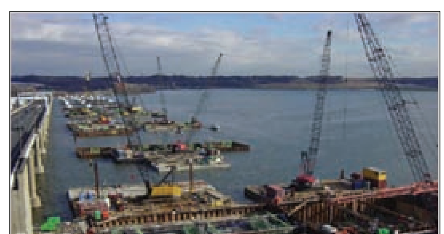
Chapter 3: Construction Activities

This chapter describes anticipated construction methods, activities, and sequencing for the 6-lane Alternative and Options A, K, and L. Information in this chapter provides context for understanding the construction effects discussed in Chapter 6. The construction durations, methods, and techniques described in this chapter will be refined during final design of the project. Construction activities are also subject to various local, state, and federal agency permit requirements. However, the information in this chapter presents WSDOT's best current estimate of how, and in what sequence, the project would be built. Information from this section is based primarily on the Construction Techniques and Activities Discipline Report included in Attachment 7.

3.1 Where and when would construction occur?

Construction of the 6-Lane Alternative would occur along the length of the SR 520 corridor between I-5 in Seattle and Evergreen Point Road in Medina. Construction would occur adjacent to the existing roadway and within WSDOT right-of-way to the greatest extent possible. Construction activities would take place on land, on work bridges constructed adjacent to the roadway, and from barges floating on the lake and outfitted with cranes. Construction would be sequenced to maintain traffic flow along the corridor; detour bridges would be constructed where roads cross SR 520 and along the main line, where needed.



Barges

Barges like these would be used to stage construction equipment and activities along the floating bridge.

Construction activities along the corridor would be ongoing for 6 to 8 years, depending on the design option. This estimated time frame is based on the assumption that the project receives full funding and that construction would occur concurrently in multiple locations along the corridor. If funding is allocated in phases, the construction period would extend over a longer time frame. Within the overall construction period, areas of the corridor would be affected for varying amounts of time.

Construction time frames in the I-5 interchange area, Portage Bay Bridge area, and Evergreen Point Bridge area are common to Options A, K, and L. Under all options, construction in the I-5 area is estimated to occur over approximately 2.25 years, construction of the Portage Bay Bridge is estimated to take approximately 6 years, and replacement of the Evergreen Point Bridge would take approximately 4.5 years. Construction time frames for the Montlake interchange and west approach would differ among the options and are estimated at between 5 and 6 years for Options A and L, and between 6 and 7 years for Option K. Subsequent sections of this chapter provide more detailed descriptions of how long specific construction activities would take, for each geographic area and each design option.

Construction Staging Areas and Equipment

Construction along SR 520 would be staged from both land and water. Land-based construction staging areas (shown in Exhibit 3-1) would be used for delivery and storage of construction materials and equipment, contractor office and storage trailers, and employee parking. These areas would be fenced and located adjacent to areas where project construction is occurring. Construction staging areas would vary in size and may require grading or excavation to level the site and install drainage improvements, depending on site conditions. Temporary driveways would be established from staging areas to the roadway network.

Exhibit 3-1. **Construction Staging Areas**

Office trailers, placed on temporary foundations, would be connected to available utilities, including power, telephone, water, and sewer as needed. Connecting to these utilities may include installing poles for power lines and excavating trenches to place water and sewer pipelines. After construction is complete, staging areas would be restored and disconnected from any utilities.

Along the corridor, construction would occur within WSDOT right-of-way to the greatest extent possible. Construction areas within WSDOT right-of-way would be cleared of vegetation and any buildings or structures in order to provide adequate work space. Temporary fencing would be installed around construction areas to separate construction zones from adjacent properties.

Temporary erosion and sediment control measures would be used to prevent runoff of untreated stormwater and sediment from staging areas into city stormwater or sewer facilities, nearby wetlands or water bodies, or adjacent properties. WSDOT would develop and implement a spill prevention control and countermeasures (SPCC) plan to prevent and minimize the potential for spills of hazardous materials and pollutants.

Work bridges and barges would be used to stage construction over water. Barges could be used to transport materials and employees, serve as a construction work platform, or be docked to serve as over-water staging areas. Tugboats would be used to maneuver barges through the Ballard Locks and Montlake Cut.

Roadway and bridge construction activities would require a variety of construction equipment. Types of equipment and their use are shown in Table 3-1. For certain activities, construction crews may also require more specialized equipment such as pile drivers, dewatering pumps and tanks, and conveyor belts.

Construction crews

Table 3-1. Typical Construction Equipment

Equipment	Typical Use
Air compressor	Pneumatic tool power and general maintenance
Backhoe	General construction
Concrete pump	Concrete pumping
Concrete saw	Concrete removal, utilities access
Crane	Materials handling, removal, and replacement
Excavator	General construction and materials handling
Forklift	Staging area work and hauling materials
Haul truck	Materials handling, general hauling
Jackhammer	Pavement removal
Loader	General construction and materials handling
Paver	Roadway paving
Pile driver	Support-installation for structures and hillsides
Pump	General construction use, water removal
Pneumatic tools	Miscellaneous construction work
Service truck	Repair and maintenance of equipment
Tractor trailer	Material removal and delivery
Utility truck	General project work
Vibratory equipment	Activities to shore up hillside or install piles

Haul Routes, Road Closures, and Truck Trips

Materials would be transported to and from the construction sites by trucks and barges. Trucks would travel over designated haul routes through Seattle to SR 520, I-5, and I-405. All haul routes would require approvals by local jurisdictions. Potential haul routes identified for material transport, road closures, and estimated truck trips are discussed in the following paragraphs. Exhibit 3-2 shows the potential truck haul routes that would be used to transport materials.

Potential construction haul routes include both local and regional roadways. Some of the haul routes would use streets that the City of Seattle classifies as “major truck streets.” Major truck streets proposed to be used as part of this project include Montlake Boulevard between SR 520 and NE Pacific Street and NE Pacific Street between Montlake Boulevard and 15th Avenue NE. Wherever possible, other haul routes would be located on arterial streets. However, because of the location of proposed construction activities and the lack of available arterial routes immediately adjacent to some construction sites, several residential streets would also be used for truck haul routes, including 11th Avenue East and East Miller Street. East Shelby Street and East Hamlin street east of Montlake Boulevard would also be used intermittently for construction of Options K and L during peak construction periods. Exhibit 3-2 shows potential haul route locations in Seattle. A more detailed discussion of haul routes and related effects can be found in Chapter 6.

Exhibit 3-2. Potential Haul Routes

Haul routes for construction of the East Approach Bridge would include SR 520 and potentially Evergreen Point Road and 92nd Avenue NE.

Temporary driveways would be constructed between the staging areas and the roadway network. These access points would link with the haul routes and be monitored by flaggers, law enforcement, or construction workers, depending on the location. A construction access ramp may be provided directly into the construction zone from the SR 520 westbound Montlake off-ramp. Outbound trucks could also re-enter the Montlake westbound off-ramp near the intersection with Montlake Boulevard. These trucks could either go straight to access the SR 520 westbound on-ramp or turn left and travel to the SR 520 eastbound on-ramp to reach their final destinations.

Peak construction activities (including concrete pours or excavation and fill) would involve the highest numbers of workers, materials, and equipment, and more trucks would use regional and local roadways. In order to meet the current schedule, it was conservatively assumed that during the peak construction activity, peak truck-haul activity would occur simultaneously for different project components, including the Portage Bay Bridge, the SPUI, and the west approach bridge.

Table 3-2 summarizes the potential number of haul route trips on SR 520, I-5, and I-405 during peak construction (per day and per hour for each option).

Table 3-2. Estimated Number of Peak Construction Period Haul Route Trips on Local Highways						
	Per Day			Per Hour		
Regional Freeway[a]	A	K[b]	L	A	K[b]	L
SR 520	350	620	420	45	70	65
I-5	270	400	300	35	55	50
I-405	190	320	220	20	40	35

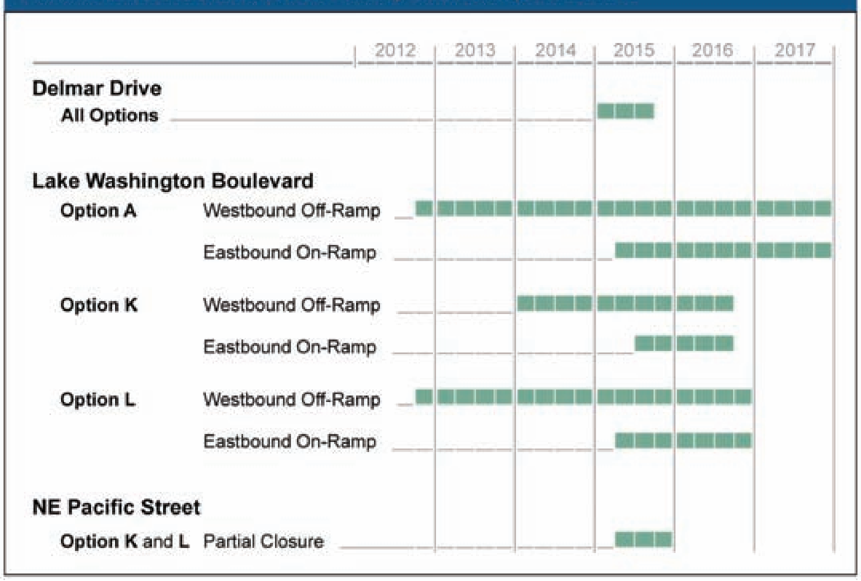
[a]No effects are expected on I-90.

[b]The hauling of material out of the SPUI and tunnel (Option K) would typically occur for 10 hours per day, and occasionally for up to 16 hours per day.

Roadway and Ramp Closures

WSDOT would maintain two through lanes in each direction on SR 520 during weekday peak travel times. On- and off-ramps at Montlake Boulevard would remain open to traffic while being reconstructed, with lane shifts using temporary ramp connections as needed (Exhibit 3-3).

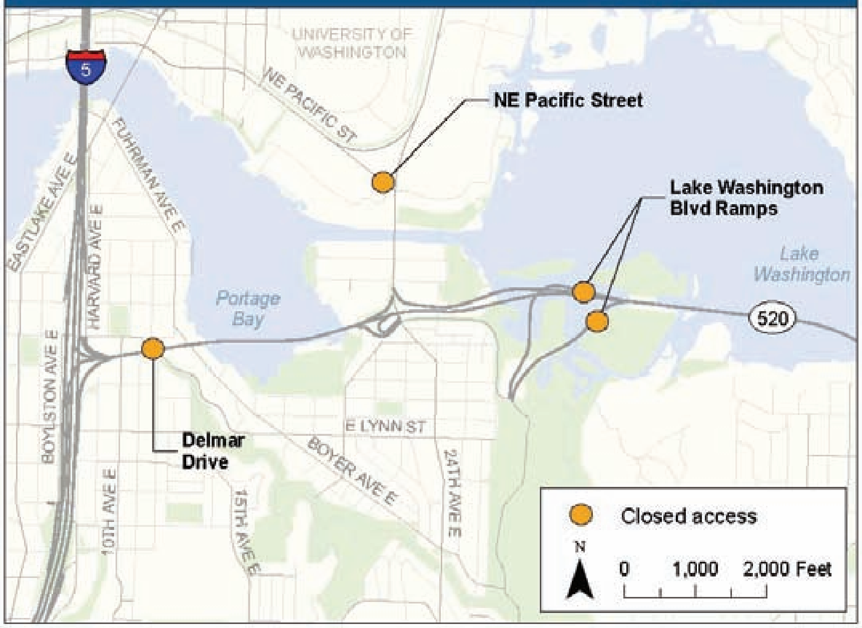
Exhibit 3-3. **Durations for Roadway and Ramp Closures**



Portions of SR 520 and its ramps would be closed at night and on weekends for the duration of the project. Closure hours and dates would be timed to accommodate special events and coordinated with closures on other freeways.

All design options would require two long-term roadway closures: the Lake Washington Boulevard ramps and the Delmar Drive bridge over SR 520. Options K and L would include an additional long-term closure of a portion of Pacific Street that would not occur with Option A. Exhibit 3-4 shows the locations of project-related road closures and detours. The Transportation section in Chapter 6 (Section 6.1) describes how traffic would be affected by the temporary closures described below.

Exhibit 3-4. Road Closures and Detours



Lake Washington Boulevard Ramps

The Lake Washington Boulevard ramps would be closed to make room for the construction work bridges and the west approach structure. The closures would be for different durations for each option. While the Lake Washington Boulevard ramps are closed, traffic would be detoured to Montlake Boulevard. Prior to closing the Lake Washington Boulevard ramps, a number of capacity improvements would be made to the SR 520 ramps at Montlake Boulevard (see Section 6.1 for details).

Delmar Drive East

Delmar Drive East would be closed temporarily under all options to accommodate construction on SR 520, as well as construction of the 10th Avenue and Delmar Drive East lid. The Delmar Drive East bridge would be closed for approximately 9 months under all design options. While it's closed, traffic would be detoured to 10th Avenue East.

Pacific Street

A portion of Pacific Street would also be closed under Options K and L only. The portion of Pacific Street from Montlake Boulevard to just west of the University of Washington Medical Center access driveway would be closed for 9 to 12 months. This temporary closure would accommodate the lowering of the Pacific Street/Montlake Boulevard intersection, proposed under Options K and L, and construction of the lid in this area.

In-Water Construction

In-water work requires specific permits from several resource agencies. These permits, which are separate from the NEPA process, specify constraints and guidelines to minimize construction effects on fish and aquatic habitat. Design considerations for in-water construction techniques include the location and configuration of permanent and temporary in-water structures, the timing of construction (i.e., appropriate in-water work windows), and measures to protect water quality.

In-water construction activities would occur at various points along the SR 520 corridor, including the Portage Bay Bridge, Montlake Cut crossing, east and west approaches to the Evergreen Point Bridge, the floating portion of the bridge, and the bridge maintenance facility on the shoreline beneath the east approach. Examples of in-water construction activities include the following:

- Pontoon towing and assembly
- Floating bridge superstructure/pontoon outfitting
- Anchor system installation
- Work bridge construction and removal
- Cofferdam construction and removal
- Drilled shafts and bridge footings
- Existing bridge demolition

To minimize effects on fisheries and other natural resources, in-water construction would be limited by permit conditions to the approved work windows. Table 3-3 identifies the current in-water work windows established by the Washington State Department of Fish and Wildlife (WDFW) for the Lake Washington Ship Canal and for Lake Washington. Locations and types of in-water work are summarized in Exhibit 3-5. WSDOT is working with resource agencies to develop project-specific work windows that would be applied to construction.

Table 3-3. WDFW-Established In-Water Work Windows

Area	Work Window
Lake Washington Ship Canal (from the Chittenden Locks to the east end of the Montlake Cut)	October 1 – April 15
Lake Washington between I-90 and SR 520	July 16 – April 30
North of SR 520	July 16 – March 15
Between SR 520 and a line drawn due west from Arrowhead Point	July 16 – July 31 and November 16 – February 1

DEFINITION

What is an in-water work window?

Work windows are time periods specified by natural resource agencies for conducting work in streams, lakes, and rivers. The periods are selected to minimize harm to fish and other aquatic resources. For example, work windows in Lake Washington were established by the Washington Department of Fish and Wildlife (WDFW) to minimize construction effects on salmon during critical times of the year, such as when the salmon are spawning or migrating.

Bridge Demolition

The photo above shows over-water demolition, which requires special precautions and equipment to prevent debris or concrete-laden water from entering the natural water system.

Exhibit 3-5. Area and Types of In-Water Work

Construction Activity or Method[a]	Portage Bay Area	Montlake Area	West Approach Area	Floating Bridge Area	Eastside Transition Area
Pontoon towing	●	●	●	●	
Anchor installation				●	
Pontoon assembly and disassembly				●	
Bridge superstructure outfitting				●	
Work bridge construction and removal	●		●	●	
Cofferdam or sheetpile installation and removal	●		●	●	
Drilled shafts	●		●	●	
Mudline footings	●				
Waterline footings	●		●	●	
Column/Pier construction on waterline footing	●		●	●	
Cast-in-place or precast girder superstructure	●		●	●	
Existing bridge removal	●		●	●	
Tunneling (Option K)		●			
Bascule bridge (Options A and L)		●			

[a] Construction methods identified for the Portage Bay, west approach, and east approach locations cover a range of methods that could be used in the construction design for Options A, K, and L.

In addition to defining in-water work windows, resource agencies place other types of conditions on their permits to protect aquatic species and habitat. Conditions for the SR 520 project will include requirements that WSDOT apply specified best management practices to prevent construction activities from exceeding state water quality standards. Noise attenuation measures will likely also be required to reduce the effects of in-water pile-driving on fish and other aquatic species. Chapter 6 contains more detailed information on potential BMPs, noise attenuation measures, and other forms of construction mitigation.

Demolition would be required for those fixed structures that will be replaced by new structures as well as the existing floating bridge. This type of demolition would require impact hammers to remove traffic barriers and rails, saw cutting to cut the bridge deck before girder removal, and torch cutting to cut reinforcing steel. Pieces of the roadway would be loaded by crane onto trucks or barges for disposal or recycling. Columns and piles would be removed by vibratory extraction where possible, or cut 2 feet below the mudline (ground surface).

Over-water demolition requires special precautions and equipment to prevent debris or concrete-laden water from entering the natural water system. Nets, tarps, platforms, scaffolds, blankets, barges, and floats can be used to contain the debris; vacuums, diverters, absorption materials, holding tanks, and drainage systems can be used to contain concrete-contaminated water.

Bridge Demolition and Disposal

Construction of the SR 520, I-5 to Medina project would require extensive demolition and removal of over-water and in-water structures. Demolition is defined as major breaking, crushing, and cutting of existing structures for eventual disposal; it may include salvage of reusable or recyclable materials. In the context of the project, removal is defined as vibrating, pulling, and dismantling existing structures for eventual disposal, reuse, or recycling.

Option K would result in the largest amount of structure demolition with an estimated 1.85 million square feet of demolition debris. Options A and L would have similar quantities, and result in approximately 1.47 million square feet of debris. Option K requires more demolition due to the temporary detour bridge that would be necessary to maintain traffic in the corridor during construction.

Floating Bridge

Demolition of the floating bridge would involve removal of the transition spans, elevated superstructure, pontoons, and anchor cables.

Transition Spans

Two truss structures currently serve as transition spans and link the floating structure to the fixed approach structures on each end of the floating bridge. Demolition would likely be performed by removing each truss structure in one piece, either by using floating cranes to lift the truss off its bearings or by positioning a barge under each transition span and using jacks to lift each truss vertically off its bearings.

The Ballard Locks have a width limit of about 79 feet. The availability of floating cranes that would fit through the locks and also have the capacity to lift an entire transition span could be limited. Because of this, it may be necessary to remove the roadway deck and barriers to reduce weight before removing the steel truss structure in one piece.

Elevated Superstructure

The extent of elevated superstructure removal would likely be dictated by the destination of individual pontoons after leaving Lake Washington. For pontoons that may be towed in the open ocean, the road deck and columns that rest on some of the pontoons could be removed to maintain pontoon stability while under tow. Demolition of the elevated superstructure and columns would be the same as that described for fixed bridges, except that columns would be cut flush with the top of the pontoons. For pontoons that are not towed in the open ocean, much of the elevated superstructure could remain in place until they leave Lake Washington. Options for pontoon disposal are discussed below.

Pontoon Disassembly and Removal

Pontoon disassembly and removal consists of saw-cutting the pontoon joints, disconnecting pontoons from their anchor cables, and towing them away. Some, or all, of the roadway that rests on the pontoons may need to be removed before the pontoons are transported out of Lake Washington.

Anchor Cable Removal

Typically, anchor cable removal consists of detaching anchor cables at their connections to the pontoons and anchors, then winding the cables onto spools on barges for transport. Floating cranes would be used to wind the cable onto spools. Divers would detach the anchor cables from the anchors.

Underwater Anchor Decommissioning

The existing floating bridge has three types of anchors: concrete fluke anchors, rock-filled concrete gravity anchors, and pile anchors. Underwater anchor decommissioning consists of abandoning all anchors in place with the exception of pile anchors, which will be removed to the mudline (ground surface).

Disposal

Trucks, barges, and tugs would be used to transport materials from demolition and construction sites along SR 520. Barges and tugs would transport a large portion of the material through the Montlake Cut and the Ballard Locks to disposal sites or transfer facilities accessible by water. Due to the large amount of disposal material and the transport required by land and water, multiple disposal sites would likely be used.

Materials disposal would occur at approved disposal sites. Demolition materials would be disposed of in accordance with federal, state, and local laws and ordinances. Demolished concrete pieces could also be transported to local concrete recycling facilities.

As with past WSDOT floating bridge projects, all pontoons, including the elevated superstructure in the existing floating bridge, could be made available for purchase. All existing pontoons, including the elevated superstructure, that were removed as part of the recent Hood Canal Bridge project were sold to private parties. Pontoons could be reused for a wide variety of waterfront functions such as docks, breakwaters, and dolphins. If pontoons are not sold, they would be towed to an approved site, such as a graving dock or floating dry dock, and demolished. Pontoons would not be submerged in any water body.

3.2 What are the construction activities and sequencing for Options A, K, and L?

The following subsections describe the general nature and sequence of construction activities in each area of the SR 520 corridor. Because the project is at a preliminary level of design, project details and construction methods have not been fully defined and may change somewhat as the design evolves. In addition, construction contractors typically have many choices about construction methods to be used. However, the descriptions below provide a reasonable assessment of how the project would be constructed.

Site Preparation

The first step in construction would be preparation of staging and construction areas. As part of this work, temporary erosion and sediment control (TESC) measures and temporary drainage structures would be installed to prevent run-off of untreated stormwater and sediment from entering City stormwater or sewer facilities, nearby water bodies, or adjacent properties. A variety of temporary construction BMPs could be used, including silt fences, berms, storm drain inlet protection, straw bale barriers, and detention or siltation ponds.

Specialized BMPs are needed around concrete-handling areas to prevent water contaminated by uncured cement from entering water bodies or stormwater facilities. Conveyance systems for the movement of stormwater from a collection point to an outfall can consist of drainage pipes and retention facilities (such as ponds, vaults, and catch basins) and can use gravity or pumps to move the stormwater. Staging areas are often equipped with wheel washes that clean truck tires to reduce tracking of dirt and dust offsite.

Temporary fencing would be installed around construction areas to prevent machinery and equipment, materials storage, and construction activity from

Sensitive Areas Buffer

Example of fencing to protect a wetland during construction.

intruding into adjacent properties, wetland and stream buffers, and shoreline areas. Staging and right-of-way construction areas would be cleared of any unneeded structures and vegetation to provide adequate work space. Remaining vegetation would be clearly marked to protect it from harm during clearing and use of the site. Staging area sites that are uneven are usually graded flat to facilitate parking, storing materials and equipment, and setting up a construction trailer if needed.

Roadway Excavation

Roadway excavation, also called "cuts," involves removing ground surface or other material to the depth and width necessary to achieve a desired grade and slope for a roadway or structure. Heavy equipment is used to remove soil and dozers usually push the material into piles, which are then loaded into haul trucks for transportation. A dumptruck and trailer can typically carry 20 to 30 cubic yards of soil. The photo above shows crews working in the median between westbound I-90 and the center roadway to excavate and install water lines.

I-5 Area

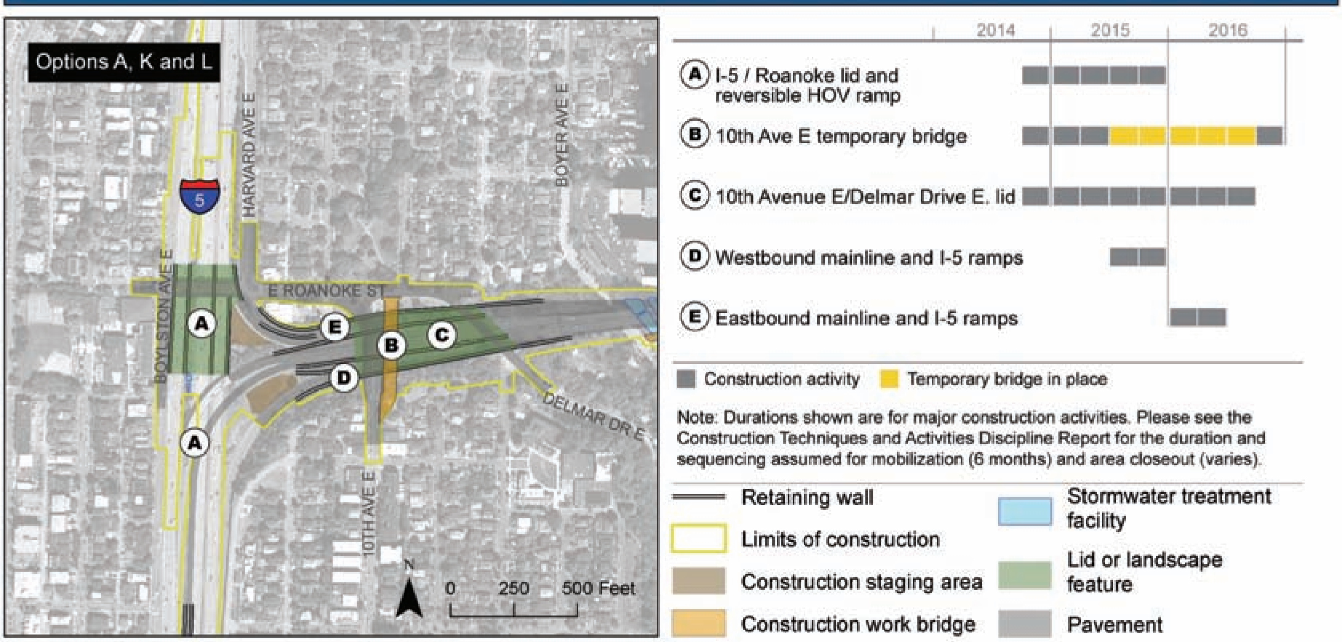
Construction activities and durations in the I-5 area would be the same for all options and would occur over a 2.25-year period (see Table 3-4). Activities in this area would include roadway reconstruction, excavation and embankment grading, retaining wall and abutment construction, and paving. Potential staging areas would be located within the existing right-of-way. Haul trucks would use designated haul routes. The areas affected by construction and demolition and the duration and sequence of activities are described below and shown in Exhibit 3-6.

Table 3-4. I-5 Area – Construction Elements and Truck Trips

Excavation (cubic yards)	76,000
Retaining walls (area in square feet)	33,000
Daily truck trips (average) Daily truck trips (during peak activity)	10 to 20 70 to 85
Construction duration	2.25 years

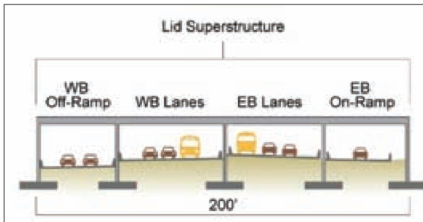
Note: Construction duration does not include mobilization and project closeout.

Exhibit 3-6. **Construction Elements and Durations in I-5 Area**



I-5/Roanoke Lid

Construction of the I-5/Roanoke lid would start at the north end of the new lid. When completed, this portion of the lid would be used as a temporary detour for Roanoke Street when the Roanoke Street bridge is demolished and replaced. Abutments and support walls for the new lid would be constructed in the median and on both sides of I-5. The support walls would be constructed on footings, which are concrete pads that provide a large area to distribute the weight of the lid. The walls would provide continuous support for the girders that span the roadways underneath.



Lids

As shown, lids would be located over the freeway lanes and would be supported by walls. The walls would occupy the spaces in the medians and at the limits of the lid. The walls would provide continuous support for the superstructure that spans the roadways underneath.

During construction of the support walls, the I-5 northbound and southbound lane widths would be temporarily reduced, and the lanes would be shifted to the center. Boylston Avenue East would be temporarily narrowed and shifted to the west to allow for the I-5 lid abutment and wall construction. Once the walls are completed, the lid superstructure would be constructed with girders that would span over I-5. The lids would be constructed in three sections across the width of I-5. For safety reasons, I-5 traffic would be shifted to lanes not under construction when girders are being placed.

Landscaping would be installed in a soil layer on top of the lid structure. The adjacent surface streets, Harvard Avenue East and East Roanoke Street, would be reconstructed to match the final lid configuration.

10th Avenue East/Delmar Drive East Lid

Construction of the 10th Avenue East/Delmar Drive East lid would start with a detour bridge just east of the existing 10th Avenue East crossing. Traffic would use the detour bridge during construction of the lid and demolition of the 10th Avenue East and Delmar Drive East overcrossings. Delmar Drive East would remain closed for 9 to 12 months and then would be reopened as part of the new lid structure.

Construction of the lid would use the same methods and sequencing as described above for the I-5/Roanoke lid. Retaining walls and support walls for the new lid would be constructed in the median and on both sides of SR 520. 10th Avenue East and Delmar Drive East would be reconstructed to match the final lid configuration.

SR 520 Main Line and Ramps

The SR 520 main line and ramps in this area would be reconstructed in generally the same location as today. The lanes would be reconstructed from the I-5 interchange (including ramps) to the 10th Avenue East/Delmar Drive East lid. The Harvard off-ramp retaining walls and westbound lanes would be reconstructed first, followed by the eastbound lanes. Activities would include roadway excavation, embankment construction, grading, and temporary and permanent paving. Cast-in-place retaining walls would be constructed to support the south end of the reversible HOV ramp and the on- and off-ramps at the I-5 interchange.

Portage Bay Bridge Area

The new Portage Bay Bridge would be built in halves so that traffic flow would not be interrupted. Traffic would use the existing bridge until the new north half is built, and then would be shifted to the new north half while the existing bridge is demolished and the new south half is built. Construction activities and durations in this area would be similar for all options and occur over a 6-year period. Activities in this area would include work bridges, bridge demolition, and construction of new structures. The areas affected by construction and demolition and the duration and sequence of activities are described below and shown in Exhibit 3-7.

Work Bridges in Portage Bay

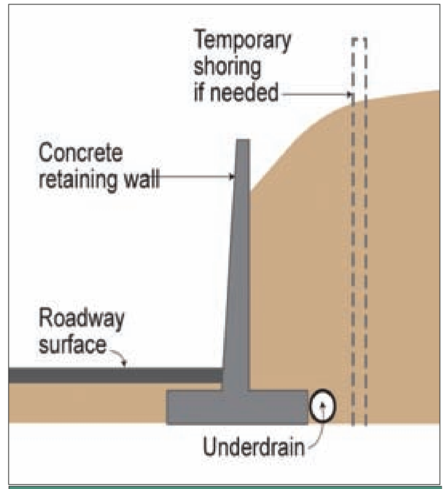
The typical shallow water (3 to 6 feet) in Portage Bay would likely limit the use of barges as work platforms for constructing the proposed new Portage Bay Bridge. Therefore, work bridges would be constructed along both the south and north sides of the existing bridge. The work bridges would be approximately 30 feet wide and approximately 10 to 15 feet above the high water elevation.

Vertical shafts called piles are used to connect a structure to the deep soils. Piles differ from columns in that they penetrate deep into the ground and are often used in groups connected together by a beam or cap. Construction of the work bridges would require installing approximately 741 temporary 24- to 30-inch-diameter hollow steel piles (Table 3-5). The piles would be installed in bents (rows) spaced at approximately 25- to 40-foot intervals, with 3 to 4 piles per bent.

Table 3-5. Portage Bay Area – Construction Elements and Truck Trips

	Option A	Options K and L
Excavation (cubic yards)	75,000	64,000
Permanent columns	66 to 72	56–62
Temporary support piles	740 to 750	700 to 710
Falsework piles	300	300
Daily truck trips (average) Daily truck trips (during peak activity)	10 50	10 50
Construction duration	6 years	6 years

Note: Construction duration does not include mobilization and project closeout.



DEFINITION

Cast-in-place Retaining Walls

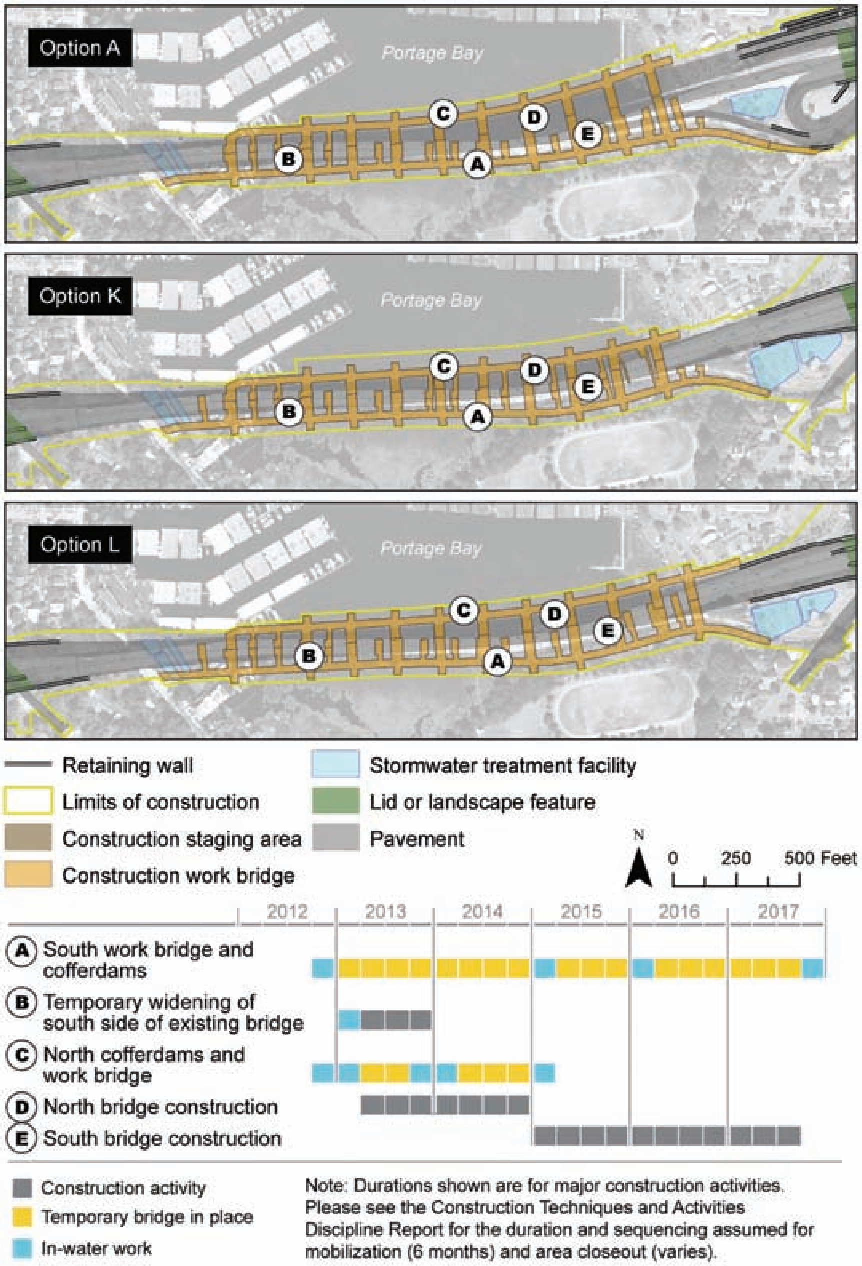
The schematic above shows a cast-in-place wall with spread footings. Excavation is generally needed to set the footing of the wall beneath the ground surface. Forms made of metal or wood are set in place to hold the wet concrete. Concrete is delivered in mixer trucks and poured into the forms. The concrete is poured in stages from the bottom base up. If the wall will be used to retain a cut slope, temporary shoring may be needed to support the slope until the permanent wall can be backfilled.

DEFINITION

Work Bridge

The photo above is an example of a work bridge. Similar work bridges would be used in Portage Bay and for construction of the west approach structure. These bridges would be approximately 30 feet wide and approximately 10 to 15 feet above the high water elevation.

Exhibit 3-7. Construction Elements and Durations in the Portage Bay Area



Two types of pile-driving hammers (impact and vibratory) would likely be used for the project. A vibratory hammer would be used to set the piles, and an impact hammer would be used to confirm the load-bearing capacity of each pile at the end of the driving. Pile-driving would take place during the established in-water work windows and would be limited to daytime hours to minimize noise effects (see Section 6.7). The current estimate for work bridge advancement is two bents per day per work crew, depending on the structure.

Construction of work bridges is accomplished from a crane that starts out on land behind a temporary wall on a pad prepared at the edge of the water. The crane swings out and starts driving piling in the water for the first pile bent. After all piles for each bent are driven, they are cut off at the same elevation. Steel cap beams are set on top of the piles to complete the bent. Support beams are welded from one bent to the next and timber deck panels are then bolted to the support beams. After the deck span is in place, the crane is advanced out onto the span and the operation continues until all the bents and work bridge spans are in place.

In-water work would include construction and installation of temporary cofferdams to create dry work areas below the water level for bridge foundation construction. Cofferdams are generally constructed with steel sheet-piling vibrated into the mud with a vibratory hammer, typically to 20 feet below the bottom of the excavation. Water is then pumped out of the area within the cofferdam to provide a dry working environment.

All temporary structures would be removed after the new Portage Bay Bridge is complete. Removal would be accomplished by reversing the installation process. The timber deck panels would be unbolted and removed, the piles would be pulled out, and the crane would be backed off the span while demolition work continues. The temporary piles would be removed with a vibratory hammer.

Permanent Bridge Construction in Portage Bay

The Portage Bay Bridge substructure would have three main parts: drilled shafts, shaft caps, and concrete support columns. Drilled shafts are used to support bridge loads in deep layers of less dense materials. They can be constructed in the ground or lakebed, with bridge columns constructed on top of the shafts. Construction of the drilled shafts would begin with an 8- to 12-inch-diameter steel casing or large hollow pipe vibrated into the lakebed. A crane would lower an auger into the casing to excavate sediment from the shaft area. Concrete would then be pumped into the shaft. The accumulating concrete would displace any water in the casing, and the displaced water would be collected and treated. The casing pipe would then be lifted out of the shaft excavation far enough to form the top of the shaft.

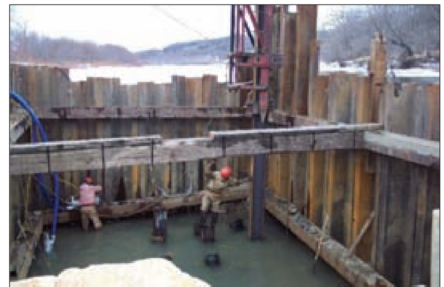
When more than one drilled shaft is required, a shaft cap would be constructed. The shaft caps would tie the multiple shafts together and spread the load from the columns. They are generally needed when soil conditions are poor and the bridge has long spans.

The support column would be constructed on top of the shaft cap. Concrete shaft caps are constructed at the top of columns using formwork, reinforcing steel, and poured concrete footings or columns. The columns are constructed by building a cylindrical wire "cage" of reinforcing steel on top of the footings; forms for the concrete columns are constructed around

DEFINITION

Pile Bent

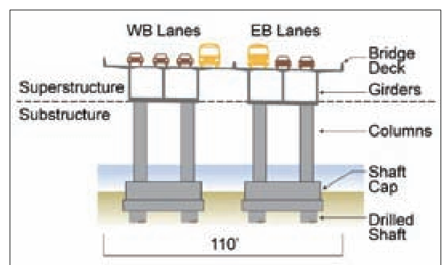
A pile bent is an engineering term that refers to a row of piles that are fastened together. The row of piles together provides a framework for carrying the bridge deck.



DEFINITION

Cofferdam

The photo above is an example of a cofferdam. Cofferdams provide a dry work area when construction takes place within a water body.



DEFINITION

Substructure and Superstructure

A bridge consists of two major parts: a substructure and a superstructure. The substructure includes the bridge foundation and support structures. For Portage Bay, this would include the drilled shafts, shaft caps, and support columns. The superstructure is the part of the bridge above the columns. For Portage Bay, this would include the girders and the roadway slab.

the wire cage, and concrete is poured into the forms. In-water columns can be constructed within cofferdams or installed from barges or work bridges.

The Portage Bay Bridge superstructure would have two main parts: the girders that span between the bridge columns and the roadway slab (bridge deck). Girder bridge sections can either be cast in place or precast. The bridge superstructure selected will depend on site conditions, which dictate the distance between columns and the clearance needed under the bridge. For cast-in-place construction, falsework (see sidebar) is constructed first. Falsework is constructed directly under and adjacent to the bridge area. It generally consists of steel pipe and/or timber columns, piles, beams, and bracing members, as well as scaffolding and connecting hardware. Forms for the girders and deck are placed on top of the falsework, reinforcing steel is installed inside the forms, and concrete is poured. The forms and falsework are removed after the concrete develops enough strength to support itself.

Precast girders are hauled in on trucks and placed on pier caps by cranes on the work bridge. The cranes reach out to construct each connecting span to be fixed into place. Forms for the deck slab are then placed along with reinforcing steel and concrete is poured.

As described in Chapter 2, Option K and L would include “faux” (false) arches underneath the bridge deck, which would be completed last. This architectural treatment would also require the use of falsework, and additional temporary piles would be needed.

Falsework construction techniques would be similar to work bridge construction techniques, except that construction would not need to progress from the shoreline out over the water. Falsework would be built from the work bridge and removed before dismantling the work bridge.

After completion of the north half of the bridge structure in Portage Bay, the existing bridge would be removed. Most of the demolition would be conducted from the construction work bridges, although the existing bridge piers would be removed down to below the mud line and would require additional in-water work. The pier removal process would occur inside cofferdams to protect water quality. WSDOT would dismantle the existing Portage Bay Bridge by sawing the bridge deck into pieces, removing the existing caps, and pulling out the piles. As an alternative, the piles could be cut off where the lake sediments begin, but this could be difficult and time-consuming.

Montlake Interchange Area

Construction activities and durations in this area would differ substantially among the options. Construction would occur over a 4-year period for Option A, a 6.5-year period for Option K, and a 5-year period for Option L

DEFINITION

Falsework

Falsework is a structure built to hold precast bridge sections or forms for concrete in the correct place. The photo above shows falsework supporting a freshly placed concrete bridge deck. Falsework remains in place until the permanent structure is capable of supporting its own weight.

Precast Concrete Segmental Box Girder

(Table 3-6). Activities in this area would include roadway reconstruction, excavation, retaining wall and abutment construction, and paving.

Table 3-6. Montlake Interchange Area – Construction Elements and Truck Trips

	Option A	Option K	Option L
Construction duration[a]	4 years	6.5 years	5 years
Excavation (cubic yards)	92,000	580,000	164,000
Retaining walls (area in square feet)	49,000	54,000	45,000
Daily truck trips (average) Daily truck trips (peak activity)	6 45 to 50	70 120 to 320	20 65 to 140

[a]Construction duration does not include mobilization and project closeout.

Option K would also include tunnel construction using both cut and cover and sequential excavation method (SEM), which are described below. Option K would require excavation of approximately 3.5 to 6 times as much material as the other options to construct the depressed SPUI, the tunnel ramps to the north, and the depressed ramps to the south (Table 3-6). Dump trucks and haul trucks would use designated haul routes.

Potential staging areas would be similar among the options and would include portions of the E-12 parking lot on the University of Washington campus, the unused R.H. Thomson Expressway ramps, the closed Lake Washington Boulevard ramps, and unused WSDOT right-of-way adjacent to SR 520. The areas affected by construction and demolition and the duration and sequence of activities are described below and shown in Exhibit 3-8.

Option A

The Montlake interchange would be widened to the north to accommodate a shift in the main line alignment, the HOV lanes, the HOV direct-access ramps, and the widened main line ramps. The Montlake Boulevard overcrossing and the 24th Avenue East overcrossing would be demolished and replaced with a lid structure, and a new bascule bridge would be constructed over the Montlake Cut. Exhibit 3-9 is a simulation showing how Option A construction would progress in the Montlake area.

Construction of an Overcrossing

The photos above show the construction sequence of the NE 10th Street overcrossing above I-405 in Bellevue. The support walls were constructed first within the median and on either side of the main line. The second and third photos depict construction of the superstructure and the roadway slab.

Exhibit 3-8. Construction Elements and Durations in the Montlake Area

Note: Durations shown are for major construction activities. Please see the Construction Techniques and Activities Discipline Report for the duration and sequencing assumed for mobilization (6 months) and area closeout (varies).

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Retaining wall
Tunnel
Limits of construction
Construction staging area
Construction work bridge
Stormwater treatment facility
Lid or landscape feature
Pavement

N
0 250 500 Feet

Exhibit 3-9. Option A - Construction of the Montlake Interchange

View showing existing Montlake interchange

- Demolition of MOHAI and NOAA facilities
- Montlake lid walls
- Temporary westbound off-ramp

- Montlake Boulevard lid and crossing
- North half of Montlake lid near 24th Avenue E
- Westbound off-ramp, mainline and bicycle/pedestrian path
- Temporary eastbound off-ramp from Portage Bay Bridge

- South half of the Portage Bay Bridge
- Eastbound off-ramp
- Eastbound SR 520 mainline
- South half of Montlake lid near 24th Avenue E

Montlake Lid

The Montlake lid for Option A includes three sections. The first section is a three-span structure replacing the Montlake Boulevard overcrossing. The second is a single-span structure adjacent to East Lake Washington Boulevard. The third section is a four-span structure replacing the 24th Avenue East overcrossing. The northeast portion of the Montlake overcrossing and lid would be constructed first with a temporary detour bridge at its east end. The temporary detour bridge would be used by traffic on Montlake Boulevard and 24th Avenue East as those overcrossings are demolished and replaced.

The new lid structures would be constructed on reinforced concrete walls with spread footings located within the widened SR 520 footprint. The lids would be constructed in sections across the width of SR 520. The walls would support the girders and cast-in-place decks that span over the SR 520 corridor. For safety reasons, SR 520 traffic would be shifted to lanes not under construction when girders are being placed. Lid landscaping would be installed in a soil layer on top of the structure. The single-span landscaped lid adjacent to Lake Washington Boulevard would be a cantilevered structure over the eastbound on-ramp to SR 520 from Montlake Boulevard.

Main Line and Ramps

The main line profile in the Montlake area underneath Montlake Boulevard would be lowered by 5 feet. The north half of the Montlake interchange would be reconstructed first. Roadway reconstruction would occur in the areas outside of the existing travel lanes between Montlake Boulevard and the eastern shoreline for the westbound lanes and for portions of the westbound off-ramp to Montlake Boulevard just east of the Montlake Boulevard crossing. Once completed, SR 520 traffic would be shifted so that the eastbound main line lanes could be reconstructed. Activities would include roadway excavation, embankment grading, and paving.

On- and off-ramps at Montlake Boulevard would remain open to traffic while being reconstructed, with lane shifts using temporary ramp connections as needed.

Bascule Bridge

A new parallel bascule bridge would be constructed across the Montlake Cut. A “two-leaf” bascule bridge is a movable bridge with counterweights on either end that balance the leaves (or spans) throughout their upward swing. Hydraulic or gear mechanical systems are used to operate the bridge. When open, the bridge provides unlimited vertical clearance for boat traffic. The existing Montlake and University bridges are examples of bascule bridges.

Activities associated with this work would occur outside and east of the existing Montlake Boulevard roadway. The upland pier supports for the bridge would be constructed first, and may be built within a temporary sheet-pile wall enclosure that surrounds the bascule pier. The bascule span itself could be assembled either onsite or offsite. If assembled offsite, it would be barged to the project and erected with several crane-mounted barges.

Option K

Under Option K, the Montlake interchange on- and off-ramps would be removed, and the existing Montlake Boulevard and 24th Avenue East overcrossings would be demolished and replaced with a lid structure. A new SPUI would be constructed near the Museum of History and Industry (MOHAI). The northern ramps of the SPUI would tunnel under the Montlake Cut, and the southern ramps would travel through the Arboretum. Because it would be located entirely below the existing grade, this interchange is referred to as a “depressed” SPUI. Exhibit 3-10 shows the construction elements and durations of Option K in the Montlake

DEFINITION

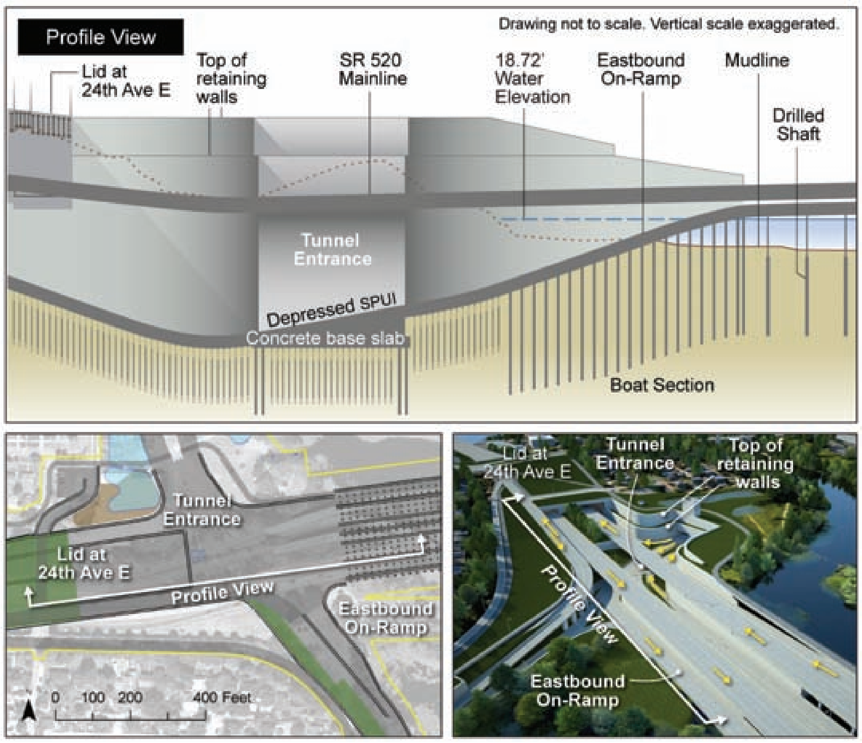
Sheet Pile Walls

Sheet pile walls are temporary walls typically used in areas with high ground water or in underwater situations. Long, slender interlocking steel sheets 2 to 4 feet wide and up to 50 feet long are driven or vibrated into place one at a time. The piling is driven deeper than the wall in order to provide the necessary resistance to hold the soil. After the sheet pile wall is completed, the area inside is dewatered and construction can commence. Sheet pile walls would look similar to a cofferdam.

interchange area. Exhibit 3-11 is a simulation showing how Option K construction will progress in the Montlake area.

The Montlake lid would be a two-span structure replacing the Montlake Boulevard and 24th Avenue East overcrossings. Activities for construction of the Montlake lid would be similar to those described for Option A.

Exhibit 3-10. **Option K - SPUI Construction**

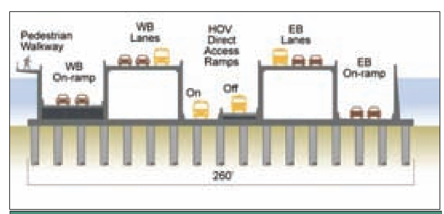


Main Line and Ramp Removal

As in Option A, the SR 520 main line profile under Montlake Boulevard would be lowered by 5 feet. Construction of the main line would begin in areas outside the existing travel lanes between Montlake Boulevard and the shoreline. The north half of the main line (the westbound lanes) would be reconstructed first. Once completed, SR 520 traffic would be shifted so that the south half (the eastbound lanes) could be reconstructed. Activities would include excavation, embankment grading, and paving.

SPUI

The depressed SPUI would be located at the south entrance to the Montlake Cut tunnel, approximately 50 feet below the existing ground surface. The interchange would be contained within a concrete base slab connected to exterior retaining walls. Because of its large size (approximately 800 feet long by 400 feet wide) and depth, the SPUI would require extensive excavation (see Exhibit 3-11).



DEFINITION

Option K SPUI Boat Section

A watertight box known as the "boat section" would connect the depressed SPUI to the new west approach bridge. Within this section, the roadway would be located below the lake water level. Drilled shafts would be integral with the concrete base slab to resist buoyancy forces.

Exhibit 3-11. **Option K - Construction of the SPUI and Tunnel**

View showing existing Union Bay Bridge and unused R.H. Thomson ramps, MOHAI building, and McCurdy Park.

- Temporary detour bridge
- Secant pile wall around depressed SPUI
- Ground freezing under Montlake Cut
- Demolition of existing SR 520 mainline Union Bay Bridge
- Westbound off-ramp to Montlake

- Drilled shafts to support boat section in Lake Washington
- Excavation of depressed SPUI section and ramps
- Excavation of tunnel

- Micropile tie-downs in SPUI floor
- Elevated mainline through boat section

- Mainline bridges over depressed SPUI and ramps
- North half of lid at 24th Avenue E

Prior to excavation, secant pile walls would be constructed around the perimeter of the area to be excavated. These walls would be drilled into the ground to an elevation below the bottom of the SPUI. Because the elevation of the interchange would be below the water table, constant dewatering would be needed to lower the groundwater level during construction. The soil inside the retaining walls would be excavated by backhoes and/or cranes with clamshell buckets. Once the area is excavated, the concrete base slab would be constructed. In the area east of the Montlake shoreline, the base slab would be integrated into the side retaining walls with a watertight connection, essentially forming a watertight box (or "boat section") below the water table level.

Temporary sheet-pile walls would be driven into place in the lake surrounding the boat section. The boat section would encompass an area approximately 400 feet long and 250 feet wide, and would consist of retaining walls, interior support walls, a concrete base slab, and drilled shafts. The drilled shafts would be integral with the concrete base slab to resist buoyancy forces, similar to the micropiles used in the SPUI base slab.

This portion of the interchange would extend east of the existing Montlake shoreline and would require placement of about 2.7 acres of fill material in Union Bay. The area inside the sheet-pile walls would be dewatered using pumps. The retaining walls would be constructed in the dry inside the sheet piling. The retaining walls and the base slab would function similarly to a drydock by keeping the water out of the SR 520 ramps and the interchange. The exterior walls would be at least 5 feet above the water surface elevation and would be watertight. Interior retaining walls would function like an interior support wall on a typical lid structure.

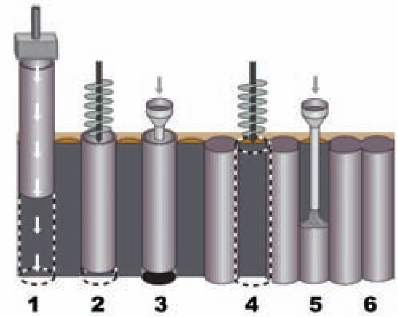
After the boat section is constructed, dewatering would be discontinued. To keep the boat section from floating as the water table rises, micropiles would be drilled into the ground and cast into the base slab. The piles would anchor the intersection to the ground.

To the east, the boat section would contain the ramps that connect the new interchange to the Union Bay portion of the west approach bridge structure.

Construction of the westbound and eastbound lanes would occur simultaneously with the boat section, forming one continuous structure. The SR 520 main line lanes would span the new SPUI ramps. The spans would be constructed of precast concrete girders and supported on drilled shafts.

Traffic on SR 520 would be maintained by constructing a temporary detour bridge around the excavation area for the depressed SPUI. The 60-foot-wide temporary detour bridge would carry the SR 520 main line lanes around the work areas and would be supported on hollow steel piles, similar to those used to construct the temporary work bridges. The temporary detour bridge would require approximately 231 temporary piles. This over-water structure would be in place for approximately 4 years.

The SR 520 main line lanes would span the new SPUI ramps. The spans would be constructed of precast concrete girders and supported on drilled shafts.



1. Installation of casing with a vibro-hammer
2. Drilling of primary borehole with an auger
3. Pouring of concrete into primary borehole
4. Primary piles in place; drilling of secondary borehole
5. Pouring cement into secondary borehole
6. Repeat the process to complete secant wall

DEFINITION

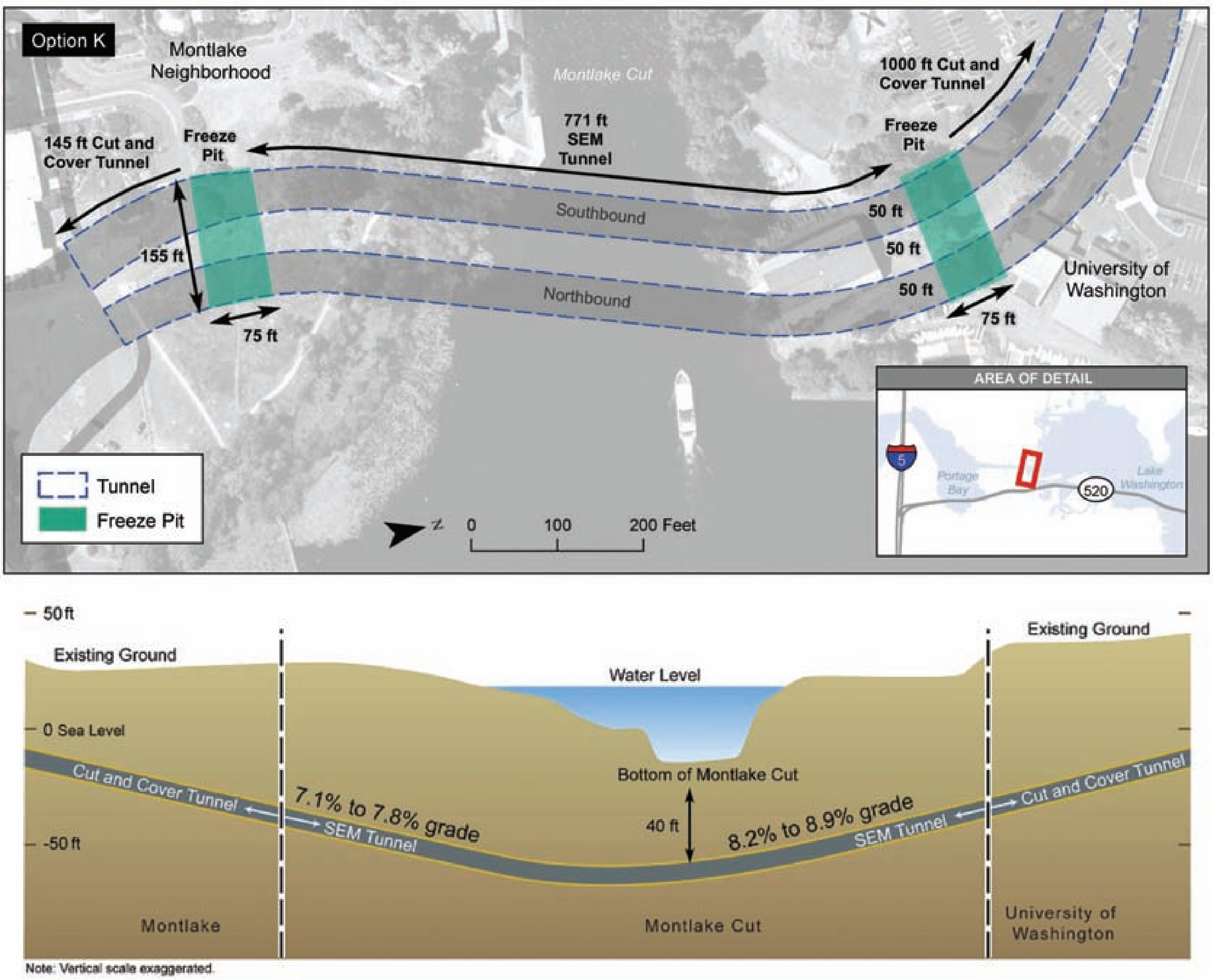
Secant Pile Walls

Secant pile walls are constructed with overlapping drilled shafts that are filled with concrete. They are useful when wall construction is restricted by tight right-of-way requirements. Secant pile and cylinder pile wall construction methods enable the wall construction to precede wall excavation. They are built to retain cut slopes and have been constructed with heights up to 50 feet.

North Ramps (Tunnel)

Two tunnels under the Montlake Cut would connect the north ramps from the interchange on SR 520 to a reconstructed Pacific Street/Montlake Boulevard intersection (Exhibit 3-12). The tunnels would be completed in two segments—one from the south and one from the north of the Montlake Cut—and would meet at approximately the middle of the cut. Two types of tunnel construction would be employed: cut-and-cover and sequential excavation method (SEM), a tunnel excavation technique that takes place underground without the use of a tunnel boring machine (Exhibit 3-12).

Exhibit 3-12. **Tunnel Construction Plan View and Cross Section**



The cut-and-cover tunnels would be constructed from the SEM tunnel portals to the point where the tunnels connect with the surface roadway. The cut-and-cover tunnel south of the Montlake Cut would be 145 feet long, and the tunnel north of the cut would be 1,000 feet long. Depth would range from 100 feet adjacent to the SEM tunnel to 60 feet near the surface roadways. The cut-and-cover tunnel sections would be constructed by excavating two deep trenches and then constructing the tunnels in the trenches. A concrete foundation and box structure would be constructed for the floor, walls, and roof of each tunnel. Once the concrete boxes are completed, soil would be backfilled over the tunnel roof and the area would be restored with vegetation, drainage features, parking, and utility access.

Because the soils beneath the Montlake Cut are soft and high in water content, SEM tunnel construction would require freezing the ground to stabilize the soil prior to tunneling. The work would start from two "freeze pits" at the north and south portals to the SEM tunnels. Each freeze pit would be approximately 50 feet long and as wide as the face of both tunnels (approximately 155 feet wide).

Pipes to convey a freezing liquid would be inserted all the way around the tunnel circumference at about 5-foot intervals. Drilling these pipes would require two drill rigs operating simultaneously, one in the north freeze pit and one in the south freeze pit. A refrigeration system would be used to circulate the coolant within the freezing pipes. It would take approximately 6 months for the soil to become sufficiently frozen for work to begin. Power to operate the refrigeration system could be supplied by the local power system or by generators at the construction site. After the initial freezing has been completed and the frozen barrier is in place, the refrigeration capacity required to maintain the frozen barrier would be significantly reduced.

The circulation of coolant would convert the groundwater in the soil to ice, creating a strong, watertight material. Once this is completed, excavation of the SEM tunnel would begin. SEM tunneling and excavation would occur simultaneously at each end of the northbound and southbound tunnels. The tunnels would advance at an estimated average of 1 foot per day at each end. As excavation advances, the interior walls of the tunnel would be lined with unreinforced concrete. A second reinforced concrete waterproof liner would be installed after the tunnel is complete.

South Ramps

Similar to the depressed SPUI structure, excavation for the base slab that supports the depressed roadway section of the south ramps would occur below the water level, with retaining walls constructed on either side. An overhead landscaped feature would be constructed and supported by the continuous walls at the edges of the roadway and in the median. Beyond the

DEFINITION

Sequential Excavation Method

SEM is a tunnel excavation technique that takes place underground without the use of a tunnel boring machine. The photo above is an example of SEM tunnel construction.

limits of the landscape feature, retaining walls would be required to support the embankments along the adjacent frontage road.

Because the elevation of the ramps would be below the water table, constant dewatering would be needed to lower the groundwater level during construction. The soil inside the retaining walls would be excavated by backhoes and/or cranes with clamshell buckets.

DEFINITION

Dewatering

Dewatering is the temporary removal of ground or surface water from a construction site to allow construction to be done under dry conditions. Water is usually removed using a power driven pump that is installed for the purpose of removing water that collects in the sump.

Pacific Street/Montlake Boulevard Intersection

The NE Pacific Street/Montlake Boulevard East intersection would be lowered as part of Option K. A temporary sheet-pile wall would be constructed through the center of the intersection so that excavation could occur on one half while traffic continued to use the other half. Once the first half is completed, traffic would be shifted and excavation would occur on the second half. Retaining walls would be constructed on the east side of Montlake Boulevard and the north and south sides of NE Pacific Street east of Montlake Boulevard. After the intersection is complete, the lid superstructure would be constructed on top of the retaining walls. As noted above, the portion of Pacific Street from Montlake Boulevard to just west of the University of Washington Medical Center access driveway would be closed for 9 to 12 months to accommodate the lowering of the Pacific Street/Montlake Boulevard intersection. See Section 6.1 for a discussion of detour routes.

Option L

Under Option L, the existing Montlake interchange would be replaced with an elevated SPUI (i.e., one in which the ramps pass above the SR 520 main line). The Montlake interchange on- and off-ramps would be removed, and the Montlake Boulevard and 24th Avenue East overcrossings would be demolished and replaced with a lid structure. A new SPUI would be constructed near the current location of MOHAI with northern ramps that bridge over the Montlake Cut and elevated southern ramps that travel through the Arboretum. Exhibit 3-8 shows the construction elements and durations of Option L in the Montlake Interchange area. Exhibit 3-13 is a simulation showing how Option L construction would progress in the Montlake area.

Montlake Lid

Activities for construction of the Montlake lid would be similar to those described for Options A and K.

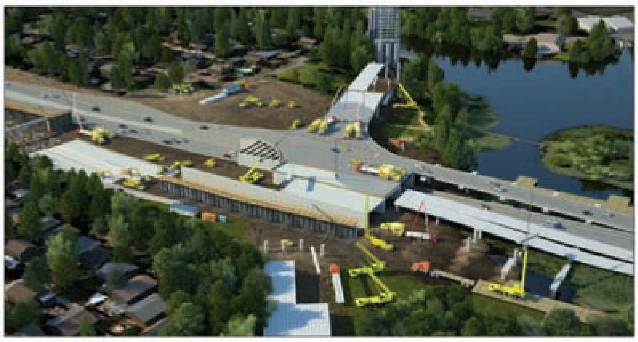
Main Line

Activities for construction of the main line lanes between Montlake Boulevard and the east shoreline would be similar to those described for Options A and K.

Exhibit 3-13. **Option L - Construction of the SPUI and Bascule Bridge**

- Work bridges for new west approach bridge
- Clearing and grubbing for SPUI ramps and Montlake Cut crossing
- Demolition of MOHAI building

- Drilled shafts for west approach bridge and Montlake Cut crossing bridge
- Wall for the north half of elevated SPUI
- Excavation for bascule bridge foundations
- Demolition of westbound off-ramp to Montlake Blvd



- HOV direct-access ramps and westbound mainline
- North half of west approach bridge
- North SPUI ramp approach
- Approach to new bascule bridge

- HOV direct-access ramps and westbound mainline
- South half of west approach bridge
- South SPUI ramp approach
- Bascule bridge drawspan

SPUI

The elevated SPUI would be a six-span lid structure consisting of concrete superstructure elements, support walls, and spread footings. The elevated SPUI structure would connect to the north ramps (crossing the new bascule bridge), the west approach, and the south ramps to Lake Washington Boulevard. The SPUI structure would be approximately 340 feet long from east to west and approximately 350 feet long from north to south. The structure would be supported on spread footings.

Because SR 520 currently occupies the southern portion of the area where the SPUI would be built, the northern portion of the structure would be built first. Once this portion is completed, traffic would be shifted before the existing main line is demolished and the southern portion of the SPUI constructed.

North Ramps (Bascule Bridge)

The new bascule bridge across the Montlake Cut would be constructed by methods similar to those for the new bridge for Option A. The bascule bridge approaches would be supported by multi-column bents on drilled-shaft foundations. The approach from Montlake Boulevard to the bascule bridge would be a two-span structure that would carry the roadway from the north end of the bascule bridge to the intersection at Pacific Street. The structure would be located southwest of Husky Stadium in the existing parking lot. Each span of the 240-foot structure would be 120 feet long.

South Ramps

The south ramps would approach the SPUI on an elevated structure. The superstructure would consist of girders supported by drilled shafts.

Pacific Street/Montlake Boulevard Intersection and Lid

Construction of the lowered Pacific Street/Montlake Boulevard intersection would use methods similar to those described for Option K.

West Approach Area

Under all design options, the west approach structure would consist of two bridges: an eastbound and a westbound bridge structure. The west approach would travel through Union Bay, across Foster Island, and out into Lake Washington to the beginning of the floating bridge (the west transition span). Under all designs, the west approach as a whole would be wider than the existing bridge. The spans of the new bridges would be longer than those of the existing bridge (i.e., the columns would be farther apart). The increase in span length would result in fewer piers and foundations in the water east of Foster Island. Table 3-7 summarizes construction elements and truck trips for the west approach area.

Like the Portage Bay Bridge, the new west approach area bridges would require construction of construction work bridges adjacent to the existing bridge. The construction work bridges would allow the new bridges to be built in halves so that traffic flow would not be interrupted. Traffic would use the existing bridge until the north half of the new bridge is built, then shift to the new north structure while the existing bridge is demolished and the new south structure is built. Construction activities and durations in this area would be similar for all options and occur over a 4- to 6-year period. The areas affected by construction and demolition and the duration and sequence of activities are described below and shown in Exhibits 3-14 and 3-15.

Option A

In-water construction would occur from work bridges installed between Montlake and Foster Island, as well as eastward for several thousand feet from Foster Island to a point where water depths would allow construction staging from barges. Work bridges would be constructed on both the north and south sides of the existing west approach structures and along the existing Lake Washington Boulevard ramps (see Exhibit 3-8).

Table 3-7. West Approach Area – Construction Elements and Truck Trips

	Option A	K	L
Excavation (cubic yards)	50,000	531,000	77,000
Retaining walls (area in square feet)	Included in Montlake area		
Permanent columns	208	993[a]	227
Temporary support piles	1,990 to 2,040	2,800	1,980
Daily truck trips (average) Daily truck trips (peak activity)	16 100 to 175	16 100 to 175	16 100 to 175
Construction duration[b]	4.75 years	5.75 years	4.75 years

[a]Total number of columns does not include the micropiles that would be used to support Option K SPUI.
[b]Construction duration does not include mobilization and project closeout.

The construction work bridges would require driving about 1,990 to 2,040 in-water support piles. These bridges would be constructed in a manner similar to those in the Portage Bay area and would be in place for 3 to 6 years. Construction barges may also be temporarily anchored in the deeper-water areas.

The northern half of the permanent bridges in the west approach area would be constructed from the work bridges. The new bridges would have a substructure with drilled shafts and a superstructure with girders and a cast-in-place deck slab. This type of superstructure would minimize the number of piers in the water.

Construction of the drilled shafts would occur in a manner similar to that described for the Portage Bay Bridge. Following construction of the north portion of the new west approach bridge, the existing west approach bridge would be demolished (see bridge demolition description for the Portage Bay area), and construction of the southern half of the proposed west approach bridge would begin. Work bridges would also be constructed adjacent to the Lake Washington Boulevard on- and off-ramps. These temporary bridges would be in place for 5 years and would help facilitate demolition of the existing ramps.

Exhibit 3-14. Construction Elements and Durations in the West Approach Area for Options A and L

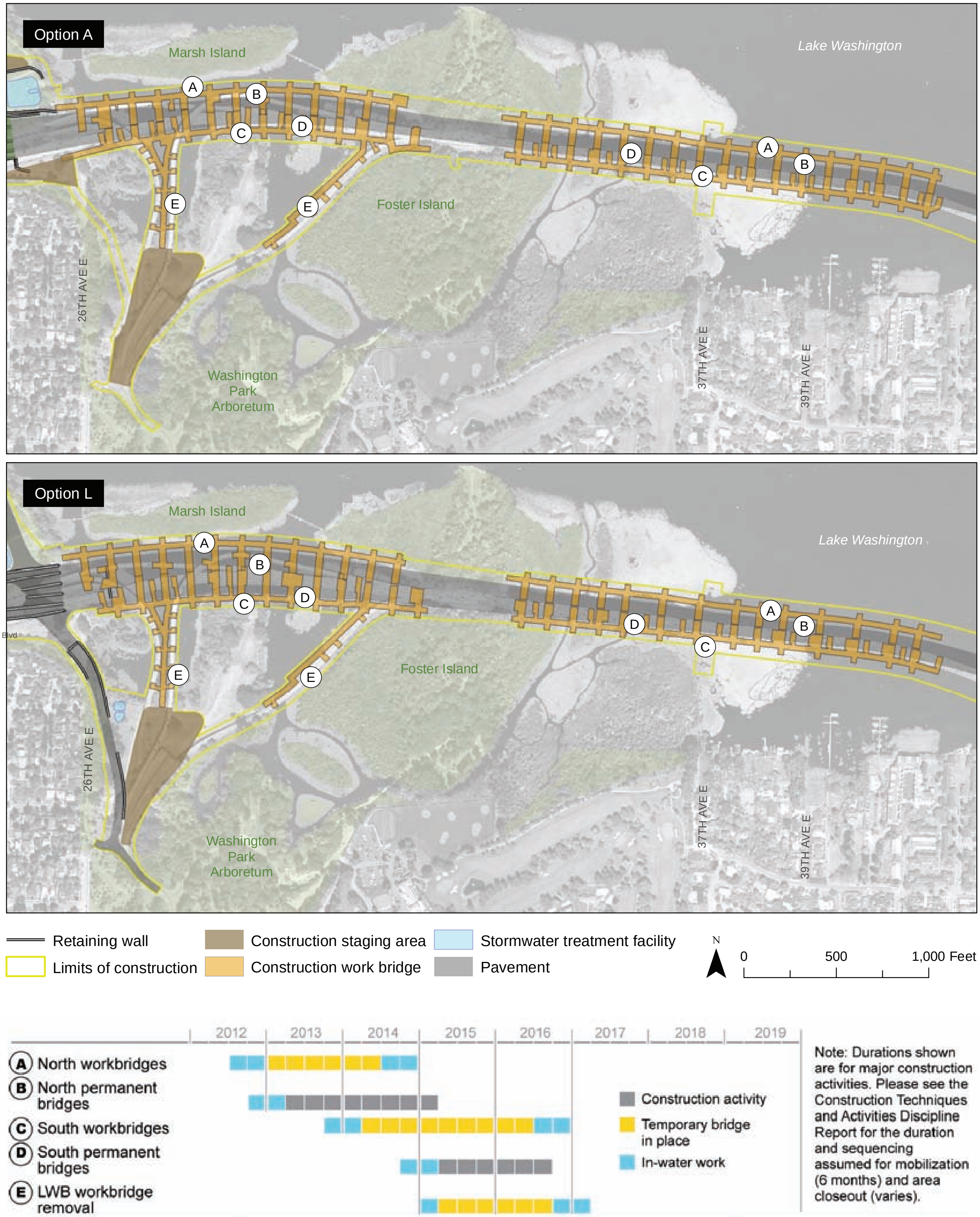
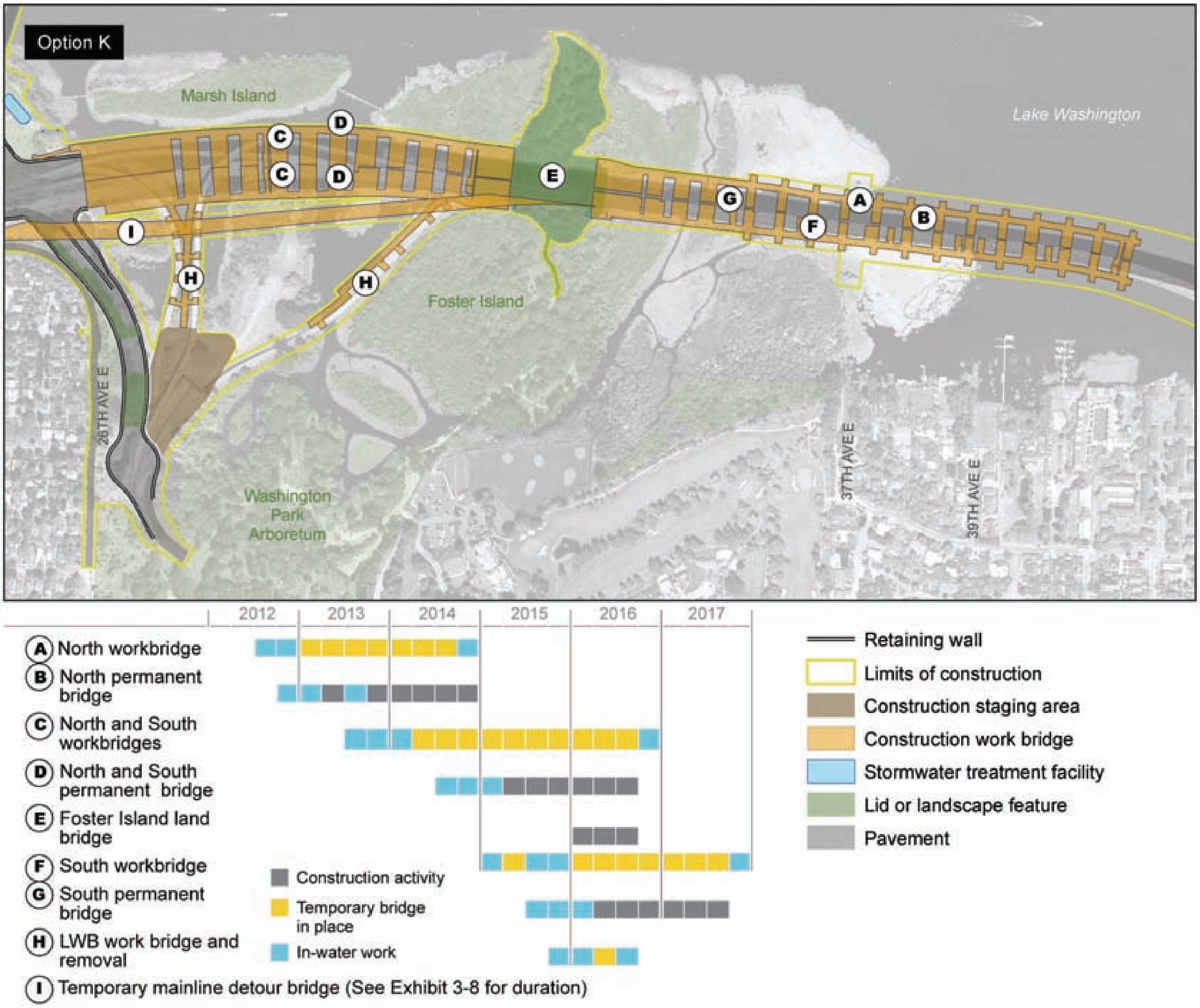


Exhibit 3-15. Construction Elements and Durations in the West Aproach Area for Option K



Note: Durations shown are for major construction activities. Please see the Construction Techniques and Activities Discipline Report for the duration and sequencing assumed for mobilization (6 months) and area closeout (varies).

N
0 300 600 Feet

Option K

As with Option A, Option K would involve construction of temporary work bridges; construction of permanent bridge substructures, superstructures, and in-water pier footings and columns; and demolition of existing bridges.

The low profile through this area, however, would require more piles for the temporary bridge (approximately 2,800) and approximately five times more permanent columns than Option A (see Table 3-7).

Option K would also require a 60-foot-wide detour bridge between Foster Island and the eastern shoreline of the Washington Park Arboretum to bypass traffic around the excavation area needed to construct the SPUI. The detour bridge would be supported by hollow steel piles similar to those used in the construction of the work bridges, requiring approximately 230 piles. This overwater structure would be in place for approximately 4 years.

Option K would also include a lowered profile (lower than existing) across Foster Island to allow construction of a land bridge over the top of the highway. This would require excavation of the east and west shorelines of the island to 4 feet, as well as approximately 1.2 acres of excavation across the island to place the roadway foundation below the existing grade. The low profile through this geographic area, particularly on the east and west shorelines of Foster Island and the Washington Park Arboretum western shoreline, would require approximately twice as many support columns as the existing structure and about 3.2 times more columns than Option A. The land bridge would be supported on spread footings in areas where the existing ground is close to the proposed roadway grade. Piles would be used at both ends of the structure to transition from the over-water areas.

The Foster Island land bridge would be designed to provide connectivity of regional trails to the Washington Park Arboretum. Pedestrian and bicyclist access from the south side of Foster Island would be possible along a new path on top of the land bridge. The land bridge would extend the existing Foster Island landform to the top of the structure and remove vegetation on Foster Island north of SR 520 (see Exhibit 3-15). The land bridge would require fill soil to be placed on the island north to the water's edge, and short retaining walls would be needed around the land bridge north of SR 520. The land bridge would be landscaped and would provide views of the lake. The woods on the north and south sides of the land bridge would be replanted to screen the structure and blend with the remaining existing woods.

Option K would maintain a low profile (below existing conditions) for approximately 2,000 feet east of Foster Island and would reach the peak elevation of the west transition span at least 500 feet west of the existing highrise structure. This peak would also be several feet lower than the existing west highrise.

Similar to Option A, work bridges would be constructed adjacent to the Lake Washington Boulevard on- and off-ramps. These temporary bridges would be in place for one year and would help facilitate demolition of the existing ramps (see bridge demolition for Portage Bay area).

Option L

Construction of the west approach bridges for Option L would be similar to that described for Option A, including construction of temporary work bridges, construction of permanent bridge substructures and superstructures, and demolition of the existing bridge. The construction work bridges would be in place for approximately 4 years.

Similar to Option A, work bridges would be constructed adjacent to the Lake Washington Boulevard on- and off-ramps. These temporary bridges would be in place for one year and would help facilitate demolition of the existing ramps (see bridge demolition for Portage Bay area).

Construction of Option L would require about 1,980 temporary piles to support the work bridges through the west approach area, which is similar to Option A. The new bridges would have the same type of substructure and superstructure as Option A. Option L would require more excavation than Option A.

Construction of Suboptions

Option A Suboptions

Option A with added Lake Washington Boulevard Ramps

Lake Washington Boulevard ramps would increase the construction footprint of Option A slightly. Adding these ramps would require additional construction activities to occur near the west approach and East Lake Washington Boulevard, as compared to Option A.

Construction of the ramps near the west approach would occur within and adjacent to the main line of SR 520. Most of the length of the ramps would run along the north and south sides of the main line. Construction activities near the west approach would use the same techniques as those described for Option A. The new ramps would require an additional 27 permanent columns and 55 temporary piles. The overall construction activities and durations described for Option A would not change.

Construction activities along Lake Washington Boulevard would require clearing, grading, and paving activities where the new ramps would transition to the local roadway. The overall construction activities and durations described for Option A would not change.

Option A with Eastbound HOV Direct-Access On-Ramp

Adding the eastbound HOV direct-access ramp would not change the overall construction activities and durations described for Option A.

Option A with the Constant Slope Profile of Option L

Changing the profile of Option A to a constant slope in the west approach would not change the overall construction activities and durations as described for Option A.

Option K Suboption

Option K with Added Eastbound Off-ramp to Montlake Boulevard

Adding an eastbound off-ramp to Montlake Boulevard would not increase the construction footprint as shown for Option K. Construction of the eastbound off-ramp to Montlake Boulevard East would occur within the right-of-way of the existing Montlake Boulevard ramp and would require only minor grading and paving activities. The overall construction activities and durations as described for Option K would not change.

Option L Suboptions

Option L with Added Capacity on Montlake Boulevard North of NE Pacific Street

Adding capacity on northbound Montlake Boulevard NE north of NE Pacific Street would require additional construction activities north of the Montlake Cut. Widening would occur on the east side of Montlake Boulevard between NE Pacific Street and 25th Avenue NE. Construction would include clearing, grading, and paving activities. The centerline alignment of Montlake Boulevard would remain in its existing location and 12 feet of widening for the additional lane would occur to the east. The existing 8-foot sidewalk along the east side of the roadway would be reconstructed adjacent to the new northbound lane.

The existing right-of-way width is 110 feet from the intersection of NE Pacific Street to 25th Avenue NE. Because the existing roadway centerline is not aligned within the right-of-way centerline in all locations, additional right-of-way would be required in some locations. New stormwater treatment facilities would be required for the additional impervious surface added due to widening. The new stormwater facilities would be constructed in the UW driving range north of the Montlake parking lot.

The three pedestrian footbridges over Montlake Boulevard would need to be replaced. The bridges serve pedestrian traffic passing from the main UW campus to Hec Edmundson Pavilion, Husky Stadium, and the parking lots on the east side of Montlake Boulevard. These pedestrian bridges and their structural foundations would be reconstructed to accommodate roadway widening.

Option L with Left-Turn Access at NE Lake Washington Boulevard

Adding left-turn access to the Lake Washington Boulevard/SR 520 on-ramp would require no additional pavement or construction. The overall construction activities and durations as described for Option K would not change as a result of either suboption.

Floating Bridge Area

As described in Chapter 1, WSDOT recognized the urgent need to prepare for catastrophic failure of the Evergreen Point Bridge, and initiated the Pontoon Construction Project under an independent NEPA process in January 2008. Construction of 21 longitudinal pontoons, two cross pontoons, and 10 supplemental stability pontoons (33 total pontoons) necessary to replace the existing 4-lane capacity of the bridge in the event of a catastrophic failure are being evaluated in the EIS for the Pontoon Construction Project. The Draft EIS for the Pontoon Construction Project is scheduled for publication in early 2010.

If the floating portion of the Evergreen Point Bridge does not fail before its planned replacement, WSDOT would use the pontoons constructed and stored as part of the Pontoon Construction Project for use in the SR 520, I-5 to Medina: Bridge Replacement and HOV Project. The design for the new 6-lane floating bridge would require 21 longitudinal pontoons, two cross pontoons, and 54 supplemental stability pontoons (77 total pontoons). As shown in Table 3-8, the SR 520, I-5 to Medina project would require an additional 44 supplemental stability pontoons beyond those constructed for the Pontoon Construction Project. The additional pontoons would be needed to provide buoyancy and stability for the new 6-lane floating bridge. Exhibit 3-16 shows the new pontoon configuration, pontoon dimensions, and floating bridge cross section.

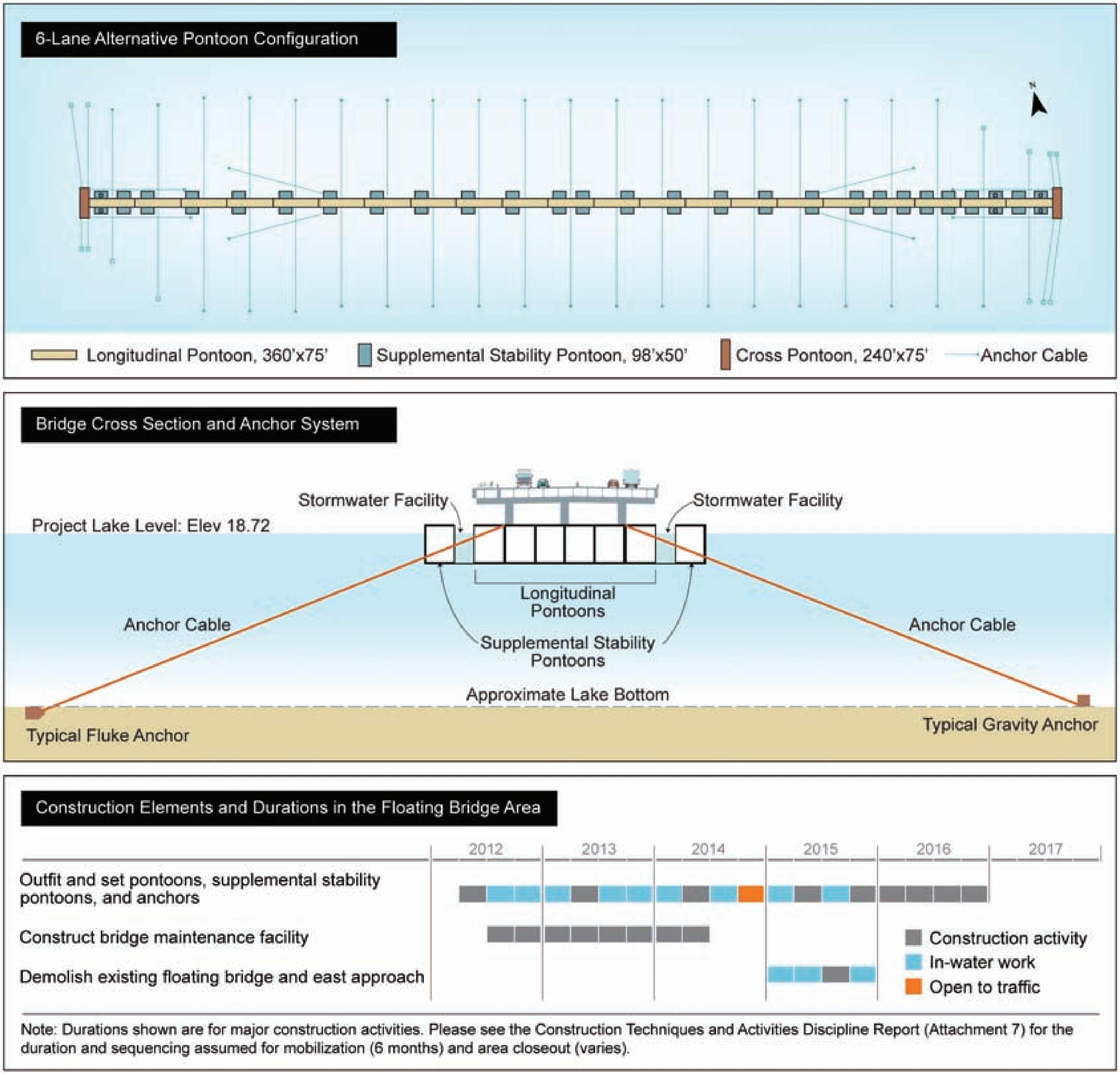
Table 3-8. Pontoons to be Constructed for Evergreen Point Bridge

	Pontoon Construction Project	SR 520 Bridge Replacement Project	Total
Longitudinal pontoons (360-foot-long by 75-foot-wide by 28.5-foot-deep)	21	0	21
Cross pontoons (240-foot-long by 75-foot-wide by 34.5-foot-deep)	2	0	2
Supplemental stability pontoons (98-foot-long by 50-foot-wide by 28.5-foot-deep)	10	44	54

Note: The existing cross pontoons for the floating bridge are 110 feet wide by 60 feet long. The existing longitudinal pontoons are approximately 60 feet wide by 360 feet long. The increase in pontoon size (272% increase in cross pontoon size, 125% increase in longitudinal pontoon size) and number of pontoons is due to the added lane width, added shoulders, and added bicycle and pedestrian path.

Pontoon Construction Locations

Exhibit 3-16. **Pontoon and Anchor Configuration**



The 44 supplemental stability pontoons would be constructed in a casting basin. A casting basin is a large concrete construction area adjacent to a navigable waterway. The interior of the casting basin provides a flat, dry work space where several pontoons can be constructed at the same time. After the pontoons are complete, the basin is flooded in a controlled manner to allow the pontoons to float. When the pontoons are floating, a gate to the basin is opened, allowing tug boats to pull the pontoons out of the basin into the navigable waterway.

A new casting basin facility located on the shoreline of Grays Harbor and/or an existing facility at Concrete Technology Corporation (CTC) in Tacoma would be used to construct the pontoons needed in the event of a catastrophic failure. The EIS for the project is evaluating two alternative Grays Harbor sites for the casting basin. After completion of Pontoon Construction Project, the casting basin would be available for construction of the additional supplemental stability pontoons needed for the SR 520, I-5 to Medina project. WSDOT would use the casting basin in Grays Harbor, and potentially the casting basin at CTC, to build the 44 additional supplemental stability pontoons. Exhibit 3-17 shows the approximate locations of the proposed casting basin facilities.

Exhibit 3-17. **Proposed Pontoon Construction Locations**

The CTC casting basin is located on the Blair Waterway on the eastern edge of Commencement Bay. WSDOT used this facility to construct pontoons for the Hood Canal Bridge Project. The CTC facility is fully constructed and operating and is routinely used for industrial activities that require a casting basin. The CTC casting basin is located adjacent to an existing concrete batch plant. WSDOT would lease an additional 17 acres at several nearby properties for construction laydown areas, parking areas, and office space to support pontoon construction at the CTC site.

The casting basin facility at Grays Harbor (if built) would have a concrete batch plant, large laydown areas, and water treatment and stormwater systems that would be used and maintained during pontoon construction activities. WSDOT anticipates providing basic water quality treatment for all stormwater runoff at this location, in accordance with WSDOT's Highway Runoff Manual (WSDOT 2008a).

A permanent dewatering system would be in place during operation of the Grays Harbor facility in order to keep the casting basin dry during pontoon construction. All groundwater leaving the site would be monitored and treated as needed to meet applicable water quality standards before being discharged into the harbor or an approved offsite facility.

The launch channel for the casting basin in Grays Harbor may need periodic maintenance in the form of dredging. This activity would take place within the boundaries of the previously established launch channel, and WSDOT would coordinate with resource agencies to obtain all necessary approvals and permits prior to any in-water maintenance activities. All appropriate BMPs would be employed to minimize effects on the aquatic environment.

Pontoon Construction

As previously described, the 44 supplemental stability pontoons would be constructed in a casting basin. Pontoons are reinforced concrete structures.

To build them, concrete would be poured around steel rebar cages surrounded by wooden or steel forms. When the concrete is set, the forms would be removed and the pontoons would be cured inside the casting basin. After curing, the pontoons would be floated out of the casting basin and towed to Lake Washington for inclusion in the new floating bridge.

Pontoon construction and towing activities would be the same at both facilities. The pontoons would be built and cured in the casting basin, floated from the basin into a launch channel, and then floated into open water. When bridge construction commences, pontoons built and stored under the Pontoon Construction Project would either be towed from moorage to the Puget Sound for outfitting, or towed directly to Lake Washington for immediate incorporation into the floating bridge. If pontoons are built in Grays Harbor, supplemental stability pontoons constructed as part of the SR 520, I-5 to Medina project would be towed to Lake Washington for incorporation into the new floating bridge.

What is outfitting?

Pontoon outfitting is a process by which the columns and elevated roadway of the bridge are built directly on the surface of the pontoon. This activity will take place at several possible outfitting locations within the Puget Sound, as well as in Lake Washington during construction and placement of the floating bridge.

Pontoon Towing

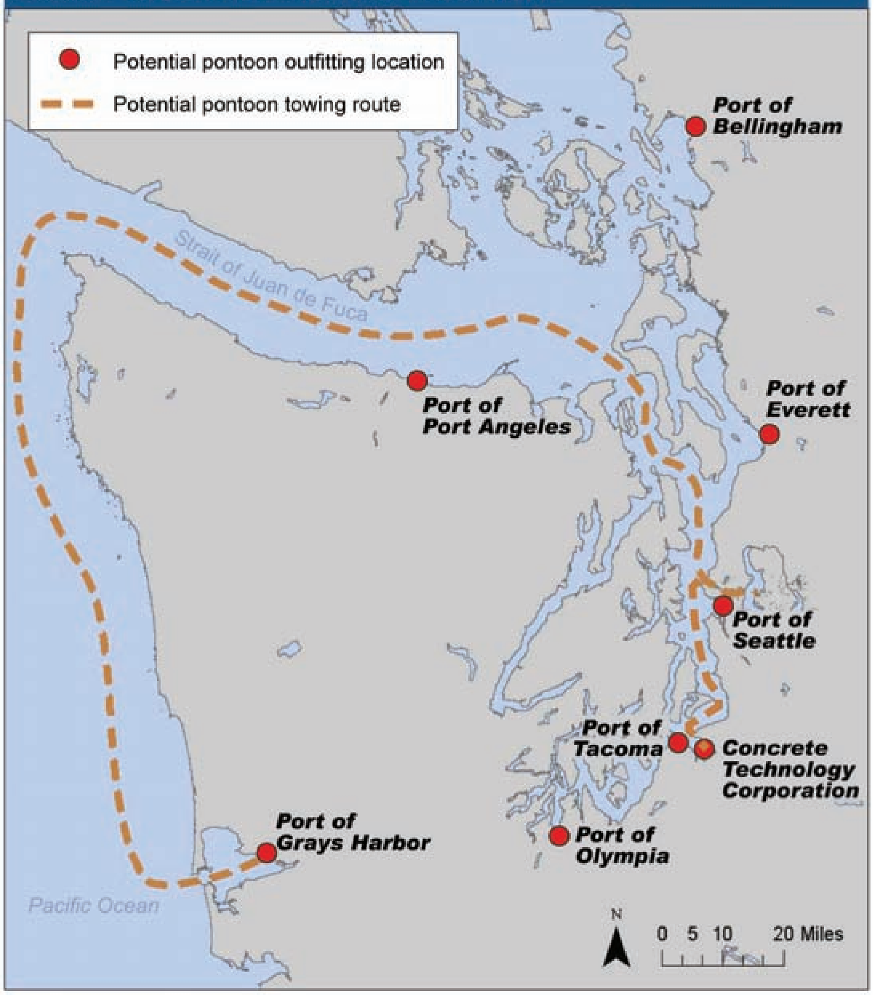
Pontoons would be towed from Grays Harbor between the months of March and October. Towing would not occur during the winter months (November through February) because of greater potential for inclement weather conditions. Towing would be limited to times when the ocean has a maximum wave height of 7 feet. Pontoons would be towed at approximately 4 knots and could take up to two days to travel from Grays Harbor into the calmer Strait of Juan de Fuca.

Pontoons would be escorted by tug boat(s) from the casting basin to the final destination in Lake Washington. Pontoons arriving from Grays Harbor would travel through the Strait of Juan de Fuca into the Puget Sound, and enter the Lake Washington Ship Canal at the Ballard Locks. Ocean-going tugs moving pontoons from Grays Harbor north to Puget Sound would follow international rules of right-of-way. Pontoons being towed from CTC would follow typical shipping lanes from the Port of Tacoma to the Port of Seattle, and would also enter Lake Washington via the Ship Canal at the Ballard Locks. Exhibit 3-18 shows the coastal towing route from Grays Harbor, the location of CTC in Commencement Bay, and potential port locations that may be used to outfit the pontoons.

All pontoons would enter Lake Washington through the Lake Washington Ship Canal at the Ballard Locks. The Lake Washington Ship Canal includes Salmon Bay, the Fremont Cut, Lake Union, Portage Bay, and the Montlake Cut. Tug boat(s) could escort one pair of longitudinal pontoons through the Ballard Locks at a time. After passing through the Lake Washington Ship Canal, pontoons would be towed into Lake Washington and placed in the alignment of the new floating bridge.

As many as 11 pontoons may be outfitted at available port locations in Puget Sound. These outfitting locations would be at existing commercial shipping or mooring facilities regularly used by large vessels or barges. Potential port locations include the Port of Bellingham, Port of Everett, Port of Seattle, Port of Tacoma, Port of Olympia, and Port of Grays Harbor. Outfitting of pontoons could take up to 4 months in these port locations and would be consistent with the typical operation of the existing facilities. Once outfitting construction is complete, pontoons would be towed from the port location through the Ballard Locks and into Lake Washington for immediate incorporation in the floating bridge.

Exhibit 3-18. **Potential Pontoon Transport Route**



Pontoon Installation and Construction on Lake Washington

The new alignment of the floating span would be approximately 190 feet north of the existing bridge at the west end and 160 feet north at the east end. A single row of longitudinal pontoons would support the floating bridge. Floating bridge construction would start from each end of the bridge and progress toward the middle. One cross pontoon at each end of the bridge would be set perpendicularly to the longitudinal pontoons. The longitudinal pontoons would be bolstered by supplemental stability pontoons on each side for buoyancy and stability.

As previously discussed, some pontoons would be outfitted with columns and bridge structure before they reach Lake Washington. The remaining pontoons would be outfitted while being incorporated into the new floating bridge. For the new 6-lane floating bridge, rows of 10-foot concrete columns would support the roadway above the surface of the pontoon. The new bridge deck would be approximately 22 feet higher than the existing bridge deck. Construction activities on the lake would take place from barges and boats. The longitudinal and cross pontoons would be bolted together first. The supplemental stability pontoons would be connected to the north and south sides of the longitudinal pontoons. Once the entire floating portion has been bolted together, the structure would be permanently anchored into place.

Approximately 58 anchors would be used to secure the new bridge in place. The two main anchor types are (1) gravity anchors for harder lakebed materials and sloped areas near the shores and (2) fluke anchors for soft bottom sediments and flat areas in the middle of the lake. Both types of anchors would be connected to the floating pontoons with steel cables. Gravity anchors consist of large concrete blocks stacked on top of one another to provide the necessary weight to hold the pontoons in place. Gravity anchors could be 30 feet square in size, and up to 20 feet tall. Fluke anchors could be up to 40 feet wide and 20 feet tall, and would be installed in the soft bottom sediments of the lake using a combination of their own weight and/or air-jetting to set them below the mud line. New anchors would be connected to the floating pontoons with steel cables ranging in diameter from 2.75 to 3.5 inches. All anchors and blocks would be located at a depth of 29 feet or deeper in the lake to avoid conflicts with navigation.

As discussed in Section 3.1, once traffic shifts to the new floating bridge, the existing floating bridge would be dismantled and pontoon sections towed away. The old pontoon sections could be reused for other purposes, or demolished and recycled. The existing pontoon anchors would be abandoned in place on the lake bed.

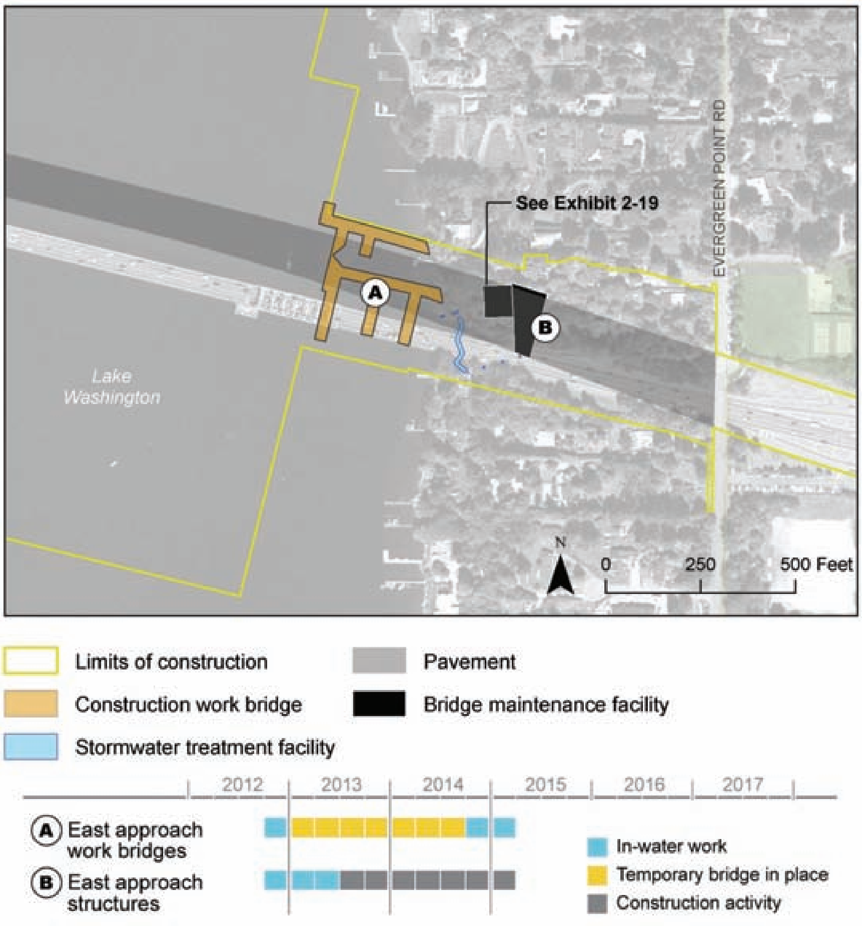
Discussion of the potential effects associated with pontoon construction, transport, and installation is included in Section 6.15 of this SDEIS.

East Approach

The new east approach of the Evergreen Point Bridge would be located north of the existing bridge. Construction would take place from work bridges and barges, and the westbound (north) side of the east approach structure would be constructed first (Exhibit 3-19). Cofferdams would be installed, and the bridge substructure and superstructure would be built as previously described for the over-water structures in the Seattle geographic area. The westbound transition span between the floating portion and the Eastside transition area would then be installed. Both the north and south structures would be completed prior to shifting traffic onto the bridge.

The construction process would require work bridges and falsework. The work bridges would require approximately 125 24- or 30-inch-diameter hollow steel piles, and the falsework would require an additional 40 piles.

Exhibit 3-19. Construction Elements in the Eastside Transition Area



Note: Durations shown are for major construction activities. Please see the Construction Techniques and Activities Discipline Report for the duration and sequencing assumed for mobilization (6 months) and area closeout (varies).

These piles would occupy approximately 520 to 810 square feet of lake bed. Table 3-9 shows estimated details for different construction elements associated with the east approach.

Bridge Maintenance Facility

The 6-Lane Alternative would also include construction of a bridge maintenance facility under the proposed east approach structure. It would consist of an upland facility constructed in the hillside under the proposed approach structure, as well as a working dock (see Exhibit 2-19). The new bridge maintenance facility would be built at the same time as the east approach structure. Permanent and temporary access roads, retaining walls, and the dock substructure would be constructed while the westbound portion of the east approach structure is being built.

Table 3-9. East Approach Area Construction Elements

East Approach	Existing Structures	6-Lane Alternative
Bridge width (feet)[a]	60	85 (westbound) 58 (eastbound)
Estimated height range above water (feet to bottom of structure)	57–60	72 to 75
Span length (feet)	100	100–350
Total number of columns	24	8
Number of columns in water	12	4
Number of temporary support piles	-	150–200

[a]Bridge widths are shown for both the westbound (WB) and eastbound (EB) structures.

The maintenance dock would be located underneath the new east approach to the Evergreen Point Bridge. The proposed maintenance dock would allow WSDOT workboats to support emergency preparedness and essential proactive maintenance activities on a daily basis. The dock would extend no more than 100 feet from the shoreline, with a width not exceeding 14 feet. The new dock design may include a wave barrier and moorage berth at the end of the dock. The dock deck may be constructed out of textured concrete and/or include metal grating, allowing sunlight to penetrate underneath the deck.

Eastside Transition Area

Once the east approach, transition span, and floating portions of the Evergreen Point Bridge have been replaced, the SR 520, I-5 to Medina project will grade and pave the section of roadway between the east approach and Evergreen Point Road to transition into the SR 520, Medina to SR 202: Eastside Transit and HOV Project.

The Evergreen Point Road Freeway Transit Station would be relocated to the Evergreen Point lid (please refer to Section 6.1 for a discussion of anticipated construction effects on the transit station). In order to make ramps and lanes connect for proper traffic operations, the SR 520 main line would be restriped beginning at the physical improvements completed near Evergreen Point Road and extending east to 92nd Avenue NE. Restriping efforts may include sand-blasting to remove existing paint lines.