Appendix F4.11
Geologic Unit Summaries, Hazard Areas, and Boring Locations

TABLE F4.11-1
Summary of Geologic Units and their Engineering Properties

Geologic Unit (Map Symbol)	Description	General Constructability	Density/ Hardness	Strength	Permeability	Liquefaction Potential[b]
Modified land (hatching) or (m)[a]	Fill and/or graded natural deposits that obscure or alter the original deposit.	Variable	Very soft to stiff or very loose to dense	Potentially low	Variable	Potentially high
Wetland deposits (Qw)	Organic-rich sediment, peat, and fine-grained alluvium, poorly drained and intermittently wet. Not all deposits have been mapped.	Low	Very soft to medium stiff or very loose to medium dense	Potentially low	Variable	Potentially high
Mass wastage (Qmw)	Colluvium, soil, landslide debris, and organic matter. Common below springs where peaty deposits are also present. Mapped on steep slopes. Deposits, both mapped and unmapped, include abundant landslides up to 500 feet long.	Low	Loose to dense and soft to stiff; variable degree of consolidation depends on material in colluvium and its coherency	Potentially low	Variable	Potentially high
Landslide (Qls)	Blocks of surficial deposits transported downslope en masse by gravity. Numerous unmapped areas of both landslide and related mass-wastage deposits occur along slopes. Landslide terrain often includes benches that slope back into the hillside and have wetlands and peat deposits.	Low	Very loose to very dense or soft to hard; variable degree of consolidation depends on material coherency	Potentially low	Variable	Potentially high
Tideflat deposits (Qtf)	Silt, sand, organic sediment, and detritus, with some shells, historically exposed in broad coastal benches at low tide and now covered with fill.	Low	Very loose to dense or very soft to stiff	Potentially low	Variable	Potentially high
Lake deposits (Ql)	Silt and clay with local sand layers, peat, and other organic sediments deposited into Lake Washington. Most mapped areas are lake bottom sediments exposed when Lake Washington was lowered in 1916. At many locations, the lake deposits are thin and overlie a dense substrate. Commonly capped by fill to improve building sites.	Low	Very soft to medium stiff or very loose to medium dense	Potentially low	Low	Potentially high
Vashon recessional outwash deposits (Qvr)	Layered sand and gravel. Deposited in outwash channels of melting glaciers during the ice retreat. Also includes deposits that accumulated in or adjacent to recessional lakes. Deposits less than about 3 feet thick not shown on map.	Medium	Loose to dense	Low t o medium	Low	Potentially high
Vashon recessional lacustrine deposits (Qvrl)	Thinly layered silt and clay with local sand layers, peat, and other organic sediments, deposited in slow-flowing water and temporary lakes.	Low to medium	Very soft to stiff	Medium	Low	Medium

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Summary of Geologic Units and their Engineering Properties

Geologic Unit (Map Symbol)	Description	General Constructability	Density/ Hardness	Strength	Permeability	Liquefaction Potential[b]
Vashon till (Qvt)	Compact mixture of silt, sand, and gravel, glacially transported and deposited under ice. Contains layers of sand and gravel and cobbles are common. Upper 3 feet of till generally weathered and only medium dense to dense.	High	Dense to very dense; sand is commonly less dense	High	Low	Low
Vashon advance outwash (Qva)	Sand and gravel deposited by streams from advancing ice sheet. Silt lenses locally present in upper part and are common in lower part.	High	Dense to very dense	High[c]	High	Low
Lawton Clay of Mullineaux and others (1965) (Qvlc)	Thinly layered to a mixture of silt and clay with scattered pebbles deposited in lowland proglacial lakes.	High	Very stiff to hard	High	Low	Low
Deposits of pre-Fraser glaciation, undifferentiated (Qpf)	Layers of sand, gravel, and silt, with and mixtures. Locally divided into: • Coarse grained deposits (Qpfc) – Sand and gravel, clean to silty, with some silt layers. • Fine grained deposits (Qpff) – Silt and clay, may have sand layers.	High	Very dense and hard	High	Variable	Low
Deposits of pre-Fraser glaciation age, nonglacial deposits (Qpfn)	Sand, gravel, silt, clay, and organic deposits.	High	Very dense and hard	High	Variable	Low
Deposits of pre-Olympia age, fine-grained deposits (Qpof)	Silt and clay, may have sand layers.	High	Hard	High	Low	Low
Deposits of pre-Olympia age, coarse grained deposits (Qpoc)	Sand and gravel, clean to silty, with some silt layers.	High	Very dense	High[c]	High	Low
Deposits of pre-Olympia age, glacial deposits (Qpog)	Silt, sand, and gravel.	High	Very dense and hard	High	Variable	Low

TABLE F4.11-1
Summary of Geologic Units and their Engineering Properties

Geologic Unit (Map Symbol)	Description	General Constructability	Density/ Hardness	Strength	Permeability	Liquefaction Potential[b]
Deposits of pre-Olympia age, fine-grained glacial deposits (Qpogf)	Silt and clay, may have sand layers.	High	Hard	High	Low	Low
Deposits of pre-Olympia age, glacial diamict (Qpogd)	Till-like material, but finer grained and with fewer gravel.	High	Very dense and hard	High	Low	Low
Deposits of pre-Olympia age nonglacial deposits (Qpon)	Sand, gravel, silt, clay, and organic deposits.	High	Very dense and hard	High	Low	Low
Deposits of pre-Olympia age fine-grained nonglacial deposits (Qponf)	Silt and clay, may have sand layers and peat.	High	Hard	High	Low	Low

[a] Areas mapped as artificial fill are locations where fill placement is relatively extensive and is likely to be thick enough to be of geotechnical significance (greater than about 6.5 feet thick).

[b] Liquefaction depends in part on density of the material and the groundwater table elevation. These ratings assume a shallow groundwater condition.

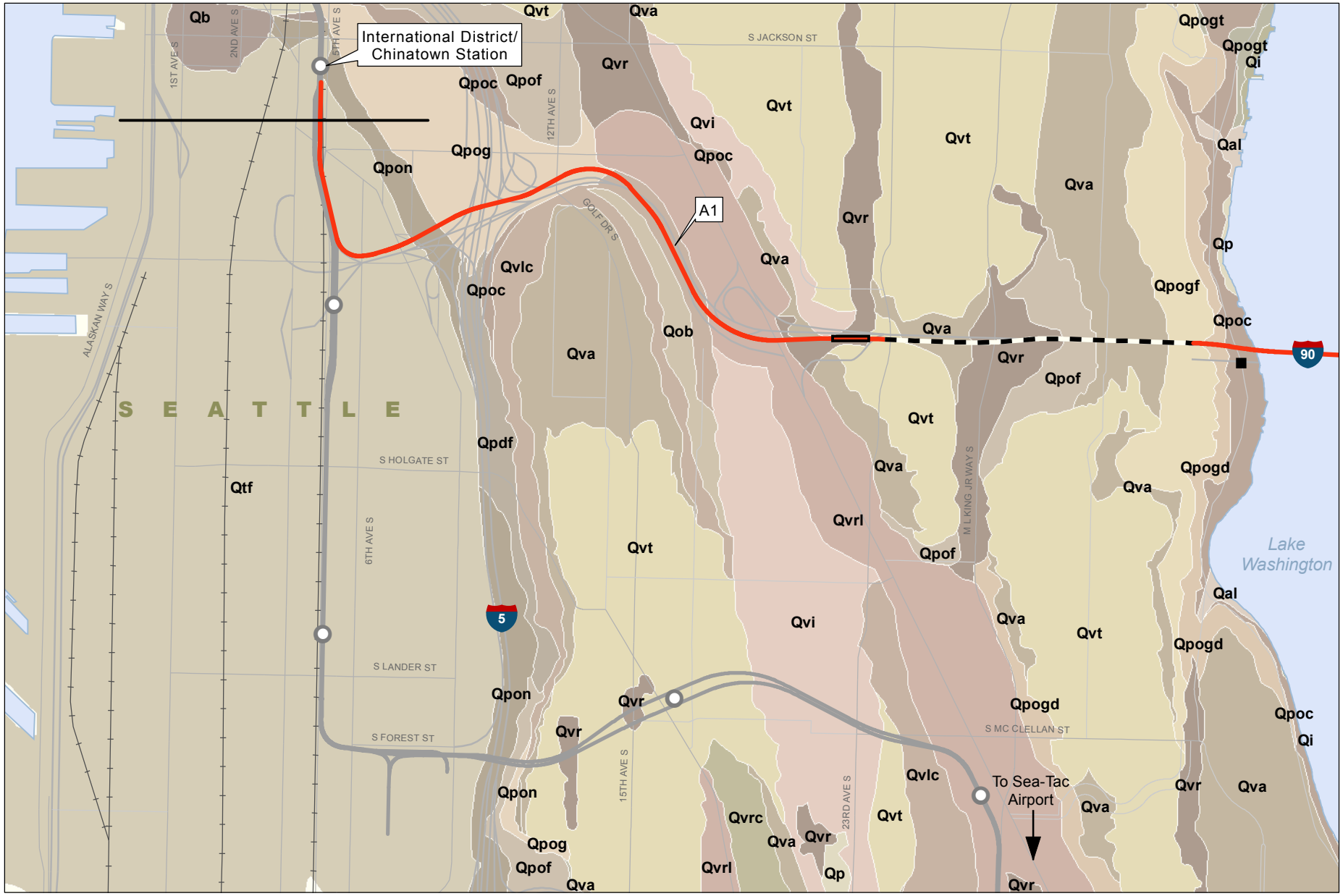
[c] High strength unless cut vertically below the water table, then potentially low to medium strength.

Notes:

The descriptions and density/hardness are based on the following sources: Troost et al. (2005), Troost and Wisher (2006).

The terms low, medium, and high were determined based on professional opinion from experience with the soil types.

Hazard susceptibility was determined based on criteria in the cities of Seattle, Bellevue, and Redmond Code; King County Code; and professional opinion.



Source: Data digitized from GeomapNW at the University of Washington (2007); Sound Transit (2007) and King County (2006).

- Route at Grade
- Elevated Route
- Route in Retained Cut
- Route in Tunnel
- Traction Power Substation
- Proposed Station
- Central Link Alignment and Station

Exhibit F4.11-1
Surficial Geology
Segment A - Seattle
East Link Project

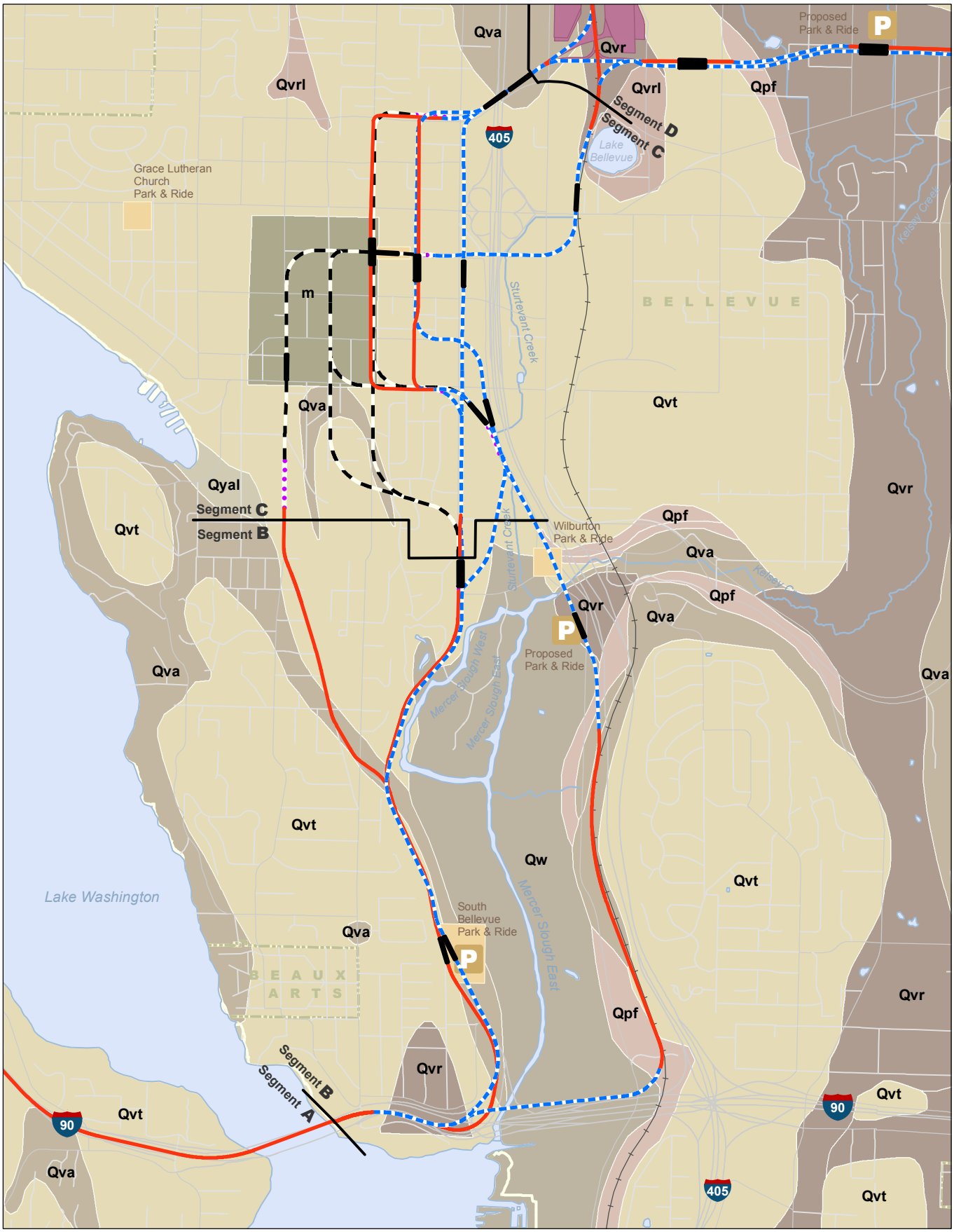
Source: Data digitized from GeomapNW at the University of Washington (2007); King County (2006).

- Route at Grade
- Elevated Route
- Route in Retained Cut
- Route in Tunnel
- Traction Power Substation
- Proposed Station
- City Limits

N

0 0.25 Miles

Exhibit F4.11-2
Surficial Geology
Segment A - Mercer Island
East Link Project



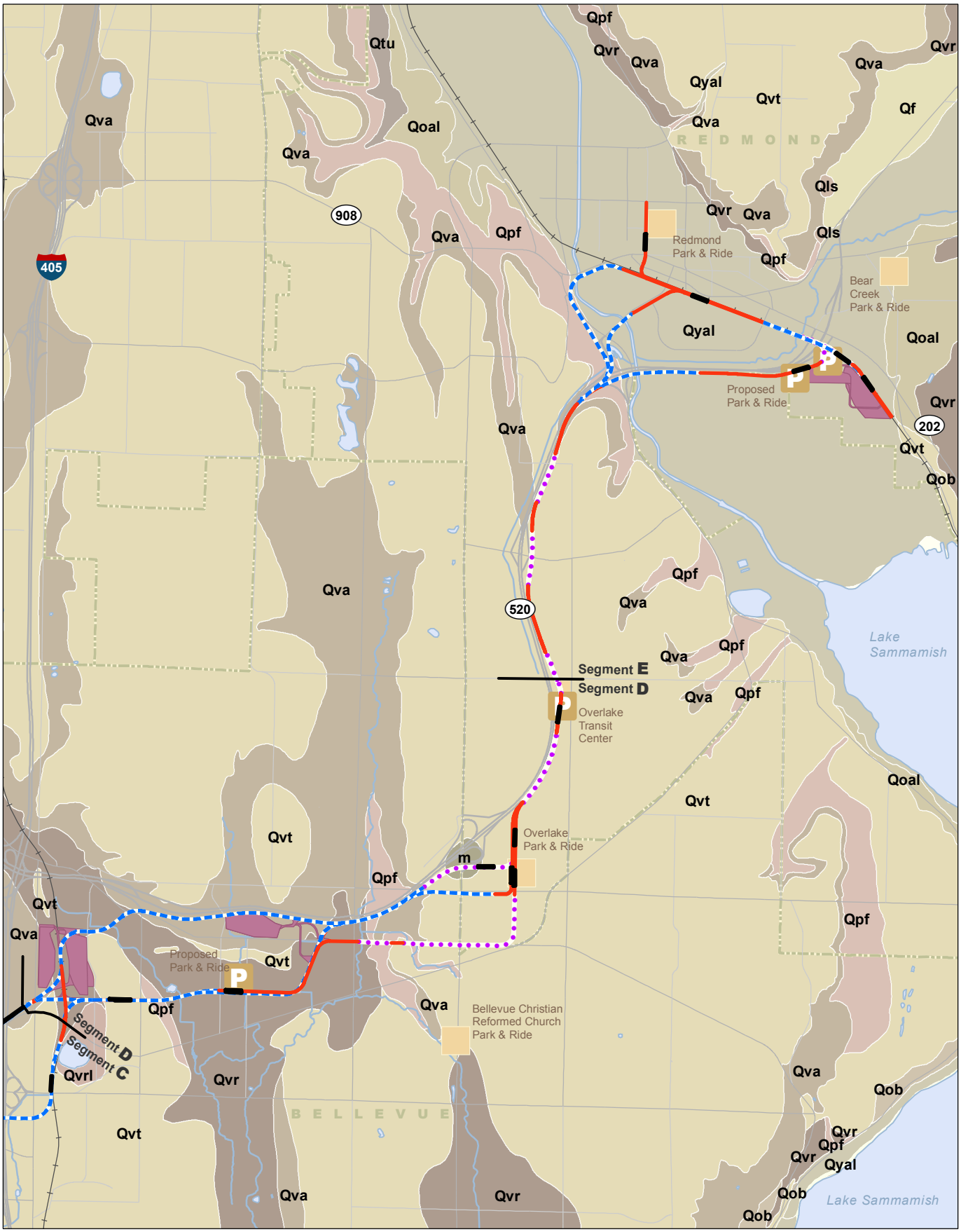
Source: Data from City of Bellevue (2005) and King County (2006).

- Route at Grade
- Elevated Route
- Route in Retained Cut
- Route in Tunnel
- Proposed Station
- City Limits

N

0 0.25 Miles

Exhibit F4.11-3
Surficial Geology Segments B and C
East Link Project



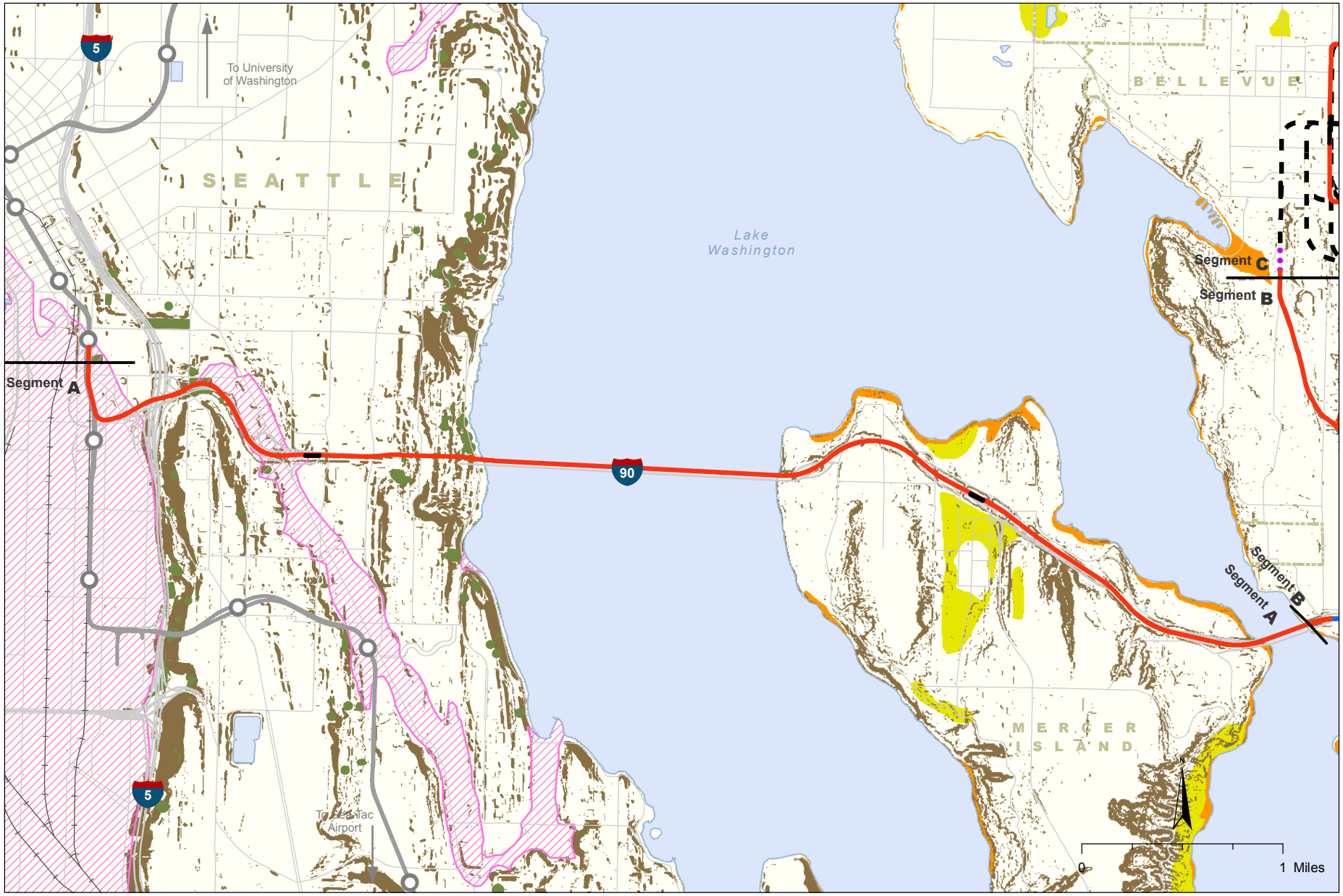
Source: Data from City of Bellevue (2005) and King County (2006).

- Route At Grade
- Elevated Route
- Route in Retained Cut
- Route in Tunnel
- Proposed Station
- Maintenance Facility
- City Limits

N

0 0.5 Miles

Exhibit F4.11-4
Surficial Geology Segments D and E
East Link Project



Source: Data from City of Seattle (2003), City of Bellevue (2003), King County (2006), and Sound Transit (2007).

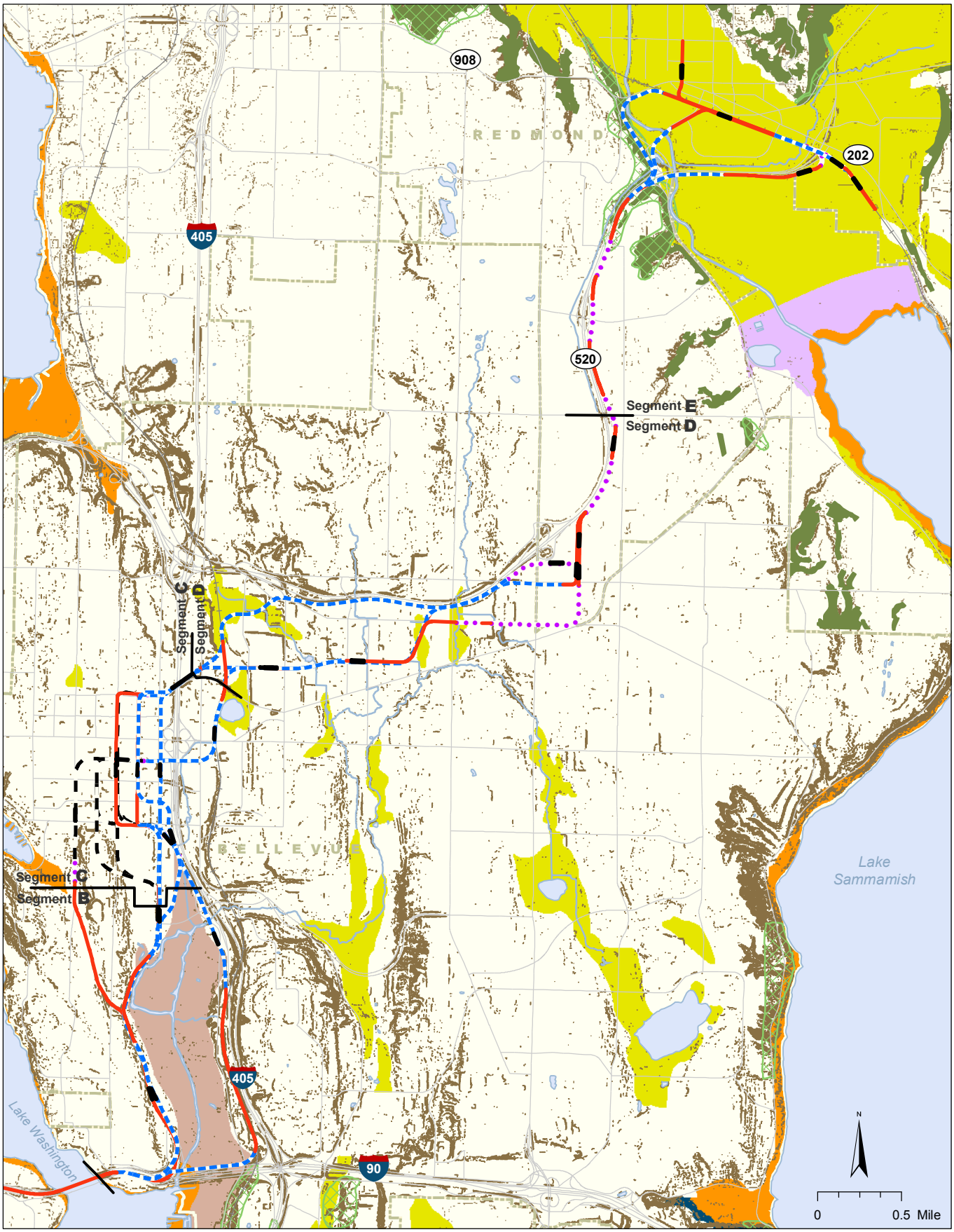
Liquefaction Hazard Type
(City of Bellevue including Mercer Island)
- Low to Moderate
- Moderate to High
- Bedrock
- Peat
- Transition Zone

- Liquefaction Hazard Area (City of Seattle)
- Landslide Hazard Area (City of Seattle)
- Steep Slope Greater than 40% (City of Seattle & King County)

- Route at Grade
- Elevated Route
- Route in Retained Cut
- Route in Tunnel

- Proposed Station
- Central Link Alignment and Station
- City Limits

Exhibit F4.11-5
Geologic Hazard Areas
Segment A
East Link Project



Liquefaction Hazard Type

- Low to Moderate
- Moderate to High
- Bedrock
- Peat
- Transition Zone

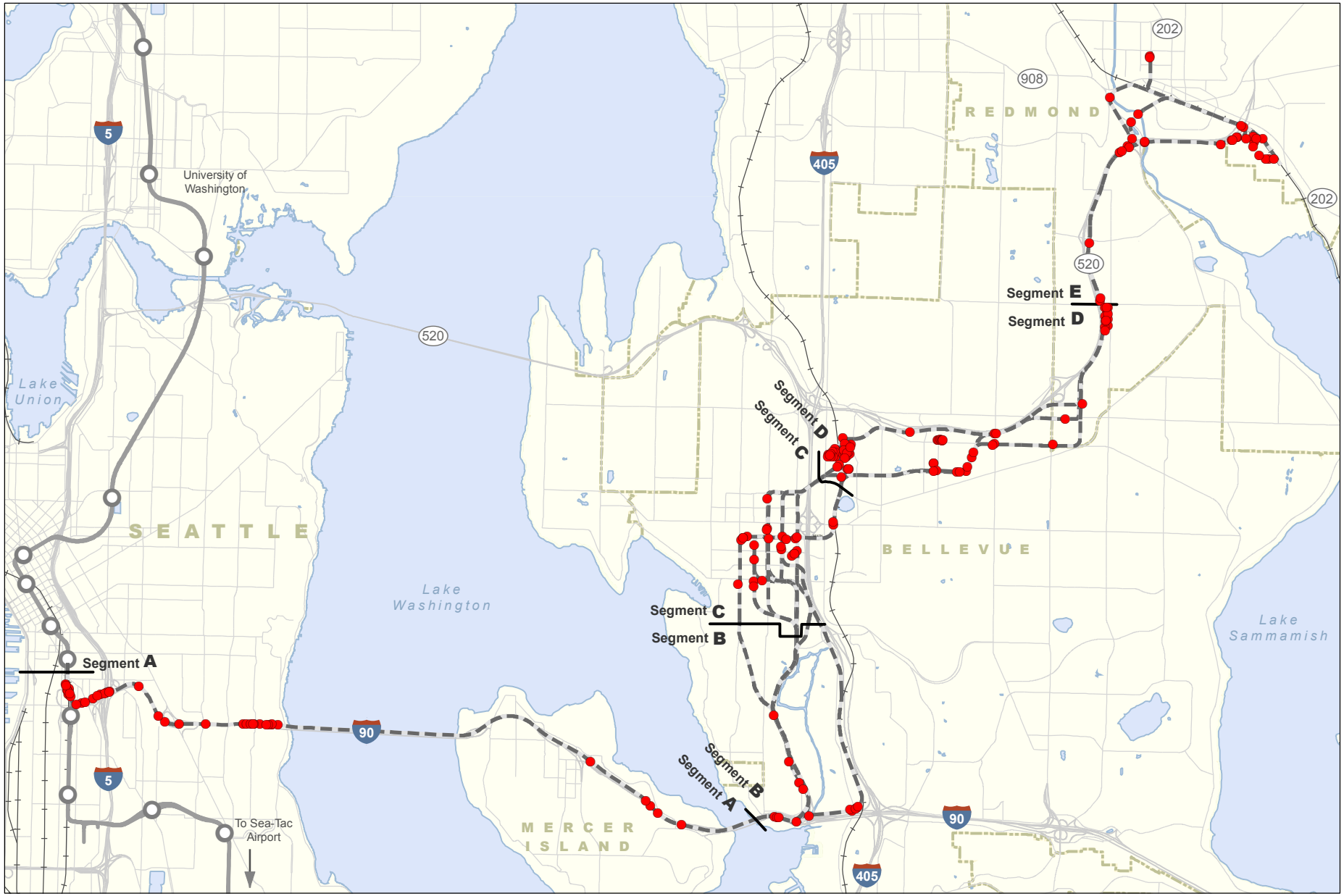
- Landslide Hazard Area (City of Redmond)
- Landslide Hazard Area (King County)
- Steep Slope Greater than 40% (City of Bellevue & King County)

- Route at Grade
- Elevated Route
- Route in Retained Cut
- Route in Tunnel

- Proposed Station
- City Limits

Source: Data from City of Bellevue (2003), City of Redmond (2007), and King County (2003 and 2006).

Exhibit F4.11-6
Geologic Hazard Areas Segments B,C,D, and E
East Link Project



Source: Data from GeoMapNW at the University of Washington (2007), Sound Transit (2007), and King County (2006).

Existing Soil Boring Within the Alternative and Maintenance Facility Right-of-Way

East Link Proposed Alternative

Central Link Alignment and Station

N

0 1 Mile

Exhibit F4.11-7
Existing Soil Borings Segments A,B,C,D, and E
East Link Project