2004 (Port of Seattle 2003). Pier 48 in this area is currently vacant, but is categorized as a multi-use facility.

Because of the detailed nature of some of the emergency response plans, they are no longer publicly available due to homeland security issues (Serrill 2003) and are discussed only generally in this report. In the event of an emergency or a major disaster, these plans are the primary controlling documents. The focus of the emergency response and maintenance plan includes establishing designated meeting areas, managing disaster equipment and materials, conducting initial property damage assessments, coordinating electric utility shut-offs, implementing an emergency response organization plan, and managing recovery and resumption of business (Port of Seattle 2003).

4.1.5 Public Schools

With more than 46,000 students, Seattle Public Schools forms the largest school district in Washington State. The system includes 61 elementary schools, 10 middle schools, 10 high schools, and a number of alternative schools and special programs (Seattle School District 2002). Two public schools operate within the AWV study area (Exhibit 4-2). Other schools are discussed in Appendix I, Social Resources Technical Memorandum.

The Center School, in the AWV north segment, serves over 220 high school students inside the Center House, in the Seattle Center. The Youth Education Program, an Interagency Academy School, is located in the north section of the study area at the Alaska Building, 618 Second Avenue. This school serves nearly 90 students, each of whom is provided with a Metro bus pass for transportation to and from the area.

Public School Transportation

While student transportation within the AWV study area is provided by contract with First Student (Seattle Public Schools 2003), coordination of routes is managed by the Seattle School District Transportation Office. Buses serving Seattle Public Schools travel in the study area on a daily (weekday) basis. School buses make 45 trips along the AWV Corridor daily. Driver-only buses, traveling to and from bus yards, make an additional 81 trips through the study area daily (Anderson 2003). The distribution of trips and times are reported in Exhibit 4-6. Detailed information dealing with exact routes and times has been withheld for security reasons. However, it is anticipated that the bus routes travel through the AWV study area along the adjacent surface streets in downtown Seattle.

Exhibit 4-6. Distribution of Seattle Public School Transportation in the AWV Study Area

Trip Times	Trip Status	Total Buses
6:00–7:30 a.m.	Drivers only	10 buses
7:00–9:00 a.m.	Students aboard	19 buses
8:45–9:30 a.m.	Drivers only	28 buses
1:20–3:00 p.m.	Drivers only	35 buses
2:25–4:15 p.m.	Students aboard	19 buses
4:00–5:00 p.m.	Drivers only	8 buses
4:30–6:00 p.m.	Students aboard	7 buses

Source: Seattle Public School Transportation Office.

4.1.6 Solid Waste Collection, Disposal, and Recycling

The Seattle Solid Waste Utility, a division of Seattle Public Utilities, currently contracts with two private firms, Waste Management of Seattle and Northwest Waste Industries, to collect commercial and residential solid waste generated in Seattle. Residential waste is delivered to one of two City-owned facilities operated by the Solid Waste Division. These facilities consist of the North Transfer Station immediately north of Lake Union, and the South Transfer Station, located near the South Park area (City of Seattle Comprehensive Plan 2001).

Commercial garbage generated in the city, as well as construction, demolition, and land clearing waste, is delivered to two private transfer stations in the city: Waste Management's Eastmont Station (located in the South Park area near the City's South Recycling and Disposal Station) and the Rabanco-owned station (located at Third Avenue S. and S. Lander Street). The Rabanco station also handles contaminated soils; contaminated soils handled by Waste Management are sent to a second and separate Waste Management facility, the Alaska Street Recycling Station.

Municipal solid waste and construction-demolition waste are transferred by truck and rail from the transfer stations to the Argo Intermodal Facility in south Seattle, where it is transported by rail to landfills. Eastmont sends its waste to the Columbia Ridge Landfill in Arlington, Oregon, and Rabanco sends its waste to both Columbia Ridge and the Roosevelt Landfill on the Columbia River in Washington (Jiries 2003; Zimmerman 2003).

Capacity of Waste Processing Facilities

The Eastmont and Rabanco transfer stations have the current available capacity to process 300,000 to 400,000 tons of waste per year, including waste from Seattle's businesses. In 1999, the two stations processed 225,000 tons of garbage from the City of Seattle (Seattle Comprehensive Plan 2001). This capacity has significantly increased in the past 4 years. Eastmont alone handled approximately 650,000 tons, or 2,500 tons a day in 2002–2003, with 30 percent of the waste coming from construction sites (Bridges 2003). Waste Management's Alaskan Street facility handled 220,000 tons of waste in 2002 (Borghese 2003).

The Columbia Ridge Landfill in Oregon opened in 1990 and has a current lifespan of 100 years and a capacity of 230 million tons. Unused capacity after 13 years stands at 207 million tons (Jiries 2003). The Roosevelt Landfill in Washington has a lifespan of 100+ years and had an initial capacity of 217 million tons (Keller 2003). The landfill handles approximately 2 million tons of waste per year and has a current available capacity of 196 million tons. The local transfer and recycling stations and the regional landfills have indicated that their facilities have sufficient capacity to handle increases in the amount of solid waste expected from both growth in Seattle and potential demolition of the Alaskan Way Viaduct (Jiries 2003). In addition, the rail transfer capacity between the transfer stations and the landfills has been doubled in recent years and is also expected to have sufficient capacity to manage area growth and project waste (Borghese 2003).

Disposal of Materials From Roadway and Building Demolition Projects

The difference in the disposal of materials from a roadway demolition project as compared to a building demolition project depends primarily on the type of materials involved. Roadway demolition projects generate materials such as asphalt and concrete, while building demolition projects generate wood, metal, drywall, roof shingles, and other wastes. Some companies such as Construction Waste Management will contract with a construction contractor to sort the materials on-site and direct the materials to different processing and recycling facilities.

Currently, as much as 40 percent of construction and demolition waste is recyclable, a disposal method considerably less expensive than the traditional reliance on landfills. As a result, recycling on construction projects is increasing. Asphalt and concrete are two materials that can be recycled. Recycled concrete can be ground into a finer material used for retaining wall blocks or gravel for temporary roads or as base course for permanent roads. Asphalt can be reused for temporary roads on construction sites or in a final blacktop product.

Building materials such as wood and metal are sent to the Eastmont and Rabanco transfer stations, where they are compacted and then transferred by rail to landfills in Oregon and Washington. While the Columbia Ridge and Roosevelt Landfills handle a range of solid waste types, there are a number of demolition-only landfills for inert materials in Western Washington that are regulated by the Washington State Department of Ecology and the Washington Administrative Code (WAC) (Keller 2003).

Disposal of Contaminated Materials

Contaminated soils are either buried at a disposal facility, or burned to remove contaminants. This cleaned soil can then be reused as fill for construction or land reclamation projects or as a component in making cement (Keller 2003).

Recycling

Two private material recovery facilities serve as the processing and transfer facilities for most of the recyclable materials collected from City of Seattle residents. In 1999, these facilities processed nearly 35,000 tons of recyclable materials. Recycle Seattle is located south of downtown on S. Lander Street, and Recycle America is located in the South Park area (Seattle Comprehensive Plan 2001).

4.2 Operational Impacts

Operational impacts are those impacts that occur over the long term as the facility is in operation. Unless otherwise noted, operation impacts apply to all areas. For a breakdown of the construction impacts by alternative, refer to Section 4.3. Mitigation measures for the potential operational impacts are discussed in Section 4.4.

Six different alternatives are being considered for the project and are discussed as follows:

- No Build Alternative
- Rebuild Alternative
- Aerial Alternative
- Tunnel Alternative
- Bypass Tunnel Alternative
- Surface Alternative

4.2.1 No Build Alternative

Scenario 1 – Continued Operation of the Viaduct and Seawall With Continued Maintenance

The existing 50-year-old viaduct has experienced corrosion damage, and components susceptible to performance failure either were constructed as part of the facility or were made vulnerable by later events such as material spills, fires, and earthquakes. Due to a combination of factors, including a material spill near Elliott Avenue that degraded the concrete deck cover; a number of earthquakes of various magnitude, each of which caused small, incremental amounts of cracking and spalling; and fires both on and under structures that damaged the concrete supporting elements, the continued degradation of the structure increases its vulnerability to seismic events and limits the capacity of the structure to support current traffic operational loads.

The existing condition represents a moderate operational impact to public services. Continued degradation of the facility would require continual repairs and maintenance activities to help offset public safety and risk factors and would create the potential for greater demand on public services. In addition, a decrease in mobility through the corridor would affect emergency service vehicles, as well as postal carriers, school buses, and solid waste transport. Traffic studies of current conditions indicate that by the year 2030 under the No Build Alternative, approximately 15 intersections in the AWV study area would be operating at a level of service (LOS) D or below (see Appendix C, Transportation Discipline Report). Levels of service are reflected as A through F, with A representing the best conditions and F the worst. The American Association of State Highway and Transportation Officials (AASHTO) recommends at least LOS C for freeways and arterials in heavily developed metropolitan areas (AASHTO 2001).

Scenario 2 – Sudden Unplanned Loss of the Viaduct and/or Seawall Without Major Collapse or Injury

Under this scenario, a moderate earthquake slightly larger than the Nisqually earthquake is likely to initiate more widespread liquefaction and increased loads on the existing seawall (Appendix B, Alternatives Description and Construction Methods Technical Memorandum). As such, sudden unplanned loss of the facilities is possible at some locations in the study area. Type A and Type B Seawall structures would likely fail in some locations, making replacement and/or reconstruction necessary, at substantial cost and disruption to waterfront activities (Appendix B, Alternatives Description and Construction Methods Technical Memorandum). This disruption would have considerable impact on public services, including operations for disaster preparedness (Seattle Emergency Management, Port of Seattle, Washington State Ferries) and Fire Station No. 5.

If the seawall were to move several inches due to landslide, impacts could include damage of underground utilities and services to the pier structures. Potential loss of utility services on or underneath the existing facility due to damaged utility lines or inability to access lines in need of maintenance could also occur. The sudden unplanned loss of the facilities without major collapse or injury would represent a substantial operational impact to utilities and public services, as fire flow to piers would be virtually eliminated, along with electricity to power alarm systems and security lighting. Potential loss of traffic lanes related to this scenario could also restrict and inhibit access of emergency and other public service vehicles and overall mobility within the corridor.

Scenario 3 – Catastrophic Failure and Collapse of the Viaduct and/or Seawall

Under this scenario, a catastrophic seismic event could trigger failure of significant portions of the existing seawall. Soil liquefaction could cause lateral movement in the soils, causing large earth movements behind the seawall and possibly triggering the collapse of the wall itself and the existing viaduct. These events would also likely cause the damage or collapse of piers and buildings near the seawall due to movement of liquefiable soils that extend east from the existing seawall to Western Avenue. The ripple effect from this catastrophic event would include disruption to all utilities in the project area, including power, water, sanitary and storm sewer, natural gas, petroleum, steam, and telecommunications.

Failure of the existing viaduct would cause significant interruption of power to the downtown area. Although a short-term impact, this outage could affect a large percentage of the downtown area, and it could be expected to last from several days to several weeks. Other direct effects may include economic impacts due to loss of business, the displacement of housing (due to loss of electrical services, including heat), traffic detour impacts (related to signal outages), and corresponding response time and travel time delays to public services.

In addition to potential loss of services due to damaged utility lines or inability to access lines in need of maintenance, potential flooding and soil loss issues related to broken water, storm drain, or sewer pipes; potential fire events related to damaged and/or exposed electrical equipment; and potential hazardous materials seepage related to damaged natural gas or petroleum pipes could occur. Proximity of electrical systems to gas or petroleum lines could produce a second catastrophic incident should sparks ignite or explode flammable materials. Loss of fire flow due to damaged water pipes could prevent firefighters from containing incidents in a reasonable amount of time to ensure public safety. The City has requested funds in a recent emergency levy to create alternative sources of water for fire suppression should the existing system fail due to seismic or other events (SFD 2003).

Other effects would be the delay of emergency service response due to decreased mobility in the corridor, as well as increased demand on emergency management agencies (City of Seattle, SEM, Port of Seattle, Washington State Ferries) for disaster readiness and response. Overall, this scenario would represent a major adverse impact to utilities as well as public services.

4.2.2 Impacts Common to All Build Alternatives

Operational impacts to public services typically include potential demands placed on law enforcement services, fire services, emergency medical services, public schools, postal delivery, and solid waste and recycling. In addition, the primary differences among the Build Alternatives involve location-specific changes in access for public services and related roadway changes and transportation conditions, which may affect response times and travel time. In most cases, the demand for public services would be similar among Build Alternatives. Thus, the analysis focuses on the relative change between the Build Alternatives and the baseline No Build conditions.

Response Time/Mobility Impacts to Public Services

Impacts to public services as a result of changes in traffic patterns could include delay of police, fire and emergency service vehicles, postal carriers, and school buses, and reduced access to public services due to traffic congestion, changes to the transportation system, and/or reduction in parking. Benefits to public services could include reduced levels of congestion and improved access. For a detailed description of roadway levels of service with the various Build Alternatives compared to the No Build Alternative, see Appendix C, the Transportation Discipline Report.

Specific potential impacts of the AWV Build Alternatives on emergency service response times are difficult to quantify because response time is dependent on a large number of variable factors, such as time of day, degree of traffic congestion, types of uses in the neighborhood, extent of construction activity in the neighborhood, and how response time is calculated. Average citywide response times for the Seattle Fire Department fire, rescue, and hazardous material calls, for example, have varied from a low of approximately 4 minutes in 1995 to a high of 4.24 minutes in 2002 (SFD 2003).

Fire and Emergency Medical Services Impacts

Potential impacts to fire and emergency medical services include changes in aid calls and changes in the emergency vehicle and personnel access and response time. Access to fire and medical emergencies (specifically response times for some public services such as police, fire suppression, and emergency medical aid) may be affected by placement and type of structural configuration of the AWV Build Alternatives. In addition, the AWV Build Alternatives could also result in an overall beneficial effect on access to public services by providing enhanced mobility.

Other operational impacts common to all Build Alternatives include the risks of potential spills of hazardous materials or wastes resulting from accidents involving vehicles traveling through the AWV Corridor. For the Tunnel or Bypass Tunnel Alternative, these risks would be increased by the tunnel structure itself and the difficulty of emergency access during an incident. Refer to Section 4.2.4 for additional discussion on this topic.

Additional operational impacts will also include the proposed relocation of Fire Station No. 5 during construction. In operational terms, Fire Station No. 5 is housed in the only facility west of the existing viaduct that delivers first response coverage for fire and emergency services along the entire waterfront (between Broad and Spokane Streets). The current location of Fire Station No. 5 allows unrestricted coverage to both cruise ship terminals (Piers 30 and 66). Secondly, there is a need to maintain the land- and marine-based companies (Engine 5 is land based, Engine 4 is marine based) in the central waterfront to uphold and deliver the capacity and effective fire/life safety response. Therefore, the proposed temporary relocation of this facility will need to be designed to allow unrestricted operational coverage to the central waterfront and the ability to maintain the joint marine- and land-based coverage.

Law Enforcement Services Impacts

The overall effects of operation of some AWV Build Alternatives could require additional police staff or additional patrol cars to monitor the system, including tunnels, parking facilities, and other areas. However, careful planning and design of the system and its related facilities, in association with local law enforcement services, would help deter criminal activity. As with fire and emergency medical services, police access to tunnel configuration options could pose more difficulty. For example, responding to crimes, disturbances, or other emergencies occurring in these sections could be difficult for both drivers and police to control and manage. Typically, at-grade configurations are easier to patrol and have a deterrent benefit related to officers who are on the ground actively patrolling the area.

School Bus Route Impacts

School buses traveling along, crossing, or making turns from some major roadways in the AWV study area could experience delays during operation, particularly during peak hour periods. Delays resulting from reduced LOS are described in Section 4.2.4 for the Build Alternatives.

Solid Waste Collection and Disposal Impacts

No significant impacts on solid waste collection and disposal in the project area during operation are expected. Trucks and transport vehicles using the affected intersections would either experience temporary delay or be required to find alternate routes along parallel arterials. Delays resulting from reduced LOS are described below in Section 4.2.4 for the Build Alternatives.

Disaster Preparedness Impacts

Other operational impacts include potential catastrophic spills of hazardous materials or wastes resulting from vehicle accidents or natural and human-caused hazards occurring in the corridor. Such an incident would place a demand on public services in terms of emergency service response. Depending on the location and extent, such an incident could affect a number of emergency management agencies, including the SEM, Port of Seattle, Washington State Ferries, and the City of Seattle. The existing AWV facility currently operates within the jurisdiction of each of these agencies, and emergency management functions are in place.

4.2.3 Benefits Common to All Build Alternatives

Operational benefits include fire/life safety improvements to the BST (common to all alternatives except the Rebuild Alternative). These improvements would include providing emergency egress points, improving existing electrical systems in the tunnel, and adding ventilation improvements to meet current fire codes. In addition, to accommodate the operational needs in the area of Terminal 46, Pier 48, and the Colman Dock Ferry Terminal, the AWV Build Alternatives have assumed the construction of a permanent parallel service road west of the Alaskan Way surface street between S. King Street and Yesler Way. The new service road would be a key component to maintain operational efficiency along the waterfront, in particular to maintain egress/ingress for ferry operations and emergency services.

4.2.4 Impacts by Build Alternative

The principal operational impacts to public services common to all Build Alternatives are discussed in Section 4.2.2 above. To the extent that differences exist between the Build Alternatives, those differences are noted below. The main difference for operational impacts relates to changes in response time and the effects on mobility in the AWV Corridor. Other differences relate to risks posed by the Build Alternatives for non-motorized access/pedestrian mobility, accidents, and safety concerns associated with the SR 99 mainline and northbound and southbound ramp improvements and transporting of hazardous materials.

This section also provides an overview of the potential safety risks and hazards posed to public services from the Build Alternatives. Following traffic impacts related to level of service (LOS), the discussion focuses on the effects on non-motorized routes and mobility, the overall safety and risks for accidents from the ramp and mainline (SR 99) layout improvements, and additional fire/life safety concerns associated with transporting hazardous materials through the corridor. Each of these elements has the ability to potentially increase the demand for public services, in particular with regard to fire, emergency medical, and police services.

Response Time Impacts

Roadway level of service (LOS) is one of the most common terms used to describe how good or bad traffic is projected to be and is also one measure of identifying response time impacts to public services, such as police, fire, and emergency medical aid. LOS is a measure of roadway congestion ranging from LOS A (least congested) to LOS F (most congested). Impacts to public services as a result of changes in traffic patterns could include delay of fire, police, and emergency service vehicles, postal carriers, and school buses, and reduced access to public services due to traffic congestion, changes to the transportation system, and/or reduction in parking. Benefits to public services could include reduced levels of congestion and improved access.

The analysis presented in this section reflects four segments in the AWV Corridor: South, Central, North Waterfront, and North. For each segment, in general those intersections with LOS E or below (i.e. LOS F) are considered congested to highly congested. Other factors have also been considered when identifying congested intersections, such as the average vehicle delay (in seconds), and the signalized intersections capacity utilization (ICU). It should be noted that the transportation analysis used the PM peak hour to establish their ratings for congested intersections.

Exhibit 4-7 provides a comparative summary (by segment) of the congested intersections for the 2030 Existing Facility and the Build Alternatives. The AWV Corridor uses the 2030 Existing Facility as the baseline condition for comparison purposes. The projections for the 2030 Existing Facility assume no further damage to the Viaduct has occurred as a result of an earthquake, landslide, or catastrophic incident. Therefore, the Build Alternatives are the differences between that alternative and Existing Facility for the year 2030, and the fact that congested intersections can pose additional response difficulties and travel time delays for public services.

For purposes of this analysis, congested intersections have been categorized into two levels: (1) congested intersections include those operating under LOS F conditions or where the Intersection Capacity Utilization (ICU) is greater than 100 percent, and (2) highly Congested Intersections (Delay >110 seconds per vehicle and ICU > 110%).

For a more detailed description of the LOS analysis, including average vehicle delays, and ICU for the Build Alternatives, refer to Appendix C, Transportation Discipline Report.

Exhibit 4-7. Congested Intersections by Segment

Segment	Street	2002 Existing	2030 Existing Facility	Rebuild	Aerial	Tunnel	Bypass Tunnel	Surface
South	*Moderately Congested*	*0*	*0*	*3*	*3*	*3*	*3*	*2*
	Highly Congested	*0*	*2*	*0*		*0*	*0*	*0*
	Congested Intersections	0	2	3	3	3	3	2

Exhibit 4-7. Congested Intersections by Segment (continued)

Segment	Street	2002 Existing	2030 Existing Facility	Rebuild	Aerial	Tunnel	Bypass Tunnel	Surface
Central	*Moderately Congested*	*7*	*5*	*5*	*5*	*4*	*3*	*7*
	Highly Congested	*0*	*3*	*2*	*2*	*1*	*2*	*7*
	Congested Intersections	7	8	7	7	5	5	14
North Waterfront	*Moderately Congested*	*0*	*0*	*0*	*0*	*1*	*1*	*0*
	Highly Congested	*0*	*0*	*0*	*0*	*0*	*0*	*0*
	Congested Intersections	0	0	0	0	1	1	0
North	*Moderately Congested*	*3*	*5*	*5*	*7*	*7*	*7*	*6*
	Highly Congested	*0*	*0*	*0*	*1*	*0*	*0*	*1*
	Congested Intersections	3	5	5	8	7	7	7
Total	*Moderately Congested*	*10*	*10*	*13*	*14*	*15*	*14*	*15*
	Highly Congested	*0*	*5*	*2*	*3*	*1*	*2*	*8*
	Congested Intersections	10	15	15	18	16	16	23

Source: Appendix C, Transportation Discipline Report. Congested Intersections (LOS F or Intersection Capacity Utilization (ICU)>100%. (2) Highly Congested Intersections (Delay >110 seconds per vehicle and ICU > 110%).

2030 Existing Facility (No Build Alternative)

South – S. King Street to S. Spokane Street

Highly congested conditions would occur at two intersections. These intersections include:

- First Avenue and S. Royal Brougham Way (LOS F, average vehicle delay of 123 seconds)
- First Avenue and S. Atlantic Street (LOS F, average vehicle delay of 132 seconds)

Central – S. King Street to Battery Street Tunnel

Highly to moderately congested intersections would occur at eight intersections, including:

- Alaskan Way and Marion Street (LOS F, average vehicle delay of 171 seconds)

- Alaskan Way and Yesler Way (LOS F, average vehicle delay of 124 seconds)
- Western Avenue and Wall Street (LOS E, average vehicle delay of 71 seconds)
- First Avenue and Marion Street (LOS E, average vehicle delay of 60 seconds)
- First Avenue and Columbia Street (LOS F, average vehicle delay of 151 seconds)
- Second Avenue and Spring Street (LOS F, average vehicle delay of 185 seconds)
- Second Avenue and Madison Street (LOS F, average vehicle delay of 225 seconds)
- Second Avenue and Marion Street (LOS F, average vehicle delay of 117 seconds)
- Second Avenue and Columbia Street (LOS E, average vehicle delay of 66 seconds)

North Waterfront – Pike Street to Broad Street

Congested conditions would not occur in this segment under the 2030 Existing Facility.

North – Battery Street Tunnel to Ward Street

Moderately congested conditions would occur at five intersections, including:

- Elliott Avenue and Denny Way (Western Avenue) (LOS F, average vehicle delay of 91 seconds)
- First Avenue and Denny Way (LOS D, average vehicle delay of 51 seconds)
- Second Avenue and Denny Way (LOS F, average vehicle delay of 108 seconds)
- Dexter Avenue and Denny Way (LOS B, average vehicle delay of 20 seconds, and ICU = 120 percent)
- Aurora Avenue northbound and Denny Way (LOS D, average vehicle delay of 44 seconds)

Conclusion

Response Times

The 2030 Existing Facility would pose the lowest overall impacts to response time based strictly on the number of congested intersections (15), although it would also have the second greatest total of highly congested intersections (5), and the effects to response times at these specific intersections could pose additional response time difficulties. In particular, Alaskan Way/Marion Street (LOS F), Alaskan Way/Yesler Way (LOS F), First Avenue/Columbia Street (LOS F), Second Avenue/Spring Street (LOS F), and Second Avenue/Madison Street (LOS F) intersections could pose additional response difficulties and travel time delays for Fire Stations No. 2, No. 5, and No. 10, as well as police (City of Seattle West Precinct and East Precinct and Port of Seattle Police) and emergency vehicles. Travel time delays could also be experienced by other public services, such as solid waste/recycling services, postal services, and school buses.

As identified in Exhibit 4-7, the Central and North Segments would experience the highest levels of congestion, and therefore, these segments would be expected to experience additional response difficulties and travel time delays. For example, due to worsening LOS conditions and access and egress limitations, the greatest impact to response times and travel time delays could occur at Alaskan Way at Yesler Way (LOS F) and Marion Street, and the Colman Dock Ferry Terminal. This intersection could also pose response difficulties for the Washington State Ferries Operations Center.

Rebuild Alternative

South – S. King Street to S. Spokane Street

Moderately congested conditions would occur at three intersections. These intersections include:

- Alaskan Way (Central District Northbound) and S. Royal Brougham Way (LOS D, average vehicle delay of 54 seconds)
- First Avenue and S. Royal Brougham Way (LOS F, average vehicle delay of 84 seconds)
- First Avenue and S. Atlantic Street (LOS F, average vehicle delay of 84 seconds)

Central – S. King Street to Battery Street Tunnel

Highly to moderately congested conditions would occur at seven intersections. These intersections include:

- Alaskan Way and Marion Street (LOS F, average vehicle delay of 141 seconds)
- First Avenue and Marion Street (LOS D, average vehicle delay of 45 seconds)
- First Avenue and Columbia Street (LOS F, average vehicle delay of 154 seconds)

- First Avenue and S. Jackson Street (LOS E, average vehicle delay of 73 seconds)
- Second Avenue and Spring Street (LOS F, average vehicle delay of 166 seconds)
- Second Avenue and Madison Street (LOS F, average vehicle delay of 125 seconds)
- Second Avenue and Marion Street (LOS F, average vehicle delay of 129 seconds)

North Waterfront – Pike Street to Broad Street

Congested conditions would not occur in this segment under the Rebuild Alternative.

North – Battery Street Tunnel to Ward Street

Moderately congested conditions would occur at five intersections, including:

- Elliott Avenue and Denny Way (Western Avenue) (LOS F, average vehicle delay of 101 seconds)
- First Avenue and Denny Way (LOS D, average vehicle delay of 51 seconds)
- Second Avenue and Denny Way (LOS F, average vehicle delay of 100 seconds)
- Dexter Avenue and Denny Way (LOS C, average vehicle delay of 29 seconds)
- Aurora Avenue northbound and Denny Way (LOS F, average vehicle delay of 85 seconds)

Conclusion

Response Times

Traffic operations at downtown intersections under the Rebuild Alternative generally mirror those under the 2030 Existing Facility with two exceptions. The first difference is that congested conditions are expected at all intersections on Second Avenue (even though volumes and the amount of delay are decreased from the 2030 Existing Facility). The second difference is that under the Rebuild Alternative, ferry traffic access to Colman Dock is provided remotely via a parallel frontage road with access at S. King Street and Alaskan Way. Removing ferry access traffic from the central waterfront is expected to significantly improve local traffic operations at Alaskan Way at Yesler Way.

Compared to the 2030 Existing Facility, the Rebuild Alternative would have the same overall total of 15 congested intersections (refer to Exhibit 4-7). The main distinction is that the 2030 Existing Facility would have five highly congested intersections, compared to two highly congested intersections for the Rebuild Alternative. Traffic operations on Alaskan Way, as well as those on connecting east–west arterials, could directly affect response time and access from the waterfront fire station (Fire Station No. 5), and to a lesser extent Fire Station No. 2 and Fire Station No. 10, and police services. Travel time delays could also be experienced by other public services, such as solid waste/recycling services, postal services, and school buses traveling on the east–west arterials. As identified in Exhibit 4-7, the Central and North Segments would experience the highest levels of congestion, and therefore, these segments would be expected to experience additional response difficulties and travel time delays.

Nonmotorized Routes/Mobility

For effects on nonmotorized routes and mobility, the Rebuild Alternative includes elevated structures that impose a psychological barrier to pedestrians crossing to the waterfront from the Central Business District (CBD) (Appendix C, Transportation Discipline Report).

Accidents and Safety (SR 99 Mainline and Northbound/Southbound Ramps)

For accidents and safety, the Rebuild Alternative includes specific ramp and mainline layout improvements as compared to the original structure. For the northbound ramp improvements, the northbound Seneca off-ramp will be rebuilt as it currently exists with some minor improvements, including adding a lane to the ramp. The shoulders, however, will not be widened and this may result in accidents at this interchange. The existing roadway has experienced a high number of rear-end collisions or accidents with fixed objects. Improvements at this location under the Rebuild Alternative may not significantly reduce the current accident rate. The northbound off-ramp at Western will be improved and include a new, signalized pedestrian crossing. The opposing southbound ramp will be closed, eliminating conflicting vehicle movements. At Battery Street, the northbound on-ramp and southbound off-ramp will be closed, potentially improving safety at the tunnel portal. The relocation of the First Avenue off-ramp from the left side to connect with SR 519 in the right side will reduce weaving maneuvers between the Columbia Street and First Avenue ramps. (Appendix C, Transportation Discipline Report).

No additional demand on law enforcement and emergency services is expected to result from the Rebuild Alternative.

Aerial Alternative

South – S. King Street to S. Spokane Street

Moderately congested conditions would occur at three intersections. These intersections include:

- Alaskan Way (Central District Northbound) and S. Royal Brougham Way (LOS C 28, average vehicle delay of 54 seconds)
- First Avenue and S. Royal Brougham Way (LOS F, average vehicle delay of 99 seconds)
- First Avenue and S. Atlantic Street (LOS F, average vehicle delay of 109 seconds)

Central – S. King Street to Battery Street Tunnel

Highly to moderately congested conditions would occur at seven intersections. These intersections include:

- Alaskan Way and Marion Street (LOS F, average vehicle delay of 138)
- Alaskan Way and Yesler (LOS F, average vehicle delay of 113 seconds)
- First Avenue and Marion Street (LOS D, average vehicle delay of 44 seconds)
- First Avenue and Columbia Street (LOS F, average vehicle delay of 145 seconds)
- Second Avenue and Spring Street (LOS F, average vehicle delay of 166 seconds)
- Second Avenue and Madison Street (LOS F, average vehicle delay of 121 seconds)
- Second Avenue and Marion Street (LOS F, average vehicle delay of 132 seconds)

North Waterfront – Pike Street to Broad Street

Congested conditions would not occur in this segment under the Aerial Alternative.

North – Battery Street Tunnel to Ward Street

Moderately congested conditions would occur at eight intersections. These intersections include:

- Elliott Avenue and Denny Way (Western Avenue) (LOS F, average vehicle delay of 84 seconds)

- First Avenue and Denny Way (LOS D, average vehicle delay of 51 seconds)
- Second Avenue and Denny Way (LOS F, average vehicle delay of 93 seconds)
- Fifth Avenue and Mercer Street (LOS E, average vehicle delay of 57 seconds)
- Dexter Avenue and Roy Street (LOS F, average vehicle delay of 122 seconds)
- Dexter Avenue and Mercer Street (LOS E, average vehicle delay of 61 seconds)
- Dexter Avenue and Denny Way (LOS C, average vehicle delay of 21 seconds)
- Aurora Avenue northbound and Denny Way (LOS E, average vehicle delay of 76 seconds)

Conclusion

Response Times

The Aerial Alternative would pose the second greatest overall impacts to response times based strictly on the number of congested intersections (17), although the majority of these intersections (14) would be categorized as moderately congested. Overall, traffic operations under the Aerial Alternative are expected to closely mirror those of the 2030 Existing Facility. Consequently response time impacts would be comparable, with some modest reduction in delay (particularly on Second Avenue) due to improved traffic signal optimization (refer to Exhibit 4-7). Like the2030 Existing Facility, the Aerial Alternative provides access to Colman Dock at Yesler Way, and as such, is forecasted to operate overcapacity and under heavily congested conditions at that location (Appendix C, Transportation Discipline Report).

If not properly mitigated, the congested conditions and travel time delays identified above could pose additional response difficulties for fire (Fire Station 2, Fire Station 5, Fire Station 10), police services (City of Seattle West Precinct and East Precinct and Port of Seattle Police), and emergency vehicles in the study area. Travel time delays could also be experienced by other public services, such as solid waste/recycling services, postal services, and school buses. As identified in Exhibit 4-7, the Central and North Segments would experience the highest levels of congestion, and therefore, these segments would be expected to experience additional response difficulties and travel time delays.

Nonmotorized Routes/Mobility

For effects on nonmotorized routes and mobility, the Aerial Alternative includes elevated structures that impose a psychological barrier to pedestrians crossing the waterfront from the CBD (Appendix C, Transportation Discipline Report). This location is a major pedestrian destination, and the barrier could create confusion and increase the risk of crossing conflicts. As a result, an additional demand on law enforcement and emergency services may result from the Aerial Alternative due to the elevated structures creating possible confusion and crossing conflicts.

Accidents and Safety (SR 99 Mainline and Northbound/Southbound Ramps)

For accidents and safety, the Aerial Alternative includes specific ramp and mainline layout improvements as compared to the original structure. For the northbound ramp improvements, one area of concern is at the SR 519 Interchange and the northbound off-ramp to S. Royal Brougham Way. The ramp exit ties into a signal at S. Royal Brougham Way and First Avenue S. If exiting drivers wish to travel eastbound on S. Royal Brougham Way, they would be forced to cross two lanes of northbound traffic on First Avenue S. The lane configuration for the crossing is short and may affect ramp operations and accident potential at this signalized intersection.

North of the BST in the South Lake Union area, limited access (right-on and right-off) from the side streets would continue to be allowed under the Aerial Alternative, and the off-ramp to Mercer Street would be eliminated. The removal of this ramp will likely increase the number of right-off movements at the surrounding side streets (Roy, Republican, Harrison, and Thomas Streets), potentially increasing accidents related to turning movements at these locations.

For southbound ramps, similar to northbound travel, limited (right-on and right-off) movements from the side streets would continue to be accommodated in the Queen Anne/South Lake Union area. However, the off-ramp to Broad Street would be eliminated, and removal of the ramp will likely increase the number of right-off movements at the surrounding side streets. If not properly mitigated, these additional right-off movements could result in an increase in the number of accidents related to reduced-speed turning movements.

The Denny Way off-ramp would remain as the primary exit for downtown Seattle; therefore, the South Lake Union and Queen Anne areas may experience increased congestion due to the elimination of the Broad Street exit. Increased congestion at this exit may increase the potential for congestion on the mainline SR 99 and, if not properly mitigated, congestion-related accidents. An overpass at Thomas Street will provide an additional grade separated crossing for this area, potentially reducing pedestrian accident rates.

The southbound on-ramp at Columbia Street would be reconstructed with wider shoulders and improved curvature and will join the mainline as an add lane (rather than a side merge), eliminating conflicts with the mainline traffic (Appendix C, Transportation Discipline Report).

Based on the above discussion, a slight additional demand on law enforcement and emergency services may result from the Aerial Alternative due to accident risks.

Tunnel Alternative

South – S. King Street to S. Spokane Street

Moderately congested conditions would occur at three intersections. These intersections include:

- Alaskan Way (Central District Northbound) and S. Royal Brougham Way (LOS C, average vehicle delay of 33 seconds)
- First Avenue and S. Royal Brougham Way (LOS F, average vehicle delay of 108 seconds)
- First Avenue and S. Atlantic Street (LOS E average vehicle delay of 77 seconds)

Central – S. King Street to Battery Street Tunnel

Highly to moderately congested intersections would occur at five intersections. These intersections include:

- Alaskan Way and Marion Street (LOS F, average vehicle delay of 155 seconds)
- First Avenue and Madison Street (LOS F, average vehicle delay of 88 seconds)
- Second Avenue and Spring Street (LOS F, average vehicle delay of 114 seconds)
- Second Avenue and Madison Street (LOS F, average vehicle delay of 126 seconds)
- Second Avenue and Marion Street (LOS F, average vehicle delay of 133 seconds)

North Waterfront – Pike Street to Broad Street

Congested conditions would occur at one intersection, Elliott Avenue and Alaskan Way Extension (LOS F, average vehicle delay of 107 seconds).

North – Battery Street Tunnel to Ward Street

Moderately congested conditions would occur at seven intersections. These intersections include:

- Elliott Avenue and Denny Way (Western Avenue)(LOS F, average vehicle delay of 90 seconds)
- Second Avenue and Denny Way (LOS F, average vehicle delay of 92 seconds)
- Fifth Avenue and Mercer Street (LOS E, average vehicle delay of 62 seconds)
- Dexter Avenue and Roy Street (LOS F, average vehicle delay of 112 seconds)
- Dexter Avenue and Mercer Street (LOS E, average vehicle delay of 66 seconds)
- Dexter Avenue and Denny Way (LOS C, average vehicle delay of 35 seconds)
- Aurora Avenue northbound and Denny Way (LOS F, average vehicle delay of 84 seconds)

Conclusion

Response Times

With a total of 16 congested intersections, the Tunnel Alternative would be proportionately greater than the 2030 Existing Facility and slightly lower than the Aerial Alternative, although the effects to response times would be similar. The main distinction is that the Tunnel Alternative would have only one highly congested intersection (Alaskan Way/Marion Street), with the majority of intersections (15) identified as moderately congested.

In addition, the Tunnel Alternative is forecasted to result in the fewest congested or overcapacity intersections downtown (five for the Tunnel Alternative, versus eight for the 2030 Existing Facility) compared to the 2030 Existing Facility or other Build Alternatives due primarily to the redistribution of traffic expected as a result of the access provided to SR 99. The Tunnel Alternative would increase vehicle activity on Alaskan Way, but improvements to the roadway facility are forecasted to maintain LOS at D or better along the waterfront (except for at Marion Street, which would be congested under all Build Alternatives). The other exception would be First

Avenue and Madison Street, where LOS F conditions would occur, posing additional response difficulties. Some improvement in operations on other surface streets downtown is also expected. In general, the Tunnel Alternative would not be expected to affect public service response times and operations compared to the 2030 Existing Facility in a significant way (Appendix C, Transportation Discipline Report).

Nonmotorized Routes/Mobility

For effects on nonmotorized routes and mobility, the Tunnel Alternative includes an increased number of lanes on Alaskan Way, providing a somewhat more difficult pedestrian crossing (Appendix C, Transportation Discipline Report). As a result, a slight additional demand on law enforcement and emergency services may result due to a slightly longer pedestrian crossing and the risk of accidents.

Accidents and Safety (SR 99 Mainline and Northbound/Southbound Ramps)

South of the BST, lane widths and shoulder widths for the Tunnel Alternative would be improved compared to the existing facility. Lane widths would taper approaching the BST to match the existing configuration. In this area, 2-foot-wide shoulders will be provided, which could prolong fixed object accidents in this location.

Access to the Tunnel will be provided at SR 519 and King Street. No ramps will be provided to downtown in the new tunnel segment. The King Street ramp will be constructed to higher standards than the existing Seneca Street ramp, and is expected to avoid congestion.

North of the BST in the South Lake Union area, limited access (right-on and right-off) from the side streets would continue to be allowed under the Aerial Alternative, and the off-ramp to Mercer Street would be eliminated. The removal of this ramp will likely increase the number of right-off movements at the surrounding side streets (Roy, Republican, Harrison, and Thomas Streets), potentially increasing accidents related to turning movements at these locations (Appendix C, Transportation Discipline Report).

Based on the above discussion, some additional demand on law enforcement and emergency services may result from the Tunnel Alternative due to the risk of accidents in the north segment.

Hazardous Materials

Other operational impacts include the risk of potential catastrophic spills of hazardous materials or wastes resulting from accidents. Specifically for the Tunnel Alternative, such an incident would represent an additional risk factor for public services in terms of emergency service response and/or fire and life safety concerns. Due to the tunnel configuration and access limitations, emergency response for the Tunnel Alternative would be more difficult and dangerous than for other Build Alternatives (with the exception of the Bypass Tunnel Alternative). This Build Alternative would result in potentially greater emergency services impacts in the AWV study area if the transport of hazardous or flammable materials were not expressly prohibited. Specifically, fires within enclosed tubes, such as cut-and-cover tunnels, are difficult and dangerous to fight. Even with ventilation and suppression systems in place, tunnel fires can quickly become unmanageable and require fire personnel to allow them to burn down before approaching (FHWA 2003). Typically, highway tunnel fires originate in vehicles and their cargo, fuel, or furnishings. No evidence of fires related to tunnel structure or materials only has been found, and the nonflammable nature of these materials suggests that highway tunnel fires will continue to originate in passing vehicles (FWHA 2003). As a result, a higher demand on fire and emergency services may result from the project if there are any large spills of fuels or other flammable fluids associated with transporting hazardous materials through the AWV Corridor. However, the new tunnel segment between King Street and Pike Street will require fire suppression systems and emergency egress facilities.

Bypass Tunnel Alternative

South – S. King Street to S. Spokane Street

Moderately congested conditions would occur at three intersections. These intersections include:

- Alaskan Way (Central District, Northbound) and South Royal Brougham Way (LOS B, average vehicle delay of 18 seconds, and ICU=109 percent)
- First Avenue and S. Royal Brougham Way (LOS F, average vehicle delay of 97 seconds)
- First Avenue and S. Atlantic Street (LOS E, average vehicle delay of 80 seconds)

Central – S. King Street to Battery Street Tunnel

Highly to moderately congested conditions would occur at five intersections. These intersections include:

- Alaskan Way and Marion Street (LOS F, average vehicle delay of 148 seconds)
- Alaskan Way and S. King Street (LOS F, average vehicle delay of 87 seconds)

- Second Avenue and Spring Street (LOS F, average vehicle delay of 176 seconds)
- Second Avenue and Madison Street (LOS F, average vehicle delay of 147 seconds)
- Second Avenue and Marion Street (LOS F, average vehicle delay of 159 seconds)

North Waterfront – Pike Street to Broad Street

Congested conditions would occur at one intersection at Elliott Avenue and Alaskan Way Extension (LOS D, average vehicle delay of 40 seconds).

North – Battery Street Tunnel to Ward Street

Moderately congested conditions would occur at seven intersections. These intersections include:

- First Avenue and Denny Way (LOS C, average vehicle delay of 35 seconds)
- Second Avenue and Denny Way (LOS F, average vehicle delay of 99 seconds)
- Fifth Avenue and Mercer Street (LOS E, average vehicle delay of 65 seconds)
- Dexter Avenue and Roy Street (LOS F, average vehicle delay of 102 seconds)
- Dexter Avenue and Mercer Street (LOS E, average vehicle delay of 78 seconds)
- Dexter Avenue and Denny Way (LOS D, average vehicle delay of 42 seconds)
- Aurora Avenue northbound and Denny Way (LOS E, average vehicle delay of 80 seconds)

Conclusion

With a total of 16 congested intersections, the Bypass Tunnel Alternative would be proportionately greater than the 2030 Existing Facility and slightly lower than the Aerial Alternative, although the effects to response times would be similar. The main distinction is that the Tunnel Alternative would have only two highly congested intersections (Alaskan Way/Marion Street, and Second Avenue/Madison Street), with the majority of intersections (14) identified as moderately congested.

In terms of basic capacity, the Bypass Tunnel Alternative is forecasted to result in somewhat improved conditions over the 2030 Existing Facility due primarily to the redistribution of traffic accessing southbound SR 99 (similar to under the Tunnel Alternative). In addition, improvements to Alaskan Way would maintain LOS D or better except at Marion Street (LOS F) and Madison Street (LOS F).

Some increased congestion would be experienced elsewhere in downtown Seattle and in the central waterfront. In particular, increased traffic on First Avenue will result in lower LOS conditions than under the Rebuild, Aerial, or Tunnel Alternatives (though intersections on First Avenue are still classified as moderately congested—refer to Exhibit 4-7 and Appendix C, Transportation Discipline Report). Arterials along First Avenue, in particular Spring Street and Madison Street, could pose additional response difficulties for Fire Stations No. 5 and No. 10, as well as police (City of Seattle West Precinct and East Precinct) and emergency vehicles. Travel time delays would also be experienced by other public services, such as solid waste/ recycling services, postal services, and school buses traveling on connecting arterials.

Nonmotorized Routes/Mobility

For effects on nonmotorized routes and mobility, the Bypass Tunnel Alternative includes an increased number of lanes on Alaskan Way, providing a more cumbersome crossing of that street for pedestrians. The Bypass Tunnel Alternative may also result in the greatest loss of parking spaces in the waterfront area. The Bypass Tunnel Alternative is anticipated to result in increased traffic volumes on Alaskan Way, adding an increased risk for pedestrian crossings.

As a result, a slight demand on law enforcement and emergency services may result from the Bypass Tunnel Alternative due to a somewhat more difficult pedestrian crossing and the risk of accidents.

Accidents and Safety (SR 99 Mainline and Northbound/Southbound Ramps)

For accidents and safety, the Bypass Tunnel Alternative includes specific ramp and mainline layout improvements compared to the original structure. Access to the Tunnel will be provided at SR 519 and King Street. No ramps will be provided to downtown in the new tunnel segment. The King Street ramp will be constructed to higher standards than the existing Seneca Street ramp, and is expected to avoid congestion. The northbound on-ramp from SR would carry high traffic volumes expecting to merge into two mainline lanes. Although this ramp will be constructed to higher standards than the existing ramp, volumes merging into the mainlines could potentially increase accident rates.

North of BST in the South Lake Union area, the off-ramp to Mercer Street would be eliminated. The removal of the ramp will likely increase the number of right-off movements at the surrounding side streets (Roy, Republican, Harrison, and Thomas Streets) and possibly increase accidents related to turning movements at these locations. Due to higher volumes and turning movements under the Bypass Alternative, potential exists for higher accident rates in this area. For southbound ramps, similar to northbound travel, limited access (right-on and right-off) movements from the side streets will continue to be accommodated in the Queen Anne/South Lake Union area. However, the off-ramp to Broad Street will be eliminated, and removal of the ramp will likely increase the number of right-off movements at the surrounding side streets, which may result in accident risk due to reduced-speed turning movements off of SR 99 (Appendix C, Transportation Discipline Report).

The Denny Way off-ramps will continue to be the primary exit for downtown Seattle, and ramp use will likely increase for travelers to South Lake Union and Queen Anne. The Denny Way exit may experience increased congestion due to the elimination of the Broad Street exit. This could result in an increase in congestion-related incidents on the ramp and mainline SR 99 (preceding the ramp) (Appendix C, Transportation Discipline Report).

Similar to the northbound off-ramps at Western Avenue, the southbound off-ramps at Battery Street would be retained under the Bypass Tunnel Alternative.

The Columbia Street on-ramp is also proposed to be eliminated. Removing a left-side entrance, which is contrary to driver expectations and does not meet current WSDOT design guidelines, may decrease accident risk.

Based on the above discussion, additional demand on law enforcement and emergency services may result from the Bypass Tunnel Alternative due to the increased risk of accidents.

Hazardous Materials

Other operational impacts include the risks of potential catastrophic spills of hazardous materials or wastes resulting from accidents involving vehicles traveling through the corridor. Specifically, for the Bypass Tunnel Alternative, such an incident would represent an additional risk for public services in terms of emergency service response and/or fire and life safety concerns. Due to the tunnel configuration and access limitations, emergency response for the Bypass Tunnel Alternative would be more difficult than for other Build Alternatives, but would be very similar to the Tunnel Alternative.

This alternative would result in potentially greater emergency services impacts in the AWV study area if the transport of hazardous or flammable materials were not expressly prohibited (see description under Tunnel

Alternative above). However, the new tunnel segment between King Street and Pike Street will require fire suppression systems and emergency egress facilities.

Surface Alternative

South – S. King Street to S. Spokane Street

Moderately congested conditions would occur at two intersections. These intersections include:

- First Avenue and S. Royal Brougham Way (LOS F, average vehicle delay of 89 seconds)
- First Avenue and S. Atlantic Street (LOS E, average vehicle delay of 77 seconds)

Central – S. King Street to Battery Street Tunnel

Highly to moderately congested conditions would occur at 14 intersections. These intersections include:

- Alaskan Way and Seneca Street (LOS E, average vehicle delay of 68 seconds)
- Alaskan Way and Spring Street (LOS B, average vehicle delay of 13 seconds, and ICU= 109 percent)
- Alaskan Way and Madison Street (LOS F, average vehicle delay of 116 seconds)
- Alaskan Way and Marion Street (LOS F, average vehicle delay of 85 seconds)
- Alaskan Way and Columbia Street (LOS F, average vehicle delay of 96 seconds)
- Alaskan Way and Yesler Way (LOS F, average vehicle delay of 99 seconds)
- Alaskan Way and S. King Street (LOS F, average vehicle delay of 158 seconds)
- First Avenue and Spring Street (LOS F, average vehicle delay of 85 seconds)
- First Avenue and Marion Street (LOS F, average vehicle delay of 128 seconds)
- First Avenue and Columbia Street (LOS F, average vehicle delay of 222 seconds)
- Second Avenue and Spring Street (LOS F, average vehicle delay of 225 seconds)

- Second Avenue and Madison Street (LOS F, average vehicle delay of 171 seconds)
- Second Avenue and Marion Street (LOS F, average vehicle delay of 156 seconds)
- Second Avenue and Columbia Street (LOS F, average vehicle delay of 185 seconds)

North Waterfront – Pike Street to Broad Street

Congested conditions would not occur in this segment under the Surface Alternative.

North – Battery Street Tunnel to Ward Street

Moderate to highly congested conditions would occur at seven intersections. These intersections include:

- First Avenue and Denny Way (LOS D, average vehicle delay of 44 seconds)
- Second Avenue and Denny Way (LOS F, average vehicle delay of 107 seconds)
- Fifth Avenue and Mercer Street (LOS E, average vehicle delay of 77 seconds)
- Dexter Avenue and Roy Street (LOS F, average vehicle delay of 136 seconds)
- Dexter Avenue and Mercer Street (LOS C, average vehicle delay of 29 seconds)
- Dexter Avenue and Denny Way (LOS E, average vehicle delay of 63 seconds)
- Aurora Avenue northbound and Denny Way (LOS F, average vehicle delay of 99 seconds)

Conclusion

As noted above in Exhibit 4-7, in terms of total congested intersections, the Surface Alternative would pose the greatest impacts to response times with 23 intersections in the Corridor operating at congested to highly congested levels. Approximately 15 of these intersections are classified as moderately congested, while 8 are classified as highly congested. Thus, fire and police operations could be adversely affected by traffic congestion under the Surface Alternative. This would particularly apply during the peak hours, although high traffic volumes on Alaskan Way could be expected throughout the day (Appendix C, Transportation Discipline Report). The affected intersections would occur at the waterfront and along First and Second Avenues

Given the capacity constraints on the SR 99 corridor, increased dependence on downtown arterials is forecasted under the Surface Alternative, and as identified in Exhibit 4-7, the Central and North Segments would experience the highest levels of congestion, and therefore, these segments would be expected to experience additional response difficulties and travel time delays.

As a result of higher traffic volumes on these streets, the number of intersections in the downtown study area that operate at congested conditions or overcapacity is forecasted to increase sharply. The increased congestion and access limitations under this alternative pose additional response time difficulties for fire (Fire Stations No. 2, No. 5, and No. 10), emergency vehicles, and police (City of Seattle West Precinct, East Precinct, and Port of Seattle Police). Travel time delays would also occur to solid waste/recycling services, postal services, and school buses traveling along the waterfront or First and Second Avenues on the connecting arterials.

Nonmotorized Routes/Mobility

For effects on nonmotorized routes and mobility, the Surface Alternative includes an increased number of lanes on Alaskan Way, providing a somewhat more difficult pedestrian crossing. The Surface Alternative is also anticipated to result in the greatest loss in parking spaces in the waterfront area, as well as the greatest impacts to access to parking from the waterfront due to increased traffic volumes on Alaskan Way. The Surface Alternative is anticipated to result in increased traffic volumes on Alaskan Way, adding an increased burden to pedestrians crossing the street.

As a result, an increased demand on law enforcement and emergency services may result from the Surface Alternative due to the increased traffic volumes and increased length of the pedestrian crossing.

Accidents and Safety (SR 99 Mainline and Northbound/Southbound Ramps)

For accidents and safety, the Rebuild Alternative includes specific ramp and mainline layout improvements as compared to the original structure. For the northbound ramp improvements, the northbound Seneca off-ramp will be rebuilt as it currently exists with some minor improvements, including adding a lane to the ramp. The shoulders, however, will not be widened and this may result in accidents at this interchange. The existing roadway has experienced a high number of rear-end collisions or accidents with fixed objects. Improvements at this location under the Rebuild Alternative may not be much of an improvement to the current accident rate.

The northbound off-ramp at Western will be improved and include a new, signalized pedestrian crossing. The opposing southbound ramp will be closed, eliminating conflicting vehicle movements. At Battery Street, the northbound on-ramp and southbound off-ramp will be closed, potentially improving safety at the tunnel portal. The relocation of the First Avenue off-ramp from the left side to connect with SR 519 in the right side will reduce weaving maneuvers between the Columbia Street and First Avenue ramps. (Appendix C, Transportation Discipline Report).

Because this alternative will considerably increase traffic volumes on Alaskan Way, reducing it from a high speed, limited access highway to a congested, lower speed arterial, accident rates could potentially rise, increasing demand on emergency services.

North of the BST in the South Lake Union area, the off-ramp to Mercer Street would be eliminated. The removal of the ramp would likely increase the number of right-off movements at the surrounding side streets (Roy, Republican, Harrison, and Thomas Streets) and possibly increase accidents related to turning movements at these locations (Appendix C, Transportation Discipline Report).

For southbound ramps, similar to northbound travel, limited (right-on and right-off) movements from the side streets would continue to be accommodated in the Queen Anne/South Lake Union area. However, the off-ramp to Broad Street would be eliminated, and removal of the ramp would likely increase the number of right-off movements at the surrounding side streets. If not properly mitigated, these additional right-off movements could result in an increase in the number of accidents related to reduced-speed turning movements (Appendix C, Transportation Discipline Report).

The Denny Way off-ramp would continue to be the primary exit for downtown Seattle, and its use would likely increase for travelers heading to South Lake Union and Queen Anne. The Denny Way exit may experience increased congestion due to the elimination of the Broad Street exit, which could result in an increase in congestion-related incidents on the ramp and mainline SR 99 (preceding the ramp) (Appendix C, Transportation Discipline Report).

Based on the above discussion, an additional demand on law enforcement and emergency services may result from the Surface Alternative due to the continued and/or slightly increased risk of accidents.

4.2.5 Project Benefits by Build Alternative

Rebuild Alternative

The Rebuild Alternative would have no major adverse effects and would offer benefit to law enforcement and emergency services in terms of protected or improved cross-access routes and increased lane widths on SR 99. This is the only alternative, however, that would not include fire/life safety improvements in the BST.

The south segment of this alternative leaves intact three lanes and improves two of the five surface cross-access routes between First Avenue S. and E. Marginal Way S. (S. Spokane Street, Horton Avenue, Hanford Street, S. Atlantic Street, and S. Royal Brougham Way) that are used as detours around contained fire and SWAT emergency sites, when not blocked by trains. Additionally, these five routes are regularly used for responses to fire, serious industrial injury incidents, alarms, and traffic incidents. This cross-access improvement is a potential benefit for police services.

In the central project area, the off-ramp at S. King Street is expected to alleviate the northbound lane-merging problem between the Seneca Street and Western Avenue off-ramps.

For LOS and response times, improvements under the Rebuild Alternative could occur at 7 intersections (Refer to Appendices C, Transportation Discipline Report). These intersections include:

- Alaskan Way (Central District, Southbound) and South Royal Brougham Way (LOS C to LOS B)
- Alaskan Way and Columbia Street (LOS B to LOS A)
- Alaskan Way and Yesler Way (LOS F to LOS A)
- Alaskan Way and S. Main Street (LOS C to LOS B)
- Western Avenue and Wall Street (LOS E to LOS D)
- Western Avenue and Marion Street (LOS B to LOS A)
- First Avenue and Marion Street (LOS E to LOS D)

Compared to the 2030 Existing Facility, these improvements could result in modest decreases to the average vehicle delay in the corridor at select locations, which could have beneficial response and travel time effects to police, fire, and emergency services.

Aerial Alternative

The Aerial Alternative is expected to be the most beneficial for law enforcement and emergency services in terms of overall traffic-flow enhancement. Other benefits include increased response access in the north, and the fire/life safety improvements to the BST common to all alternatives. The principal impact for this alternative would be the SR 519 connection, which is anticipated to cause confusion to motorists.

In the south segment, the Aerial Alternative keeps intact the current necessary east–west surface emergency cross-access routes south of S. Stacy Street. However, there is a concern about motorist confusion at street level, when combining on-/off-ramps with the overpasses at SR 519. Motorists arriving on football/baseball game days may be caught in the congestion that results from seeking parking.

In the central segment, increasing the number of lanes and eliminating the Railroad Avenue off-ramp between S. King and Pike Streets is expected to reduce the current concerns related to merging southbound traffic with exiting traffic. Closing the Battery Street on-ramp to all but emergency vehicles is expected to eliminate near accidents and road rage caused by overly cautious motorists stopping at the northbound on-ramp.

Fire/life safety improvements to the BST in the north segment (as noted in Section 4.2.3) would improve firefighter and emergency medical response to this facility. The Lowered Aurora/SR 99 Option is expected to allow increased capability for emergency response on five streets. This could be especially important in the event of closure of Denny Way due to a tunnel fire or serious collision (2003c).

For LOS and response time, improvements under the Aerial Alternative could occur at 8 intersections (Refer to Appendices C, Transportation Discipline Report). These intersections include:

- Alaskan Way (Central District, Southbound) and S. Royal Brougham Way (LOS C to LOS B)
- Alaskan Way and Madison Street (LOS C to LOS B)
- Alaskan Way and Columbia Street (LOS B to LOS A)
- Alaskan Way and S. Main Street (LOS C to LOS B)
- Western Avenue and Wall Street (LOS E to LOS D)
- Western Avenue and Battery Street (LOS B to LOS A)
- Western Avenue and Madison Street (LOS B to LOS A)
- First Avenue and Marion Street (LOS E to LOS D)

Compared to the 2030 Existing Facility, these improvements could result in modest decreases to the average vehicle delay in the corridor at select locations, which could have beneficial response and travel time effects to police, fire, and emergency services.

Tunnel Alternative

The potential benefits for the south segment are expected to be similar to those described for the Rebuild Alternative.

The elimination of the viaduct columns in the central segment improves line-of-sight visibility and pedestrian access. Both of these elements are conducive to improving public safety in this heavily parked area, while keeping cross-traffic access the same.

The north segment of this alternative is expected to have the same potential benefits as those associated with the Aerial Alternative.

For LOS and response time, improvements under the Tunnel Alternative could occur at 13 intersections (Refer to Appendices C, Transportation Discipline Report). These intersections include:

- Alaskan Way (Central District, Southbound) and S. Royal Brougham Way (LOS C to LOS B)
- First Avenue and South Atlantic Street (LOS F to LOS E)
- Alaskan Way and S. Main Street (LOS C to LOS B)
- Western Avenue and Wall Street (LOS E to LOS A)
- Western Avenue and Battery Street (LOS B to LOS A)
- First Avenue and Seneca Street (LOS C to LOS B)
- First Avenue and Marion Street (LOS E to LOS D)
- First Avenue and Columbia Street (LOS F to LOS C)
- First Avenue and S. Jackson Street (LOS E to LOS D)
- Second Avenue and Columbia Street (LOS E to LOS B)
- Elliott Avenue and Broad Street (LOS C to LOS B)
- Broad Street and Denny Way (LOS C to LOS B)
- Fifth Avenue and Broad Street (LOS C to LOS B)

Compared to the 2030 Existing Facility, these improvements could result in moderate decreases to the average vehicle delay in the corridor at select locations, and this could have beneficial effects on response and travel time for police, fire, and emergency services.

Bypass Tunnel Alternative

The potential benefits for the south segment are expected to be similar to those listed for the Rebuild Alternative.

Potential impacts and benefits for the north segment are expected to be similar to those for the Aerial Alternative (SPD 2003c).

For LOS and response time, improvements under the Bypass Tunnel Alternative could occur at 11 intersections (Refer to Appendices C, Transportation Discipline Report). These intersections include:

- First Avenue and South Atlantic Street (LOS F to LOS E)
- Alaskan Way and Yesler Way (LOS F to LOS B)
- Alaskan Way and S. Main Street (LOS C to LOS A)
- Western Avenue and Wall Street (LOS E to LOS A)
- Western Avenue and Battery Street (LOS B to LOS A)
- First Avenue and Columbia Street (LOS F to LOS E)
- Second Avenue and Columbia Street (LOS E to LOS C)
- Elliott Avenue and Broad Street (LOS C to LOS B)
- Elliott Avenue and Denny (Western) (LOS F to LOS E)
- First Avenue and Denny (LOS D to LOS C)
- Fifth Avenue and Broad Street (LOS C to LOS B)

Compared to the 2030 Existing Facility, these improvements could result in modest decreases to the average vehicle delay in the corridor at select locations, which could have beneficial response and travel time effects to police, fire, and emergency services.

Surface Alternative

The potential benefits for the south segment are expected to be similar to those listed for the Rebuild Alternative.

Elimination of parking in the central segment will improve public safety with respect to the crimes of car prowl and auto theft, but could potentially increase incidences of pedestrian-vehicle collisions, as jaywalkers attempt to cross the at-grade SR 99 highway.

In the north segment, the option of traffic signals at Roy, Republican, and Harrison Streets may further increase the travel time through Seattle; however, the signals are expected to assist with emergency cross-traffic response times (SPD 2003c).

For LOS and response time, improvements under the Surface Alternative could occur at 9 intersections (Refer to Appendices C, Transportation Discipline Report). These intersections include:

- Alaskan Way (Central District, Southbound) and S. Royal Brougham Way (LOS C to LOS A)
- First Avenue and S. Atlantic Street (LOS F to LOS E)
- Alaskan Way and S. Main Street (LOS C to LOS A)
- Western Avenue and Wall Street (LOS E to LOS B)
- Western Avenue and Battery Street (LOS B to LOS A)
- Western Avenue and Madison Street (LOS B to LOS A)
- Elliott Avenue and Denny (Western) (LOS F to LOS E)
- Broad Street and Denny Way (LOS C to LOS B)
- Dexter Avenue and Mercer Street (LOS D to LOS C)

Compared to the 2030 Existing Facility, these improvements could result in modest decreases to the average vehicle delay in the corridor at select locations, which could have beneficial response and travel time effects for police, fire, and emergency services.

4.3 Construction Impacts

Construction impacts are those that occur over a relatively short-term period. Unless otherwise noted, construction impacts apply to all areas. The principal construction impacts and benefits to public services are described under the Rebuild Alternative, and to the extent that differences in impacts exist among the Build Alternatives, those differences are noted. Mitigation measures for the potential impacts are discussed in Section 4.4.3, Construction Mitigation.

4.3.1 Impacts Common to All Build Alternatives

Construction impacts are specifically related to areas where earthwork is anticipated and/or where the physical placement of the project facilities would occur on or adjacent to public services, which could result in potential disruption to access, response times, and mobility in the corridor. Generally, the impacts on public services created by the project lie in two main areas. The first area is reductions in access and increased travel time for emergency vehicles caused by lane or road closures through the construction area. This can be a serious problem for responses to life safety emergencies and for disaster preparedness. The second area is the increased demand for public services such as police or emergency medical services caused by the construction activities themselves, although this is expected to be a minor impact, as the contractor will be required to maintain first-aid personnel during construction activity and 24-hour security to the project site.

Fire and Emergency Medical Services Impacts

Traffic routing and detours during construction would pose the greatest potential impacts to public services and response times. There could also be increases in response time from the decreased LOS and mobility in the surface streets adjacent to the viaduct, in particular at downtown and the central waterfront. However, construction of the Colman Dock Ferry Terminal access road would help alleviate some of these impacts along the corridor and the central waterfront. The access road would be designed to accommodate the existing 650-car capacity Colman Dock, or a Colman Dock facility expanded to a 1,000-car capacity or a 1,200-car capacity. The access road would also connect to several proposed off-site ferry holding areas, including those proposed under the viaduct, east of SR 99, and on Terminal 46 (Appendix B, Alternatives Description and Construction Methods Technical Memorandum).

In addition, the use of intelligent traffic signal controls at signalized intersections could be used as a partial mitigation measure for response time impacts for fire and emergency medical, particularly during construction. This will include Alaskan Way as well as adjacent streets that can be reasonably expected to see increases in volume as a result of diverted construction traffic moving from Alaskan Way.

Lane closures, other traffic revisions, and construction staging areas could reduce LOS on both roadways under construction and adjacent roadways. Emergency response times could increase due to reduced LOS and lane or roadway closures. For a complete listing of the proposed traffic detours for the Build Alternatives, refer to Appendix B, Alternatives Description and Construction Methods Technical Memorandum.

During construction, fire hydrants will need to be relocated. Most of these relocations will occur along at-grade sections (surface streets) requiring sidewalk and street curb relocations. Water line relocations during construction could temporarily affect water supplies used for fire suppression. All water service and hydrant relocations on live systems are performed by SPU. During relocation, careful coordination with affected fire departments, SPU, and hospitals would prevent service interruptions.

Fire Station No. 5 will be relocated prior to relocation of utilities in order to provide uninterrupted fire suppression services. A possible temporary relocation could be Terminal 46. In the event that the station is relocated to this area, there would likely be increases in response times for alarms north of the current location and corresponding decreases for alarm locations south (Nelsen 2003). Response times for the fireboat associated with this project are limited since the marine crew travels by water to respond to incidents located on Elliott Bay. Responses for incidents occurring on fresh water may be delayed, as the marine crew must respond via land from Fire Station No. 5 to Fishermen's Terminal under the current deployment model. Blockage or congestion issues are not expected over water, but all Build Alternatives will require the temporary relocation of both the land and water companies.

Law Enforcement Services Impacts

Construction of at-grade and elevated sections in some high-volume traffic and pedestrian areas could require additional police support services to direct and control traffic and pedestrian movements. Traffic mobility during construction in heavily traveled areas could be most difficult, especially during peak hours. Construction contractors will be responsible for maintaining security at sites and staging areas during construction.

School Bus Route Impacts

Delays for school buses and other school traffic could occur due to reduced LOS and lane or roadway closures. Construction of at-grade and elevated sections would delay buses traveling on, crossing, or making turns on the roadway under construction. Major north–south school bus thoroughfares, including Alaskan Way and adjacent surface streets, will be affected as key intersections along these roads (refer to Appendix C, Transportation Discipline Report).

Solid Waste Collection and Disposal Impacts

Solid waste haulers could experience slight delays or disruptions in collection routes during construction activities, especially along route segments that access curbside, driveways, or other collection points that could be closed or more difficult to access.

Depending on the Build Alternative, the quantity of concrete expected to be demolished and removed from the existing viaduct ranges from 80,000 to 110,000 cubic yards plus an additional 1,000 to 40,000 cubic yards removal from the temporary trestles, aerial structures, roadway slabs, and other existing concrete structures (Appendix B, Alternatives Description and Construction Methods Technical Memorandum). In general, concrete from the viaduct could be ground into aggregate for reuse either on-site or as part of the construction operation, or it would be hauled off to an approved off-site location for processing. The old viaduct material not suitable for reuse will be hauled away by truck, rail, or barge (Appendix B, Alternatives Description and Construction Methods Technical Memorandum).

Construction waste and debris could be disposed of at a number of disposal facilities in the Puget Sound region. A portion of the debris, including clean wood waste, metals, gypsum, and other materials could be recycled at facilities such as Seattle's recycling and disposal stations. Sufficient capacity exists at area transfer stations and regional landfills to accommodate the construction waste and debris generated from construction activities proposed under the Build Alternatives. It is important to note that the disposal of construction waste and debris is unresolved at this time, and pending selection of the Preferred Alternative and more refined engineering, a detailed analysis will be provided.

Disaster Preparedness Impacts

Mobility could be affected along the central Seattle waterfront for the piers and terminals during construction, which could also affect disaster preparedness and cause delayed response times. This may affect SEM, the Port of Seattle, and Washington State Ferries operations, especially during peak hours.

4.3.2 Impacts by Build Alternative

The following section describes the types of construction impacts that will or may occur for each alternative and option. Mitigation measures for construction impacts are described in Section 4.4.3, Construction Mitigation. To the extent that impact differences exist between the Build Alternatives and segments, these areas are discussed below.

Rebuild Alternative

The Rebuild Alternative includes a combination of retrofitting and rebuilding the existing Alaskan Way Viaduct and reconstruction of the existing seawall. The alignment for the Rebuild Alternative generally follows the existing SR 99 alignment from south of S. Hanford Street to the BST west portal at First Avenue. Construction impacts to public services are discussed below for each of the project segments and the seawall.

South – S. Spokane Street to S. King Street

The south portion of the Rebuild Alternative would begin on SR 99 at S. Hanford Street with an at-grade road section that continues to approximately S. Dearborn Street, where it would transition to a single-level side-by-side aerial structure at S. King Street. Other improvements include relocating E. Marginal Way to the west and building elevated ramps at S. Atlantic Street and S. Royal Brougham Way.

Construction of this portion of the alignment would require lane or road closures on SR 99, E. Marginal Way, and SR 519. Road or lane closures may also result from construction of the ferry holding areas south of S. King Street and ramp construction on S. Atlantic Street and S. Royal Brougham Way.

Road closures or lane closures would result in traffic congestion and delay on the primary roads affected by construction, and also on surrounding roads that form alternate routes around the construction area. This could affect emergency vehicle access to and through this area, particularly for Fire Stations No. 10 and No. 14, which serve this area with both emergency medical aid and fire suppression services. Response times for police, fire, and emergency medical aid to locations within and near the construction area, as well as the time for emergency medical vehicles to travel from the construction site to area hospitals, would likely increase. Lane or road closures could increase the need for police services if officers are required for traffic direction. Road or lane closures may have a slight impact on school buses by delaying travel time through the area.

Demand for police security may increase because construction sites and staging areas can attract people who commit vandalism, theft, or trespass. Although this impact could occur, the contractor will be responsible for security measures during construction. This would minimize direct impacts.

Demand for emergency medical aid from the fire department is also likely to increase in the construction area as construction activities typically involve work with heavy machinery and other hazardous situations (for example, working within excavated areas such as trenches, working on high platforms, exposure to hazardous materials, etc.). A higher demand on fire services may result from the project if there are any large spills of fuels or other flammable fluids associated with construction activity, such as during the refueling of vehicles and construction equipment (see Appendix U, Hazardous Materials Discipline Report for more information on construction guidelines for dealing with hazardous materials spills).

Fire suppression services may also be affected by water line relocations, which could temporarily affect the water supply. For example, the Rebuild Alternative would affect 19 fire hydrants in this segment, creating a greater impact than all other Build Alternatives except the Tunnel Alternative.

The relocation of the BNSF tail track from its planned location on Terminal 46 to the east side of SR 99 may affect waste rail loading from the adjacent BNSF Intermodal Yard. Rabanco ships construction, demolition, and land clearing (CDL) waste to Roosevelt Landfill in southeastern Washington from the intermodal yard (Seattle 2003).

Central – S. King Street to Battery Street Tunnel

From S. King Street, the existing viaduct would be reconstructed and transition from a single-level side-by-side aerial structure to a double-decked stacked structure. Ramps at Columbia and Seneca Streets would be retrofitted. Road or lane closures associated with this segment include the existing viaduct itself and Columbia and Seneca Streets.

Impacts to public services would be similar to those described for the south, except that construction in this area would affect access to emergency response teams coming from Fire Stations No. 5 and No. 10, slightly increasing response times. Fire Station No. 5 could be temporarily relocated to Terminal 46 prior to construction activities for utility relocation. This would slightly increase the response times from Fire Station No. 5 to an emergency in the central segment.

Fire suppression services may also be affected by water line relocations, which would temporarily affect the water supply. In the central segment, the Rebuild Alternative would affect five vaults (see Exhibit 5-7 for details), 24 fire hydrants, and over 2,600 feet of main lines. These combined impacts would cause the greatest impact to water facilities.

North Waterfront – Pike Street to Broad Street

From Pike Street north to Broad Street, the viaduct would be retrofitted to seismically strengthen the existing structure. Ramps at Western and Elliott Avenues would be retrofitted. Road or lane closures associated with this segment include the existing viaduct and Western and Elliott Avenues. While no work would occur in the BST as part of this segment, the tunnel would be closed during reconnection with the reconstructed viaduct.

Impacts to public services would be similar to those described for the south and central segments, except that construction in this area would affect access to emergency response teams by increasing response times coming from Fire Stations No. 2 and No. 5.

Fire suppression services may also be affected by water line relocations, which would temporarily affect the water supply. The Rebuild Alternative would affect 19 fire hydrants in this segment. No fire flow vaults would be affected in this segment for the Rebuild Alternative.

North – Battery Street Tunnel to Ward Street

Generally, there would be no construction activities associated with this segment under this alternative, except for connections to the reconstructed viaduct. Therefore, no construction impacts are anticipated.

Seawall – S. King Street to Myrtle Edwards Park

Rebuilding the seawall would require lane closures on Alaskan Way S. Any lane closures would result in impacts to access and through travel for emergency services (increased response times) similar to those described for the south and central segments. Fire Station No. 5 will be relocated prior to construction to allow continued operation along the waterfront.

Aerial Alternative

The Aerial Alternative would rebuild the existing viaduct with a new aerial structure in its existing location from S. Walker Street to the BST. Additional construction would include fire/life safety improvements to the BST and reconstruction of the seawall. Construction impacts to public services are discussed below for each of the project sections and the seawall.

South – S. Spokane Street to S. King Street

This segment would consist of an at-grade segment from S. Stacy Street to S. Walker Street and a stacked aerial structure from S. Walker to S. King Streets. Potential lane/road closures would occur at S. Royal Brougham Way and S. Atlantic Street due to ramp construction, and SR 99.

Impacts to public services would be similar to the Rebuild Alternative for the south segment. Fire Stations No. 10 and No. 14 would be most affected by construction activity in this segment (increased traffic delays and resulting increases in response times).

Fire suppression services may also be affected by water line and fire hydrant relocations, which would temporarily affect the water supply. The Aerial Alternative would affect 11 fire hydrants in this segment.

Relocation of the BNSF tail track from its planned location on Terminal 46 to the east side of SR 99 may affect waste rail loading from the adjacent BNSF Intermodal Yard. Rabanco ships CDL waste to Roosevelt Landfill in southeastern Washington from the intermodal yard (Seattle 2003).

Central – S. King Street to Battery Street Tunnel

The stacked aerial viaduct structure would continue north to Virginia Street with ramps at Columbia and Seneca Streets. Thus, potential lane/road closures would occur at Columbia and Seneca Streets. Under the Broad Street Detour, additional road/lane closures may occur at Vine Street and Broad Street.

Impacts to public services would be similar to the Rebuild Alternative central segment. Fire Stations No. 5 and No. 10 would be most affected by construction activity in this segment (increased traffic delays and resulting increases in response times).

Fire suppression services may also be affected by water line and fire hydrant relocations, which would temporarily affect the water supply. In the central segment, the Aerial Alternative would affect over 3,500 feet of pipe, five vaults (see Exhibit 5-7), and 12 fire hydrants.

Under the Broad Street Detour, a temporary aerial structure would be built to remove southbound traffic from the BST. This detour may facilitate construction on the tunnel, reducing the amount of time it is closed, as well as providing an additional route. This detour is likely to improve access and traffic flow through the study area and benefit public services by reducing response times for police, fire, and emergency medical services. Similarly, the Battery Street Flyover Detour Option could benefit public services by reducing response times.

North Waterfront – Pike Street to Broad Street

The stacked aerial viaduct structure would continue north from Pike Street. Potential lane/road closures would occur at Western and Elliott Avenues due to ramp construction.

Impacts to public services would be similar to the Rebuild Alternative and the discussion of the central segment of the Aerial Alternative for the detour option. The fire stations most affected by this alternative would be Fire Stations No. 2 and No. 5.

Fire suppression services may also be affected by water line and fire hydrant relocations, which would temporarily affect the water supply. In the north waterfront, nearly 5,000 feet of main lines and 19 fire hydrants would be relocated.

North – Battery Street Tunnel to Ward Street

The BST will be improved for life safety under this segment of the alternative. These improvements include emergency egress and ingress, new ventilation, and an incident response facility.

Impacts to public services would be similar to the Rebuild Alternative and the discussion of the central segment of the Aerial Alternative with detour. The fire stations most affected by this alternative would be Fire Stations No. 2 and No. 5. The construction of the improvements to the BST will require closure of the tunnel. This would adversely impact public service response times during construction.

There would be no impacts to service lines, main lines, or fire hydrants in the north segment for any of the Build Alternatives.

Seawall – S. King Street to Myrtle Edwards Park

Construction and impacts to public service would be similar to those noted in the discussion of the seawall under the Rebuild Alternative.

Tunnel Alternative

This alternative would replace the existing viaduct and on- and off-ramps with an underground tunnel. The overall construction calls for a combination of at-grade, aerial, and underground structures.

South – S. Spokane Street to S. King Street

Construction activities and impacts to public services would generally be similar to the Rebuild Alternative, except for the portion that would be constructed underground. In this area, access for emergency medical services is likely to be further reduced, resulting in increased response time to the properties on the west side of the alignment due to construction work on the tunnel.

Fire suppression services may also be affected by water line and fire hydrant relocations, which would temporarily affect the water supply. This segment would require the relocation of approximately 3,100 feet of pipe. No main lines (16-inch or greater) or vaults would be affected for this segment for any of the Build Alternatives. The Tunnel Alternative would affect 39 fire hydrants in this segment.

Under the Tunnel Alternative, the BNSF tail track could remain in its planned location on Terminal 46 or alternatively be relocated to the east of SR 99. If relocated, this action may affect waste rail loading from the adjacent BNSF Intermodal Yard. Rabanco ships CDL waste to Roosevelt Landfill in southeastern Washington (Seattle 2003). Coordination with Rabanco and BNSF would be initiated during project design to coordinate construction activities and reduce direct impacts.

Central – S. King Street to Battery Street Tunnel

Impacts to public services would be similar to the Rebuild and Aerial Alternatives central segment. The cut-and-cover tunnel would further restrict emergency access to properties on the west side of the alignment, resulting in increased response times.

Fire suppression services may be affected by water line and fire hydrant relocations, which would temporarily affect the water supply. In this segment, nearly 3,000 feet of main line in the first phase and well over 3,000 feet of service line in the second (see Exhibit 5-7) would be relocated. This alternative would also affect 18 fire hydrants and two vaults (one at University Street and one at Virginia Street).

North Waterfront – Pike Street to Broad Street

The alignment would transition out of the tunnel to an at-grade aerial road section. Impacts to public services would be similar to the Rebuild and Aerial Alternatives for the north waterfront and the detour option.

Fire suppression services may be affected by water line and fire hydrant relocations, which would temporarily affect the water supply. Impacts to water pipes in the north waterfront would be similar for all Build Alternatives, including the relocation of nearly 5,000 feet of main lines. The Tunnel Alternative would additionally affect 19 fire hydrants. No vaults would be affected in this segment for the Tunnel Alternative.

North – Battery Street Tunnel to Ward Street

Construction activities would be similar to the Aerial Alternative, and impacts on public services would also be similar.

There would be no impacts to service lines, main lines, or fire hydrants in the north segment for any of the Build Alternatives.

Seawall – S. King Street to Myrtle Edwards Park

Construction impacts to public services would be similar to the discussion of the seawall under the Rebuild Alternative.

Bypass Tunnel Alternative

The Bypass Tunnel Alternative is similar to the Tunnel Alternative in terms of the construction activity impacts on public services, including increased response times for emergency medical vehicles, demand for police services for traffic control and construction area security, and potential disruption of water supply for fire suppression support.

South – S. Spokane Street to S. King Street

Fire suppression services may be affected by water line and fire hydrant relocations, which would temporarily affect the water supply. No main lines (16-inch or greater) or vaults would be affected for this segment for any of the Build Alternatives. The Bypass Tunnel Alternative would affect 11 fire hydrants in this segment.

Relocation of the BNSF tail track from its planned location on Terminal 46 to the east side of SR 99 could affect waste rail loading from the adjacent BNSF Intermodal Yard.

Central – S. King Street to Battery Street Tunnel

Fire suppression services may be affected by water line and fire hydrant relocations in this segment, which would temporarily affect the water supply. A total of approximately 1,000 feet of pipe and five hydrants would be affected by this alternative.

North Waterfront – Pike Street to Broad Street

Fire suppression services may be affected by water line relocations in this segment, which would temporarily affect the water supply. Impacts to water main lines in the north waterfront would be similar for all Build Alternatives, including the relocation of nearly 5,000 feet of main lines. No hydrants or vaults would be affected in this segment for the Bypass Tunnel Alternative.

North – Battery Street Tunnel to Ward Street

There would be no impacts to service lines, main lines, or fire hydrants in the north segment for any of the Build Alternatives.

Seawall – S. King Street to Myrtle Edwards Park

Construction activities and impacts to public services would be similar to the discussion of the seawall under the Rebuild Alternative.

Surface Alternative

This alternative would replace the viaduct with a six-lane roadway. Combined with the seawall improvements, this alternative would require extensive road/lane closures along Alaskan Way/SR 99. Impacts to public services would be similar to the Rebuild and Aerial Alternatives, except that access for emergency vehicles to properties west of the alignment would be more difficult (similar to the tunnel alternatives).

South – S. Spokane Street to S. King Street

These alternatives would each require the relocation of approximately 3,100 feet of pipe. No water main lines (16-inch or greater) would be affected for this segment for any of the Build Alternatives. The Surface Alternative would not impact fire hydrants in this segment.

Relocation of the BNSF tail track from its planned location on Terminal 46 to the east side of SR 99 may affect waste rail loading from the adjacent BNSF Intermodal Yard.

Central – S. King Street to Battery Street Tunnel

The Surface Alternative affects a greater length of water main lines in the central segment than either the Bypass or Aerial Alternatives, but less than the

Tunnel or Rebuild Alternatives. There would be no impacts to hydrants for this alternative.

<u>North Waterfront – Pike Street to Broad Street</u>

Impacts to water pipes in the north waterfront would be similar for all Build Alternatives, including the relocation of nearly 5,000 feet of water main lines. No hydrants would be affected in this segment for the Surface Alternative.

<u>North – Battery Street Tunnel to Ward Street</u>

There would be no impacts to service lines, main lines, or fire hydrants in the north segment for any of the Build Alternatives.

4.4 Mitigation for Public Services

Mitigation measures considered to help minimize potential construction and operational impacts to public services related to the AWV Build Alternatives are discussed below. Proposed mitigation measures are based on NEPA requirements, WSDOT and City of Seattle policies, mitigation proposed for similar projects, and discussions with agencies during the planning process. These and other policies will be refined and additional or more specific mitigation measures will be developed as the planning and design process continues.

4.4.1 Operational Mitigation Common to All Build Alternatives

Because the Build Alternatives would be a combination of at-grade, elevated, surface, and tunnel configurations, the project would likely change access to or from public services. However, effective transportation service and circulation could be maintained in select locations through provision of left turns at intersections and the ability to make u-turns or circular routes. Increases in emergency services response times could be further minimized through coordination of project design and emergency response route planning and through the potential for medians to be designed to allow emergency vehicles to cross. In some cases, preliminary analysis indicates that the Build Alternatives, with the exception of the Surface Alternative, might improve access to some public services along the corridor.

The following additional mitigation measures are recommended to minimize potential operational impacts of the AWV Build Alternatives on public services:

- Work with Seattle and Port of Seattle police and fire departments, transportation divisions, and other appropriate agencies during preliminary and final design and operation of the proposed facilities to ensure that reliable emergency access is maintained, alternate plans or routes can be developed to avoid delays in response times, and general emergency management services are not compromised.

- Work with the Seattle School District to maintain school bus service for routes traveling through the AWV Corridor.
- Work with the Seattle Police Department to implement crime prevention through environmental design (CPTED) principles where feasible.
- Implement intelligent traffic signalization measures for intersections along the construction detour routes, prior to start of relocation construction, to minimize response time impacts to fire and emergency medical services.

4.4.2 Operational Mitigation Measures by Build Alternative

Rebuild, Aerial, and Surface Alternatives

- The primary mitigation measures applied to these Build Alternatives would be the implementation of a traffic demand strategy to offset potential increases in congestion and impacts to response times.

Tunnel and Bypass Tunnel Alternatives

- Construction of the Tunnel or Bypass Tunnel Alternatives will require appropriate tunnel rescue services in accordance with WAC 296-155-730(10) – Safety Standards for Underground Construction Work. Tunnel rescue can be provided either by the contractor or by the Seattle Fire Department. The Seattle Fire Department is currently providing similar services for other projects, including the Sound Transit Light Rail project and the King County Department of Natural Resources Combined Sewer Overflow projects at Mercer Street and Henderson Street.

- To minimize the potential risk of tunnel fire, a variety of measures can be taken, including restricting flammable liquids in tunnels, prohibiting combustible solids, establishing a program of supervised transit of hazardous materials, controlling drivers' actions, and enforcing regulations. In addition, the tunnels must be designed to provide emergency access and evacuation in conformance with NFPA 101 (Life Safety Code), NFPA 502 (Standard for Road Tunnels, Bridges, and Other Limited Access Highways), and other codes and regulations. The tunnel would also need to be ventilated, and access to tunnel sections would need to be maintained at all times to ensure prompt response times and the safety of both passengers and service providers.

4.4.3 Construction Mitigation

- Lane and road closures would impede the movement of emergency vehicles through the construction area and increase response times. The City of Seattle and WSDOT will work with the Seattle Police and Fire Departments and area hospitals and ambulance services to ensure that reliable emergency access is maintained and that alternate plans or routes are developed to avoid significant delays in response times. The local school district will also be notified of potential lane or road closures so that alternate bus routes can be established.
- Additional coordination could occur with the police and fire departments: (1) to notify and work with the Seattle Fire Department regarding any water line relocations that could affect water supply for fire suppression and establish alternate supply lines prior to any breaks in service, and (2) to coordinate with contractors and, if necessary, with local police departments to ensure adequate staffing during construction for traffic and pedestrian movement control and other necessary policing efforts.
- Intelligent traffic signalization measures could be implemented along construction detour routes to minimize response time impacts to fire and emergency medical services. Transportation control measures to reduce traffic volumes and congestion would also serve to reduce potential impacts to public services by promoting mobility in the project corridor.
- The City of Seattle and WSDOT could coordinate with local jurisdictions and solid waste services to minimize impacts to solid waste collecting operations. Coordinating the location of construction staging in the south end of the project could minimize access impacts to the South Lander Transfer Station and adjacent facilities (tracks).

Chapter 5 UTILITIES

A number of utility providers in the AWV study area (including municipal agencies and private companies) provide electricity, water, wastewater, stormwater collection, natural gas, petroleum, steam, and communication and telecommunication services. The construction and operation of the AWV Build Alternatives will be largely within public street rights-of-way, where utilities are also generally located.

5.1 Affected Environment

Major utility providers are consistent within the study area regardless of segment. The major providers in the study area are described below. For a representative example of the approximate utility locations, refer to Exhibit 5-1 at the end of this section.

5.1.1 Electrical Power

Seattle City Light (City Light), which supplies electric power to customers in Seattle and some portions of King County north and south of the city limits, provides electrical power to the AWV study area. City Light, a municipal electric utility, serves approximately 131 square miles and generates 70 percent of the energy that it sells to retail customers from its own facilities (Seattle Comprehensive Plan 2001). City Light owns and maintains approximately 657 miles of 115-kilovolt (kV) and 230-kV transmission lines that carry power to its distribution substations. City Light also owns and maintains 3,100 circuit miles of distribution lines within Seattle that deliver power from the principal distribution stations to over 350,000 customers (Seattle City Light 2003).

Electrical power is dispersed from these substations via primary voltage feeder lines to numerous smaller distribution substations and overhead and underground transformers, which reduce voltage to required levels for customers. The utility currently has capacity to generate an annual average output of approximately 1,900 megawatts (MW) of hydroelectric generation.

In the AWV study area, the City Light system uses a combination of overhead and underground electrical transmission and distribution lines. Seattle City Light has a combination of transmission and distribution lines running along and under the viaduct structure. The downtown area, including the AWV Corridor, is served by a network distribution system. This one-of-a-kind distribution system is complicated, expensive, and reliable. It serves the downtown area from S. King Street to Denny Way, and east to First Hill.

Substations in the study area include the Massachusetts Substation at Colorado Avenue and Massachusetts Street, the Union Substation at Western Avenue and Union Street, and the Broad Substation at Sixth Avenue and Broad Street. A fourth potentially affected station could be the South Substation, south of the study area on Fourth Avenue S. (RWE 2002e). Overhead and underground distribution lines are also located along many streets in the study area. Although the system is designed and operated to minimize the likelihood of a problem in one area cascading into other areas, the system must still be approached as an integrated whole; impacts on one area could lead to impacts on other areas.

City Light has increased its system security and provision for continued reliability to minimize potential impacts of both criminal acts and natural disaster. For more information on security measures taken by City Light, refer to the Draft Seattle All-Hazard Mitigation Plan, October 2003.

5.1.2 Water

Seattle Public Utilities (SPU) provides potable water to more than 1.3 million King County customers through two surface water sources. The Cedar River provides approximately 70 percent of their service area's annual average consumption, and the South Fork Tolt River provides approximately 30 percent (SPU 2002). The major water main located within the study area includes sections of 20-inch and 21-inch welded steel lines along Alaskan Way. Other mains along the corridor abut the existing viaduct at major intersections, including on Broad Street, Union Street, Madison Avenue, Yesler Way, S. Main Street, S. Jackson Street, S. King Street, S. Washington Street, and S. Atlantic Street. The system consists of transmission and distribution mains, fire hydrants, water services and service lines, corrosion protection systems and valves, and water valve chambers. The entire study area is served by a single pressure zone (RWE 2002a). SPU inspects, repairs, operates, and maintains the water system. SPU also installs water services, hydrants, or other appurtenances on any charged water system.

Typically, water lines and high-pressure gas mains are located about 3 to 6 feet underground, and sewer pipes are located at least 6 feet below the surface. Smaller pipes, fiber-optic cables, telephone lines, and other utilities are often less than 3 feet underground.

Water, sewer, and storm drain pipelines typically run parallel beneath streets, placed in various locations ranging from the center of the roadway to the periphery. Fiber-optic cables, telephone lines, underground electrical conduits, and smaller pipes are often located beneath sidewalks.

5.1.3 Sanitary Sewer and Storm Drainage

The storm, sanitary, and combined sewer system within the study area varies by function and jurisdiction (e.g., King County and City of Seattle). Seattle is a combined sewer area, with a variety of non-standard pipes, regulator structures, low-flow diversions, weirs, outfalls, and combined sewer overflows. The King County Department of Natural Resources Wastewater Treatment Division (formerly Metro) provides sewage treatment services throughout the study area. King County bills SPU for services provided (King County Wastewater Treatment Division 2002).

SPU inspects, repairs, operates, and maintains wastewater (sewer) pipes in the study area to protect public health and avoid property and environmental damage from sanitary sewer overflows (SSOs) and combined sewer system overflows (CSOs). Wastewater in the study area is conveyed to King County's West Point Treatment Plant, which processes an average of 119 million gallons per day (King County 2003). The pipelines and other conveyance facilities within the AWV study area are owned, operated, and maintained by SPU or King County Wastewater Treatment Division. Individual sewer service lines are owned privately according to the property they serve.

Major Combined Sewer Interceptors

The major combined sewer interceptor lines within the project limits include the Elliott Bay Interceptor (EBI), the Lake Union Tunnel, the Mercer Street Tunnel, and the Central Trunk at Dexter (RWE 2002c). Within the AWV study area, the EBI extends from S. Spokane Street north to Denny Way. The EBI is subdivided into several sections of various dimensions and materials. From S. Spokane Street to S. King Street, the EBI runs parallel to Colorado Avenue S., turning east at S. Massachusetts Street. The EBI proceeds north on Occidental Avenue S. to approximately Broad Street as a 96-inch concrete pipe, reaching a maximum depth of 140 feet below the surface at Pike Street. From approximately Broad Street to Denny Way, the EBI runs below Second Avenue as a 102-inch tunnel. There are several regulators, flow diversion structures, and outfalls associated with the EBI. These are located at S. Connecticut Street (Royal Brougham), S. Lander Street, S. Hanford Street, S. King Street, and Denny Way (RWE 2002c).

The Lake Union Tunnel is a 72-inch brick-lined tunnel that extends from the Denny Way Regulator (at an approximate invert elevation of –1.0 foot) northeast to Lake Union at Westlake Avenue N. and Republican Street (at an approximate invert elevation of + 4.0 feet) (RWE 2002c).

The Mercer Street Tunnel is a 14-foot-8-inch-diameter, 6,200-foot-long pipe that travels primarily beneath Mercer Street from Eighth Avenue W. to Elliott Avenue W. This tunnel was designed to store flows diverted from the EBI, the Lake Union Tunnel, City of Seattle pipelines, the Dexter Central Trunk, and the Elliott West CSO pipeline. The Mercer Street Tunnel can store up to 7.2 million gallons, until the EBI has capacity available to transport the wastewater to the West Point Treatment Plant.

The Elliott West CSO Control Facility is located at the west end of the Mercer Street Tunnel, in the vicinity of Elliott Avenue W. Connected to this facility are the Elliott West Pipelines, which consist of a south-flowing 96-inch effluent pipeline connected to the Elliott West Outfall and a north-flowing 84-inch CSO pipeline connected to the Denny Way Diversion Structure.

Central Trunk Line

A central sewer trunk line belonging to King County is located beneath Dexter Avenue N., near South Lake Union. A new pipeline under construction will connect this line to the Mercer Street Tunnel.

New South Lake Union CSO pipelines, a trunk diversion structure, and the Lake Union Tunnel regulator will ultimately connect with the Mercer Street Tunnel for storage.

Outfalls and Drainage System

Almost all stormwater in the AWV Corridor ultimately drains into Puget Sound. The City of Seattle has over 800 storm drainage, combined, and sanitary sewer manholes within the study area (RWE 2002c). The associated outfalls are located at Vine Street, University Street, Madison Street, S. Washington Street, and S. King Street. Madison Street has an emergency sanitary sewer overflow structure that parallels the stormwater outfall. The intersection of Madison Street and Alaskan Way has many large-diameter sewers and dedicated storm mains (RWE 2002c).

The AWV study area drainage system includes bridge drains from the existing viaduct connecting to the existing drainage system and/or combined sewer system via a series of downspouts. The downspouts are attached to the exterior of bent columns on the existing viaduct structure. Some locations do not have bridge drains. This may be due to portions of the viaduct being super-elevated with bridge drains on the lower side of the structure. However, settlement may have occurred since initial construction, creating low spots in the deck resulting in ponding (RWE 2002c). For more detailed analysis of surface water and storm drainage (including wet weather flow capabilities for secondary and primary treatment), refer to Appendix S, Water Resources Discipline Report.

5.1.4 Natural Gas

Puget Sound Energy (PSE) provides natural gas service throughout the study area. PSE serves more than half of the residents of Washington State over a 6,000-square-mile service area. Their 620,000 natural gas customers are primarily in Western Washington (Puget Sound Energy 2002).

Natural gas mains, along with distribution and service lines, are located within the study area. A 12-inch high-pressure line is located along the AWV study area between S. Main and Blanchard Streets. PSE's network consists of transmission and distribution pipes, pressure controls, and meters and service lines (RWE 2002b).

5.1.5 Steam

Seattle Steam Company provides steam service throughout the entire AWV study area. Steam distribution lines located in the study area include a 12-inch intermediate pressure line traveling north/south along First Avenue. Privately held Seattle Steam continues to pump steam through four main boilers with operating pressures of 140 pounds per square inch that service an 18-mile system of underground pipes dating back to the late 1880s.

Originally called the Seattle Steam Heat and Power Co. when it opened in 1893, today Seattle Steam operates in Seattle via a franchise agreement with the City (PSBJ 2001). Seattle Steam operates around the clock, every day of the year, using natural gas to make nearly 500,000 pounds of steam per hour (average during the winter peak season). In the summer, the steam company produces about 100,000 pounds of steam per hour. More than 200 downtown buildings are customers. The three biggest users are Swedish, Harborview, and Virginia Mason medical centers, which use steam to heat their buildings and to sterilize instruments. Hotels are the next biggest customers, using steam for heat and to generate hot water for showers and laundry (PSBJ 2001).

5.1.6 Petroleum

Olympic Pipeline (owned by BP) delivers various refined petroleum products to storage and high-volume users in south King County. Within the study area, Olympic Pipeline has a 12-inch steel transmission pipeline in the Spokane Street right-of-way and an oil line that serves the steam plant near Union and University Streets (RWE 2002a). The entire pipeline spur, called the Seattle Lateral, runs 12.5 miles (from Renton to Harbor Island) in the City Light Transmission Line right-of-way (SEM 2003).

The franchise agreement between the City of Seattle and Olympic Pipeline expired in 2002. Negotiations are currently underway to create a new agreement for Olympic to continue to run its Seattle Lateral line through the city. In the process, the City is studying safety issues and emergency preparedness issues related to petroleum pipelines. While in negotiations, the City is protected by an Indemnity Agreement (SEM 2003).

5.1.7 Telecommunications

Qwest provides local telephone service throughout Seattle and the AWV study area. Telephone lines in urban areas are typically located within street rights-of-way, aboveground on utility poles in most areas, and underground in some areas (including part of downtown Seattle). Qwest also has fiber-optic lines in the study area. Qwest has underground feeders located along Broad, Wall, Pike, Spring, Marion, and Washington Streets (RWE 2002a–e). Qwest also provides service to the Port of Seattle.

Comcast (formerly AT&T Cable Services) is the primary provider of cable television in Seattle and the AWV study area. Several private companies and public utilities also own fiber-optic cable and/or provide long-distance and other telecommunication services in downtown Seattle and the greater study area. These providers include but are not limited to 360 Networks, AT&T Broadband, City of Seattle Fiber Optics, Comcast (formerly TCI/AT&T), CNI Locates, Electric Lightwave, Inc., Global Crossing, Time Warner (formerly GST), Level 3, Looking Glass Network, Metromedia Fiber Network Services, MCI WorldCom (formerly MFS), Sprint, Millennium Digital Media (formerly Summit), Terrabeam, US Crossings, Nextira One (formerly Williams & Staples), Williams Communications, XO Communications, and Yipes Communications (RWE 2002a–e).

The City of Seattle Department of Information Technology (DoIT) also provides telecommunications, telephone, data network capability, and cable management services in the AWV study area. DoIT provides a data network connecting the City's computers and City departments together. DoIT also operates and maintains the City's private telephone network, consisting of about 12,000 telephones, voicemail, a telephone management system, and the City's telecommunications and data networking functions (Seattle, City of 2003).

The basic fiber-optic system typically consists of manholes, conduits, and switching stations. Switching stations are usually located inside buildings. Conduits are either buried or mounted under the existing viaduct. From where they are mounted on the viaduct, they are routed down the columns in various locations into the manholes to allow connection to the buried system. Fiber-optic companies sometimes find it necessary to lease copper wire space from the telephone company to access the switching station locations within the buildings (RWE 2002a-e).

5.1.8 Traffic Signal Optimization Program

Seattle Department of Transportation (SDOT) operates traffic signals within the AWV study area and within the Seattle city limits, including over 975 signalized intersections, three quarters of which are on major transportation corridors such as Aurora Avenue N., Delridge Way S.W., Rainier Avenue S., and in the entire downtown area. The Signal Optimization Program is a coordinated effort designed to make the most efficient use of Seattle's traffic signals by improving existing signals, gathering up-to-date traffic data, and taking advantage of new technologies. Optimization refers to all maintenance upgrades, timing adjustments, and other efforts to improve signalization (Seattle, City of 2003).

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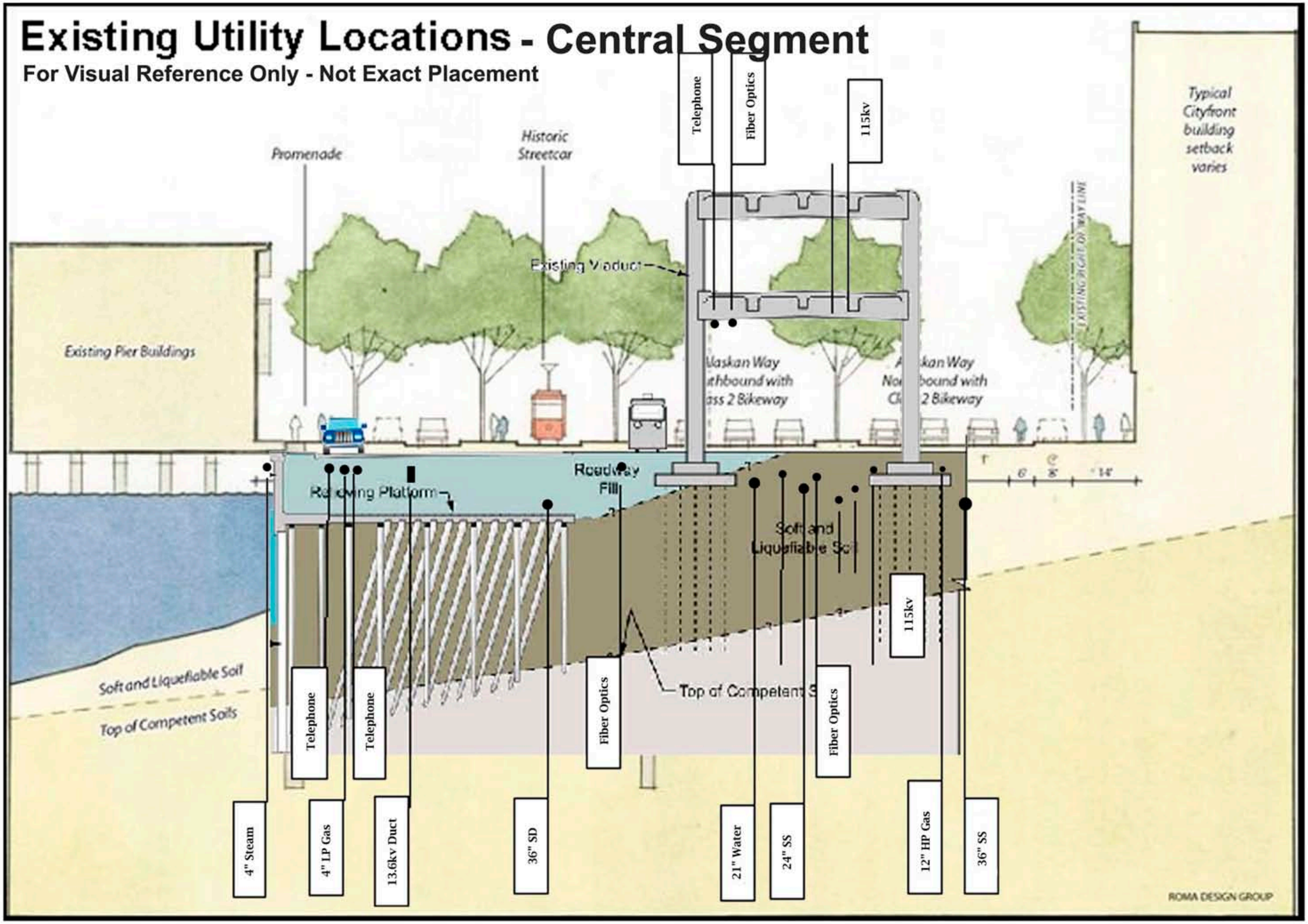

Exhibit 5-1
Approximate Utility Locations

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5.2 Operational Impacts to Utilities

5.2.1 No Build Alternative

Scenario 1 – Continued Operation of the Viaduct and Seawall With Continued Maintenance

As noted in Section 4.2.1, the existing 50-year-old structure has experienced corrosion damage, and viaduct components susceptible to performance failure either were constructed as part of the facility or were made vulnerable by later events such as material spills, fires, and earthquakes. The continued degradation of the structure increases its vulnerability to seismic events and limits the capacity of the structure to support current traffic operational loads.

With continued maintenance and repair, utilities could be protected from service disruption. However, the existing condition represents a considerable operational impact to utilities based on the potential difficulty of accessing utilities for general routine maintenance. The continued degradation of the facility poses a potential safety risk to utility workers accessing pipelines or cables on or under the viaduct. Additionally, increased traffic demand (as noted in Public Services Section 4.2.1) limits the frequency and length of time the viaduct can be partially blocked off for utility maintenance. The continued maintenance will also be very disruptive to utilities, particularly as it relates to construction sequencing, duration, and other effects, such as traffic disruption, impaired access, and potential utility conflicts.

Scenario 2 – Sudden Unplanned Loss of the Viaduct and/or Seawall Without Major Collapse or Injury

Under this scenario, a moderate earthquake slightly larger than the Nisqually earthquake is likely to initiate more widespread liquefaction and increased loads on the existing seawall (Appendix B, Alternatives Description and Construction Methods Technical Memorandum). As such, sudden unplanned loss of the facilities is possible at some locations in the study area. Type A and Type B Seawall structures would likely fail in some locations, making replacement and/or reconstruction necessary, at a substantial cost and disruption to waterfront activities (Appendix B, Alternatives Description and Construction Methods Technical Memorandum).

If the seawall were to move several inches, impacts could include damage of underground utilities, including services to the pier structures. Potential loss of utility services on or underneath the existing facility due to damaged utility lines or inability to access lines in need of maintenance could also occur. The sudden unplanned loss of the facilities without major collapse or injury would represent a substantial operational impact to utilities and public services, as water flow to piers for fire suppression would be virtually eliminated, along with electricity to power alarm systems and security lighting. The unplanned loss would also result in the potential loss of use of the existing corridor for utilities currently attached to the structure.

Scenario 3 – Catastrophic Failure and Collapse of the Viaduct and/or Seawall

Under this scenario, a catastrophic seismic event could trigger failure of significant portions of the existing seawall. Soil liquefaction could cause lateral movement in the soils, causing large earth movements behind the seawall, and possibly triggering the collapse of the wall itself and the existing viaduct. These events would also likely cause the damage or collapse of piers and buildings near the seawall due to movement of liquefiable soils that extend east from the existing seawall to Western Avenue. The ripple effect from this catastrophic event would include disruption to all utilities in the project area, including power, water, sanitary and storm sewer, natural gas, petroleum, steam, and fiber optics.

Failure of the existing viaduct would cause significant interruption of power to the downtown area. Although a short-term impact, this outage could include a large percentage of the downtown core and may last several days or weeks.

In addition to potential loss of services due to damaged utility lines or inability to access lines in need of maintenance, potential flooding and soil loss issues related to broken water, storm drain, or sewer pipes; potential fire events related to damaged and/or exposed electrical equipment; and potential hazardous materials seepage related to damaged natural gas or petroleum pipes could occur. Proximity of electrical systems to gas or petroleum lines could produce a second catastrophic incident should sparks ignite or explode flammable materials. Loss of fire flow due to damaged water pipes could prevent firefighters from containing incidents in a reasonable amount of time to ensure public safety. Finally, the catastrophic failure and collapse would result in the permanent loss of use of the existing corridor for utilities currently attached to the structure. Overall, this scenario would represent a major adverse impact to utilities as well as public services.

5.2.2 Impacts Common to All Build Alternatives

The operational impacts summarized below are presented as potential risks and benefits. The operation impacts and benefits identified in this section will be refined once a Preferred Alternative is selected and additional information is known regarding project design and funding. In addition, this analysis will be modified as additional information is acquired from local utility purveyors.

Potential operational risks associated with utilities and the Build Alternatives include design elements that could affect capacity, disrupt service, and impair access and maintenance functions. Examples of these potential risks are discussed below, although it is anticipated that these risks could be minimized or avoided through refinements in the project design.

Operational Risks

Seattle Public Utilities

SPU has noted that there would be long-term operational and maintenance impacts if a Build Alternative were chosen that would require the duplication (or mirroring) of facilities on both sides of Alaskan Way (SPU 2003). SPU indicates that side sewer lines are the responsibility of the property owners, so extending the length of individual services across the project would be a long-term operational impact to individual property owners (SPU 2003). For all Build Alternatives, determination of the final location of underground utilities will not be made until a later design stage, upon selection of a Preferred Alternative. Coordination will be initiated with SPU during project design to reduce these and other potential operational impacts.

Seattle City Light

Seattle City Light and others have noted that current design and implementation uncertainties of the Build Alternatives could generate substantial schedule delays and/or costs. The schedule could also be a long-term impact if the nature of the various tasks and their scheduling does not take into account available labor resources or potential risk of construction delays. The four primary risk areas potentially affecting the electrical power system are identified as substations, design constraints, schedule conflicts, and extended outages (City Light 2003).

For substations, designs that would risk the present capacity of the transmission and feeders within a two-block range of substations or risk damage to the station itself would result in substantial costs. Design constraints focus on options that could negatively alter or restrict current capacity or power quality as compared to the existing system. Schedule conflicts relate to maintaining system reliability.

Extended outages in the form of a transmission outage on two or more lines would cause an extended downtown power outage, resulting in substantial service interruptions to businesses who depend on the system's reliability (City Light 2003). Coordination will be initiated with City Light during project design to reduce these and other potential operational impacts.

Other Utility Concerns

Placement of the transportation system and support structures could complicate long-term maintenance of underground utilities when these structures are in the immediate vicinity of the utility facility, although utility locations will be one factor used to determine placement. Where foundations or structures might limit access, these will be addressed on a case-by-case basis during final design, pending selection of the Preferred Alternative.

5.2.3 Benefits Common to All Build Alternatives

The potential exists for utility infrastructure upgrades at select locations under the Build Alternatives. Although the details of these potential upgrades will be specified at a later date upon selection of a Preferred Alternative and in consultation with utility purveyors, utility system upgrades that enhanced system reliability and capacity could achieve a net operational benefit. In addition, under the No Build Alternative, in the event of a sudden unplanned loss of facilities (without major collapse) or the catastrophic failure of the existing system, moderate to severe utility impacts would result, including the loss of the existing structure as a utility corridor. The Build Alternatives would eliminate this considerable risk through the permanent placement of utilities in new utility corridors designed to meet current codes and standards.

5.2.4 Impacts by Build Alternative

A primary difference associated with the Build Alternatives for operations is the potential for impaired access and maintenance functions from increased congestion (back-ups or slow-downs due to high traffic volumes) and decreased mobility in the corridor. (Section 4.2.4 provides further discussion of congestion impacts as modeled out to the year 2030 for the Existing Condition and each of the Build Alternatives.) The impairment of access and maintenance functions under the Build Alternatives could pose operational impacts to utilities. Closures of roadways that are heavily used and frequently congested require more inter-agency coordination and advance planning. Emergency repairs could potentially lead to secondary impacts, primarily due to the added effects on traffic from lane closures, which are typically required to access utilities. It is anticipated that access and maintenance functions would be addressed during final design, and efforts will be made to reduce conflicts where possible. Therefore, these risks are disclosed only as potential impacts.

Rebuild Alternative

Year 2030 forecasted congestion figures for the Rebuild Alternative would be similar to those for the 2030 Existing Facility (see Exhibit 4-7). However, the level of congestion would be reduced from high to moderate for three of the impacted intersections. The improvement in level of congestion could improve access and maintenance at select locations for utilities in the AWV study area. Therefore, the impairment of access and maintenance for the Rebuild Alternative would be comparable to the No Build Alternative.

Aerial Alternative

The Aerial Alternative is projected to have more congested intersections in the year 2030 than the 2030 Existing Facility. The slightly increased congestion could pose access and maintenance difficulties at select locations for utilities in the AWV study area.

Tunnel Alternative

Year 2030 forecasted congestion figures for the Tunnel Alternative would add only one congested intersection, while reducing the level of congestion from high to moderate at four intersections. The improvement in level of congestion could improve access and maintenance at select locations for utilities in the AWV study area.

Bypass Tunnel Alternative

Year 2030 forecasted congestion figures for the Bypass Tunnel Alternative would add only one congested intersection, while reducing the level of congestion from high to moderate at three intersections. The improvement in level of congestion could improve access and maintenance at select locations for utilities in the AWV study area.

Surface Alternative

The Surface Alternative would increase the number of congested intersections from the 15 projected for the 2030 Existing Facility to 23. In addition, the number of highly congested intersections increases from five to eight. The increased congestion could pose additional access and maintenance difficulties for utilities at select locations in the AWV study area.

Comparative Ranking

The comparative ranking listed below is based primarily on travel times estimated under the Build Alternatives and the potential for increased levels of roadway congestion:

- The Surface Alternative is forecasted to result in longer travel times, particularly for trips that travel through (rather than to) the downtown area, and therefore could pose additional access restrictions due to increased levels of roadway congestion.
- The Bypass Tunnel Alternative is forecasted to provide competitive travel times for some routes, but longer travel times for others. Therefore, this alternative would pose lower, but similar comparable impacts to access restrictions and roadway congestion as described under the Surface Alternative.
- The Rebuild, Aerial, and Tunnel Alternatives would provide the best overall travel times of the alternatives studied, and would result in the lowest comparable impacts for access restrictions, due to decreased levels of congestion (Appendix C- Transportation Discipline Report, 2004).

5.3 Construction Impacts to Utilities

5.3.1 Impacts Common to All Build Alternatives

An extensive network of utilities is located in the AWV study area. Potential construction impacts to utilities are based on examination of available utility maps, discussions with utility representatives, and data and literature review. Exact locations and depths of utilities and impacts on them will be verified with utility providers during design stages and prior to construction of the Build Alternatives. During the final design, construction methods and Best Management Practices (BMPs) will be developed in consultation with the utility purveyors to provide spacing and protection measures specific to each site (to minimize issues such as customer outages, lack of access, damage to facilities, settlement, vibration, dewatering groundwater, and hazardous materials) and to provide erosion and sediment control. The contractor will perform installation in accordance with vendor direction, agency regulations, and BMPs.

Utilities could be affected during construction, depending on their depth below grade, material composition, the construction excavation limits, the exact location of the proposed transportation facility (and the support structures where applicable), and other factors. Additionally, relocation of some utilities may have a subsequent impact on other utilities near relocation work. For a cut-away view of approximate utility locations along the study area, see Exhibit 5-1.

The potential impacts have been described broadly in this section. For example, where the proposed Build Alternative is located in the same general area as the utility, the relocation estimates have assumed that the entire length of the utility would be relocated. Design solutions could potentially reduce or eliminate many utility relocation impacts. In addition, all of the alternatives have been designed to accommodate the utilities currently located in the study area, although it is important to note that the project may move utilities from existing locations. For a general overview of the utility relocation sequencing, refer to Chapter 6, Utility Construction Sequencing.

5.3.2 Typical Construction Impacts

All underground utility relocations share relatively common construction impacts, including pavement demolition, excavation, repaving, ground support systems, groundwater control, relocation impacts to other localized utilities, dust and noise monitoring, and traffic disruptions. For aboveground utilities, direct effects typically include placement of new or temporary poles, disruption of utility service during the cutover from existing to temporary service feeds and again when permanent utilities are completed, and lane and/or sidewalk closures.

In general, most underground utilities within the study area could be affected. Utility pipes, conduits, cables, and other infrastructure in construction areas for the Build Alternatives would need to be relocated, protected, or otherwise avoided during construction. Pipes that cannot be supported or protected in place would be relocated. All SPU-owned utilities will be reviewed and approved on a case-by-case basis prior to being relocated. Utilities not owned by SPU will be reviewed with the owner's established criterion prior to being relocated.

Several construction activities could result in the need to temporarily interrupt utility service to customers within the study area. The primary activity will be the rebuilding of the seawall and construction of the tunnels. Utility services to customers west of the existing seawall will have connections interrupted at least once, to connect to new or temporary facilities when an area is cleared for the seawall construction. In the case of the Tunnel or Bypass Tunnel Alternatives, the same utilities will be interrupted a second time as they are moved from their temporary to permanent locations.

Additionally, utility mains would need to be cleared (portions of the utility system temporarily removed from service) to connect new facilities to existing facilities and convert operations. The full impact and duration of utility interruptions will not be known until final roadway and utility designs are completed and a construction plan is developed. For more information on utility construction staging and duration, refer to Chapter 6, Utility Construction Sequencing, and Appendix B, Alternatives Description and Construction Methods Technical Memorandum's Chapter 4-Construction Sequencing. .

Inadvertent damage to underground utilities could occur during construction if locations are uncertain or misidentified, or in the event of a construction error or accident. While such incidents do not occur frequently, they could temporarily affect services to customers served by the affected utility. For instance, inadvertent damage to transmission lines could be very costly and disruptive to the project schedule by causing long-term outages to downtown Seattle.

Construction activities could also affect access to service providers near construction areas by creating detours, delays, and temporary displacement of parking or loading areas. As with any major construction project, activities proposed under the Build Alternatives could cause increased localized congestion, traffic delays, and truck traffic. In addition, water lines and fire hydrants could be obstructed, which could affect utility services and fire suppression capabilities if alternative supplies are not provided.

Removing concrete pavement and installing roadway facility support structures (columns/foundations) are anticipated activities with potential adverse impacts to vibration-sensitive underground utilities, such as water lines. The cast-iron, lead-joint water lines could require replacement or joint reinforcement before these construction activities commence.

Regarding soils-related construction impacts to utilities, temporary or permanent relocation of utilities might be required prior to constructing fill embankments, foundations, or ground improvements. Underground utilities beneath and near fills might settle or displace laterally or experience vertical and lateral loading due to embankment loading and settlement of subgrade soils beneath the fill. In addition, abandoned utilities that are not backfilled could become conduits for water or gases, which could affect existing and future facilities.

Jet grouting for a distance of approximately 30 feet east of the existing seawall starting at a depth of about 14 feet would potentially affect utility facilities within this area. For more information on jet grouting methods and potential backfill operations following jet grouting, see Chapter Three of *Alaskan Way Seawall Rebuild Options* (PB 2004).

Soil improvements south of S. King Street, necessary for aerial structure support columns or other purposes, may affect utility facilities in these areas. There is limited exposure to existing power facilities. Any new power facilities in this area will use thermal engineered backfills. For additional discussion on geology and soils, see Appendix T, Geology and Soils Technical Memorandum.

In reference to hazardous materials encountered in the AWV study area, impacts could arise if contaminated soil and/or groundwater is encountered during construction activities (e.g., drilled shafts, piles, deep soil mixing, jet grouting, excavation), including the relocation of utilities. Some existing electrical transmission lines in the AWV study area are high-pressure systems containing a highly refined dielectric fluid. Preliminary utility relocation plans show an increase of this type of transmission line system. For additional discussion on hazardous materials, see Appendix U, Hazardous Materials Discipline Report.

For aboveground utilities, direct effects typically include placement of new or temporary poles, interruption of utility service during the cutover from existing to temporary service feeds and again when permanent utilities are completed, and lane and/or sidewalk closures. If not properly mitigated, these anticipated activities can generate potential adverse impacts.

5.3.3 Potentially Affected Utilities

The following is a brief description of the utilities discussed in this section.

Electric Power

This topic describes the potential relocation impacts to the electrical distribution network (underground), electrical distribution non-network, and transmission lines. For the electrical distribution network (underground), categories include trench, primary lines, secondary lines, individual lines, manholes/handholes, vaults, transformers, and switches. For the electrical distribution non-network, categories include overhead primary, overhead secondary, underground primary, and underground secondary. Power relocations are expressed in circuit feet for the length of line and as individual units for facilities.

Water Facilities

This topic describes the potential relocation impacts to water distribution mains (8- to 12-inch lines), large water feeder mains (16- to 48-inch lines), water services, and hydrants. Water main relocations are expressed in lineal feet for the length of line and as individual units for facilities.

Sanitary Sewer

This topic describes the potential relocation impacts to sewer mains (8- to 12-inch lines), large conveyances (16- to 48-inch and 60-inch and greater), and manholes. Sewer lines that will be protected in place are also identified. Relocations are expressed in lineal feet for the length of line and as individual units for facilities.

Storm Drainage

Potential impacts to storm drainage and combined sewer facilities will vary depending on system design. For discussion of these issues, refer to Appendix S, Water Resources Technical Memorandum.

Gas/Steam/Oil Services

This topic describes the potential relocation impacts to intermediate-pressure and high-pressure gas lines and valves, as well as steam lines and petroleum oil pipelines. Impacts to steam and petroleum will be similar for all Build Alternatives, as described in Sections 5.3.4 and 5.4.

Telecommunications

This topic describes the potential relocation impacts to telephone services and fiber-optic cable. Telephone services and fiber-optic lines would have similar impacts for all Build Alternatives and will be relocated into a common duct bank for the entire length of the project. These relocations will occur prior to project construction and relocation of most other utilities.

5.3.4 Summary of Preliminary Utility Relocation Impacts by Segment

This section discusses utility impacts by segment, with an overview of impacts for each alternative within the segments. Exhibits 5-2 through 5-5 provide an at-a-glance overview of potential impacts in each segment. The summary is provided as a general comparison of the potential relocation impacts of the Build Alternatives for the south, central, north waterfront, and north segments. Affected utilities include power, wet utilities (water, sewer, and storm drainage), natural gas/steam/oil, and telecommunications. For a more detailed breakdown of the specific utilities and the associated impacts and benefits by alternative, refer to Section 5.4 and Exhibits 5-6 through 5-13.

The rankings provided in this section are stated in terms of greatest to lowest potential impacts, based in part on the length of utility relocation, the size and criticality of the utility, and the risks of generating other direct effects. Where impacts are similar to one another, comparisons are stated. As the engineering data is preliminary, the potential utility impacts from the Build Alternatives are generalized for each segment. The conceptual engineering data will continue to be refined, and more detailed information will be available further in the design process.

Exhibit 5-2. South Segment Utility Impact Summary

Alternative	Electric Power	Wet Utilities	Gas/Steam/Oil	Telecommunications
Rebuild	19,500 feet of power distribution 7,600 feet of power transmission	2,900 feetof 8-inch or greater water 2,500 feet of 8-inch or greater sewer lines relocated/ 2,100 feet protected in place	400 feet of natural gas No impact to steam No impact to petroleum	5,300 feet of telephone 36,800 feet of fiber-optic
Aerial	19,000 feet of power distribution 7,600 feet of power transmission	3,000 feet of 8-inch or greater water 6,600 feet of 8-inch or greater sewer	400 feet of natural gas No impact to steam No impact to petroleum	8,000 feet of telephone 56,100 feet of fiber-optic
Tunnel (Utilities are relocated twice for the tunnel alternative – figures here are greatest relocation amount.)	17,300 feet of power distribution 7,600 feet of power transmission	11,800 feet of 8-inch or greater water 11,800 feet of 8-inch or greater sewer	3,000 feet of natural gas No impact to steam No impact to petroleum	7,200 feet of telephone 50,500 feet of fiber-optic
Bypass Tunnel	17,300 feet of power distribution 7,600 feet of power transmission	3,100 feetof 8-inch or greater water 4,100 feet of 8-inch or greater sewer relocated/ 2,100 feet protected in place	400 feet of natural gas No impact to steam No impact to petroleum	7,200 feet of telephone 50,500 feet of fiber-optic
Surface	19,000 feet of power distribution 7,600 feet of power transmission	3,100 feet of 8-inch or greater water 5,000 feet of 8-inch or greater sewer relocated/ 1,300 feet protected in place	400 feet of natural gas No impact to steam No impact to petroleum	8,200 feet of telephone 57,300 feet of fiber-optic

Utility impacts are listed in this summary table by Build Alternative to provide a general overview of potential impacts. Options within alternatives are not expected to substantially increase quantity of utility impacts within alternatives. Unless otherwise noted, all impacts refer to length of cable or pipeline to be relocated.
Sources: Rosewater Engineering, Inc. (2003e); BJT Associates, Inc. (2003).

Exhibit 5-3. Central Segment Utility Impact Summary

Alternative	Electric Power	Wet Utilities	Gas/Steam/Oil	Telecommunications
Rebuild	8,400 feet of power distribution 9,400 feetof power transmission	3,200 feet of 8-inch or greater water 4,800 feet of 8-inch or greater sewer relocated/ 200 feet protected in place	4,900 feet of natural gas 2,900 feet of steam relocated/ 900 feet supported in place 300 feet of 4-inch fuel line supported in place	5,500 feet of telephone 38,700 feet of fiber-optic
Aerial	9,700 feet of power distribution 9,400 feet of power transmission	3,500 feet of 8-inch or greater water 5,800 feet of 8-inch or greater sewer	5,700 feet of natural gas 200 feet of steam 200 feet of 4-inch fuel line supported in place	7,300 feet of telephone 50,900 feet of fiber-optic
Tunnel (Utilities are relocated twice for the tunnel alternative – figures here are greatest relocation amount.)	54,400 feet of power distribution 16,800 feet of power transmission	5,000 feet of 8-inch or greater 8,300 feet of 8-inch or greater sewer	6,100 feet of natural gas 700 feet of steam lines relocated/ 1,600 feet supported in place 200 feet of 4-inch fuel line supported in place	6,300 feet of telephone 43,800 feet of fiber-optic relocation
Bypass Tunnel	49,000 feet of power distribution 10,200 feet of power transmission	1,200 feet of 8-inch or greater water lines relocated 3,700 feet of 8-inch or greater sewer lines relocated	2,900 feet of natural gas 300 feet of steam lines relocated/ 900 feet supported in place 300 feet of 4-inch fuel line supported in place	6,300 feet of telephone 44,300 feet of fiber-optic
Surface	6,000 feet of power distribution 9,400 feet of power transmission	2,500 feet of 8-inch or greater water 4,900 feet of 8-inch or greater sewer	1,700 feet of natural gas lines relocated 300 feet of steam lines supported in place No impact to petroleum lines	5,800 feet of telephone 40,700 feet of fiber-optic

Unless otherwise noted, all impacts refer to length of cable or pipeline to be relocated.
Sources: Rosewater Engineering, Inc. (2003e); BJT Associates, Inc. (2003).

Exhibit 5-4. North Waterfront Utility Impact Summary

Alternative	Electric Power	Wet Utilities	Gas/Steam/Oil	Telecommunications
Rebuild	No impact to power distribution No impact to power transmission	5,300 feet of 8-inch or greater water 5,200 feet of 8-inch or greater sewer	4,000 feet of natural gas 2,300 feet of steam No impact to petroleum	5,000 feet of telephone 21,700 feet of fiber-optic
Aerial	8,800 feet of power distribution No impact to power transmission	5,300 feet of 8-inch or greater water 5,200 feet of 8-inch or greater sewer	4,000 feet of natural gas 2,300 feetof steam No impact to petroleum	5,000 feet of telephone 21,700 feet of fiber-optic
Tunnel (Utilities are relocated twice for the tunnel alternative – figures here are greatest relocation amount.)	17,500 feet of power distribution No impact to power transmission	5,300 feet of 8-inch or greater water 6,100 feet of 8-inch or greater sewer	4,000 feet of natural gas 2,300 feet of steam No impact to petroleum	5,000 feet of telephone 21,700 feet of fiber-optic
Bypass Tunnel	8,800 feet of power distribution No impact to power transmission	5,300 feet of 8-inch or greater water 6,500 feet of 8-inch or greater sewer	4,000 feet of natural gas 2,300 feet of steam No impact to petroleum	5,000 feet of telephone 21,700 feet of fiber-optic relocation
Surface	8,800 feet of power distribution No impact to power transmission	5,300 feet of 8-inch or greater water 5,200 feet of 8-inch or greater sewer	4,000 feet of natural gas 2,300 feet of steam No impact to petroleum	5,000 feet of telephone 21,700 feet of fiber-optic

Unless otherwise noted, all impacts refer to length of cable or pipeline to be relocated.
Sources: Rosewater Engineering, Inc. (2003e); BJT Associates, Inc. (2003).

Exhibit 5-5. North Segment Utility Impact Summary

Alternative	Electric Power	Wet Utilities	Gas/Steam/Oil	Telecommunications
Rebuild	No impact to power distribution No impact to power transmission	No impact to water 200 feet of 8-inch or greater sewer	400 feet of natural gas No impact to steam No impact to petroleum	No impact to telephone No impact to fiber-optic
Aerial	5,500 feet of power distribution 2,100 feet of power transmission	No impact to water 200 feet of 8-inch or greater sewer	900 feet of natural gas No impact to steam No impact to petroleum	600 feet of telephone 3,900 feet of fiber-optic
Tunnel (Utilities are relocated twice for the tunnel alternative – figures here are greatest relocation amount.)	5,500 feet of power distribution 2,100 feet of power transmission	No impact to water 200 feet of 8-inch or greater sewer	900 feet of natural gas No impact to steam No impact to petroleum	600 feet of telephone 3,900 feet of fiber-optic
Bypass Tunnel	5,500 feet of power distribution 2,100 feet of power transmission	No impact to water 300 feet of 8-inch or greater sewer	400 feet of natural gas No impact to steam No impact to petroleum	No impact to telephone 3,900 feet of fiber-optic
Surface	5,500 feet of power distribution 2,100 feet of power transmission	No impact to water 200 feet of 8-inch or greater sewer	900 feet of natural gas lines relocated No impact to steam No impact to petroleum	600 feet of telephone 3,900 feet of fiber-optic

Unless otherwise noted, all impacts refer to length of cable or pipeline to be relocated.
Sources: Rosewater Engineering, Inc. (2003e); BJT Associates, Inc. (2003).

South – S. King Street to S. Spokane Street

Electric Power

Relocation Impacts

In the south segment, the Rebuild Alternative poses the greatest impact to power with the relocation of 19,500 circuit feet of distribution. The other Build Alternatives would have proportionately lower but similar impacts for distribution with the relocation of 19,000 circuit feet (Aerial, Surface) and 17,300 circuit feet (Tunnel, Bypass Tunnel) respectively. All of the Build Alternatives would relocate 7,600 circuit feet of transmission lines. For a detailed breakdown of power relocation impacts, refer to Section 5.4.

Other Direct Effects

Other direct effects of construction could include pavement demolition, excavation, backfill, repaving, ground support systems, dust and noise monitoring, relocation impacts to other localized utilities, traffic disruptions, and the increased risk of schedule delays, temporary service outages, and construction accidents. If not properly mitigated, these anticipated activities can generate potential adverse impacts.

For power in the south segment, the risk of direct effects will be similar for all Build Alternatives, although slightly greater for the Rebuild, Aerial, and Surface Alternatives due to the highest relocation totals for both distribution and transmission. The added effects for power will be placement of new or temporary poles for aboveground relocations (refer to Section 5.4).

Wet Utilities

Water Relocation Impacts

The Tunnel Alternative poses the greatest impact with the relocation of 11,800 feet of 8-inch or greater water mains. Impacts of the other Build Alternatives would be considerably lower by comparison, with the relocation of 3,000 feet (Rebuild, Aerial) to 3,100 feet (Bypass Tunnel, Surface) of water mains. In addition, it is important to note that the utilities for the tunnel alternatives would be relocated twice, which corresponds to the greatest impact. For a detailed breakdown of water relocation impacts, refer to Section 5.4.

Sewer Relocation Impacts

The Tunnel Alternative is associated with the greatest impact with the relocation of 11,800 feet of 8-inch or greater sewer line, which includes 4,000 feet of large sewer conveyance (60-inch or greater). Impacts of the other Build Alternatives would be considerably lower by comparison, with the relocation of 6,600 feet (Aerial), 5,000 feet (Surface), 4,100 feet (Bypass Tunnel), and 2,500 feet (Rebuild) respectively of 8-inch or greater sewer line. These estimates include impacts to large sewer conveyances (60-inch or greater), such as the relocation of 3,600 feet (Aerial), 3,300 feet (Surface), 2,000 feet (Rebuild), and 1,900 feet (Bypass Tunnel). The Rebuild (2,100 feet protected), Bypass Tunnel (2,100 feet protected), and Surface (1,300 feet protected) Alternatives would also protect in place a sizeable amount of existing lines. The higher relocation impacts for the tunnel alternatives reflect the relocation of utilities twice. For a detailed breakdown of sewer relocation impacts, refer to Section 5.4.

Other Direct Effects

For wet utilities in the south section, the risk of direct effects will be greatest for the Tunnel Alternative as it relates to water and sewer facilities due to the highest relocation totals for sewer and the most impact to large conveyances. The other Build Alternatives would have considerably lower risks but similar direct effects.

Gas/Steam/Oil

Relocation Impacts

The Tunnel Alternative poses the greatest impact with the relocation of 3,000 feet of natural gas lines. The remaining Build Alternatives would affect 400 feet of natural gas lines. There would be no impacts to steam or oil for any of the Build Alternatives in this segment.

Other Direct Effects

In the south segment for gas/steam/oil, the risk of direct effects would be greatest for the Tunnel Alternative due to the length of relocation.

Telecommunications

Relocation Impacts

For telephone, the Surface Alternative poses the greatest impact with the relocation of 8,200 feet of services. The Aerial Alternative would have proportionately lower but similar impacts with the relocation of 8,000 feet of telephone services. The other Build Alternatives would have lower impacts by comparison and vary in relocation impacts, with 7,700 feet (Tunnel), 7,200 feet (Bypass Tunnel), and 5,300 feet (Rebuild) respectively. For fiber optics, the Surface Alternative poses the greatest impact with the relocation of 57,300 feet of cable. The Aerial Alternative will be slightly lower, with approximately 56,000 feet of cable relocated. The Tunnel and Bypass Tunnel Alternatives would range between 50,500 feet (Bypass Tunnel) and 53,900 feet (Tunnel) respectively. The Rebuild Alternative poses the lowest impacts for this segment with the relocation of 37,000 feet of cable.

Other Direct Effects

For telecommunications, the risk of direct effects would be greatest for the Surface and Aerial Alternatives as they relate to telephone and fiber-optic services due to the highest relocation totals. The Tunnel and Bypass Tunnel Alternatives would have proportionately lower risks but similar direct effects to telephone and fiber-optic services, while the Rebuild Alternative poses the lowest risks of the Build Alternatives for direct effects.

Central – S. King Street to Battery Street Tunnel

Electric Power

Relocation Impacts

In the central section, the Tunnel Alternative poses the greatest impact to power with the relocation of 54,400 circuit feet of distribution and 16,800 circuit feet of transmission. The Bypass Tunnel Alternative would have proportionately lower but similar impacts with the relocation of 49,000 circuit feet of distribution and 10,200 circuit feet of transmission. The other Build Alternatives would have considerably lower distribution impacts with the relocation of 9,700 circuit feet (Aerial), 8,300 circuit feet (Rebuild), and 6,000 circuit feet (Surface) respectively. The Rebuild, Aerial, and Surface Alternatives would relocate 9,400 circuit feet of transmission lines. For a detailed breakdown of power relocation impacts, refer to Section 5.4.

Other Direct Effects

Other direct effects of construction could include pavement demolition, excavation, backfill, repaving, ground support systems, dust and noise monitoring, relocation impacts to other localized utilities, utility offset/spacing conflicts, traffic disruptions, and the increased risk of schedule delays, temporary service outages, and construction accidents. If not properly mitigated, these anticipated activities could generate potential adverse impacts.

For the central segment, the risk of direct effects would be greatest for the Tunnel and Bypass Tunnel Alternatives due to the highest relocation totals for both power distribution and transmission. The other Build Alternatives would have considerably lower risks but similar direct effects. The added effects for power would be placement of new or temporary poles for aboveground relocations (refer to Section 5.4).

Wet Utilities

Water Relocation Impacts

The Tunnel Alternative would have the most potential impact with the relocation of 5,000 feet of 8-inch (or greater) water line, which includes the relocation of 2,900 feet of 16- to 21-inch water main. The other Build Alternatives would have lower impacts by comparison, with the relocation of 3,500 feet (Aerial), 3,200 feet (Rebuild), 2,500 feet (Surface), and 1,100 feet (Bypass Tunnel) of 8-inch or greater water line. These estimates include impacts to 16- to 21-inch water mains, such as 2,600 feet (Rebuild), 2,500 feet (Surface), 1,800 feet (Aerial), and 600 feet (Bypass Tunnel). In addition, it is important to note that the utilities for the tunnel alternatives would be relocated twice, which corresponds to the greatest impact. For a detailed breakdown of water relocation impacts, refer to Section 5.4.

Sewer Relocation Impacts

The Tunnel Alternative would have the greatest impact with the relocation of 8,200 feet of 8-inch or greater sewer line. The other Build Alternatives would have lower impacts by comparison, with the relocation of 5,800 feet (Aerial), 4,900 feet (Surface), 4,800 feet (Rebuild), and 3,700 feet (Bypass Tunnel) respectively of 8-inch or greater sewer line. The Rebuild Alternative would also protect in place a small amount (200 feet) of existing line. The higher relocation impacts for the tunnel alternatives reflect that the utilities would be relocated twice. For a detailed breakdown of sewer relocation impacts, refer to Section 5.4.

Other Direct Effects

For the central segment and wet utilities, the risk of direct effects would be greatest for the Tunnel Alternative as it relates to water and sewer services due to the highest relocation totals, and in reference to water, the most impacts to large water mains. The other Build Alternatives would have proportionately lower risks but similar direct effects to water and sewer facilities.

Gas/Steam/Oil

Relocation Impacts

For natural gas, the Tunnel Alternative poses the greatest impact with the relocation of 6,000 feet of lines. Two of the Build Alternatives would have proportionately lower but similar impacts, with the Aerial Alternative relocating 5,600 feet and the Rebuild Alternative relocating 5,000 feet. The Surface Alternative and Bypass Tunnel Alternative would pose the lowest impacts with the relocation of 1,700 feet and 2,800 feet respectively.

The greatest impact to steam would result from the Rebuild Alternative with the relocation of 2,900 feet of line. This alternative would also support in place 900 feet of line. Impacts of the other Build Alternatives would be considerably lower for steam relocations with 700 feet (Tunnel), 300 feet (Bypass Tunnel and Surface), and 200 feet (Aerial) respectively; 1,600 feet of line for the Tunnel Alternative and 300 feet of line for the Surface Alternative would be supported in place.

For oil services, all of the Build Alternatives with the exception of the Surface Alternative (no impacts) would support between 210 and 250 feet of 4-inch fuel line (refer to Exhibit 5.3).

Other Direct Effects

In the central area, the risk of direct effects on gas/steam/oil services would be greatest for the Tunnel Alternative due to the highest relocation totals. The Aerial and Rebuild Alternatives would have proportionately lower risks but similar direct effects. The Surface and Bypass Tunnel Alternatives would have the lowest potential for direct effects to gas, oil, and steam services.

<u>Telecommunications</u>

Relocation Impacts

For telephone, the Aerial Alternative carries the greatest impact, requiring the relocation of 7,300 feet of services. The other Build Alternatives would be comparable, although impacts would be slightly lower with the relocation of 6,300 feet (Tunnel and Bypass Tunnel), 5,800 feet (Surface), and 5,500 feet (Rebuild). For fiber optics, the Aerial Alternative poses the greatest impact with the relocation of 50,900 feet of cable. The other Build Alternatives would be lower by comparison, with the relocation of 44,300 feet (Bypass Tunnel), 43,800 feet (Tunnel), 40,700 feet (Surface), and 39,000 feet (Rebuild).

Other Direct Effects

For telecommunications, the risk of direct effects would be greatest for the Aerial Alternative as it relates to telephone and fiber-optic services due to the highest relocation totals. The other Build Alternatives would have proportionately lower risks but similar direct effects to telephone and fiber-optic services.

North Waterfront – Pike Street to Broad Street

<u>Electric Power</u>

Relocation Impacts

In the north waterfront, with the exception of the Rebuild Alternative, all of the Build Alternatives would pose comparable impacts to power with the relocation of 8,800 circuit feet of distribution and no impacts to transmission lines. The Rebuild Alternative would not affect distribution or transmission lines in this segment. For a detailed breakdown of power relocation impacts, refer to Section 5.4.

Other Direct Effects

Other direct effects of construction could include pavement demolition, excavation, backfill, repaving, ground support systems, dust and noise monitoring, relocation impacts to other localized utilities, utility offset conflicts, traffic disruptions, and the increased risk of schedule delays, temporary service outages, and construction accidents. If not properly mitigated, these anticipated activities could generate potential adverse impacts.

With the exception of the Rebuild Alternative (no impacts), all of the Build Alternatives would have similar risks for direct effects to power.

Wet Utilities

Water Relocation Impacts

All of the Build Alternatives would have comparable impacts on water lines with the relocation of 5,300 feet of 8-inch or greater water lines. Of that amount, 4,800 feet would be 16- to 20-inch water main. For a detailed breakdown of water relocation impacts, refer to Section 5.4.

Sewer Relocation Impacts

The Bypass Tunnel Alternative would have the greatest impacts with the relocation of 6,600 feet of 8-inch or greater sewer line. The other Build Alternatives would have proportionately lower but similar impacts with the relocation of 6,100 feet (Tunnel) and 5,200 feet (Rebuild, Aerial, Surface) of 8-inch or greater sewer line. For a detailed breakdown of sewer relocation impacts, refer to Section 5.4.

Other Direct Effects

For wet utilities in the north waterfront, the Build Alternatives would have similar risks for direct effects to water services based on the same number of relocations. For sewer, the Bypass Tunnel Alternative would have the greatest risks of direct effects due to the highest relocation totals. The other Build Alternatives would have proportionately lower risks but similar direct effects to sewer services.

Gas/Steam/Oil

Relocation Impacts

For natural gas, all of the Build Alternatives would pose comparable impacts with the relocation of 4,000 feet of gas lines. All of the Build Alternatives would pose comparable impacts to steam with the relocation of 2,300 feet of line. The Build Alternatives would not affect oil lines in this segment.

Other Direct Effects

In the north waterfront for natural gas, all of the Build Alternatives would have similar direct effects. For steam, the Build Alternatives would have similar direct effects with the relocation of the same amount of services. The Build Alternatives would not affect oil lines in this segment.

Telecommunications

Relocation Impacts

For telephone, the Build Alternatives would all have comparable impacts with the relocation of 5,000 feet of services. For fiber optics, the Build Alternatives would also pose comparable impacts with the relocation of 21,700 feet of cable.

Other Direct Effects

For telecommunications (telephone and fiber optics), the Build Alternatives would have similar direct effects with the relocation of the same amount of services.

North – Battery Street Tunnel to Ward Street

Electric Power

Relocation Impacts

In the north segment, with the exception of the Rebuild Alternative, all of the Build Alternatives would pose comparable impacts to power with the relocation of 5,500 circuit feet of distribution and 2,200 feet of transmission lines. The Rebuild Alternative would not affect distribution or transmission lines in this segment. For a detailed breakdown of power relocation impacts, refer to Section 5.4.

Other Direct Effects

Other direct effects of construction could include pavement demolition, excavation, backfill, repaving, ground support systems, dust and noise monitoring, relocation impacts to other localized utilities, utility offset conflicts, traffic disruptions, and the increased risk of schedule delays, temporary service outages, and construction accidents. If not properly mitigated, these anticipated activities could generate potential adverse impacts.

With the exception of the Rebuild Alternative, all of the Build Alternatives would have similar risks for direct effects. The Rebuild Alternative would not affect distribution or transmission lines in this segment.

Wet Utilities

Water Relocation Impacts

The Build Alternatives would not affect water services in this segment. For a detailed breakdown of water relocation impacts, refer to Section 5.4.

Sewer Relocation Impacts

The Build Alternatives would have similar impacts with the relocation of 200 feet of 8-inch or greater sewer line. For a detailed breakdown of sewer relocation impacts, refer to Section 5.4.

Other Direct Effects

No relocation impacts would occur to water services in this segment. For sewer, all of the Build Alternatives would have similar risks for direct effects.

Gas/Steam/Oil

Relocation Impacts

For natural gas, all of the Build Alternatives would pose comparable impacts with the relocation of 400 feet of gas lines. The Build Alternatives would not affect steam or oil lines in this segment.

Other Direct Effects

For gas/steam/oil services, all of the Build Alternatives would have similar risks for direct effects.

Telecommunications

Relocation Impacts

For telephone, the Aerial, Tunnel, and Surface Alternatives would pose comparable impacts with the relocation of 600 feet of services. The Rebuild and Bypass Tunnel Alternatives will not affect telephone services in this segment. For fiber optics, the Aerial, Tunnel, and Surface Alternatives would pose comparable impacts with the relocation of 3,900 feet of cable. The Rebuild and Bypass Tunnel Alternatives would not affect fiber-optic cable services.

Other Direct Effects

For telecommunications (telephone and fiber optics), the Aerial, Tunnel, and Surface Alternatives would have similar risks of direct effects. The other Build Alternatives would not affect telecommunications.

5.4 Detailed Impacts by Build Alternative

This section describes the various utilities that would be affected by the Build Alternatives, including power (distribution/transmission); wet utilities (water and sanitary sewer); gas, steam, and oil; and telecommunications. The approximate length of utility infrastructure that could be relocated is identified by alternative and segment in Exhibits 5-6 through 5-12. Following the exhibits, this section provides a narrative description of the estimated relocation impacts.

The conclusions in this section are largely drawn from the conceptual engineering data prepared to support the AWV Build Alternatives, completed in the summer and fall of 2003 (Rosewater Engineering, Inc. 2003e; BJT Associates, Inc. 2003). As the engineering data is preliminary, the potential utility impacts from the Build Alternatives are generalized for each segment. With the exception of electrical data, all utility information includes the seawall area of the project within the respective south, central, and north segments.

The conceptual engineering data will continue to be refined, and more detailed information will be available further in the design process. Where facilities and services would be either supported or protected in place or where upgrades would occur, these potential benefits are disclosed.

Exhibit 5-6. Electric Power Relocations for AWV Build Alternatives

		Electrical Distribution Network (Underground)								Electrical Distribution Non-Network				Transmission Lines
		Permanent Relocation of Lines and Facilities								Permanent Relocation of Lines				
		Trench	Primary Lines	Secondary Lines	Indiv. Services	Manholes Handholes	Vaults	Trans-formers	Switches	Overhead Primary	Overhead Secondary	Underground Primary	Underground Secondary	Underground
Alternative	Segment	Feet	Circuit Ft	Circuit Ft	Each	Each		Each	Each	Circuit Ft	Circuit Ft	Circuit Ft	Circuit Ft	Circuit Feet
Rebuild		14,300	18,200	1,300	11,000	2	1	0	0	4,500	0	2,200	1,700	17,000
	South	3,600	11,100	0	15	0	1	0	0	4,500	0	2,200	1,700	7,600
	Central	2,100	7,100	1,300	0	0	0	0	0	0	0	0	0	9,400
	North Waterfront	0	0	0	0	0	0	0	0	0	0	0	0	0
	North	0	0	0	0	0	0	0	0	0	0	0	0	0
	Seawall	8,600	0	0	11,000	2	0	0	0	0	0	0	0	0
Aerial		18,500	25,500	6,000	13,700	7	5	3	3	6,300	1,700	1,700	1,700	19,100
	South	3,600	11,100	0	15	0	1	0	0	4,500	0	1,700	1,700	7,600
	Central	3,100	8,000	1,700	200	3	1	2	2	0	0	0	0	9,400
	North Waterfront	2,400	4,900	3,900	1,000	0	0	0	0	0	0	0	0	0
	North	800	1,500	400	1,500	2	3	1	1	1,800	1,700	65	65	2,100
	Seawall	8,600	0	0	11,000	2	0	0	0	0	0	0	0	0
Tunnel		28,600	59,300	25,600	13,500	14	17	12	11	7,500	1,700	600	65	26,600
	South	3,600	11,100	0	15	0	1	0	0	5,700	0	500	0	7,600
	Central	15,400	36,800	17,600	5,000	10	11	10	9	0	0	0	0	16,800
	North Waterfront	4,000	9,900	7,600	1,000	2	3	1	1	0	0	0	0	0
	North	800	1,500	400	1,500	2	3	1	1	1,800	1,700	65	65	2,200
	Seawall	4,800	0	0	6,000	0	0	0	0	0	0	0	0	0

Exhibit 5-6. Electric Power Relocations for AWV Build Alternatives (continued)

		Electrical Distribution Network (Underground)								Electrical Distribution Non-Network				Transmission Lines
		Permanent Relocation of Lines and Facilities								Permanent Relocation of Lines				
		Trench	Primary Lines	Secondary Lines	Indiv. Services	Manholes Handholes	Vaults	Trans-formers	Switches	Overhead Primary	Overhead Secondary	Underground Primary	Underground Secondary	Underground
Alternative	Segment	Feet	Circuit Ft	Circuit Ft	Each	Each		Each	Each	Circuit Ft	Circuit Ft	Circuit Ft	Circuit Ft	Circuit Feet
Bypass Tunnel		26,500	51,400	19,400	13,700	8	12	8	7	7,500	1,700	600	65	20,000
	South	3,600	11,100	0	15	0	1	0	0	5,700	0	500	0	7,600
	Central	14,900	33,900	15,100	5,100	6	8	7	6	0	0	0	0	10,200
	North Waterfront	2,400	4,900	3,900	1,000	0	0	0	0	0	0	0	0	0
	North	800	1,500	400	1,500	2	3	1	1	1,800	1,700	65	65	2,200
	Seawall	4,800	0	0	6,100	0	0	0	0	0	0	0	0	0
Surface		16,900	23,500	4,300	13,500	4	4	1	1	7,500	3,400	600	65	19,200
	South	3,600	11,100	0	15	0	1	0	0	5,700	1,700	500	0	7,600
	Central	1,500	6,000	0	0	0	0	0	0	0	0	0	0	9,400
	North Waterfront	2,400	4,900	3,900	1,000	0	0	0	0	0	0	0	0	0
	North	800	1,500	400	1,500	2	3	1	1	1,800	1,700	65	65	2,200
	Seawall	8,600	0	0	11,000	2	0	0	0	0	0	0	0	0

All impacts are approximated to the nearest 100 feet.

Length is based on trench foot and includes temporary and permanent trenches.

The existing underground transmission circuits will remain in place with one exception—electric facilities relocated west of E. Marginal Way between S. King Street and S. Royal Brougham Way can be overhead. There will also be overhead facilities relocated along Mercer and Broad Streets in the north, for all alternatives except Rebuild.

Approximately 2,700 feet of underground circuit from Union Street to Bell Street will be replaced twice.

The planning level estimates reflected in this exhibit will be refined once a Preferred Alternative is selected and additional information is known regarding project design and funding. The preliminary data will also be modified, if necessary, as additional information is acquired from local utility purveyors.

Source: BJT Associates, Inc. (2003).

Exhibit 5-7. Water Facility Relocations for AWV Build Alternatives

		Water Facilities to be Relocated		
Alternative	**Segment**	**8- to 12-inch (LF)**	**16–inch or greater (LF)**	**Hydrants**
Rebuild		4,000	7,400	62
	South	2,900	0	19
	Central	600	2,600	24
	North Waterfront	500	4,800	19
	North	0	0	0
Aerial		5,200	6,600	42
	South	3,000	0	11
	Central	1,700	1,800	12
	North Waterfront	500	4,800	19
	North	0	0	0
Tunnel Ph. 1		4,500	7,700	44
	South	2,800	0	10
	Central	1,200	2,900	15
	North Waterfront	500	4,800	19
	North	0	0	0
Tunnel Ph. 2		15,100	6,400	76
	South	11,200	0	39
	Central	3,400	1,600	18
	North Waterfront	500	4,800	19
	North	0	0	0
Bypass Tunnel		4,200	5,400	16
	South	3,100	0	11
	Central	600	600	5
	North Waterfront	500	4,800	0
	North	0	0	0
Surface		3,600	7,300	0
	South	3,100	0	0
	Central	0	2,500	0
	North Waterfront	500	4,800	0
	North	0	0	0

LF = linear feet of pipe.
All impacts are approximated to the nearest 100 feet.
Quantity take-offs are based on proposed pipe lengths scaled from the drawings with an assumed equivalent quantity of existing pipe demolished.
The planning level estimates reflected in this exhibit will be refined once a Preferred Alternative is selected and additional information is known regarding project design and funding. The preliminary data will also be modified, if necessary, as additional information is acquired from local utility purveyors.
Sources: Rosewater Engineering, Inc. (2003e).

Exhibit 5-8. Sewer Facility Relocations for AWV Build Alternatives

Alternative	Segment	Sewer Services to be Relocated				Sewer Services Protected in Place	
		Mains 8"-12" (LF)	Mains 16" – 48" (LF)	Mains 60" + (LF)	Man Holes	Mains 16" – 48" (LF)	Mains 60" + (LF)
Rebuild		4,900	5,700	2,100	76	800	1,500
	South	400	0	2,100	16	600	1,500
	Central	1,500	3,300	0	36	200	
	North Waterfront	3,000	2,200	0	22		
	North	0	200	0	2		
Aerial		6,400	7,800	3,600	109	0	0
	South	400	2,600	3,600	32		
	Central	2,800	3,000	0	45		
	North Waterfront	3,000	2,200	0	22		
	North	200	25	0	10		
Tunnel Ph 1		5,200	7,900	4,000	0	0	0
	South	400	1,800	4,000			
	Central	1,600	3,100	0			
	North Waterfront	3,000	3,000	0			
	North	200	0	0			
Tunnel Ph 2		5,800	19,100	1,500	149	0	0
	South	1,800	8,500	1,500	69		
	Central	800	7,500	0	44		
	North Waterfront	3,000	3,100	0	26		
	North	200	0	0	10		
Bypass Tunnel		3,700	7,200	3,700	79	0	2,100
	South	400	1,800	1,900	35	0	2,100
	Central	0	1,900	1,800	15	0	0
	North Waterfront	3,000	3,500	0	27	0	0
	North	300	0	0	2	0	0
Surface		4,800	4,900	5,600	88	600	700
	South	400	1,300	3,300	31	600	700
	Central	1,200	1,400	2,300	25		
	North Waterfront	3,000	2,200	0	22		
	North	200	0	0	10		

LF = linear feet of pipe.
All impacts are approximated to the nearest 100 feet.
Quantity takeoffs are based on proposed pipe lengths scaled from the drawings with an assumed equivalent quantity of existing pipe demolished.
The planning level estimates reflected in this exhibit will be refined once a Preferred Alternative is selected and additional information is known regarding project design and funding. The preliminary data will also be modified, if necessary, as additional information is acquired from local utility purveyors.
Source: Rosewater Engineering, Inc. (2003e).

Exhibit 5-9. Natural Gas Relocations for AWV Build Alternatives

Alternative	Segment	2"-4" IP LF	6"-8" IP LF	12" HP LF	Valves Each
Rebuild		3,700	600	5,400	0
	South	0	400	0	0
	Central	1,200	200	3,500	0
	North Waterfront	2,100	0	1,900	0
	North	400	0	0	0
Aerial		5,100	800	5,100	0
	South	0	400	0	0
	Central	2,100	400	3,200	0
	North Waterfront	2,100	0	1,900	0
	North	900	0	0	0
Tunnel Ph 1		2,500	2,200	2,800	0
	South	0	400	0	0
	Central	0	1,800	900	0
	North Waterfront	2,100	0	1,900	0
	North	400	0	0	0
Tunnel Ph 2		3,200	5,000	5,800	0
	South	0	3,000	0	0
	Central	200	2,000	3,900	0
	North Waterfront	2,100	0	1,900	0
	North	900	0	0	0
Bypass Tunnel		3,800	1,500	2,400	0
	South	0	400	0	0
	Central	1,300	1,100	500	0
	North Waterfront	2,100	0	1,900	0
	North	400	0	0	0
Surface		3,000	400	3,600	0
	South	0	400	0	0
	Central	0	0	1,700	0
	North Waterfront	2,100	0	1,900	0
	North	900			

IP = intermediate-pressure; HP = high-pressure; LF = linear feet of line.
All impacts are approximated to the nearest 100 feet.
Quantity take-offs are based on proposed pipe lengths scaled from the drawings with an assumed equivalent quantity of existing pipe demolished.
The planning level estimates reflected in this exhibit will be refined once a Preferred Alternative is selected and additional information is known regarding project design and funding. The preliminary data will also be modified, if necessary, as additional information is acquired from local utility purveyors.
Sources: Rosewater Engineering, Inc. (2003e).

Exhibit 5-10. Steam Relocations for AWV Build Alternatives

Alternative	Segment	Steam Services to be Relocated or Supported in Place: Relocated 2" LF	4" LF	6" LF	8" LF	12" LF	Supported 2" LF	4" LF	6" LF	12" LF
Rebuild		900	200	3,900	200	0	900	0	0	0
	South	0	0	0	0	0	0	0	0	0
	Central	900	200	1,600	200	0	900	0	0	0
	North Waterfront	0	0	2,300	0	0	0	0	0	0
	North	0	0	0	0	0	0	0	0	0
Aerial		0	0	2,500	0	0	0	0	0	0
	South	0	0	0	0	0	0	0	0	0
	Central	0	0	200	0	0	0	0	0	0
	North Waterfront	0	0	2,300	0	0	0	0	0	0
	North	0	0	0	0	0	0	0	0	0
Tunnel Ph 1		0	0	2,400	0	0	0	0	0	0
	South	0	0	0	0	0	0	0	0	0
	Central	0	0	100	0	0	0	0	0	0
	North Waterfront	0	0	2,300	0	0	0	0	0	0
	North	0	0	0	0	0	0	0	0	0
Tunnel Ph 2		0	700	2,300	0	0	600	200	800	0
	South	0	0	0	0	0	0	0	0	0
	Central	0	700	0	0	0	600	200	800	0
	North Waterfront	0	0	2,300	0	0	0	0	0	0
	North	0	0	0	0	0	0	0	0	0
Bypass Tunnel		300	0	2,300	0	0	900	0	0	0
	South	0	0	0	0	0	0	0	0	0
	Central	300	0	0	0	0	900	0	0	0
	North Waterfront	0	0	2,300	0	0	0	0	0	0
	North	0	0	0	0	0	0	0	0	0
Surface		0	0	2,300	0	0	0	0	0	300
	South	0	0	0	0	0	0	0	0	0
	Central	0	0	0	0	0	0	0	0	300
	North Waterfront	0	0	2,300	0	0	0	0	0	0
	North	0	0	0	0	0	0	0	0	0

LF = linear feet of pipe.
All impacts are approximated to the nearest 100 feet.
Quantity take-offs are based on proposed pipe lengths scaled from the drawings with an assumed equivalent quantity of existing pipe demolished.
The planning level estimates reflected in this exhibit will be refined once a Preferred Alternative is selected and additional information is known regarding project design and funding. The preliminary data will also be modified, if necessary, as additional information is acquired from local utility purveyors.
Sources: Rosewater Engineering, Inc. (2003e).

Exhibit 5-11. Petroleum Supported in Place for AWV Build Alternatives

Alternative	Segment	Petroleum Services to be Supported: Fuel Oil 4" LF
Rebuild		300
	South	0
	Central	300
	North Waterfront	0
	North	0
Aerial		200
	South	0
	Central	200
	North Waterfront	0
	North	0
Tunnel Ph 1		0
	South	0
	Central	0
	North Waterfront	0
	North	0
Tunnel Ph 2		200
	South	0
	Central	200
	North Waterfront	0
	North	0
Bypass Tunnel		300
	South	0
	Central	300
	North Waterfront	0
	North	0
Surface		0
	South	0
	Central	0
	North Waterfront	0
	North	0

LF = linear feet of pipe.
All impacts are approximated to the nearest 100 feet.
Quantity take-offs are based on proposed pipe lengths scaled from the drawings.
The planning level estimates reflected in this exhibit will be refined once a Preferred Alternative is selected and additional information is known regarding project design and funding. The preliminary data will also be modified, if necessary, as additional information is acquired from local utility purveyors.
Sources: Rosewater Engineering, Inc. (2003e); BJT Associates, Inc. (2003).

Exhibit 5-12. Telephone and Fiber Optics Relocations for AWV Build Alternatives

Alternative	Segment	Services to be Relocated: All Telephone LF	Services to be Relocated: All Fiber Optics LF
Rebuild		15,800	97,200
	South	5,300	36,800
	Central	5,500	38,700
	North Waterfront	5,000	21,700
	North	0	0
Aerial		20,900	132,600
	South	8,000	56,100
	Central	7,300	50,900
	North Waterfront	5,000	21,700
	North	600	3,900
Tunnel Ph 1		19,100	119,900
	South	7,200	50,500
	Central	6,300	43,800
	North Waterfront	5,000	21,700
	North	600	3,900
Tunnel Ph 2		0	0
	South	0	0
	Central	0	0
	North Waterfront	0	0
	North	0	0
Bypass Tunnel		18,500	120,400
	South	7,200	50,500
	Central	6,300	44,300
	North Waterfront	5,000	21,700
	North	0	3,900
Surface		19,600	123,600
	South	8,200	57,300
	Central	5,800	40,700
	North Waterfront	5,000	21,700
	North	600	3,900

LF = linear feet of cable or line.
All impacts are approximated to the nearest 100 feet.
Quantity takeoffs for telecom lines (fiber-optic and telephone) are estimated from the existing duct lengths within the corridor. (Estimated as the number of ducts in a given segment multiplied by the segment's length along the alignment, with a 20% allowance for bends and jogs, etc.)
The telecom relocation corridor is from the eastern edge of the viaduct footings to the seawall. Additional lines in other streets are assumed to be relocated as noted on the plan set.
The planning level estimates reflected in this exhibit will be refined once a Preferred Alternative is selected and additional information is known regarding project design and funding. The preliminary data will also be modified, if necessary, as additional information is acquired from local utility purveyors.
Source: Rosewater Engineering, Inc. (2003e).

5.4.1 Rebuild Alternative

Electric Power

South – S. Spokane Street to S. King Street

Impacts to the underground electrical distribution network and underground transmission lines in the south segment would be similar, though not identical, for all Build Alternatives. Specific impacts of the Rebuild Alternative in the south segment include:

Distribution

1) S. Hanford Street to S. Forest Street
    a) Relocate 26-kV pole line from the east side of E. Marginal Way to the west side of E. Marginal Way.
2) S. Lander Street to S. Holgate Street
    a) Relocate 26-kV pole line from the east side to the west side of E. Marginal Way.
    b) Relocate two 26-kV pole lines crossing SR 99 at S. Holgate Street.
3) South of S. Massachusetts Street to S. Atlantic Street
    a) Relocate 26-kV pole line from the east side to the west side of E. Marginal Way.
    b) Replace five network feeders on Colorado Avenue (in two duct banks).
4) S. Atlantic Street to S. King Street
    a) Replace 26-kV pole lines on the east and west side of E. Marginal Way with new pole line on the west side of the new frontage road west of SR 99.
    b) Replace five network feeders attached to the existing viaduct in two new duct banks (one on the east side of SR 99 and one on the west side of E. Marginal Way/frontage road).
    c) Relocate existing underground duct bank on S. Atlantic Street between Utah and First Avenues to clear the new on- and off-ramps on S. Atlantic Street.

Transmission

1) S. Massachusetts Street to S. King Street

    a) Replace a pair of transmission lines attached to the existing viaduct with a pair of underground transmission lines.

2) S. Atlantic Street to S. King Street

    a) Relocate two existing underground transmission lines on S. Atlantic Street between Utah and First Avenues to clear the new on- and off-ramps on S. Atlantic Street.

Central – S. King Street to Battery Street Tunnel

The Rebuild Alternative would have fewer impacts to the underground electrical distribution network in this segment than all Build Alternatives except the Surface Alternative. It would have no impact to non-network lines in this segment. The Rebuild Alternative would have similar impacts to underground transmission lines as the Aerial and Surface Alternatives, but less than the Tunnel or Bypass Tunnel Alternatives. Specific impacts of the Rebuild Alternative in the central segment include:

Distribution

1) S. King Street to Yesler Way

    a) Install two duct banks, one on the west side and one on the east side of Alaskan Way, to replace feeders attached to the viaduct and provide network service to the west side.

2) Marion Street to Yesler Way

    a) Relocate one duct bank 30 feet west to provide adequate offset from new transmission line.

3) Seawall

    a) Locate and protect facilities during soil improvement. Relocate services that cross the seawall temporarily and permanently. Remove service to trolley barn.

Transmission

1) S. King Street to Union Street

    a) Replace a pair of lines attached to the viaduct with a pair of underground lines. Rearrange lines into Union Substation to eliminate crossover.

2) Lenora Street to Bell Street

   a) Relocate underground line temporarily and permanently.

North Waterfront – Pike Street to Broad Street

The Rebuild Alternative would not affect power in the north waterfront.

North – Battery Street Tunnel to Ward Street

The Rebuild Alternative would not affect power in the north segment.

Water Facilities

South – S. Spokane Street to S. King Street

All Build Alternatives, with the exception of the Tunnel Alternative, have similar impacts to water mains 4 inches or larger in the south segment. These alternatives would each require the relocation of approximately 2,900 feet of water mains. The 20- and 21-inch water main along Alaskan Way would be affected with all Build Alternatives. The Rebuild Alternative would affect 19 fire hydrants in this segment, creating a slightly higher impact than any other Build Alternative except the Tunnel Alternative.

Central – S. King Street to Battery Street Tunnel

In the central segment, the Rebuild Alternative would affect 24 fire hydrants and approximately 3,200 feet of water mains. These combined impacts would cause the greatest impact to water facilities, despite the fact that the overall length of water mains relocated would be less than with the Tunnel or Aerial Alternatives.

North Waterfront – Pike Street to Broad Street

Impacts on water mains in the north waterfront would be similar for all Build Alternatives, including the relocation of over 5,000 feet of 16-inch or greater water mains. The Rebuild, Aerial, and Tunnel Alternatives would additionally affect 19 fire hydrants.

North – Battery Street Tunnel to Ward Street

No impacts to water mains or fire hydrants are expected in the north segment for any of the Build Alternatives.

Sewer Services

South – S. Spokane Street to S. King Street

The Rebuild Alternative would have fewer impacts on sewer lines and conveyance piping in the south segment than any of the other Build Alternatives. Impacts to large conveyance (60-inch and larger) for this alternative would be less than those for all other Build Alternatives except the Bypass Tunnel Alternative. Additionally, over 1,500 feet of large conveyance would be protected in place during construction.

<u>Central – S. King Street to Battery Street Tunnel</u>

The Rebuild Alternative would require less sewer relocation in this segment than any of the Build Alternatives other than the Bypass Tunnel Alternative. This alternative would have no impact to large conveyance for this segment.

<u>North Waterfront – Pike Street to Broad Street</u>

Impacts on sewer lines in the north waterfront would be similar for the Rebuild, Aerial, and Surface Alternatives. Impacts for these alternatives would be less than those of the Bypass Tunnel and Tunnel Alternatives. No sewer facilities would be protected in place in the north waterfront for any Build Alternatives.

<u>North – Battery Street Tunnel to Ward Street</u>

All Build Alternatives would have minor impacts to sewer in the north segment. There would be no relocations of large conveyance and no protected facilities in this segment.

Storm Drainage

Potential impacts to storm drainage facilities will vary depending on system design. For discussion of these issues, refer to Appendix S, Water Resources Technical Memorandum.

Natural Gas

<u>South – S. Spokane Street to S. King Street</u>

All Build Alternatives except the Tunnel Alternative would affect approximately 400 feet of 6-inch intermediate-pressure (IP) gas line in the south segment.

<u>Central – S. King Street to Battery Street Tunnel</u>

Of all Build Alternatives, the Rebuild Alternative would have the second greatest impact to high-pressure (HP) gas lines in the central segment. In terms of overall relocation impact, the Rebuild Alternative would relocate the third greatest length of pipeline.

<u>North Waterfront – Pike Street to Broad Street</u>

Natural gas impacts to the north waterfront would be similar for all Build Alternatives, including approximately 2,100 feet of IP and 1,900 feet of HP pipeline.

North – Battery Street Tunnel to Ward Street

The Rebuild Alternative would affect approximately 400 feet of IP gas lines in the north segment.

5.4.2 Aerial Alternative

Electric Power

South – S. Spokane Street to S. King Street

Impacts to the underground electrical distribution network and underground transmission lines in the south segment would be similar, although not identical, for all Build Alternatives. Specific impacts of the Aerial Alternative in the south segment would be similar to the Rebuild Alternative.

Transmission

1) S. Atlantic Street to S. King Street
   a) Relocate two existing underground transmission lines on S. Atlantic Street between Utah and First Avenues to clear the new on- and off-ramps on S. Atlantic Street.

Central – S. King Street to Battery Street Tunnel

The Aerial Alternative would have fewer impacts on the underground electrical distribution network in this segment than the Tunnel or Bypass Tunnel Alternatives, slightly less than the Rebuild Alternative, but more impacts than the Surface Alternative. It would have no impact to non-network lines in this segment. The Aerial Alternative would have similar impacts to underground transmission lines as both the Rebuild and Surface Alternatives, but less than the Tunnel or Bypass Tunnel Alternatives. Specific impacts of the Aerial Alternative in the central segment would be similar to the Rebuild Alternative.

North Waterfront – Pike Street to Broad Street

Impacts to all electrical distribution and transmission lines in the north waterfront would be similar for all Build Alternatives except the Rebuild and Tunnel Alternatives. The Aerial Alternative would affect approximately 9,000 feet of underground network distribution lines but would have no impact to underground transmission lines or non-network distribution lines in this segment.

Network Distribution

1) Broad Street to Vine Street
   a) Relocate duct bank to clear detour trestle structure.

2) Broad Street from Alaskan Way to Western Avenue

    a) Relocate duct bank to clear detour trestle structure.

North – Battery Street Tunnel to Ward Street

Impacts to all electrical distribution and transmission lines in the north segment would be similar for all Build Alternatives except the Rebuild Alternative. Impacts include approximately 2,000 feet of underground electrical distribution network, 2,500 feet of overhead non-network line, and 2,200 feet of underground transmission lines.

Water Facilities

South – S. Spokane Street to S. King Street

All Build Alternatives, with the exception of the Tunnel Alternative, have similar impacts to water mains 4 inches or larger in the south section. The Aerial Alternative would require the relocation of approximately 3,000 feet of water mains. The 20- and 21-inch water main along Alaskan Way would be affected with all Build Alternatives. The Aerial Alternative would affect 11 hydrants in this segment.

Central – S. King Street to Battery Street Tunnel

In the central segment, the Aerial Alternative would affect over 3,500 feet of water mains and 12 fire hydrants. The Aerial Alternative would have the second-greatest impact to water facilities for this segment.

North Waterfront – Pike Street to Broad Street

Impacts to water mains in the north waterfront would be similar for all Build Alternatives, including the relocation of over 5,000 feet of main lines. The Rebuild, Aerial, and Tunnel Alternatives would additionally affect 19 fire hydrants.

North – Battery Street Tunnel to Ward Street

There would be no impacts to water mains or fire hydrants in the north segment for any of the Build Alternatives.

Sewer Services

South – S. Spokane Street to S. King Street

The Aerial Alternative would require relocation of nearly 7,000 feet of sewer pipes in the south segment, including 3,600 feet of large conveyance. There will be no large conveyance protected in place during construction for this alternative, with the exception of the lines under Royal Brougham as required by the surrounding construction activities.

Central – S. King Street to Battery Street Tunnel

The Aerial Alternative would have one of the highest relocation impacts on sewer lines in the central segment (second to the Tunnel Alternative) and the highest impact to manholes. No sewer facilities would be protected in place in the central segment for this alternative, with the exception of lines larger than 30 inches in diameter that cross near proposed columns and foundations.

North Waterfront – Pike Street to Broad Street

Impacts on sewer lines in the north waterfront would be similar for the Rebuild, Aerial, and Surface Alternatives. Impacts for these alternatives would be less than those of the Bypass Tunnel and Tunnel Alternatives. No sewer facilities would be protected in place in the north waterfront for any Build Alternatives.

North – Battery Street Tunnel to Ward Street

All Build Alternatives except the Rebuild Alternative would have minor impacts to sewer in the north segment. There would be no relocations of large conveyance and no protected facilities in this segment.

Storm Drainage

Potential impacts to storm drainage facilities will vary depending on system design. For discussion of these issues, refer to Appendix S, Water Resources Technical Memorandum.

Natural Gas

South – S. Spokane Street to S. King Street

All Build Alternatives except the Tunnel Alternative would affect approximately 400 feet of 6-inch IP gas line in the south segment.

Central – S. King Street to Battery Street Tunnel

The Aerial Alternative would have the second greatest impact to natural gas lines in the central segment, and the third highest impact to HP line, behind the Tunnel and Rebuild Alternatives.

North Waterfront – Pike Street to Broad Street

Natural gas impacts to the north waterfront would be similar for all Build Alternatives, including approximately 2,100 feet of IP and 1,900 feet of HP pipeline.

North – Battery Street Tunnel to Ward Street

The Aerial, Tunnel, and Surface Alternatives would have similar impacts to natural gas in the north segment, affecting approximately 900 feet of IP lines.

5.4.3 Tunnel Alternative

Electric Power

South – S. Spokane Street to S. King Street

Impacts to the underground electrical distribution network and underground transmission lines in the south segment would be similar, although not identical, for all Build Alternatives. Specific impacts of the Tunnel Alternative in the south segment include:

Distribution

1) S. Hanford Street to S. Forest Street
   a) Relocate 26-kV pole line from the east side of E. Marginal Way to the east side of SR 99.
2) S. Lander Street to S. Holgate Street
   a) Relocate 26-kV pole line from the east side to the west side of E. Marginal Way.
   b) Relocate two 26-kV pole lines crossing SR 99 at S. Holgate Street.
3) South of S. Massachusetts Street to S. Atlantic Street
   a) Relocate 26-kV pole line from the east side to underbuild temporary 115-kV pole line.
   b) Replace five network feeders on Colorado Avenue (in two duct banks).
4) S. Atlantic Street to S. King Street
   a) Replace 26-kV pole lines on east and west side of E. Marginal Way with new pole line on the west side of the new frontage road west of SR 99.
   b) Replace five network feeders attached to the existing viaduct in two new duct banks (one on the east side of SR 99 and one on the west side of E. Marginal Way/frontage road).
   c) Relocate existing underground duct bank on S. Atlantic Street between Utah and First Avenues to clear the new on- and off-ramps on S. Atlantic Street.

Transmission

1) S. Massachusetts Street to S. King Street
   a) Replace pair of transmission lines attached to the viaduct first with temporary double-circuit pole line and then with a pair of underground transmission lines.

2) S. Atlantic Street to S. King Street

   a) Relocate two existing underground transmission lines between Utah and First Avenues to clear the new on- and off-ramps on S. Atlantic Street.

Central – S. King Street to Battery Street Tunnel

The Tunnel Alternative would have greater impacts to the underground electrical distribution network and underground transmission lines in this segment than all other Build Alternatives. It would have no impact to non-network lines in this segment. Specific impacts of the Tunnel Alternative in the central segment include:

Distribution

1) S. King Street to Pike Street

   a) Replace two duct banks and feeders attached to the viaduct on the west half of Alaskan Way with one permanent duct bank on the west half and one permanent and one temporary duct bank on the east half of Alaskan Way.

Transmission

1) S. Massachusetts Street to Union Substation

   a) Install temporary overhead double circuit transmission line.

2) S. King Street to Union Street

   a) Install two pair of underground lines.

3) Pike Street to Bell Street

   a) Relocate underground line temporarily and permanently.

North Waterfront – Pike Street to Broad Street

The Tunnel Alternative would have a greater impact to the underground electrical distribution network in the north waterfront segment than any of the other Build Alternatives. Specific impacts of the Tunnel Alternative would include:

Network Distribution

1) Pike Street to Lenora Street

   a) Replace two duct banks with two new duct banks, one on the east side of the tunnel ramp and one on the west side of the tunnel ramp.

2) Lenora Street to Broad Street

    a) Locate and protect facilities during soil improvement. Relocate services that cross the seawall temporarily and permanently. Remove service to trolley barn.

3) Clay Street to Broad Street

    a) Relocate duct bank to clear mechanically stabilized earth (MSE) wall for trestle.

4) Broad Street from Alaskan Way to Western Avenue

    a) Relocate duct bank to clear MSE wall for trestle.

Transmission

No relocations.

North – Battery Street Tunnel to Ward Street

Impacts to all electrical distribution and transmission lines in the north segment would be similar for all Build Alternatives except the Rebuild Alternative. Impacts include approximately 2,000 feet of underground electrical distribution network, 2,500 feet of overhead non-network line, and 2,200 feet of underground transmission lines.

Water Facilities

South – S. Spokane Street to S. King Street

All Build Alternatives, with the exception of the Tunnel Alternative, have similar impacts to water mains 4 inches or larger in the south segment. While the other Build Alternatives would each require the relocation of approximately 2,800 feet of water mains, the Tunnel Alternative would affect over 11,000 feet of water main in the second phase (see Exhibit 5-7). The 20- and 21-inch water main along Alaskan Way would be affected with all Build Alternatives. The Tunnel Alternative would also affect 39 fire hydrants in this segment, the highest impact to hydrants for any of the Build Alternatives.

Central – S. King Street to Battery Street Tunnel

The Tunnel Alternative would affect the greatest overall length of water mains in the central segment, relocating nearly 3,000 feet of 16-inch or greater line in the first phase and well over 3,000 feet of 8- to 12-inch line in the second (see Exhibit 5-7). This alternative would also affect 18 fire hydrants.

North Waterfront – Pike Street to Broad Street

Impacts to water pipes in the north waterfront would be similar for all Build Alternatives, including the relocation of over 5,000 feet of main lines. The

Rebuild, Aerial, and Tunnel Alternatives would additionally affect 19 fire hydrants.

North – Battery Street Tunnel to Ward Street

There would be no impacts to water mains or fire hydrants in the north segment for any of the Build Alternatives.

Sewer Services

South – S. Spokane Street to S. King Street

The Tunnel Alternative would have greater impacts to sewer lines in the south segment than any of the other Build Alternatives. The nearly 12,000 feet of relocation for this alternative includes over 4,000 feet of large conveyance. This alternative also has the greatest impact to manholes for the segment, with nearly twice as many impacts as the Bypass Tunnel Alternative. There would be no large conveyances protected in place during construction for this alternative, with the exception of the lines under Royal Brougham as required by the surrounding construction activities.

Central – S. King Street to Battery Street Tunnel

The Tunnel Alternative would have the greatest impact to sewer in the central segment, requiring relocation of over 8,000 feet of pipeline. This alternative also would affect 44 manholes in this segment, second only to the Aerial Alternative. There would be no facilities protected in place for this alternative, with the exception of lines larger than 30 inches in diameter that cross the project and connect to existing outfalls in the seawall.

North Waterfront – Pike Street to Broad Street

The Tunnel and Bypass Tunnel Alternatives would affect over 6,000 feet of sewer lines in this segment. Tunnel Alternative impacts to main lines and manholes would be greater than those for the Rebuild, Aerial, and Surface Alternatives, but slightly less than those for the Bypass Tunnel Alternative. No sewer facilities would be protected in place in the north waterfront for any Build Alternatives.

North – Battery Street Tunnel to Ward Street

All Build Alternatives would have minor impacts to sewer in the north segment. There would be no relocations of large conveyance and no protected facilities in this segment.

Storm Drainage

Potential impacts to storm drainage facilities will vary depending on system design. For discussion of these issues, refer to Appendix S, Water Resources Technical Memorandum.

Natural Gas

South – S. Spokane Street to S. King Street

The Tunnel Alternative would have the greatest impact to natural gas in the south segment, relocating nearly 3,000 feet of IP pipeline.

Central – S. King Street to Battery Street Tunnel

The Tunnel Alternative would have the greatest impact to natural gas in the central segment, nearly 2,000 feet of IP pipeline and nearly 4,000 feet of HP pipeline.

North Waterfront – Pike Street to Broad Street

Natural gas impacts to the north waterfront would be similar for all Build Alternatives, including approximately 2,100 feet of IP and 1,900 feet of HP pipeline.

North – Battery Street Tunnel to Ward Street

The Aerial, Tunnel, and Surface Alternatives would have similar impacts to natural gas in the north segment. The Bypass Tunnel Alternative would have a similar relocation requirement; however, the pipe size is yet to be determined.

5.4.4 Bypass Tunnel Alternative

Electric Power

South – S. Spokane Street to S. King Street

Impacts to the underground electrical distribution network and underground transmission lines in the south segment would be similar, although not identical, for all Build Alternatives. Specific impacts of the Bypass Tunnel Alternative in the south segment include:

Distribution

1) S. Hanford Street to S. Forest Street
    a) Relocate 26-kV pole line from the east side of E. Marginal Way to the east side of SR 99.

2) S. Lander Street to S. Holgate Street

   a) Relocate 26-kV pole line from the east side to the west side of E. Marginal Way.

   b) Relocate two 26-kV pole lines crossing SR 99 at S. Holgate Street.

3) South of S. Massachusetts Street to S. Atlantic Street

   a) Relocate 26-kV pole line from the east side of E. Marginal Way to underbuild temporary 115-kV pole line.

   b) Replace five network feeders on Colorado Avenue (in two duct banks).

5) S. Atlantic Street to S. King Street

   a) Replace 26-kV pole lines on the east and west side of E. Marginal Way with a new pole line on the west side of the new frontage road west of SR 99.

   b) Replace five network feeders attached to the existing viaduct in two new duct banks (one on the east side of SR 99 and one on the west side of E. Marginal Way/frontage road).

   c) Relocate existing underground duct bank on S. Atlantic Street between Utah and First Avenues to clear the new on- and off-ramps on S. Atlantic Street.

Transmission

1) S. Massachusetts Street to S. King Street

   a) Replace pair of transmission lines attached to the viaduct with a pair of underground transmission lines.

2) S. Atlantic Street to S. King Street

   a) Relocate two existing underground transmission lines on S. Atlantic Street between Utah and First Avenues to clear the new on- and off-ramps on S. Atlantic Street.

Central – S. King Street to Battery Street Tunnel

The Bypass Tunnel Alternative would have greater impacts to the underground electrical distribution network and underground transmission lines in this segment than all other Build Alternatives except the Tunnel Alternative. It would have no impact to non-network lines in this segment. Specific impacts of the Bypass Tunnel Alternative in the central segment include:

Distribution

1) S. King Street to Pike Street

    a) Replace two duct banks on the west half of Alaskan Way with one permanent duct bank on the west half and one permanent and one temporary duct bank on the east half of Alaskan Way.

Transmission

1) S. King Street to Union Street

    a) Install one pair of underground lines to replace the pair of lines attached to the viaduct.

2) Pike Street to Bell Street

    a) Relocate underground line temporarily and permanently.

North Waterfront – Pike Street to Broad Street

There are no impacts to transmission lines in the north waterfront segment for the Bypass Tunnel Alternative. Impacts to the underground electrical distribution network are similar to those of the Aerial and Surface Alternatives. Specific impacts of the Bypass Tunnel Alternative for this segment include:

Network Distribution

1) Pike Street to Broad Street

    a) Locate and protect facilities during soil improvement. Relocate services that cross the seawall temporarily and permanently.

2) Clay Street to Broad Street

    a) Relocate duct bank to clear MSE wall for trestle.

3) Broad Street from Alaskan Way to Western Avenue

    a) Relocate duct bank to clear MSE wall for trestle.

North – Battery Street Tunnel to Ward Street

Impacts to all electrical distribution and transmission lines in the north segment would be similar for all Build Alternatives except the Rebuild Alternative. Impacts include approximately 2,000 feet of underground electrical distribution network, 2,500 feet of overhead non-network line, and 2,200 feet of underground transmission lines.

Water Facilities

South – S. Spokane Street to S. King Street

All Build Alternatives, with the exception of the Tunnel Alternative, have similar impacts to water mains 4 inches or larger in the south segment. These alternatives would each require the relocation of approximately 3,100 feet of water mains. The 20- and 21-inch water main along Alaskan Way would be affected with all Build Alternatives. The Bypass Tunnel Alternative would affect 11 fire hydrants in this segment.

Central – S. King Street to Battery Street Tunnel

Compared to the other Build Alternatives, the Bypass Tunnel Alternative would have minimal impacts to water services in the central area. A total of approximately 1,200 feet of water mains and five hydrants would be affected by this alternative.

North Waterfront – Pike Street to Broad Street

Impacts to water mains in the north waterfront would be similar for all Build Alternatives, including the relocation of over 5,000 feet of main lines.

North – Battery Street Tunnel to Ward Street

There would be no impacts to water lines or fire hydrants in the north segment for any of the Build Alternatives.

Sewer Services

South – S. Spokane Street to S. King Street

The Bypass Tunnel Alternative would have the greatest amount of large conveyance protected in place (over 2,000 feet). This alternative also has the second greatest impact to manholes, affecting 35.

Central – S. King Street to Battery Street Tunnel

The Bypass Tunnel Alternative would have the least impacts to sewer facilities in the central segment of any Build Alternatives.

North Waterfront – Pike Street to Broad Street

The Tunnel and Bypass Tunnel Alternatives affect over 6,000 feet of sewer lines in this segment. Impacts to conveyance lines and manholes for the Bypass Tunnel Alternative would be greater than those of all other Build Alternatives. No sewer facilities would be protected in place in the north waterfront for any Build Alternative.

North – Battery Street Tunnel to Ward Street

All Build Alternatives would have minor impacts to sewer in the north. There would be no relocations of large conveyance and no protected facilities in this segment.

Storm Drainage

Potential impacts to storm drainage facilities will vary depending on system design. For discussion of these issues, refer to Appendix S, Water Resources Technical Memorandum.

Natural Gas

South – S. Spokane Street to S. King Street

All Build Alternatives except the Tunnel Alternative would affect approximately 400 feet of 6-inch IP gas line in the south segment.

Central – S. King Street to Battery Street Tunnel

The Bypass Tunnel Alternative would have the second lowest impact to natural gas in the central segment and would relocate the smallest length of HP pipeline.

North Waterfront – Pike Street to Broad Street

Natural gas impacts to the north waterfront would be similar for all Build Alternatives, including approximately 2,100 feet of IP and 1,900 feet of HP pipeline.

North – Battery Street Tunnel to Ward Street

Relocation impacts to natural gas in the Bypass Tunnel Alternative would be similar to those in the Aerial, Tunnel, and Surface Alternatives; however, the pipe size is yet to be determined.

5.4.5 Surface Alternative

Electric Power

South – S. Spokane Street to S. King Street

Impacts to the underground electrical distribution network and underground transmission lines in the south segment would be similar, although not identical, for all Build Alternatives. Specific impacts of the Surface Alternative in the south segment include:

Distribution

1) S. Hanford Street to S. Forest Street

a) Relocate 26-kV pole line from the east side of E. Marginal Way to the east side of SR 99.

2) S. Lander Street to S. Holgate Street

   a) Relocate 26-kV pole line from the east side to the west side of E. Marginal Way.

   b) Relocate two 26-kV pole lines crossing SR 99 at S. Holgate Street.

3) South of S. Massachusetts Street to S. Atlantic Street

   a) Relocate 26-kV pole line from the east side to underbuild temporary 115-kV pole line.

   b) Replace five network feeders on Colorado Avenue (in two duct banks).

4) S. Atlantic Street to S. King Street

   a) Replace 26-kV pole lines on the east and west sides of E. Marginal Way with new pole line on the west side of the new frontage road west of SR 99.

   b) Replace five network feeders attached to the existing viaduct in two new duct banks (one on the east side of SR 99 and one on the west side of E. Marginal Way/frontage road).

   c) Relocate existing underground duct bank on S. Atlantic Street between Utah and First Avenues to clear the new on- and off-ramps on S. Atlantic Street.

Transmission

1) S. Massachusetts Street to S. King Street

   a) Replace pair of transmission lines attached to the viaduct with a pair of underground transmission lines.

2) S. Atlantic Street to S. King Street

   a) Relocate two existing underground transmission lines between Utah and First Avenues to clear the new on- and off-ramps on S. Atlantic Street.

Central – S. King Street to Battery Street Tunnel

The Surface Alternative would have fewer impacts to the underground electrical distribution network in this segment than all other Build Alternatives. It would have no impact to non-network lines in this segment. The Surface Alternative would have similar impacts to underground transmission lines as both the Aerial and Rebuild Alternatives, but less than the Tunnel or Bypass Tunnel Alternatives. Specific impacts of the Surface Alternative in the central segment include:

Distribution

1) S. King Street to Main Street

    a) Install two duct banks, one on the east half and one on the west half of Alaskan Way, to replace feeders attached to the viaduct.

2) Main Street to Yesler Way

    a) Install one duct bank on the east half of Alaskan Way to replace feeders attached to the viaduct.

3) S. King Street to Pike Street

    a) Locate and protect facilities during soil improvement. Relocate services that cross the seawall temporarily and permanently.

Transmission

1) S. King Street to Union Street

    a) Install one pair of underground lines to replace the pair of lines attached to the viaduct.

2) Pike Street to Virginia Street

    a) Relocate underground line permanently.

North Waterfront – Pike Street to Broad Street

Impacts to all electrical distribution and transmission lines in the north waterfront would be similar for all Build Alternatives except the Rebuild Alternative, which would have none. The Surface Alternative would have no impact to underground transmission lines or non-network distribution lines in this segment but would affect nearly 8,000 feet of underground electrical distribution network.

North – Battery Street Tunnel to Ward Street

Impacts to all electrical distribution and transmission lines in the north segment would be similar for all Build Alternatives except the Rebuild Alternative. Impacts include approximately 2,000 feet of underground electrical distribution network, 2,500 feet of overhead non-network line, and 2,200 feet of underground transmission lines.

Water Facilities

South – S. Spokane Street to S. King Street

All Build Alternatives, with the exception of the Tunnel Alternative, have similar impacts to water mains 4 inches or larger in the south segment. These alternatives would each require the relocation of approximately 3,100 feet of water mains. The 20- and 21-inch water main along Alaskan Way would be affected with all Build Alternatives. The Surface Alternative would affect no fire hydrants in this segment.

Central – S. King Street to Battery Street Tunnel

The Surface Alternative would affect a greater length of water mains in the central segment than either the Bypass Tunnel or Aerial Alternatives, but less than the Tunnel or Rebuild Alternatives. Existing hydrants would need to be relocated along proposed new curbs and sidewalks.

North Waterfront – Pike Street to Broad Street

Impacts to water mains in the north waterfront would be similar for all Build Alternatives, including the relocation of over 5,000 feet of main lines. No hydrants would be affected in this segment for the Surface Alternative.

North – Battery Street Tunnel to Ward Street

There would be no impacts to water mains or fire hydrants in the north segment for any of the Build Alternatives.

Sewer Services

South – S. Spokane Street to S. King Street

The Surface Alternative would affect 5,000 feet of sewer pipeline in the south segment, including 3,300 feet of large conveyance. This alternative would be third in relocation impacts to sewer line, and would affect 31 manholes. A minimal amount of both large conveyance and main lines will be protected in place.

Central – S. King Street to Battery Street Tunnel

The Surface Alternative would be third in relocation impacts to sewer in the central segment compared to other Build Alternatives. The Surface and Bypass Tunnel Alternatives would have the least impacts to manholes for this segment. There would be no facilities protected in place for the Surface Alternative in the central segment, with the exception of the lines within Royal Brougham as required by the surrounding construction activities.

North Waterfront – Pike Street to Broad Street

Impacts on sewer lines in the north waterfront would be similar for the Rebuild, Aerial, and Surface Alternatives. Impacts for these alternatives would be less than those of the Bypass Tunnel and Tunnel Alternatives. No sewer facilities would be protected in place in the north waterfront for any Build Alternatives.

North – Battery Street Tunnel to Ward Street

All Build Alternatives would have minor impacts to sewer in the north segment.

Storm Drainage

Potential impacts to storm drainage facilities will vary depending on system design. For discussion of these issues, refer to Appendix S, Water Resources Technical Memorandum.

Natural Gas

South – S. Spokane Street to S. King Street

All Build Alternatives except the Tunnel Alternative would affect approximately 400 feet of 6-inch IP gas line in the south segment.

Central – S. King Street to Battery Street Tunnel

The Surface Alternative requires the least overall quantity of relocation for natural gas lines in the central area.

North Waterfront – Pike Street to Broad Street

Natural gas impacts to the north waterfront would be similar for all Build Alternatives, including approximately 2,100 feet of IP and 1,900 feet of HP pipeline.

North – Battery Street Tunnel to Ward Street

The Aerial, Tunnel, and Surface Alternatives would have similar impacts to natural gas in the north segment. The Bypass Tunnel and Rebuild Alternatives would have a similar relocation requirement; however, the pipe size is yet to be determined.

5.5 Utility Mitigation

Mitigation measures considered to help minimize potential construction and operational impacts to utilities related to operation of the AWV Build Alternatives are discussed below. Proposed mitigation measures are based on NEPA requirements, WSDOT and City of Seattle policies, mitigation proposed for similar projects, and discussions with agencies during the planning process. These and other policies will be refined and additional or more specific mitigation measures will be developed as the planning and design process continues.

5.5.1 Operational Mitigation

Along with design aspects of the utilities systems, the guidelines below would help to reduce operational impacts of the AWV project to utilities:

- City of Seattle and Washington State energy, building, fire, and other applicable code requirements for all design aspects of the roadway facility.
- Relevant operational utility policies and strategies listed in the adopted City of Seattle Comprehensive Plan, Utilities Element (i.e., level of service, conservation strategies, and coordination of service providers).

5.5.2 Construction Mitigation

The following potential mitigation measures are separated between common measures and measures applied to specific utility services. When implemented, these measures could reduce the potential impacts of the Build Alternatives on utility services and infrastructure.

- Design the Preferred Alternative to minimize impacts to known major utilities.
- After selection of a Preferred Alternative, a consolidated utility relocation plan will be prepared consisting of key elements including existing, temporary, and new locations for utilities; sequence and coordinated schedules for utility work; and detailed description of service disruptions. This plan will be reviewed by and discussed with affected utility providers prior to the start of construction to reduce impacts.
- Where feasible, utilities would be relocated prior to roadway construction to avoid potential operational impacts. Utilities will be reviewed on a case-by-case basis to determine which need to be protected and supported in place during construction.
- Prior to jet grouting, utilities within 40 feet of the seawall will be reviewed on a case-by-case basis to determine whether they will be relocated or protected in place.
- Power transmission lines and distribution ducts are required to be supported in place during excavation of an adjacent facility.

- The project will take steps to provide the utility purveyors necessary access to their facilities.
- For alternatives where soil improvement is considered for Seawall Rebuild, power lines running parallel to the seawall would be exposed and protected during the soil improvement construction. Power lines traversing the seawall would be moved twice to accommodate construction of the new seawall.
- Coordinate with utility purveyors to develop a Consolidated Utility Relocation Plan and a Construction Sequencing Plan that incorporates relocation schedules with project construction schedule.
- Work closely with utility purveyors to reduce any potential service disruptions. Temporary connections to customers would typically be established before relocating utility conveyances to minimize impacts of service disruptions.
- Develop a Customer Service Plan and contact information for utility customers.
- Provide on-site electrical generation to minimize or eliminate power outages to customers as determined by City Light on a case-by-case basis.
- Take steps to assure that capacity of electrical transmission and distribution lines entering/exiting substations shall be maintained.
- Continue to meet with and coordinate closely with both municipal and private utilities to ensure minimal impact to utilities during construction, including acceptable safe relocation of manholes and other maintenance access points.
- Coordinate with SPU and Seattle City Light to notify utility customers of planned service disruptions, including fire service relocations, retirements, and/or new service requests. SPU water will perform all water system work.
- Following the installation of utilities and construction activities, the roadways would be constructed to the final design and the streetscape would be restored. This would typically include concrete curbs, sidewalks, and asphalt or concrete pavement.
- Comply with federal/state/local utility offset standards/criteria.
- Before final design and construction, field verify (by potholing where appropriate) the exact locations and depths of underground utilities and conduct condition checks as necessary.

- If inadvertent damage to underground utilities occurs during construction due to uncertain locations or misidentification, the contractor would contact the appropriate utility purveyor immediately to restore service.
- Develop measures and policies with utility purveyors to address contingency plan requirements to manage any potential utility service disruptions during construction.
- Provide traffic revision equipment and personnel as required by the Seattle Traffic Control Manual for In-Street Work.
- Reduce construction activities from occurring during peak hours whenever possible to lessen traffic impacts.
- Work with emergency service providers to coordinate alternative routes that help avoid significant disruptions.
- Provide protective measures, such as pipe and conduit support systems, trench sheeting, and shoring during construction to minimize or avoid potential damage to exposed utilities and remaining pavement structure.
- Use construction techniques (e.g., drilled shafts vs. driven piles) to avoid and/or minimize vibration impacts to utilities.
- Monitor areaways for potential vibration impacts to sensitive utilities during construction. (Define a stop-work threshold and next steps in Construction Sequencing Plan.)
- Comply with 2004 WSDOT Standard Specifications (M41-10) for Structure Excavation (2-09) and Piling (6-05).
- Work with City Light to develop a cost-effective solution and schedule for potential electrical duct bank relocations.
- Coordinate with City Light to provide safety watch and standby crew to minimize the interruption of power to the customers and to speed up the power restoration in the event of accidental interruption of power caused by contractor.
- Comply with Washington State Department of Health regulations, City of Seattle Water Quality Checklist (during construction), and City of Seattle Standard Plans and Specifications on disinfecting, flushing, and sampling new water mains.
- Coordinate all services affected by the displacement of residences or businesses with utilities and property owners.

- Coordinate with SPU throughout construction to repair, modify, or operate existing water facilities, including but not limited to water services, water mains, valves, test stations, and meters.
- Comply with applicable regulations regarding the maintenance of water supply for emergency service purposes.
- Engineer new water, sewer, and storm systems as appropriate and consistent with current City of Seattle standards and specifications.
- Coordinate construction-related mitigation with other major projects in the vicinity, such as Monorail Green Line and Sound Transit Central Link, to minimize utility and traffic disruptions.
- City of Seattle Standards (along with other guidelines listed in Section 2.2) would be used with approved designation on a case-by-case basis to determine which underground utilities would need to be relocated. Existing piping, conduits, buried cable, and buried utilities that encroach on areas required for construction would be removed and relocated, within the existing right-of-way, wherever feasible.
- Coordinate determination of acceptable new locations with the utility purveyors.

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Chapter 6 UTILITY CONSTRUCTION SEQUENCING

This section provides a general overview of the utility construction sequencing for the Build Alternatives, including a list of the design assumptions related to the construction sequencing. The sequencing discussion will continue to be refined, and a more detailed analysis will be prepared pending selection of the Preferred Alternative. For a complete description of the overall construction sequencing, including traffic detours and staging, refer to Appendix B, Alternatives Description and Construction Methods Technical Memorandum, and the Activity Durations for Project Construction (PB 2003, and as amended) exhibit. The Activity Durations for Project Construction exhibit (PB 2003) is hereby incorporated by reference

As an overview, the construction sequencing is broken down between various stages. Traffic Stage 1 maintains traffic in its existing configuration for both SR 99 (Viaduct) and the surface streets (Alaskan Way). Preliminary site work that is to be performed in Traffic Stage 1 can be performed using surface street lane closures or localized rerouting of the surface street in the immediate vicinity of the preliminary site work (Appendix B, Alternatives Description and Construction Methods Technical Memorandum). Major construction improvements for this project typically begin in Traffic Stage 2 and continue through Stages 3, 4, and 5.

As noted in Appendix B, Alternatives Description and Construction Methods Technical Memorandum, utility relocation durations have been identified as two durations. Durations have been listed for the temporary relocation under Traffic Stage 1 and for the relocation to a permanent alignment that would occur near the end of the project. For purposes of the utility discussion, Section 6.3 provides a listing of the assumptions and timelines associated with utility sequencing and relocations. This section describes the relocations as "first move" (temporary relocations) and "second move" (permanent relocations) that would affect utilities.

6.1 Estimated Construction Duration for All Build Alternatives

(Stage 2 Through Completion)

- Rebuild Alternative 7.5 years
- Aerial Alternative 11 years
- Tunnel Alternative 9 years
- Bypass Tunnel Alternative 8.5 years
- Surface Alternative 8 years

6.2 Utility Design Assumptions Common to All Build Alternatives

- Utility configuration changes would be constructible and be designed using current design standards and criteria.
- Water service and fire protection would be maintained during and after construction with minimum outages.
- Utility service would be maintained during and after construction with minimum outages.

6.3 Construction Sequencing Assumptions Common to All Build Alternatives

- Construction funding will be available to construct this project in an accelerated schedule.
- The overall duration of construction for each alternative must be minimized as much as physically possible.
- SR 99 (non-summer construction) – A minimum of two (2) lanes of SR 99 traffic in each direction must be maintained during peak traffic hours or a comparable detour will be provided, except when closures are permitted as described in the bullets below.
- Alaskan Way and E. Marginal Way – One lane of traffic in each direction must be maintained during construction or a comparable detour will be provided. During off-peak traffic hours, the roadway can be closed to traffic. In addition, an occasional short-term closure of several days may be permitted for construction activities.
- Construction will occur 24 hours per day, 7 days per week for the entire construction period.
- 24-hour closures of SR 99 for up to 2-week periods will be permissible.
- Summer closures of SR 99 between BST and Pike Street will be permitted for up to 10 weeks.
- The waterfront streetcar and parking under the existing viaduct will be removed prior to the first move or temporary relocation of the utilities in Stage 1.
- Transmission line planned outage permits must be coordinated through the Western Electric Coordinated Council and the Northwest Power Pool.[2]

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[2] To enhance the probability of an outage request being granted, application for permits should be made a year or more in advance. It is usually not possible to take an outage of more than one transmission line at a time in any local area; therefore, the outages tend to be serial in nature. Outages are not typically granted in the winter months. If there is a transmission system emergency, scheduled outages may be revoked.

- Access to the Colman Dock Ferry Terminal and local businesses will be maintained.
- Utility relocations will be held to a minimum. Depending upon the alternative, the first move of the utilities will mean both temporary relocations and where possible, a permanent relocation of other utilities. It is anticipated that the major utilities will not need to be moved more than twice.
- Upon selection of the Preferred Alternative (July 2004), preliminary design of the structures will start immediately, and within 6 months, utility providers will have sufficient project design and contract division information to start the design for temporary relocation of the utilities. Once design and permits are obtained for each utility, the temporary relocation of utilities in Stage 1 can begin.

6.4 Utility Construction Sequencing Common to All Build Alternatives

First Move Relocations

The first move is scheduled very aggressively to allow the seawall and highway construction to begin about January 2008. Significant activities are shown below:

- Early 2005 – Start design of the first move or temporary relocation of utilities, including:
    - S. King Street to Pike Street for seawall and/or tunnel construction
    - Pike Street to Broad Street for seawall construction
    - Thomas Street for construction of the new bridge over Aurora Avenue
- Mid-2006 – Traffic Stage 1 Construction
    - Start relocation of utilities for the first move. Parking and traffic under the existing viaduct will be prohibited to allow for utility relocation.
    - Relocation of ferry holding area
    - Provide alternate queuing site for ferry holding area
    - Remove Whatcom Rail Yard
- Early 2008 – Traffic Stage 2 Construction
    - Existing Alaskan Way is diverted under the existing viaduct around the seawall construction
    - Seawall and or tunnel construction begins

    - Thomas Street bridge construction begins
    - Utility relocations continue as necessary to stay well in advance of the seawall and highway construction
- Early 2010 – Seawall north of Pike Street to be completed in early 2010 to allow southbound SR 99 traffic to be diverted onto the Broad Street Detour, except the Aerial Alternative, which would not divert until early 2011, and the Rebuild Alternative, which would not use the Broad Street Detour.

Second Move or Permanent Locations

Traffic Stages 3, 4, and 5

The permanent relocations for the second move will generally begin as the tunnel or seawall construction is sufficiently complete to allow the installations. This may begin as early as 2010 as the seawall is completed and would continue throughout the stages of construction until completion.

Along with design aspects of the utilities systems, the guidelines below would help to reduce operational impacts of the AWV project to utilities:

- City and state energy, building, fire, and other applicable code requirements for all design aspects of the roadway facility.
- Relevant operational utility policies and strategies listed in the adopted City of Seattle Comprehensive Plan, Utilities Element (i.e., level of service, conservation strategies, and coordination of service providers).

Chapter 7 SECONDARY AND CUMULATIVE IMPACTS

7.1 Cumulative Impacts

Cumulative impacts, as defined by the Council on Environmental Quality (CEQ), are, "the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such actions" (CEQ Regulation 1508.7). Areas included in consideration of cumulative impacts for the Alaskan Way Viaduct and Seawall Replacement Project include transportation projects, land use and development planning projects, and planned upgrades to local utility infrastructure. For a complete description of the key development projects in the AWV study area and cumulative planned actions, refer to Appendix B Alternatives Description and Construction Methods Technical Memorandum's Chapter 5, Cumulative Impacts.

The following is a summary of the key development projects relating to cumulative effects:

- Central LINK Light Rail
- Colman Dock Ferry Terminal Expansion
- Mercer Street Corridor
- Seattle Monorail Project
- Seattle Aquarium and Waterfront Park
- SR 519
- Terminal 46
- Belltown/Queen Anne Proposed Development
- Seattle Downtown Proposed Development
- South Lake Union Redevelopment

7.1.1 Public Services

The Alaskan Way Viaduct and Seawall Replacement Project, together with other multiple planned projects that may cause major roadway changes, will affect future traffic patterns. Consequently, these changes may affect existing public service access and vehicle routes. Moreover, cumulative effects could include lane closures as a result of multiple projects under construction at the same time (including utility relocations), which may result in longer emergency response times and travel time delays for other public service vehicles. Lane closures and traffic delays from multiple projects in the same or adjacent areas of the city could pose difficulties in determining efficient routes for these services. Further, if not properly mitigated, the combined effect of increased development under the planned actions in the AWV project area could be an increased demand for public services. However, as other planned actions are subject to a separate environmental review, it would be expected that mitigation would be applied to reduce these combined effects.

In addition, overlapping construction schedules for utility relocations could result in temporary disruptions to water services necessary to support fire suppression in the study area. For the potential cumulative impact of multiple utility relocations, emergency response providers will be notified of construction plans and schedules in advance to reduce the effects of service disruptions.

The tunnel closures for the Central Link Light Rail would require buses to operate on city streets, thereby increasing congestion and reducing LOS. The Seattle Police Department anticipates that reconstruction of the Alaskan Way Viaduct would require the City to convert almost all on-street parking along the north-south arterials from I-5 to the AWV reconstruction area into travel lanes to accommodate traffic diverted from the construction area (SPD 2003x). Should the construction of the two projects coincide, vehicle travel would be extremely constrained in and around the downtown core, which could pose additional response time and travel time delays to fire, police, and emergency service vehicles.

For the Mercer Street Corridor, overlapping construction schedules between 2006 and 2009 could result in periodic response time and travel time delays at select intersections in the AWV study area (crossing near Aurora Avenue N.) for police, fire, and emergency medical services.

The completion of the Monorail project would benefit other projects, including AWV, by providing a viable alternative to driving in the downtown core. Encouraging commuters and shoppers to ride the Monorail during construction of the AWV and while bus tunnels are closed for construction of the Central Link Light Rail project could reduce some traffic congestion, resulting in a decrease in emergency vehicle response times and an improvement in public service delivery as well as utility relocation efforts.

For SR 519, the cumulative effect of this project in conjunction with the Alaskan Way Viaduct and Seawall Replacement Project would be a benefit to public services as they provide smoother connections both east–west and north–south.

Additional development at Terminal 46 will undoubtedly produce additional truck traffic and need for access. The increased traffic to and from the dock and the central waterfront, combined with project construction activities, could cause further decrease in LOS along the AWV Corridor. This would also apply to the Colman Dock Ferry Terminal, although the effects would be somewhat minimized as the expansion of these facilities is currently anticipated to be completed just prior to Stage 1 construction activities for the Alaskan Way Viaduct and Seawall Replacement Project.

In combination, the effects of the development projects occurring concurrent with the Alaskan Way Viaduct and Seawall Replacement Project could include traffic disruptions and lane closures, which could result in additional response time difficulties and travel time delays to emergency and other public service vehicles at select locations in the AWV study area. If not properly mitigated, lane closures as a result of multiple projects under construction concurrently could result in substantial impacts to response times and travel time delays for police, fire, and emergency medical services. However, it is expected that SDOT will oversee the development of such projects and approvals for lane closures in such a way as to reduce construction impacts.

If construction of the Alaskan Way Viaduct and Seawall Replacement Project overlaps with construction of other planned actions, such as the Monorail and Link Light Rail, construction and demolition activities would generate solid waste that could contribute to cumulative effects for solid waste management facilities. Mitigation measures would be implemented, such as up-front coordination during planning and design with the solid waste management facilities, to reduce these effects. In addition, as other major planned actions (e.g., Monorail and Link Light Rail) are subject to separate environmental review, it is anticipated that mitigation measures applied to these planned actions would reduce the overall combined effects.

7.1.2 Utilities

In general, cumulative impacts to utilities would result from overlapping construction schedules among the planned actions by increasing the risk and frequency of service disruption. Potential utility outages would affect business and residential customers as well as public services. Services to customers could be temporarily disconnected each time a utility line is relocated. Multiple relocations of utilities could affect the local economy by increasing the risk of frequent and/or accidental loss of service to retail and commercial businesses.

The utility construction sequencing for the Alaskan Way Viaduct and Seawall Replacement Project will be a major undertaking in and of itself. If construction of the Alaskan Way Viaduct and Seawall Replacement Project overlaps with construction of other proposed actions, such as the Link Light Rail and Monorail, the multiple utility relocations will require utility purveyors to secure permitting, skilled personnel, and specialized equipment in large quantities and commit to completing relocation work at an accelerated pace. The overall cumulative impact could be substantial due to the complexity of the relocations, the critical nature of the utility facilities in downtown Seattle, the estimated cost of the relocations, and the possibility of encountering schedule delays and temporary service disruptions. However, the cumulative impacts stemming from multiple utility relocations occurring at the same time could be reduced by up-front coordination of the planning and design with the utility purveyors, through proper implementation of a consolidated utility relocation plan to minimize disruption of services (see Section 5.5.2, Construction Mitigation), and by making allowances for maintenance and repair access.

Potential cumulative benefits of these projects would be realized through the upgrade of the utility infrastructure to the latest standards versus the continuing risk of losing the existing viaduct structure as a utility corridor should a natural disaster occur, such as another earthquake the magnitude of the Nisqually Earthquake of 2001 or larger.

7.2 Secondary Impacts to Public Services and Utilities

Secondary impacts or indirect effects are those effects that are caused by or will result from the proposed action and are later in time, but are still reasonably certain to occur [50 CFR §402.02]. Secondary effects of the AWV project could include both impacts and benefits.

A secondary effect of the relocation of private utilities (including permitting costs) could be an increase in utility rates. Services involved could include Seattle Steam, Puget Sound Energy, Olympic Pipeline Fuels, and as many as sixteen private telecommunications providers. Reconnection of the Seattle street grid in the north segment (for all Build Alternatives except the Rebuild Alternative) is expected to encourage residential or business development as the area becomes more accessible. However, considerable redevelopment is already in planning and construction for this area (Vulcan projects and Mercer improvement projects around South Lake Union as noted in the Cumulative Impacts section), and the AWV project could not be considered the impetus behind the majority of this redevelopment.

For the Surface, Tunnel, and Bypass Tunnel Alternatives, it is expected that opening up the waterfront vistas will also encourage new development in that region. Combined with the Seattle Central Waterfront Plan, as noted in the Cumulative Impacts section, this could lead to major commercial, residential, or Port development. Impacts and benefits would be the same as mentioned for the north segment with the reconnection of the street grid.

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