Central Link Light Rai
Transit Project

DRAFT ENVIRONMENTAL IMPACT STATEMENT

December 1998

SOUNDTRANSIT

Central Puget Sound
Regional Transit Authority

U.S. Department of Transportation
Federal Transit Administration

Alternative F1

Angle Lake Park – Install new sidewalk and a landscaped buffer along the park's street frontage. Replace land acquired for the project, according to Section 6(f) of the Land and Water Conservation Act, with land of reasonably equivalent recreational utility and location.

Specific mitigation measures for other lesser impacts to parkland resources are identified in the Central Link Light Rail Parkland Impacts Technical Back-up.

4.16.4 Significant Unavoidable Adverse Impacts

Despite the proposed mitigation measures, some of the adverse impacts cannot be avoided or minimized to levels below the significance threshold. Those impacts include the following:

- A2.2 would interfere with westward views from Rainbow Point.
- A2.1 and A2.2 would cover a 27-ft-wide strip of land within the median of Ravenna Boulevard, requiring the removal of several trees and resulting in increased shading.
- B2.1 high-level bridge would acquire and cover portions of the North and South Passage Point Parks, resulting in additional shading effects and visual impacts (replacement land would be needed to compensate for the property acquisition).
- C3 I-90/17th Avenue S. station and the adjacent elevated section would acquire and cover portions of the Future Sister City Park (replacement land would be needed to compensate for the property acquisition).
- The proximity of the Duwamish/Green River Trail and the Alternative E2 route along Interurban Avenue could affect the recreational experience of trail users.
- With the Alternative E2 elevated structure crossing over the park, the character of the small Lookout Park would change substantially. According to the City of Tukwila Parks Department (letter from Don Williams, Director, City of Tukwila Parks and Recreation Department September 28, 1998), Lookout Park is rarely used and is not considered of significant value to the community.
- F-1 would acquire a portion of Angle Lake Park, reducing its overall size by approximately 2.2 percent and resulting in SR 99 traffic being up to 25-ft closer to central park activities. Replacement land would be needed to compensate for the property acquisition, following Section 6(f) of the Land and Water Conservation Act.

4.17 CONSTRUCTION IMPACTS

This section discusses impacts that are the direct result of construction activities and that will typically end when construction is complete. The primary goals of the evaluation of short-term (construction) impacts in the Draft EIS are to:

- Identify potential major construction impacts
- Identify potential mitigation measures for major impacts
- Compare the major construction impacts of the alternatives

Final project design, construction techniques and construction phasing will determine construction impacts. The current analysis is based on conceptual design and assumptions regarding the construction approach. After the Sound Transit Board identifies a preferred alternative, and more detailed design is available, project staff will further evaluate construction-related impacts and prepare more detailed construction mitigation. The construction mitigation plan will be refined throughout project design and construction. The major construction activities that could cause environmental impacts include:

- Demolition (buildings, pavement)
- Fill and Excavation
- Utilities (major relocations or disruptions)
- Drainage changes
- Vegetation removal (temporary)
- Construction easements
- Construction activity in or near water body or sensitive area
- Tunneling
- Elevated structure construction
- Retaining wall construction
- Pile driving or drilling
- Blasting
- Temporary partial road or lane closures
- Temporary total road closures and reroutes
- Building temporary, new detour routes

The construction activities that have been analyzed are intended to represent possible construction techniques and operations, truck routes, and staging schemes. The following discussion summarizes the assumptions used in the Draft EIS.

Typical Construction Sequence and Activities

Linear projects such as the Central Link Light Rail are typically divided into various segments or line sections for construction of trackway, structures, tunnels, park-and-ride facilities, station platforms, transit centers, maintenance yards, sub-station and signal control facilities, and other related improvements. The construction sequence would vary depending upon pre-existing conditions and the characteristics of the light rail facilities. A work-specific construction plan would be developed during the final design effort to establish the limits for the various construction phases and construction contracts, their estimated schedule and duration, and appropriate sequencing.

Open track segments of the route, consisting of at-grade tracks, would require clearing and grading. Where new right-of-way would be required, some existing buildings and other structures could be demolished. Both activities would produce debris and truck traffic for debris removal. During the grading phase, the contractors would install culverts or other permanent drainage structures. Underground utility services may be relocated during the grading phase to remove conflicts with proposed below-grade light rail infrastructure. Where in-street track is proposed within existing or expanded street right-of-way, grading would be minimal, but extensive reconstruction of streets, sidewalks, and other existing facilities may occur. The project would partially or fully close streets and reroute traffic via detours to ensure that construction proceeds in an efficient and timely manner.

For areas with elevated trackway, light rail transit infrastructure and systems would likely be incorporated within the elevated structures to minimize the probability for below-grade conflicts with existing utilities. Constructing an elevated trackway within existing street right-of-way, depending on the size and location of foundations, may temporarily close some traffic lanes and detour traffic until a sufficient portion of the elevated structure is complete and the street can be safely reopened. Some short-term, partial to full street closures may be required when completing elevated structures.

Where constructing an elevated trackway in undeveloped areas (primarily parts of Segment E), clearing and grading activities would mostly be limited to foundation locations for columns supporting elevated structures. However, clearing and grading activities, along with demolition of other structures for newly acquired right-of-way would likely be more intense where the elevated guideway transitions to at-grade track.

Tunnels and underground stations could be constructed using either mining, boring or cut-and-cover techniques. The project would likely use cut-and-cover techniques for shallow stations and where the route transitions from at-grade to tunnel sections (typically in the range of 500 to 1,000 ft long). In general, tunnel portals would likely be constructed using this technique; they are locations of potentially major noise and traffic impacts due to the need to detour vehicles and the truck activity needs to remove debris and excavation spoils or deliver construction materials.

Bored tunnels and stations could result in high levels of truck traffic for removing excavation spoils and delivering materials. These impacts would likely be limited to tunnel portal areas. For long tunnels, these activities would lengthen the need to reroute local traffic at portal locations. Also, for long tunnels and deep underground stations, there may be the need to construct shafts to provide ventilation. Construction on vent shafts generally begins at the surface and continues down to the tunnel or station level. Excavation spoils are typically brought to the surface for removal by trucks. Therefore, vent shaft locations could experience potentially high noise impacts and impacts to traffic during construction.

Trackwork, at-grade system facilities, other light rail transit-related facilities such as surface station platforms, park-and-ride lots, transit centers, and maintenance facilities would likely be the next phase in the construction sequence. Constructing elements located within or directly adjacent to the existing street right-of-way would likely fully or partially close streets. Construction parcels located away from the existing street right-of-way would likely produce high levels of construction truck traffic.

4.17.1 Transportation

4.17.1.1 Traffic and Freight Impacts

Construction of the alternatives would result in temporary impacts to local and regional automobile and truck traffic. The construction activities that have been analyzed represent construction operations, truck routes, and staging schemes, and their related effects, including:

- Potential lane closure requirements, alignment shifts, areas of construction activity adjacent to travel lanes, or other reductions to street capacity due to construction activities;
- Major construction activities where complete closures and construction of interim detour facilities or identification of available detour routes are desirable to provide the least impact to daily users;
- Potential construction access routes and the impact of construction-related traffic on these potential access routes;
- Areas that would require significant construction coordination between Sound Transit representatives and local jurisdictions, impacted neighborhoods, and other affected agencies;

Increased truck traffic would be significant where access routes to construction sites require use of streets that are not typically used by or designated for use by trucks. In these cases, local jurisdiction approval of truck routes will be required. Complete closures of arterials during peak periods would be significant, especially if other routes would be congested or lengthy. Impacts could also be significant if the arterial closure inhibits access to businesses. Any activity requiring the construction of a detour route is considered significant.

Segment A (Northgate to University District)

All alternatives in Segment A could cause partial road closures and possible short-term full closures during the placement of the elevated structure over First Avenue N.E. for the Northgate Station Option B; significant truck traffic would be expected. At the 80th/85th street ramps on I-5, full road closures may be necessary during trackway construction; ramp modifications would be required, and temporary detour routes would need to be constructed. Similarly, at Lake City Way N.E./I-5/N.E. 75th Street, all alternatives would cause partial road closures during the construction of elevated or cut-and-cover sections, and a temporary bypass route on I-5 ramps may need to be constructed. Heavy truck traffic would be expected during construction spoils removal, materials delivery, and/or placement of elevated trackway.

Alternatives A2.1 and A2.2 would require partial road closures on Eighth Avenue N.E. for construction of elevated trackway sections. Full closures would likely be required during the construction of the north tunnel portal. Traffic would need to be rerouted during peak construction periods. The longer elevated trackway needs in Alternative 2.2 would require more construction truck traffic. At N.E. Ravenna Boulevard, Alternatives A2.1 and A2.2 would involve partial to full road closures during the construction and placement of the elevated trackway. The N.E. Ravenna Boulevard off-ramps from I-5 would likely be closed and reconstructed, and temporary ramps may be needed to avoid a significant impact during construction.

Freight trucks may experience increased delay from temporary lane closures for elevated or cut-and-cover tunnel construction crossing of SR 522 and station construction near Northgate Way (all alternatives).

In general, significant traffic impacts for Segment A are concentrated at locations where an elevated trackway is proposed. Except for the ramp closures, which could be significant, minor impacts are also expected along I-5 (all alternatives), N.E. 65th Street (Alternative A2.1), and 15th Avenue N.E. (Alternatives A2.1 and A2.2). Overall, Alternative A2.2 would likely create the most impact during construction of the proposed light rail, followed by Alternative A2.1. Alternatives A1.1 and A1.2 would both result in relatively minor traffic impacts during construction.

Segment B (University District to Westlake Station)

In general, significant traffic impacts for Segment B are concentrated in areas with proposed light rail profile transitions and high traffic volumes. Minor construction impacts such as partial road closures and high truck traffic would also be expected at other locations during the construction of light rail stations, construction of elevated trackway in locations with lower traffic volumes, and tunnel boring. Freight trucks may experience delays from temporary lane closures that may be necessary during station construction near N.E. 45th Street and N.E. Pacific Street. Overall, Alternative B2.1 would likely create the most impact during construction of the proposed light rail, followed by Alternative B2.2. Alternative B1 would have fewer impacts to streets, but spoils removed from tunneling activities could involve higher volumes of truck activities on area arterials, particularly in the Pacific Street and Convention Place station areas.

For Alternatives B2.1 and B2.2, partial to full short-term road closures would be expected on Mercer Street from Eastlake Ave. E. to Minor Avenue, and on Harrison Street between 5th Street and Broad Street. This would be required for construction of transition between tunnel and elevated trackway and, on Mercer Street to construct the elevated S. Lake Union Station. Pedestrian control may be an issue. Truck traffic may be high for demolition, excavation spoils, delivery of materials, and debris removal.

Segment C (Westlake Station to S. McClellan Street)

Spoils removal at portals to C1, C3, C2.4 tunnels would cause impacts such as partial and full road closures. High levels of truck traffic would be expected for all alternatives. The E-3 busway, which is a limited access roadway, could be fully closed. Detour routes are available for all locations during construction activity. Overall, Alternative C3 would likely create the most impact during construction of the proposed light rail, followed by Alternatives C1, C2.3, and C2.4, with the least amount of impact.

Freight trucks may experience delays from temporary lane closures during at-grade construction between the E-3 busway and Airport Way S. for Alternative C1 on S. Lander Street and Alternative C3 on S. Massachusetts Street. Similar delays may occur during elevated and/or at-grade trackway construction for Alternatives C2.3 and C3 along sections of Rainier Avenue S. Maintenance Base Alternative M1 construction would create additional temporary freight truck delays, particularly on westbound S. Lander Street due to installation of the maintenance base trackway approaches.

At-grade construction for Alternatives C2.3 and C2.4 would cross Airport Way S. just north of S. Royal Brougham Way causing some additional truck traffic delay. Construction of Alternative C1 would impact BNSF railroad activity, especially north of S. Lander Street, and construction activities would need to be scheduled.

Segment D (S. McClellan Street to Boeing Access Road)

Impacts would occur along most of the segment for all alternatives. On MLK Jr. Way S., all alternatives would have high levels of truck traffic during demolition of adjacent structures and grading of newly acquired right-of-way. Construction of track within right-of-way would likely require complete lane closures during off-peak hours. Traffic detour routes using other streets would need to be examined. Roadway improvements may need to be constructed first to facilitate traffic detours during track construction. Maintaining left-turn access to businesses and active shipping routes during construction may be difficult. Special considerations for pedestrian safety, especially along school walk routes, would likely be required. Alternative D1.3 would further impact MLK Jr. Way S. with higher levels of truck traffic during construction of the elevated trackway. Partial lane closures during erection of support beams would likely be necessary.

Alternative D3.3 would involve full closure of S. Alaska Street. Other alternatives may use S. Alaska Street for removal/delivery of materials. Alternatives D3.3 and D3.4 could cause significant truck traffic on Rainier Avenue S., related to delivery of materials. Alternative D3.4 would cause similar truck traffic impacts to 37th Avenue S, and parts of the roadway would be closed during tunnel construction.

Freight trucks may experience delays from temporary lane closures on MLK Jr. Way S. during at-grade trackway and station construction for all Segment D alternatives.

Segment E (Tukwila)

Construction activity would create traffic impacts for all alternatives and along much of the segment, although the location of the impacts would differ.

All alternatives would impact MLK Jr. Way S. with high levels of truck traffic during construction of transitions to elevated trackway, and for delivery and erection of elevated structures. The cut-and-cover tunnel for Alternative E3 would require partial to full closure of roadway for short-term periods, and staged tunnel construction to maintain traffic would likely be necessary. Some minor, short-term closures of side streets would be likely.

Alternatives E1.1 and E1.2 would impact Pacific Highway S. (SR 99) due to truck traffic and reduced access to surrounding businesses. Special considerations for pedestrian safety, particularly along school walk routes, would likely be needed. Alternative E1.1 would likely require partial lane closures during off-peak hours. Alternative E1.2 would cause higher levels of truck traffic, and partial lane closures for longer periods than E1.1 due to excavation and elevated trackway construction activities.

Alternative E2 would impact Interurban Avenue north of S. 115th Street due to truck traffic for excavation and construction activities on at-grade and elevated trackway. Some short-term closures of side streets with rerouting of local traffic may be needed, and the Green River Trail may need to be partially closed or rerouted. To avoid impacts to train traffic on the BNSF and UP railroad tracks, the construction schedule may need to be restricted.

Alternative E2 may also require partial lane closures and short term full closures of Baker Boulevard and Andover Park West for construction of elevated trackway and, on Baker Boulevard, an elevated station. Pedestrian access would likely need to be rerouted. Alternative E3 would cause similar impacts to Strander Boulevard, but due to its importance as a primary access route to Southcenter Mall, careful traffic control practices would likely be required to ensure full access. Strander Boulevard would also experience high levels of truck traffic.

Alternatives E2 and E3 could cause partial lane closures at the I-5/I-405 interchange, but would likely be limited to off peak hours. There may be periods when truck traffic would need to have access to interstate right-of-way to facilitate construction of elevated sections. Alternatives E2 and E3 would cause similar impacts on SR 518, although truck traffic would likely be higher for removal of excavation spoils, delivery of materials, and placement of concrete.

Freight trucks may experience delays from temporary lane closures for at-grade trackway and station construction on Pacific Highway S. for Alternatives E1and E1.2, on Interurban Avenue for Alternative E2, and on streets in the Southcenter area for Alternatives E2 and E3. Some limited impacts to freight railroad activity may occur during elevated trackway construction for Alternatives E2 and E3.

Segment F (SeaTac)

All Segment F alternatives would have impacts, and much of the activity would occur on principal arterials. Alternative F3.2 would have the greatest construction impacts due to its relationship with Sea-Tac Airport's terminal access drives.

On International Boulevard, truck traffic would likely be high during all construction phases. Partial, short-term lane closures would likely occur. Maintaining access to office complexes, hotels, Sea-Tac International Airport and businesses would be difficult. Cross-streets would likely be impacted and this would impact access to other key transportation links. Traffic control at all major intersections would likely be required.

On 28th Avenue S., Alternatives F2.1, F2.2, F3.1 and F3.2 would require traffic control measures to maintain access to residential properties during construction. Truck traffic would likely be high for removal of excavation spoils, delivery of materials and erection of elevated trackway.

All alternatives would impact 170th Street S., requiring traffic control during erection of elevated trackway west of and on International Boulevard as well as for construction of at-grade trackway at the intersection. S. 170th Street would have increased traffic if it is used for rerouting of traffic.

All alternatives would cause short-term partial closures of S. 188th and 200th Streets, but would be restricted to off-peak to maintain access to I-5, businesses, and residential properties. The park-and-ride site at S. 200th Street would likely be used as a construction staging area.

Alternative F3.2 would require careful construction staging and other measures to maintain access on the airport's Terminal Access Drives. Truck traffic would likely be high and could cause significant impacts to departing and arriving passengers, particularly in drop-off and pick-up zones.

For all Segment F alternatives, freight trucks may experience delays from temporary lane closures during at-grade and elevated trackway and station construction on International Boulevard.

Maintenance Bases

Construction impacts for each of the maintenance bases would be very similar. In general, construction would take approximately 12 to 18 months and involve at-grade trackway approaches to the facility. Short-term construction impacts would likely include partial closure of adjacent streets during construction of at-grade trackway, and some construction truck traffic for debris removal and material delivery.

4.17.1.2 Traffic and Freight Mitigation

Mitigation measures for traffic and freight impacts due to light rail construction would include the following practices. All measures would comply with local regulations governing construction traffic control and construction truck routing. Sound Transit would finalize detailed construction mitigating plans in close coordination with local jurisdictions, King County Metro, and other affected agencies and organizations.

- Follow standard construction safety measures, such as installation of advance warning signs, highly visible construction barriers, and the use of flaggers.
- Develop specific construction truck traffic routes to minimize impacts within residential neighborhoods. Temporary truck prohibition signs may be used on certain streets with a high likelihood of truck traffic.
- In most locations, schedule traffic lane roadway closures during off-peak hours to minimize delays during higher traffic volume periods.
- Cover potholes and/or open trenches during non-construction hours where possible.
- Provide public information program regarding street closures, hours of construction, or parking impacts.
- Provide temporary parking to mitigate loss due to construction staging or work activities, where appropriate.
- Limit work in highly congested locations such as station areas in downtown Seattle, Capitol Hill and University District to two to four blocks to minimize disruptions to traffic, bus and pedestrian circulation, as well as business access.
- Stage construction to avoid impacts to vehicular traffic and pedestrians near regional shopping centers such as Southcenter, Westlake and Northgate Malls. High usage times such as Christmas and community parades, festivals, and fairs should be avoided.

4.17.1.3 Transit Impacts

Light rail construction would require closing the downtown transit tunnel for a period of up to 26 months (the closure for the downtown transit tunnel would range from 14 to 26 months depending on what light rail route is chosen north of the downtown transit tunnel and whether a light rail station is built near Convention Place). During this construction, buses that currently operate in the downtown transit tunnel would need to be accommodated on downtown streets. Some street modifications may be necessary to meet existing operating levels, and they would need to be completed before the downtown transit tunnel could be closed. Pre-tunnel closure construction activities in downtown may occur for up to 12 months. Impacts of the downtown transit closure during and after construction are discussed in more detail in section 3.2.2 of the Draft EIS and in the Central Link Transportation Technical Report.

Where existing trolley bus service directly intersects with proposed Link stations and facilities, temporary detours of trolley bus service may be required, and overhead wire and power feeders may need to be installed on detour routes. The following Link stations could require temporary detours of trolley service: N.E. 45th, Pacific, Campus Parkway, Roy/Aloha, Broadway, First Hill, Convention Place, I-90, McClellan, Charlestown, Othello and Henderson.

4.17.1.4 Transit Mitigation

Improvements to mitigate the impacts of the downtown transit tunnel closure during and after construction are discussed in more detail in Section 3.2.2 of the Draft EIS and the Central Link Transportation Technical Report.

4.17.1.5 Navigable Waterways

Navigable waterways located in the study area include: the Lake Washington Ship Canal and Portage Bay (all B alternatives), and the Duwamish and Green rivers (Alternatives E1.1, E1.2, E2, and E3).

Lake Washington Ship Canal

- The Alternative B2.1 bridge across Lake Washington Ship Canal would take an estimated 18 to 24 months to construct, beginning in the water with foundation work, but most of the remaining work would be over the water. Barges may be occasionally used, but bridge construction should not significantly impact general waterway traffic.

Portage Bay (Alternatives B1 and B2.2)

- Spoils removed for tunnel in B1 and B2.2 could require barging. A barge facility is located on the north side of Portage Bay by Pacific Avenue S. and 15th Avenue. Neither alternative should significantly impede general waterway traffic.

Duwamish and Green rivers

- Alternatives E1.1, E2, and E3 would cross the Duwamish and/or Green rivers. Depending on the alternative selected, construction would take between nine and 15 months. Because there is little to no waterway traffic on these reaches, bridge construction would not be expected to impact mitigation.

4.17.2 Land Use and Economics

Construction-related land use impacts affect the quality and character of existing land uses. These include impacts from noise, dust, access and parking restrictions. Small businesses, especially those retail businesses depending on walk-up or drive-up customers, are likely to be most vulnerable to prolonged periods of construction activity. If construction impacts are sufficiently severe, such businesses could fail or be forced to relocate. Other businesses could experience a short-term decline in revenues due to reduced business activity.

Construction activity would also result in increased output, income, and jobs for the local economy. Estimates of the economic impact of construction expenditures are provided in Section 4.1.

4.17.2.1 Impacts

In Segment A, construction impacts to businesses are likely to be greater in Alternatives A1.1 and A1.2 than in Alternatives A2.1 and A2.2 because potential cut-and-cover tunnel and station construction would occur in proximity to businesses in the Roosevelt area retail core. Construction impacts to residential land uses would be greater under Alternatives A2.1 and A2.2 because elevated track and station construction would occur in proximity to residential uses in the Roosevelt area.

In Segment B, construction impacts to businesses are likely to be greater in Alternatives B2.1 and B2.2 than in Alternative B1, a tunnel route; Alternatives B2.1 and B2.2 have both tunnel and elevated sections. Land use impacts to University of Washington educational and residency uses would be greater under Alternative B2.1, where construction of the N.E. Campus Parkway station would be near to Condon Hall (educational use) and the Terry-Lander building (residential use). However, if the Pacific Street Station site is used for tunnel muck-out (removal of soil excavated during tunnel construction) there will be considerable activity at this location and considerable truck hauling to and from this site during tunnel construction for either B1 or B2.2. There would be more utility crossings and partial lane closures in building Alternative B2.1 than B2.2.

In Segment C, there would be high economic impacts in the north Rainier Valley during construction of Alternatives C2.3, C2.4, and C3 because of displacements and construction activity disrupting the narrow strip of businesses along Rainier Avenue S. These businesses are the main source of economic activity in the area. Even businesses in this area that are not displaced would be affected because of the removal of neighboring businesses and access limitations created during construction. In general, construction economic impacts are likely to be greatest in Alternatives C3 and C2.3, and somewhat less in C2.4. Construction economic impacts would be lowest in Alternative C1 in which the route tunnels through Beacon Hill and does not travel along or parallel to Rainier Avenue S. Impacts to residential land uses would be greatest during construction of Alternatives C1, C2.3, C2.4, and C3 where construction of the I-90 station would occur in proximity to residential uses.

In Segment D, construction impacts would be highest for Alternatives D3.3 and D3.4, which would be parallel and to the west of Rainier Avenue for about a mile in the northern third of the segment. High construction economic impacts would occur along much of the route in all Segment D alternatives because of displacements and due to construction impacts to the narrow strip of businesses that provide the main economic activity in the area. Alternative D3.3 would have the greatest number and types of businesses displaced and affected by construction activity. Alternative D3.4 would have the most traffic closures of the alternatives, and substantial localized construction impacts during cut-and-cover construction of the Columbia City station.

In Segment E, construction impacts would be greatest for the combined profile (elevated and at-grade) Alternative E1.1, followed by the elevated Alternative E1.2. Many auto-oriented businesses along Pacific Highway S. could be affected by project construction. Residential uses within Segment E are generally far enough removed from rail routes and would not be substantially affected by construction activities. Residential uses would be most affected under Alternative E1.2, which would involve elevated track construction near residences at the northern end of Pacific Highway S. Alternatives E2 and E3 would be constructed in areas with relatively lower concentrations of businesses. Alternative E2 is in the lowest-density area and would accordingly have the lowest construction economic impacts of the Segment E alternatives.

In Segment F, construction of Alternative F1 in the median of International Boulevard would temporarily reduce access to local businesses and have the greatest economic impact. Alternatives F2.1 and F2.2 would have potential construction economic impacts around the City Center Station and along 28th Avenue S.; Alternative F2.1 would also have business economic impacts from the grade transition at 154th Street S. Construction impacts to residential uses would be greatest under Alternative F2.2, which would require elevated station and track construction near residences along 32nd Avenue S. Alternative F2.2 would result in more displacements and greater construction impacts than Alternative F2.1. Alternatives F3.1 and F3.2 would have similar economic impacts, and they would be less severe than the other alternatives in this segment, but impacts to businesses may be high along International Boulevard and 28th Avenue S.

For the maintenance base sites, the Lander Street site (M1) is located in an industrial area that supports a number of warehousing, industrial, and transportation facilities. The levels of business and transportation activity, and the likely construction economic impacts, are greater at the Lander Street site than at the S.W. or N.E. Boeing Access Road sites (M1, M2 and M3). The S.W. Boeing Access Road Site (M3) would probably have the lowest traffic-related construction economic impacts of the three sites; otherwise, construction economic impacts at the two Boeing Access Road sites would be similar.

4.17.2.2 Mitigation

A business relocation assistance program will be developed as discussed in Section 4.2.2. Other potential mitigation measures to reduce impacts to local businesses during project construction include:

- Establishing effective communication with residents and businesses; developing and implementing a public relations plan that would ensure that local residents and businesses are fully informed about potentially significant disruptions, such as temporary street closures, changes in transit service, and parking availability.
- Minimizing construction-related noise, vibration, dust and dirt impacts through appropriate construction methods and phasing to minimize impacts during periods of increased sensitivity.

Specific mitigation to reduce short-term economic impacts on businesses during construction are also discussed in Transportation (4.17.1), Visual and Aesthetics (4.17.4), Noise and Vibration (4.17.6), Public Services (4.17.12), and Utilities (4.17.13).

4.17.3 Neighborhoods

Noise, vibration, visual, aesthetic, and traffic impacts could temporarily affect neighborhood quality of life. Physical barriers to isolate construction sites from traffic lanes would likely restrict access across arterials on elevated and especially at-grade sections during construction. Although signed detour routes would be provided, access to community facilities (e.g., Swedish Hospital under B1; Franklin High School, the Columbia Library, the Southeast Neighborhood Service Center, and the Seattle School District Head Start Program under the D alternatives; and Highline Community Hospital, Foster High School and Library under E1.1 and E1.2) could become more circuitous. Some delays could occur along school bus routes in Tukwila and SeaTac, especially on at-grade sections.

Fire, emergency medical, and police response times could be affected due to blocking problems on at-grade and elevated sections and around cut-and-cover station construction (Roosevelt Station and Columbia City Station). This would be a particular concern on major roads and at major intersections. The safety of neighborhood residents, visitors, and employees would be a concern around construction sites.

4.17.4 Visual and Aesthetics

During construction of the Central Link alternatives, construction equipment, materials, signage, and staging areas would reduce the visual quality in the immediate area. Impacts would be greatest for at-grade and elevated route alternatives, and tunnel station locations or cut-and-cover tunnel construction.

Temporary lighting may be necessary for nighttime construction of certain project elements or at tunnel portals and along surface or elevated alternatives in existing road or highway rights-of-way (to minimize disruption of daytime traffic). This temporary lighting could impact residential areas by exposing residents to uncomfortable glare from unshielded light sources, or by increasing ambient nighttime light levels. Temporary lighting impacts could be reduced by shielding light sources to block direct views from residential areas, and by aiming and shielding to reduce spillover lighting in such areas.

4.17.5 Air Quality

4.17.5.1 Impacts

Construction activities primarily generate particulate matter (PM_{10} and $PM_{2.5}$), as well as small amounts of CO and NO_X from construction machinery exhaust and vehicular traffic delayed in construction zones. Specific sources of particulate would be dust from earth moving-excavation activities (termed fugitive dust) and diesel smoke.

Fugitive dust from construction activities would occur with all alternatives. Ground surface disturbance and rail line installation would generate fugitive dust along the entire length of the above-ground sections of the line. For underground or tunnel route alternatives, soil handling would be focused on "muck out" locations where earth removed by tunneling would be stockpiled and/or loaded for transport. In addition, demolition activities at the various station locations would create fugitive dust, as would removal of concrete foundations and asphalt paving.

The quantity of particulate emissions generated by construction would be proportionate to the construction area, and that is generally similar for all alternatives. At this time, a quantitative estimate of particulate emissions generated cannot be determined; however, temporary increases in particulate emissions would be noticeable if uncontrolled. It is typical for construction projects to implement mitigation measures similar to those listed below to offset temporary particulate increases.

All alternatives would have potential but temporary impacts from construction including exhaust from construction vehicles and equipment, and odors created during paving of station areas, parking lots, and roads.

4.17.5.2 Mitigation

PSAPCA enforces air quality regulations in King County, including those for controlling fugitive dust (Regulation 1, Section 9.15). Contractors engaged in construction activities must comply with this regulation, which requires the use of best available control technology to control fugitive dust emissions. Controls used to meet this standard may require the following actions:

- Use water spray as necessary to prevent visible dust emissions—particularly during demolition of brick or concrete buildings by mechanical or explosive methods.
- Minimize dust emissions during transport of fill material or soil by wetting down or by ensuring adequate freeboard on trucks.
- Promptly clean up spills of transported material on public roads by frequent use of a street sweeper machine.
- Cover loads of hot asphalt to minimize odors.
- Schedule work tasks to minimize disruption of the existing vehicle traffic on streets
- Keep all construction machinery engines in good mechanical condition to minimize exhaust emissions.

4.17.6 Noise and Vibration

In general, noise and vibration would be generated by heavy equipment used during major construction periods under the project alternatives.

4.17.6.1 Impacts

In Segments A through E there is the potential for tunneling, which can be performed either by conventional mining, using mechanical equipment, by blasting, or by a tunnel-boring machine. It is anticipated that either conventional mining or a tunnel boring machine will be used. Major noise sources include the boring machine, haul trucks, loaders, hoe-rams, excavators, conveyors and other miscellaneous mining equipment. Noise from the boring machine is normally not an issue, because it would be located inside the tunnel. Potential noise impacts associated with tunneling usually occur at the tunnel portals, or at alternate excavation locations. Noise levels near these areas could exceed 90 dBA L_{max} for short periods, depending on concurrent activities.

Vibration associated with tunneling can also cause impacts. With conventional tunneling methods, vibration is caused by excavation equipment and hoe-rams. When a boring machine is used, there is potential for the vibration from the machine to reach the surface and result in impacts.

Construction of elevated structures may require pile driving. Maximum noise levels associated with pile driving could reach 105 dBA at distances of 100 ft. Other noise sources associated with construction of the structures, such as trucks, cranes, and loaders, are expected to produce maximum noise levels ranging from 85 to 90 dBA at receivers within 100 ft of the construction site. Pile driving is also a potential source of vibration impacts. Other vibration sources include bulldozers and compactors.

Construction of at-grade trackway would require the use of bulldozers, haul trucks, loaders, cranes, scrapers, and soil compactors. Noise levels and mitigation would be similar to those used for roadway construction. Construction activities that may cause high vibration levels, such as pile driving and soil compacting, could cause structural damage to nearby older and historic buildings. Estimates of maximum noise levels at the closest receivers for various types of construction are provided in Table 5.17.6-1.

Table 4.17.6-1
Estimated Peak Hour Construction Noise Levels

Construction Phase	Loudest Equipment	Noise Level at 100 ft (dBA Lmax)
Clearing and grubbing	Bulldozer, Backhoe, Haul Trucks	88
Earthwork	Scraper, Bulldozer	88
Foundation	Backhoe, Loader	85
Structures	Crane, Loader, Haul Trucks	86
Base preparation	Trucks, Bulldozer	88
Tunnel Boring with Conventional Methods	Loader, Haul Trucks, Hoe-ram	90
Tunnel Boring with Boring Machine	Loader, Haul Trucks	88
Paving	Paver, Pumps, Haul Trucks	89
Pile Driving	Pile Driver, Trucks	90 – 105

Source: U.S. Department of Transportation. *Highway Construction Noise: Measurement, Prediction, and Mitigation*. 1977, and MM&A measured noise levels.

4.17.6.2 Mitigation

Mitigation for Tunneling

Several construction noise abatement methods can be used to limit impacts. These include: prohibiting construction equipment operation near occupied dwelling units at night (10 P.M. to 6 A.M.) or on Sundays or legal holidays, when noise and vibration would have the most severe effect; requiring all engine-powered equipment to have mufflers installed according to the manufacturer's specifications; and ensuring that all equipment complies with pertinent noise standards of the U.S. EPA. It is also important to limit activities that produce the highest noise levels, such as loading tunnel spoils, jack hammering, and using demolition equipment to daytime hours between 7:00 A.M. and 7:00 P.M.

Vibration mitigation for tunneling could include limiting the hours when the vibration-producing equipment can be used, as with the noise-producing equipment. Mitigation for the TBM in segments A, B, and C may not be necessary due to the geological conditions, and the type of machine expected to be used for the project.

Mitigation for Construction of Structures

As stated, maximum noise levels associated with pile driving could reach 105 dBA at distances of 100 ft. Because mitigation of the noise and vibration associated with pile driving is not feasible, the only mitigation measure may be to limit the time this activity can take place.

Alternatively, the use of auguring to install the piles instead of a pile driver would greatly reduce the noise and vibration levels,

Mitigation for At-Grade Construction

Mitigation could include limiting construction times and assuring that all equipment has the proper mufflers and shrouds. By restricting and monitoring vibration-producing activities, vibration impacts from construction could be kept to a minimum.

4.17.7 Ecosystems

4.17.7.1 Impacts

In Segment A, construction of Northgate Station options A and B would clear riparian vegetation and could increase sediment and stormwater runoff from exposed soils into S. Fork Thornton Creek and thereby displace fish.

In Segment B, Alternatives B1 and B2.2 could cause short-term construction-related impacts to wildlife and fish habitats if tunnel spoils are barged from the north side of Portage Bay; impacts could include water quality degradation, shading of fish habitat, and a barge berthing area. Alternative B2.1 could involve in-water activity to construct pier fittings and false work support for the high level bridge, including in-water pile-driving and temporary disturbance of peregrine falcons that winter-roost and hunt from the I-5 bridge. For Alternative B1 or B2.2, peregrine falcons may avoid the construction area if activities take place during winter months, but effects on peregrine foraging ability are not expected to be significant. Bridge construction from Alternative B2.1 would not be likely to raise noise levels enough to affect the roost site, but human activity near the site may displace peregrines. Additionally, if pile-driving occurs, the noise may cause some disruption to peregrines. Short-term construction impacts on Chinook salmon also may occur under Alternative B2.1.

In Segment C, under Alternatives C1 and C3, construction noise and activity could disturb wildlife in the forested habitat at Beacon Hill.

In Segment D, potential short-term water quality impacts on wetlands (AR-3) could occur, and some clearing of trees at the edges of deciduous forest patches would occur. Two bald eagle nests are located in Seward Park, but no adverse impacts are expected.

In Segment E, potential wintering habitat for bald eagles has been identified, specifically large trees along the Duwamish/Green River, and construction activities would likely cause eagles to avoid the area. Alternatives E1.1 and E1.2 would affect wetlands, wildlife, and fish habitat due to bridge construction over the Duwamish/Green River, crossing of several wetlands, and clearing of deciduous trees. The estimated 12- to 18-month construction period for bridges over the Duwamish/Green River would involve in-water and over-water work, impacting fish habitat, and potentially impacting water quality. Chinook salmon could be impacted by construction during the in-migration of adults spawning in the fall and out-migration of juveniles in the spring, but impacts may be minimized by performing in-water construction when Chinook salmon are not migrating through the project area. Standard measures for controlling stormwater and water quality effects of construction could also minimize impacts to Chinook salmon.

The greatest ecosystem impacts in Segment E would occur under Alternative E2, which would have four bridge crossings. Alternative E2 would have lower impacts to wetlands than Alternatives E1.1 and E1.2, but would have greater impacts to fish and wildlife habitat. E2 would require clearing of deciduous forest and would displace a wider variety of wildlife species. It would also have higher impacts to fish habitat due to construction of three bridges over the Duwamish/Green River, and a bridge over the Black River. Alternative E3 would have similar ecosystems impacts to E2, but a lesser impact to fish habitat because only two river crossings are proposed.

In Segment F, Alternative F2.2 would cross Bow Lake on an elevated structure, requiring clearing of riparian vegetation and in-water construction. These activities would result in the temporary displacement of fish and wildlife and may degrade water quality. Alternatives F2.1, F2.2, F3.1, and F3.2 are within a mile of an active bald eagle nest on Angle Lake; pile-driving may be used to construct the elevated portions in the area, which, depending on construction timing, could adversely impact nesting activity.

Maintenance Base Sites

No construction-related impacts on wetlands, fish, or wildlife would occur at site M1. Vegetation would be removed and common urban wildlife would be displaced from the buffers of wetland AR-4 at maintenance site M2 and wetland AR-9 at M3. There are no other construction-related impacts at maintenance sites M2 and M3.

4.17.7.3 Mitigation

Mitigation for short-term ecosystem impacts will be based on a hierarchy of avoiding and minimizing impacts and compensating for unavoidable adverse impacts. The implementation of measures such as silt fencing, stabilizing exposed soils, landscaping with native plants, marking the limits of clearing, and collecting runoff during construction would minimize impacts on wetlands, wildlife, and fish. Additional mitigation measures are described below.

In many instances, construction timing can reduce or eliminate impacts on wetlands, fish habitat, and threatened and endangered species. Restricting construction in wetland areas to the drier summer months minimizes the impact on those wetlands that flood only during winter and early spring months and reduces wetland impacts caused by stormwater runoff.

Impacts on some fish species may be avoided by conducting in-water construction while anadromous fish species are not migrating though the project area. The hydraulic project approval permit specifies this period of time. The development and implementation of a sediment and erosion control monitoring plan for the proposed bridge crossings and construction activities near the river would also minimize impacts on fish resources.

In addition, high-level bridge construction in Segment B could be scheduled to reduce impacts on peregrine falcon winter roosting and foraging at the I-5 bridge, and impacts on migrating salmon.

Potential construction impacts on bald eagles in Segment F could be avoided by drilling rather than driving piles, or by restricting pile-driving activities to the non-nesting period if the nest becomes active again.

A Biological Assessment reviewing effects on endangered species would likely be required during preparation of the Final EIS and would help further define appropriate mitigation measures.

4.17.8 Water Quality

Impacts during construction are temporary and would occur only during that period. Mitigation during construction will be based on generally accepted principles and local regulatory requirements which state that (1) the project should fit the natural topography, soils, and drainage patterns; (2) erosion control should be emphasized through the implementation of accepted best management practices such as barrier beams, silt fences, and sediment ponds; (3) the extent and duration of exposed areas should be minimized by using mulches or seeding; (4) runoff velocities should be kept low by installing dikes or swales; (5) erosion and sediment control measures should be monitored and maintained; (6) to the extent possible, earthwork should be scheduled during the dry season; and (7) spill controls will be implemented at all individual construction sites to prevent the uncontrolled release of fuels and any other construction materials on the site that could enter downstream receiving waters through stormwater runoff.

Segment A. Construction of Northgate Station option A, could impact water quality in Thornton Creek. Erosion and transport of sediments or spills that could occur during construction near the channel could affect water quality in the stream. Constructing Northgate Station option B would require crossing a small ditch that flows into Thornton Creek. Sediment and spills from the construction site could impact Thornton Creek; however, impacts would be prevented through the use of erosion control measures.

Segment B. Alternatives B1 and B2.2 could impact Portage Bay and Lake Union water quality during construction of the tunnel under Portage Bay. During construction, tunnel spoils would be trucked or barged off-site. Spills associated with this process, and potential erosion at the fill location, could impact short-term water quality. If they occur, impacts are expected to be minor and temporary.

Alternative B2.1 could impact water quality during construction of the bridge crossing, which is estimated to take from 18 to 24 months to complete. During over-water and in-water work, installation of support falsework and concrete placement would be required. Site access would be via adjacent streets and from barges. Erosion control measures would be implemented to mitigate any potential impacts from erosion or spills. Other standard measures would include fencing and street sweeping to reduce water quality impacts.

Segment C. Without mitigation, vegetation removal and construction (primarily alternatives C2.3 and C3) could cause small increases in runoff and sedimentation. Temporary sediment and erosion control measures would be implemented to prevent construction impacts.

Segment D. Construction of all of the alternatives (except D.1.1d) in this segment would require increasing the existing rights-of-way along much of MLK Jr. Way S. Local flooding and downstream water quality problems could occur if roadside ditches are blocked and/or if significant erosion from construction is allowed to occur. Impacts are expected to be minor and temporary with the implementation of sediment and erosion control measures.

Segment E. Several proposed actions within this segment could cause short-term impacts to water quality unless mitigated. Alternatives E1.1 and E1.2 would require construction of a bridge over the Duwamish River; this would take approximately 12 months to complete. Potential spills could impact Duwamish River water quality. Vegetation removal, soil compaction, and potential spills could increase water temperatures and turbidity, or affect Riverton Creek water quality. These alternatives would also require constructing a retaining wall north of S. 139th Street along Pacific Highway S. The retaining wall would cross culverted sections of the east and west forks of Riverton Creek and the north and middle forks of Southgate Creek, requiring approximately 4 cubic yards of fill and extension of the existing culverts. Streamside construction and in-stream work could generate sediments from bank erosion and remove vegetation. These activities would also block downstream culverts or be the source of spills that would impact the water quality of the stream. Temporary sediment and erosion control measures and spill controls would be required at all sites to prevent construction impacts.

Alternative E2 would require constructing four bridges over the Duwamish, Green, and Black rivers and crossing three minor streams; each would require some in-water work. Constructing the bridge over the Duwamish River would require from 9 to 12 months, depending on the design selected. Construction of the bridge spanning the Green and Black rivers would require approximately 15 months. Construction of the Green River bridge would require 10 months. In-water and over-water construction could impact water quality if spills or bank erosion occurs due to vegetation removal. The construction of elevated portions of the alignment over Gilliam Creek would require vegetation removal, possible in-stream work and/or crossing of the stream by construction equipment. Potential soil compaction and vegetation removal could cause increases in turbidity and stream temperature. Spills during construction could also impact water quality. Construction of an elevated structure over 42nd Avenue S., south of SR 518, could also generate sediments and spills that would impact the water quality of the spring in this location. Gilliam Creek, which receives flow from a spring approximately 400 ft downstream of the construction site, could also be impacted at this location. Construction of the retained cut south of SR 518 would result in soil compaction, vegetation removal, disruption of seeps and springs, and potential water quality degradation. Alternative E3 would require constructing bridges over the Green and Black rivers. The construction impacts would be similar to the Black River bridge in Alternative E2. Construction of the Green River bridge would take 9 to 12 months and could require in-water work. The construction would have impacts similar to Alternative E2.

Temporary sediment and erosion control measures and spill controls would be required at all sites to prevent construction impacts.

Segment F. Construction in this segment is not expected to have significant impacts to hydrology, water quality, or floodplains, except for construction of Alternative F2.2. This alternative would require shoreline and in-water construction of support piers in Bow Lake. Spills associated with this process, vegetation removal, and potential erosion, could impact short-term water quality. On-site mitigation would reduce potential impacts due to water quality. Specific mitigation, such as the use of in-water barriers, could be implemented to prevent sediment generated during construction of support piers from diffusing to the remainder of the lake.

Maintenance Base Sites. With erosion control measures, maintenance facility construction is not expected to impact hydrologic, water quality, or flooding conditions.

4.17.9 Energy

The Northgate to SeaTac alternative would consume the most energy during construction (22,616 x 10^9 Btu). The N.E. 45th to SeaTac Alternative would consume 18,104 x 10^9 Btu. The No-Build Alternative would consume no energy associated with light rail construction. However, under the No-Build Alternative there would likely be an increase in energy demand for road construction and maintenance associated with not having the Link system.

4.17.10 Geology and Soils

Tunneling creates large volumes of spoils that can have high erosion potential. The estimated volume of spoils for each alternative segment, based on conceptual design, is presented in Table 4.17.10-1. Large volumes of dewatering may be required during tunneling depending upon the type of TBM used, the depth to groundwater, and the permeability of soils. Settlement may occur due to vibrations, dewatering, or ground loss; however, the vibrations will be considerably less for soft ground tunneling than for hard ground tunneling.

Cut-and-cover construction creates more spoils per linear feet of track than tunneling or mining, and a greater potential for erosion and contamination of spoils exists. Soils may settle during dewatering and movement of structures near the excavation.

Constructing the light rail system could cause erosion impacts associated with vegetation removal, fill placement, and removal or stockpiling of spoils. Earthwork could cause silt-laden run-off to be transported off-site, thereby degrading water quality in local surface waters. The severity of potential erosion would be a function of the quantity of vegetation removed, site topography, and the volume of soils stockpiled.

Vibrations or settlements from the following construction methods may result in damage to nearby structures: excavations that encounter bedrock; installation of driven piles; tunneling, dewatering, or cut-and-cover construction. In tunneled sections, settlement could occur due to vibrations, dewatering, or ground loss; however, the vibrations would be considerably less for soft ground tunneling (such as Capitol Hill, Alternative B1) than for hard ground tunneling (such as 37th Avenue, Alternative D3.4).

Construction of the Link Light Rail could produce over 5.8 million cubic yards (yd^3) of spoils (primarily from tunnel and cut-and-cover excavations) and require about 750,000 yd^3 of structural fill (primarily for at-grade and elevated alignments and stations). The required structural fill materials will likely be generated from the excavated spoils. Of the remaining 5.1 million yd^3 of spoils, a small portion may be contaminated (most likely spoils generated from near-surface excavations) and will need to be properly treated and/or disposed (see Section 4.17.11). Most spoils will be generated from tunneling, where the likelihood of encountering contamination is very low.

Currently, there is a regional deficit of suitable structural fill materials due to the considerable growth this region has been experiencing. A high demand for coarse-grained spoils (sand and gravel) is anticipated. If growth continues, even marginal, fine-grained spoils (silt and clay) may have a market. One project of note is the Sea-Tac International Airport Third Runway. Earthwork projections for the Third Runway Project estimate that 15 to 17 million yd^3 of fill will be required and demolition waste and marginal quality fill materials may be acceptable for portions of the fills. Other currently unknown future construction projects will likely also require large quantities of fill material. Fine-grained or otherwise unsuitable spoils generated during construction that do not have a market will need to be landfilled.

4.17.10.1 Impacts by Segment

Segment A. Alternatives A1.1 and A1.2 have a high potential for requiring dewatering during construction, a low potential for settlement impacts, and would generate this segment's largest volumes of spoils. Alternatives A2.1 and A2.2 have a moderate and low potential, respectively, for both dewatering and settlement impacts associated with tunneling. Alternative A2.1 would generate more spoils than A2.2 but less than either A1.1 or A1.2. Alternative A2.2 has the highest potential for settlement due to pile installation; however, these settlements, if any, are anticipated to be relatively small. All alternatives have a moderate potential for erosion.

Segment B. All Segment B alternatives have high potential for encountering groundwater and requiring large volumes of dewatering. Alternative B1 would generate the highest volume of spoils. The Seattle Center alternatives have a high (B2.1) and moderate (B2.2) potential for settlement and vibration impacts during pile installation and would generate high spoil volumes.

Segment C. Alternative C1 (S. Lander Street Tunnel) has a high potential for dewatering, a low potential for settlement impacts and would produce moderate spoils. Alternative C2.4 (Rainier Avenue S. Tunnel) has a similarly high potential for dewatering and would produce moderate spoil volume. Alternative C2.3 has a low potential for dewatering and moderate potential for settlement impacts. Alternative C3 (S. Massachusetts Street Tunnel) has a moderate potential for requiring dewatering, a high potential for settlement impacts, and would produce moderate spoils (less than either C1 or C2.1, but more than C2.3). All Segment C alternatives have low erosion potential.

Segment D. Alternative D1.1 and D1.1d would produce moderate spoils and generally has low potential for construction-related geologic impacts. Alternative D1.3 has a moderate potential for settlement impacts and low or no potential for other construction-related geologic impacts. Alternative D3.3 has low or no potential for geologic impacts. Alternative D3.4 has a high potential for requiring dewatering, moderate potential for erosion, and would produce this segment's highest volume of spoils. This alternative would require hard ground tunneling which could cause vibration and settlement.

Segment E. Alternative E1.1 has moderate potential for settlement impacts. Alternative E1.2 has moderate erosion potential and a high potential for settlement impacts. Alternative E2 has moderate potential for requiring dewatering and a high potential for erosion and settlement impacts. Alternative E3 has high potential for erosion and settlement impacts and for requiring dewatering. It would produce the segment's largest volume of spoils, but still moderate.

Segment F. Alternative F1 has moderate erosion potential due to removing vegetation from the roadway median. None of the Segment F alternatives would produce high volumes of spoils; although, F1 would be higher than the others. Alternative F2.1 has low or no potential for construction-related geologic impacts. Alternative F2.2 has moderate potential for settlement impacts.

Table 4.17.10-1
Potential Short-term Geologic Impacts

Segment/Alternative	Groundwater/ Dewatering[10]	Excavation/ Spoils[9]	Fill[9]	Vegetation Removal (Erosion Potential)	Overwater Crossings	Vibrations and possible settlement from pile installation	Blasting/ Difficult Excavation[11]
Segment A							
A1.1 12th Ave. Tunnel	High[3]	365 K	45 K	Med.[5]	None	Low[7]	None
A1.2 Roosevelt Way Tunnel	High[3]	366 K	45 K	Med.[5]	None	Low[7]	None
A2.1 8th Ave.-Short Elev.	Med.[3]	242 K	15 K	Med.[5]	None	Med.[7]	None
A2.2 8th Ave.-Elev.	Low[6]	157 K	15 K	Med.[5]	None	High[5]	None
Segment B							
B1 Capitol Hill Tunnel	High[1]	1,210 K	200 K	None[8]	None	None	None
B2.1 Sea. Ctr.-High-level Br.	High[1]	872 K	120 K	Low[7]	Ship Canal	High[5]	None
B2.2 Sea. Ctr.-Port. Bay Tunnel	High[1]	943K	90K	Low[7]	None	Med.[7]	None
Segment C							
C1 S. Lander St. Tunnel	High[3]	226 K	5 K	Low[7]	None	Low[7]	None
C2.3 W. of Rainier-Elev.	Low[6]	32 K	5 K	Low[7]	None	Med.[7]	None
C2.4 Rainier Ave. S. Tunnel	High[3]	248 K	None	Low[7]	None	None	None
C3 S. Mass. St. Tunnel	Med.[6]	102 K	None	Low[7]	None	High[5]	None
Segment D							
D1.1d MLK S. – At-grade,4-lane	None	101 K	5 K	Low[7]	None	None	None
D1.3 MLK S. – Combined Pr.	None	47 K	5 K	Low[7]	None	Med.[2]	Low[4]
D3.3 Alaska St. Crossover	Low[6]	87 K	5 K	Low[7]	None	Low[7]	None
D3.4 37th Ave. S. Tunnel	High[6]	277 K	45 K	Med.[7]	None	Low[7]	Med.[7]
Segment E							
E1.1 Pac. Hwy. S.	None	31 K	10 K	Low[2]	One	Med.[2]	None
E1.2 Pac. Hwy. S. – Elevated	None	9 K	5 K	Med.[2]	One	High[2]	None
E2 Interurban Ave.	Med.[6]	85 K	12 K	High[2]	Three	High[5]	Low[7]
E3 MLK Jr. Way S.	High[6]	104 K	78 K	High[2]	Two	High[5]	Med.[5]
Segment F							
F1 Int. Blvd – At-grade	None	62 K	None	Med.[2]	None	Low[7]	None
F2.1 Wa. Mem. Park – City Ctr. W.	None	29K	20K	Low[5]	None	Low[2]	None
F2.2 Wa. Mem. Park – City Ctr. E.	Low	30 K	20 K	Low[5]	Bow Lake	Med.[2]	None
F3.1 W. of Int. Blvd. Gr. Knoll	None	26 K	5 K	Low[7]	None	Med.[2]	None
F3.2 W. of Int. Blvd., M. Terminal	None	22 K	5 K	Low[7]	None	Med.[2]	None
Maintenance Facilities							
M1 S. Lander St.	Low	83 K	10 K	Low[7]	None	Med.[5]	None
M2 N.W. Boeing Access Rd.	Low	80 K	10 K	Low[7]	None	Med.[5]	None
M3 S.W. Boeing Access Rd.	Low	107 K	10 K	Med.[2]	None	Med.[5]	Low[7]

Note: A high rating in one segment does not necessarily correspond to a high rating in another segment. The qualitative ratings are relative to an individual segment with the purpose being to differentiate between alternatives within a segment.

1 >50% of route affected, temporary condition or no mitigation required
2 >50% of route affected, mitigable through design or construction methods
3 <50 % of route affected, temporary condition or no mitigation required
4 <50% of route affected, impractical to mitigate with current design
5 <50% of route affected, mitigatable through design or construction methods
6 <25% of route affected, temporary condition or no mitigation required
7 <25% of route affected, mitigatable through design or construction methods
8 Only near portals
9 Approximate only. (Units in thousands of cubic yards).
10 Primarily associated with tunnel and underground construction. Open-faced TBM is assumed for worst case scenario.
11 Difficult excavation is considered excavation which encounters bedrock.

The two alternatives west of International Boulevard (F3.1 and F3.2) both have moderate potential for settlement impacts and low or no potential for other geologic impacts.

Maintenance Facility Sites. All three maintenance facility sites have moderate potential for settlement impacts. Site M3 also has moderate erosion potential. All sites have low or no potential for other construction-related geologic impacts.

4.17.10.2 *Mitigation*

Additional study will be conducted during project design to determine the specific extent and severity of geologic hazards of the preferred alternative and to develop specific mitigation details.To control erosion during construction, contractors would employ standard mitigation measures within the construction limits. This would also reduce the amounts of silt-laden run-off leaving the construction site, minimize dust, and other measures. Use of clean fill soils containing little or no silt and clay would also help reduce the erosion potential.

Mitigation for vibration and settlement impacts to shallow foundations would include a pre-condition survey and a construction monitoring program. Additional mitigation could include underpinning structures, installing recharge wells (for dewatering), modifying construction techniques, displacement grouting (during tunneling), or re-leveling and repair.

For dewatering mitigation, detailed analysis during project design will estimate potential dewatering effluent volumes and the potential presence of contaminants. Construction techniques would be used to reduce the sediment and contaminants in the effluent, if necessary, prior to disposal. The project would coordinate with local jurisdictions to dispose large volumes of dewatering effluent.

For pile drilling and driving, selecting the appropriate pile type would balance the potential impacts associated with vibrations, spoils, and dewatering. Construction techniques, such as selection of hammer size and cushion material for driven piles, and following the mitigations as described for construction-induced vibrations and settlement would reduce impacts. In areas with over-water construction, compressible soils may require pre-loading to reduce settlement under the approach fills, and turbidity could be controlled by appropriate erosion control methods.

For tunneling and mined stations, standard mitigation measures would minimize the erosion potential of the spoils and stockpiles. A closed-face, positive pressure TBM could reduce the need for dewatering during tunneling. Using the mitigations discussed for construction-induced vibrations and settlement could help to alleviate settlement-related impacts.

Erosion impacts of cut-and-cover construction could be mitigated by using standard measures to minimize the erosion potential of the spoils and stockpiles. Designing and installing suitable shoring systems and following the mitigations described for construction-induced vibrations and settlement would reduce the potential for settlement-related damage to nearby structures.

As indicated in Table 4.17.10-1, underground construction for many of the alternatives would generate large volumes of spoils. Potential impacts include erosion at stockpile and disposal sites. Erosion mitigation is discussed above. Disposal of the spoils will depend upon whether the spoils are clean or contaminated, the type of soil (coarse-grained or fine-grained), soil moisture content, regional demand for fill soils at the time the project is undertaken, availability of disposal sites, and several other factors. These determinations require site-specific analysis, construction planning and sequencing, and an economic evaluation.

4.17.11 Hazardous Materials

Potential hazardous materials impacts will be largely beneficial because existing contaminated sites would be cleaned up during project construction. However, adverse impacts can occur if cleanup activities create opportunities for public contact with contaminated soil and groundwater, and if dewatering during construction causes contamination within groundwater to migrate.

Cleanup efforts during construction include removal of contaminated soil and/or groundwater. Contaminated soil typically will be stockpiled then transported from the construction area for further accumulation, treatment, or disposal. Contaminated groundwater removed as a result of dewatering, may be stored in tanks, discharged to the sewer, or transported from the construction site for treatment or disposal.

Soil contamination typically affects only a portion of the property reporting a release, but a release to groundwater may more easily spread beyond property boundaries. Contaminated groundwater poses a potential problem along properties adjacent to tunnels where natural flow induces contaminant migration. Contamination may move laterally into the construction area or vertically to deeper water-bearing zones when underground construction makes connection to the surface (such as at tunnel vents and station entrances). Construction dewatering associated with tunneling or installing structural supports for elevated sections may facilitate contaminant transport into the construction area.

All sites discussed below have documented releases to soil or groundwater. Sites that are on or closely adjacent to the route were considered to have the most likely potential construction impact. Sites of highest concern are noted in Table 4.11-1 (Section 4.11), which lists those sites where a known release is on a displaced property or directly on the route, or which sites adjacent to the route have a documented release to groundwater and subsurface construction is probable.

Two Segment A alternatives are one to two blocks from a known release of petroleum products to groundwater; no impact is expected unless contamination in groundwater migrates. The A1.1 and A2.2 alternatives are further from this site than the A1.2 and A2.1 alternatives, and they would have lower potential for impact. The Roosevelt station in Alternative A1.2 would also directly involve one site.

In Segment B, Alternatives B2.1 and B2.2 would cross coal gasification and dry cleaner sites and be adjacent to other groundwater release sites. Alternative B1 appears to have the lowest potential to impact hazardous materials releases.

In Segment C, no significant impacts to documented hazardous materials releases are expected.

Segment D has 14 known sites adjacent to the route alternatives, including an abandoned landfill, a dry cleaner, and 12 gas stations. Alternative D1.1, which would be constructed at-grade, would have the least potential to impact these sites. Alternative D1.3 would be adjacent to the same sites as Alternative D1.1, but elevated near four of them, and the Alaska and Graham stations could cause an impact with the construction of support columns if contaminated groundwater is encountered. Alternatives D3.3 and D3.4 would cross directly through a site at a planned transition from surface track to retained fill.

Segment E includes 17 known hazardous release sites. Alternative E1.1 would be elevated over two soil petroleum release sites and one groundwater petroleum release site, and at-grade over three contaminated soil sites. Alternative E1.2 would cross the same six sites, but would have a higher likelihood for impact because it would involve subsurface work at all six. Alternative E2 would involve subsurface construction at a groundwater petroleum release site, at three soil release sites, and near six groundwater release sites. It would pass adjacent to a portion of the Renton Junction Landfill, which has not been characterized. Alternative E3 would cross two and pass adjacent to three of the 17 sites, with retain cut-and-fill construction at one site, and an elevated section passing by the Renton Junction Landfill. Alternative E3 appears to present the lowest potential for impacts.

Segment F includes 24 hazardous release sites. Alternative F1, which would be at-grade, would have the least potential for construction impact, and the other alternatives, which include some subsurface construction, would generally have similar, but still low, potential for impact.

Maintenance Base Sites. Based on reported conditions at each site, the M1 S. Lander Street site appears to have the lowest potential for construction impacts associated with existing hazardous materials releases. Site M1 includes a property with a small amount of petroleum-contaminated soil. The N.E. Boeing Access Road (M2) site includes one property with a release of gasoline and diesel oil to groundwater with some floating product noted, and one property where a heating oil release has reportedly been cleaned up. The S.W. Boeing Access Road (M3) site includes two properties with reported gasoline releases to soil where groundwater has not been investigated, as well as a firing range site with a potential for lead contamination. Similarly, no characterization data are available. Based on reported conditions, the M1 S. Lander Street site appears to have the lowest potential for construction impacts.

Mitigation

A formalized health and safety plan and a contaminated soil and groundwater management plan would be required before construction work begins. The management plan could specify contaminated soil stockpiling, transportation, disposal, and treatment elements, as well as groundwater removal, storage, treatment, discharge (to sewer), transportation, and disposal elements. Most encounters with hazardous materials are expected to involve petroleum products that can be managed using relatively standardized approaches.

Public health and safety measures will minimize exposure through both airborne and direct contact routes. Increased setbacks, additional barriers, and expeditious removal may be required to limit contact by the public.

Throughout the construction process, encounters with hazardous materials would be documented and reported appropriately. Project planning will accommodate regulatory agency requirements as well as disposal or treatment facility requirements.

4.17.12 Public Services

Fire and Emergency Medical Services

Some traffic re-routings or delays could affect emergency vehicles during construction; crossings of MLK Jr. Way S. (all D alternatives), Pacific Highway S. (E1.1 and E1.2), and International Boulevard S. (F1, F3.1, and F3.2) could be particularly affected. Emergency service providers may need to develop contingency plans to reduce response time delays during construction. The plans may involve changing routes to avoid street blockages and, depending on the extent of the area under construction, arranging to have emergencies handled by the closest service providers.

Many fire hydrants would need to be relocated during construction. Most of these relocations would occur along at-grade sections requiring sidewalk and street curb relocations, such as on MLK Jr. Way S. (D alternatives), Pacific Highway S. (E1.1), Interurban Avenue S. (E2), and International Boulevard S. (F1). Water line relocations during construction could temporarily affect water supplies used for fire-fighting and hospitals. During relocations, service disruptions would be carefully coordinated with affected fire departments and hospitals to prevent service interruptions.

Law Enforcement

Construction of at-grade and elevated sections in some high-volume traffic and pedestrian areas could require additional police support services to direct and control traffic and pedestrian movements. Traffic mobility during construction in heavily traveled areas such as MLK Jr. Way S. (all D alternatives), Southcenter Mall (E2 and E3), Pacific Highway S. (E1), and International Boulevard S. near Sea-Tac Airport (most F alternatives) could be most difficult, especially during peak hours. Construction contractors would be responsible for maintaining security at sites under construction.

School Bus Routes

Construction of at-grade and elevated Link sections would delay buses traveling on, crossing, or making turns from the roadway under construction. Major north-south school bus thoroughfares such as MLK Jr. Way S. (D alternatives), Pacific Highway S. (E1.1 and E1.2), and International Boulevard S. (F alternatives), would be affected, as would key intersections along these roads (see Section 4.13.2). Buses normally using MLK Jr. Way S. could potentially use Rainier Avenue S. as a reasonable alternate route. Alternate route options for buses on Pacific Highway S. and International Boulevard S. are fewer and less desirable because these are the only major north-south roads through Tukwila and SeaTac, respectively.

Tukwila School District buses transporting students from the west side of Pacific Highway S. to schools on the east side of the highway (that is, Foster High School and Showalter Middle School) could be particularly affected during some construction activities (E1.1 and E1.2). Highline School

District buses serving schools east of International Boulevard S. could also be affected (all F alternatives). Some bus stops would need to be relocated during construction of at-grade sections and possibly during construction of elevated sections.

School bus stops located near Link stations, elevated sections, tunnel portals, and other system features requiring aboveground construction would likely need to be temporarily or permanently relocated. The safety of school children walking to and from bus routes located in the vicinity of any aboveground construction activity is a concern, and will be carefully examined during project design.

Solid Waste Collection

Solid waste haulers could experience slight delays or disruptions on collection routes during construction activities, especially along route segments in which access to curbsides, driveways, or other access points would be closed or impeded. Alternative solid waste collection locations, modified collection times, or other elements to minimize potential impacts to the city's solid waste collection operations would be developed in coordination with solid waste haulers.

Construction and demolition debris could be disposed of at a number of disposal facilities in the Puget Sound region. A portion of this debris, including clean wood waste, metals, gypsum, and other materials, can be recycled at facilities such as Seattle's recycling and disposal stations.

Mitigation

Sound Transit will work with the cities of Seattle, Tukwila, SeaTac, and Port of Seattle police and fire departments, transportation divisions, and others, through Sound Transit's Fire and Life Safety Committee, during project construction to ensure that reliable emergency access is maintained and that alternate plans or routes are developed to avoid significant delays in response times. It will coordinate with local police departments to ensure adequate staffing during construction for traffic and pedestrian movement control and other necessary policing efforts. Additional staffing requirements and financial responsibilities for police services required during construction would be determined in collaboration with the local police departments. Sound Transit will coordinate with fire departments and hospitals during water utility relocations to prevent water supply disruptions to these facilities, and it will notify school districts of major construction activities that may affect bus routing during the upcoming school year. Sound Transit will work with local jurisdictions and solid waste haulers to minimize impacts to solid waste collecting operations during Link construction.

4.17.13 Utilities

Utility pipes, lines, conduits, cables, and other infrastructure would need to be relocated or otherwise avoided during construction. Major utilities that would be crossed, and the approximate length of utility infrastructure that could be affected in areas where the routes parallel utilities, are identified in Table 4.17.13-1. Potential impacts to utilities are based on an examination of available utility maps, discussions with utility representatives, and field visits, and may not completely or precisely assess all existing utilities. Precise locations and depths of utilities and impacts on them will be verified in later design stages and prior to construction of the Link facilities. The table identifies impacts to major utilities (e.g., minimum of 36-inch storm drains, 24-inch sewer pipes, 16-inch water lines, and high-pressure gas lines) only; numerous smaller utility conveyances and connections to homes and businesses would also be affected and would either need to be relocated or otherwise avoided during construction. Sound Transit's Utility Protection and Relocation Policy, which will be further refined in the design process, establishes specific policies and procedures for relocating, replacing, protecting, and monitoring utilities during construction, and should minimize the potential for significant impacts.

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

Table 4.17.13-1
Potential Impacts of Central Link Construction on Major Utilities.[a]

Rail Segment	Storm Drains[b]		Sanitary & Combined Sewers[c]		Water Mains[d]		Fiber Optics[e]		Overhead Power		Underground Power		Natural Gas[g]		Petroleum (Jet Fuel)		UW Utility Tunnels	
	Parallel (ft)	# of Xings	Parallel (ft)	# of Xings	Parallel (ft)	# of Xings	Parallel (ft)	# of Xings	# of Poles	# of Xings	Parallel (ft)	# of Xings	Parallel (ft)	# of Xings	Parallel (ft)	# of Xings	Parallel (ft)	# of Xings
Northgate to University District																		
A1.1	–	–	–	2	2,500	6	2,000	–	20	–	–	2	–	1	–	–	–	–
A1.2	–	–	–	2	2,500	6	–	1	20	–	1,200	1	–	1	–	–	–	–
A2.1	–	–	–	2	–	7	–	1	20	–	3,600	1	–	3	–	–	–	–
A2.2	–	–	–	2	–	7	–	–	20	–	3,600	1	–	3	–	–	–	–
Notable features: 66"/72" brick sewer on Ravenna Blvd; 42" water on 12th Ave. N.E.																		
University District to Westlake Station																		
B1[i]	–	–	–	1	4,400	4	–	4	25	–	–	–	–	–	–	–	–	3
B2.1[i]	–	–	–	7	4,100	10	–	6	17	5	–	–	–	–	–	–	1,400	2
B2.2[i]	–	–	–	6	2,900	4	–	6	NA	NA	–	–	–	–	–	–	–	3
Notable features: 96" sewer tunnel in University District; UW utility tunnel system on Campus Pkwy, N.E. 40th St., and Pacific Ave.; 108" brick sewer on N.E. Pacific; 66" sewer @ 7th Ave. and Denny Way.																		
Westlake Station to S. McClellan Street																		
C1	700	–	3,600	–	–	6	3,400	5	15	–	–	2	–	–	–	–	–	–
C2.3	4,700	1	4,000	2	1,000	6	–	4	63	–	–	2	–	–	–	–	–	–
C2.4	4,800	–	4,400	2	500	6	–	4	63	–	–	1	–	–	–	–	–	–
C3	900	–	–	2	–	5	–	4	NA	–	–	2	–	–	–	–	–	–
Notable features: 42" water on 12th Ave. S., 13th Ave. S., and Beacon Ave. S.; 66" water on 20th Ave. S.; 102" storm in old railroad ROW west of Rainier Ave. S.; numerous major utilities on Rainier Ave. S.																		
S. McClellan Street to Boeing Access Rd																		
D1.1	600	–	6,400	3	1,100	5	–	1	326[h]	1	–	–	2,500	1	–	1	–	–
D1.3	600	–	6,400	3	1,100	5	–	1	326	1	–	–	2,500	1	–	1	–	–
D3.3	600	–	6,400	3	1,100	5	–	1	326	1	–	–	–	1	–	1	–	–
D3.4	600	–	6,400	3	1,100	5	–	1	326	1	–	–	–	1	–	1	–	–
Notable features: 60" sewer on MLK Jr. Way S. and proposed 48" sewer pipes on S. Henderson St.; 42", 54", and 66" water on Beacon Ave. S.; transmission lines and jet fuel line crossings of MLK Jr. Way S. near Henderson St.; HP gas line on MLK Jr. Way S. south of Henderson St.																		
Boeing Access Rd to SR 518 (Tukwila)																		
E1.1	–	–	–	3	–	1	–	1	171	1	–	–	–	2	–	–	–	–
E1.2	–	–	–	3	–	1	–	1	171	1	–	–	–	2	–	–	–	–
E2	–	1	17,000	6	–	3	3,700	1	106	3	–	–	–	1	–	–	–	–
E3	–	1	2,800	8	–	2	–	–	43	2	–	–	–	–	2,800	–	–	–
Notable features: 20" HP gas line and other major utilities in railroad ROW at Boeing Access Rd. crossing; transmission lines and 48" water on S. 112th St. (extended); 96" and other sewer force main on Interurban Ave. S. from Interurban pump station; 60" water along Tukwila Pkwy, Andover Park E., and Baker Blvd. (extended) at Southcenter; transmission line crossings in vicinity of West Valley Hwy.																		
SR 518 to S. SeaTac Station (SeaTac)																		
F1	5,300	1	–	–	4,800	1	–	–	183	1	9,000	–	5,200	1	12,900	–	–	–
F2.1	4,800	1	–	–	2,000	2	–	–	37	–	4,000	–	3,900	2	–	9	–	–
F2.2	2,600	1	–	–	–	2	–	–	22	2	2,500	0	3,900	2	–	9	–	–
F3.1	3,100	1	–	–	2,200	1	–	–	113	–	1,000	1	6,000	–	12,900	3	–	–
F3.2	400	2	–	–	3,600	1	–	–	95	–	1,000	1	4,000	–	5,100	3	–	–
Notable features: 60" water on S. 160th St.; underground power for length of Int'l Blvd; numerous major utilities on Int'l Blvd, especially between S. 170th and S. 192nd St. (storm, HP gas, jet fuel, water); Sea-Tac Airport utility tunnel (F3.2).																		

Notes: NA not available at this time.
[a] Data compiled from June 10, 1998 in-progress utility information plans and from July 1998 data updates
[b] Major storm drainage utilities ≥36-inch diameter.
[c] Major sanitary sewer utilities ≥24-inch diameter (gravity); ≥12-inch diameter (force mains).
[d] Major water mains ≥16-inch diameter.
[e] Indicates underground fiber-optic cables only; elevated cables on utility poles may also be affected.
[f] 115-kV and 230-kV transmission crossings only. Does not include distribution line crossings.
[g] High-pressure (HP) gas lines only.
[h] Substantially fewer utility poles would be affected under Alternative D1.1d than D1.1c.
[i] All B routes would cross an underground steam line, and B2.1 would parallel the line for 350 ft.
Locations of other fiber-optic cables, including Pacific Fiber Link, MFS/Worldcom, Starcom, City of Seattle, and possibly other telecommunications fiber-optics were not available.

typically run parallel beneath streets, placed in various locations ranging from the center to the roadway periphery; fiber-optic cables, telephone lines, underground electrical conduits, and smaller pipes are often located beneath sidewalks. These utilities may or may not be affected during construction, depending on their depth below grade, material composition, the excavation limits, the exact location of proposed track, and other factors. In general, however, most underground utilities crossed by the proposed route that are located within approximately 6 ft of surface grade and within 35 ft directly under elevated segment columns would be relocated to allow for excavation and to minimize potential load impacts on existing utilities from the weight of the Link trains and infrastructure.

Several potential impacts may be significant in terms of costs, service disruption, or loss of access. These include relocation of numerous utility poles supporting overhead lines; relocation of underground utilities from the track zone, station areas, and maintenance facility site (particularly in line segments constructed in street rights-of-way) and inspection, repair, and encasement of underground utilities at track crossings. In addition to those utilities identified in Table 4.17.13-1, project construction would also affect fiber-optic cables, telephone lines, and cable television lines strung on impacted utility poles. The project may also relocate utilities occupying the right-of-way, posing a safety hazard, or conflicting with construction activities. Access to underground utilities (i.e., manholes and vaults) for maintenance activities could be affected depending on the location of Link facilities. In some cases, access points, including manholes and manhole covers, may need to be relocated. Relocating water mains could also affect access to and use of fire hydrants. Disruptions to utility service during utility relocations would likely be minimal because temporary connections to customers would typically be established before relocating utility conveyances. However, inadvertent damage to underground utilities can occur during construction if utility locations are uncertain or misidentified. While such incidents do not occur frequently, the numerous relocations required during Link construction under any alternative makes accidents more likely. Such accidents could temporarily affect service to customers served by the affected utility.

Generally, at-grade Link routes would have the greatest impacts on utility infrastructure, because at-grade segments require more relocations of aboveground utility poles for right-of-way curb and sidewalk acquisition. At-grade routes also have the potential to require relocation of longer sections of underground pipes and cables in street rights-of-way. Major underground electric distribution line relocations could require a 12-month lead time for design and construction; overhead steel transmission pole delivery could take up to 18 months; and underground transmission line relocation could take up to 30 months (Gray 1998 personal communication). Any such delays could potentially affect service to existing Seattle City Light and Puget Sound Energy customers. Bridge work and fittings and supports for elevated sections could require relocation of utilities. Tunnel sections may or may not affect underground utilities, depending on the section depth. Construction of stations, ventilation shafts, the maintenance facility, parking areas, and other Link facilities would be likely to affect utility infrastructure.

Segment Impacts

Notable or potentially significant impacts associated with specific route alternatives include the following (see Table 4.17.13-1 for more detailed information):

Segment A. A1 alternatives could require more relocations of water mains, fiber-optics (A1.1), and utility poles than A2 routes; A2 routes could require more relocations of underground and overhead power lines and natural gas lines than A1 routes.

Segment B. University of Washington utility tunnel crossings between N.E. Campus Parkway and Portage Bay could be affected under all B alternatives (including potential parallel conflicts on N.E. Campus Parkway (B2.1).

Segment C. Potential relocations of storm drains could be greater under C2.3 and C2.4. Potential impacts to combined and sanitary sewers could be greater with Alternative C1, C2.3, and C2.4 than with Alternative C3.

Segment D. All D alternatives except D1.1d would require significant relocation of aboveground utility poles. Alternative D1.1d would require taking substantially less curb and sidewalk in many areas during construction than the other D1.1 options, thereby avoiding many existing utility poles. A 230-kV transmission tower located just west of MLK Jr. Way S. and north of S. Henderson Street may have to be relocated pending design requirements.

Segment E. Alternatives E1.1, E1.2, E2, would require substantial utility pole relocations. A substantially larger amount of major sewer line could be affected under Alternative E2 than under any of the other alternatives. In addition, the city of Tukwila requires all new or relocated utilities to be located underground, including utility distribution poles requiring relocation under E1.1, E1.2, and E2. It is also possible that columns from elevated section of E2 could affect the 108-inch piped section of the Gilliam Creek drainage near the Southcenter frontage road north of Andover Park West (see Section 4.8).

Segment F. Substantially more underground power lines could be affected under Alternative F1 than under any of the other F alternatives and any other segments. Alternative F1 would also require substantial utility pole relocation. Potential impacts on storm drains, water mains, and natural gas and jet fuel lines would be greater under the F alternatives (especially F1) than under the other segment alternatives. There would also be potential conflicts with the Sea-Tac Airport utility tunnel and water cooling system (F3.2).

Maintenance Facility Impacts

Maintenance facility construction could potentially affect the following adjacent utilities during staging, facility construction, and track construction:

Site M1. Sewer line on S. Lander Street; fiber-optic cable on Sixth Avenue S.; and a water main on S. Airport Way.

Site M2. Sewer line on MLK Jr. Way S. and S. Norfolk Street; and fiber-optic cable on S. Norfolk Street. Drainage utilities at the corner of Boeing Access Road and MLK Jr. Way S.

Site M3. Sewer lines on Interurban Avenue S. and E. Marginal Way S.; three 115-kV and 230-kV transmission lines and a water main in the transmission line right-of-way on the southern border of the site (S. 112th Street extension).

Mitigation

Sound Transit would use one or more of the following mitigation measures to minimize the potential impacts of Link construction on utility services and infrastructure:

- Adjust alignment or station locations where feasible to prevent a major utility relocation.
- Identify precise locations of underground utilities in the field prior to construction; conduct condition checks as required.
- Implement and comply with Sound Transit's Utility Protection and Relocation Policy.
- Develop a contingency plan to address any potential utility service disruptions during construction.
- Notify utility customers of planned disruptions.
- Work with Seattle City Light and Puget Sound Energy to maintain energized electrical lines to provide continuous service to their customers during construction; and maintain clearances of temporary and permanent overhead lines and poles according to Washington Administrative Code safety standards.

- Comply with city requirements and procedures for utility construction, inspection, and operation.
- Use pipe and conduit support systems, trench sheeting and shoring, and other precautionary measures during construction to minimize the potential for damage to exposed utilities.

4.17.14 Historic/Archaeological/Cultural Resources

4.17.14.1 Historic Resources

No substantial impacts during construction are anticipated within Segments A, E, and F. In Segment B, construction impacts would occur under all alternatives with the new Convention Place Station option. Impacts associated with station construction would also occur under Alternative B1 and may temporarily affect the Harvard-Belmont Historic District, two Anhalt Apartment houses, and the Jesuit College (Garrand Building).

The most substantial construction impacts would occur in Segment D under Alternative D3.4. The cut-and-cover tunnel and station within the Columbia City Historic District would temporarily affect numerous contributing district buildings. Demolition and construction of trackway on the west side of Rainier Avenue S. under this alternative and Alternative D3.3 would affect four historic houses adjacent to the route.

Mitigation measures may be required for up to 12 historic resources, including two districts. Section 4.15 identifies by segment the number of historic resources that would require mitigation measures because adverse impacts caused by short-term audible, visual, and atmospheric elements that are out of character with the historic resource or which would alter its setting. In such cases, the construction methods would need to be modified to avoid or limit these impacts. Mitigation options include: protecting nearby building facades from excessive dirt by increasing the normal cleaning and maintenance program; phasing construction work to reduce noise and to limit physical obstructions that would disrupt access and/or normal daytime use of the resource; and placing temporary construction sheds, barricades, or material storage to avoid obscuring views of historic resources.

4.17.14.2 Archaeological Resources

Impacts from construction that would most likely affect archaeological sites are those associated with site preparation work. Grading/excavation to establish track grade and trenching to locate/relocate utilities can greatly harm archaeological deposits that might be present. Excavation to establish fittings for elevated track support columns can also harm such deposits. Impacts to traditional cultural properties occurring during construction are less problematic than long-term operational impacts to such properties (e.g., permanent change in land use, loss of access, increased noise levels and introduction of visual obstructions). The impacts associated with construction that are most likely to affect important paleontological deposits are similar to those that would result in adverse impacts to archaeological sites (e.g., grading, excavation/trenching, and other earth-disturbing operations). Presently undetected archaeological (or paleontological) sites that may occur in high-probability areas would be subject to similar impacts during construction.

Table 4.15-2 summarizes known/recorded archaeological sites and important paleontological deposits located in Segment E. Known/documented traditional cultural properties are present in Segment E and at Maintenance Base Site M3.

Mitigation measures for known/recorded archaeological sites located in Segment E include subsurface testing prior to construction, data recovery prior to construction, and monitoring during construction. Mitigation measures for paleontological finds would consist of salvage during construction. Mitigation measures for traditional cultural properties will be determined in consultation with affected Tribes. High probability areas are present in Segments B, D, E, F, and at the Maintenance Base Sites (see Table 4.15-2). Mitigation measures to lessen potential harmful impacts from construction at presently undetected archaeological sites include subsurface testing before construction and monitoring during construction.

4.17.15 Parklands

In general, construction impacts are related to the proximity of the parklands to the construction of nearby tunnel portals, elevated sections across or near park facilities, cut-and-cover sections and stations, at-grade sections, and TPSS and vent shafts.

The resulting impacts can be direct (such as temporary easements within park facilities, temporary trail detours, or temporary access restrictions) or indirect (increased truck traffic in the vicinity, possible street closures and resulting traffic detours, increased noise and/or vibration related to the use of heavy equipment, and dust).

4.17.15.1 Impacts by Segment

Alternatives B1, B2.1, and B2.2 would impact the Burke-Gilman Trail by requiring a possible temporary trail detour during work immediately adjacent to or across the trail. Alternative B2.1 would impact North and South Passage Point Parks because they may be temporarily closed to ensure safe access and maneuverability for trucks and heavy equipment used for the construction of the pier footings and piers and bridge structure.

Alternative C1 would impact the extreme western edge of the East Duwamish Greenbelt (along I-5) by requiring a temporary easement to clear vegetation for construction of the tunnel portal. Alternative C3 would impact the I-90 Trail and the western trail spur within the future Sister City Park. The trail could possibly be temporarily closed to ensure safe access and maneuverability for trucks and heavy equipment used to construct the I-90 (17th Avenue S.) station, place the elevated structure foundation, and (potentially) re-locate the western trail spur.

Alternatives E1.1, E2, and E3 would impact the Duwamish/Green River Trail by requiring a possible temporary trail detour during work across the trail. Alternative E1.1 would impact Southgate Greenbelt Park because a temporary construction easement at least 15 ft wide would be required to construct the footings for a retaining wall along the eastern side of SR 99; this easement would be cleared of all vegetation to allow for the necessary work.

Alternative E2 would affect the portion of the Foster Golf Course that lies within the Seattle City Light right-of-way. That area would be disturbed and fully used during construction for truck and heavy equipment movements and staging activities.

Alternative E2 would also impact the proposed Log Cabin Park, which if developed prior to the light rail route, could impede access by construction activities along the access road to the park (removal of existing pavement, grading and track work).

Alternative E2 and E3 would impact the Interurban Trail by requiring a possible temporary trail detour during work across the trail.

Angle Lake Park would be impacted by Alternative F1 to widen International Boulevard. A 25-ft-wide strip would be acquired and the existing landscaping and sidewalk within this strip would be removed to allow for construction.

4.17.15.2 Parkland Mitigation

In each case noted above, the impacts would be mitigated by restoring the site to pre-project conditions after construction. This would involve re-landscaping disturbed areas, and providing new vegetation, where possible, to buffer the facilities from the light rail. In general, access to these facilities would be maintained (although in the case of Foster Golf Course, Log Cabin Park, and Angle Lake Park, special detour entrances would need to be established, and access to North and South Passage Point Parks may be temporarily closed). Dust would be mitigated through use of dust control measures.

4.17.6 Significant Unavoidable Adverse Impacts During Construction

The potentially significant adverse impacts that would occur during construction, and may not be avoidable, are outlined below. These are based on the current conceptual design. As the design process continues, Sound Transit will refine construction approaches and attempt to further reduce potential construction-related impacts.

Potentially significant traffic impacts include:

- Temporary lane or roadway closures during off-peak hours of the day
- Temporary increase in truck traffic in construction staging areas
- Temporary loss of parking in some construction areas

Actual and perceived disruption during the construction phase could create economic hardships for some businesses. Small businesses could be more vulnerable to prolonged periods of construction activity, and could close permanently. Other businesses could experience a short-term decline in revenues due to reduced business activity. Construction activities could impact nearby residential and institutional land uses.

Construction impacts in most wetlands would not be significant; however, construction impacts to forested wetlands are more difficult to mitigate and would be significant. The USFWS and NMFS may require additional construction mitigation measures to reduce potential significant impacts on bald eagles, peregrine falcons, and Chinook salmon. These mitigation measures would be identified in a Biological Assessment.

All alternatives, especially those with at-grade segments, would likely require relocating a substantial number of major and especially smaller utilities.

4.18 CUMULATIVE EFFECTS

4.18.1 Introduction

Cumulative effects are defined as "the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency or person undertakes such other actions" (40 CFR S1508.7). The process of analyzing cumulative effects has influenced all components of the Link environmental review process, including scoping, describing the affected environment, developing alternatives and evaluating environmental impacts.

Scoping

During the EIS scoping process, and development of the Draft EIS, Sound Transit solicited information from other agencies and the public, to identify potential impacts and to develop alternatives for the Draft EIS. For example, Sound Transit received information from the following:

- Local jurisdictions provided land use plans, transportation plans, neighborhood plans and lists of known, major land use proposals
- WSDOT, Federal Transit Administration, Federal Highway Administration, and the Port of Seattle provided information on planned transportation projects and developments,
- PSRC provided population and employment growth projections, travel forecasts, and land use projections, and
- Other organizations and the public provided information on planned private projects, community values and concerns.

This information has been used to identify potential future actions by others, identify background growth projections, and define potential cumulative effects.