Northgate Pedestrian Bridge Feasibility Study Report

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King County Department of Transportation
Road Services Division
Bridge and Structural Design Unit

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Abbreviations

AASHTO: American Association of State Highway and Transportation Officials
ADA: Americans with Disabilities Act
DOT: Department of Transportation
IBC: International Building Code
KCDOT: King County Department of Transportation
LRFD: Load and Resistance Factor Design
NSCC: North Seattle Community College
NCHRP: National Cooperative Highway Research Program
ROW: Right-of-Way
SDOT: City of Seattle Department of Transportation
ST: Sound Transit
TOD: Transit Oriented Development
WSDOT: Washington State Department of Transportation

1. EXECUTIVE SUMMARY

The overall objective of this study is to evaluate and recommend alternatives of bridge alignment and type for a new proposed pedestrian and bicycle bridge crossing Interstate 5 (I-5) that links North Seattle Community College (NSCC) and its surrounding area on the west side of the freeway to a future regional transit center on the east side of the freeway. This study assumes a bridge that crosses the freeway and extends as far as the parking lot east of the freeway. Additional bridge section from the parking lot to the future Sound Transit North Link station can be considered in the future after the station final plans are available and ownership and maintenance of this bridge section can be determined.

The proposed location for the new bridge is just north of NSCC on the west end and between NE 100th Street and NE 103rd Street on the east end. Three alternative alignments were initially studied and after scrutiny, two final alignments were chosen for more detailed evaluation. Consideration was given to bridge spans, horizontal and vertical clearance from I-5 traffic lanes and city streets, Americans with Disabilities Act (ADA) requirements, and impacts to I-5 and NSCC. In addition, the study considered aesthetics, economics, environmental and construction impacts, public safety, constructability, material and durability, and future bridge inspection and maintenance.

Various bridge structures and configurations have been reviewed and evaluated. Each alignment includes main bridge spans over I-5, approach bridge spans, and approach wall and/or filled sections.

For the main bridge spans over I-5, steel plate or box girders, pre-stressed concrete bulb-tee or box girders, and cable-stayed or steel truss structures are feasible. However, due to a significant bridge high over I-5 traffic lanes and a spot that has high visibility to a variety of public activities and users, this study recommends bridge types that provide thin bridge deck and are aesthetically pleasing. For the approach bridge spans, conventional structures including precast concrete box girders, I-girders, bulb-tee girders, voided slabs, cast-in-place slab, or steel I- or plate girders are viable. At the earth-filled bridge approach, flexible retaining walls, sloped fills without wall structures, or a combination of wall and sloped fill can be considered to minimize project costs.

The recommended bridge cross section should have a skidding resistance surface with a minimum width of 14 feet for expected substantial use by pedestrians and bicyclists. The study assumes handrail heights at 4’6" along the entire bridge and wall lengths, and additional 8- to 10-foot-high screens on each side of the bridge without cover over I-5 lanes.

One considerable advantage for this project is the fact that the property for the right-of-way (ROW) is expected to be obtained at no cost. The alignments for the bridge are located on public lands owned either by NSCC or the State (I-5 ROW). We expect the ROW for the new pedestrian bridge to be donated by these public agencies.

Tables that compare various bridge alignments and structural types are included in Section 10 of this report. These tables are useful for project further consideration and determination of a final bridge alignment and structural type considering a balance among cost, function, and aesthetics. The estimated cost for the project, including design costs and construction costs, is in the range of $16,200,000 to $18,700,000.

2. INTRODUCTION AND PROJECT GOAL

King County and the City of Seattle will implement a transit-oriented development plan of regional significance in Seattle's 500-acre Northgate Regional Growth Center, one of 27 designated regional centers intended to accommodate a significant amount of growth. The Northgate Transit Oriented Development (TOD) plan, partially funded by the U.S. Department of Housing and Urban Development's Sustainable Communities Regional Planning grant for 2011-2013, will combine workforce TOD housing, enhanced multimodal access for transit users, and pedestrian and bicycle improvements. This will also directly support regionally adopted growth management plans that emphasize high-density, transit-supported mixed-use growth centers.

A new pedestrian bridge, as part of the Northgate TOD Catalyst Investment Strategy, and in partnership with the City of Seattle, King County, Sound Transit, Seattle Housing Authority, NSCC, and other key public agencies is intended to be an integral part of dramatic mobility improvements and regional accessibility benefitting the transit-dependent community college population, the local neighborhoods, and retail/service workers in the Northgate area as well as the public at large. King County Department of Transportation (KCDOT) has led pre-development and conceptual design work for this project. This effort is aligned with the critical path set by Sound Transit's Northgate Station design completion in the next two to three years with construction to begin in 2016.

A recent study of an overcrossing of I-5 at this location indicates that it would create a 30% reduction in average walking time to the Northgate Transit Center and Light Rail Station and would effectively expand the area walk shed (0.5 mile) to more than 150 buildings and bike shed (3.0 miles) to more than 3,000 additional buildings. This feasibility study serves to identify feasible and favorable alignments for the bridge and to recommend structure types that meet Northgate TOD Catalyst Investment Strategy and general project requirements with respect to the following criteria:

- Provide pedestrian and bicycle bridge to enhance multimodal access to regional transit center.
- Support city's larger growth strategy for transforming Northgate into a full-fledged urban center.
- Least environmental impact.
- Aesthetics.
- Minimal disruption to traffic during construction.
- Sustainability and minimum maintenance.
- Cost savings.
- Public safety.

The project is intended to reduce the walking distance from the transit center to the community college from 1.2 miles to approximately 0.25 mile. The effect will be to reduce single-occupancy vehicle congestion on the surrounding streets, reduce greenhouse gas emissions, and reduce the consumption of fossil fuels. In addition, construction of the pedestrian bridge will result in a lower demand for parking adjacent to the transit center and a reduction in costly investments required for construction of parking facilities.

3. PROJECT LOCATION

The project is located along the I-5 corridor between North Seattle Community College west of I-5 and the Northgate park-and-ride lots on the east side of I-5. The proposed alignments fall in a zone from NE 100th Street on the south to NE 103rd Street on the north. Figure 1 shows the project location relative to the surrounding roads and streets.

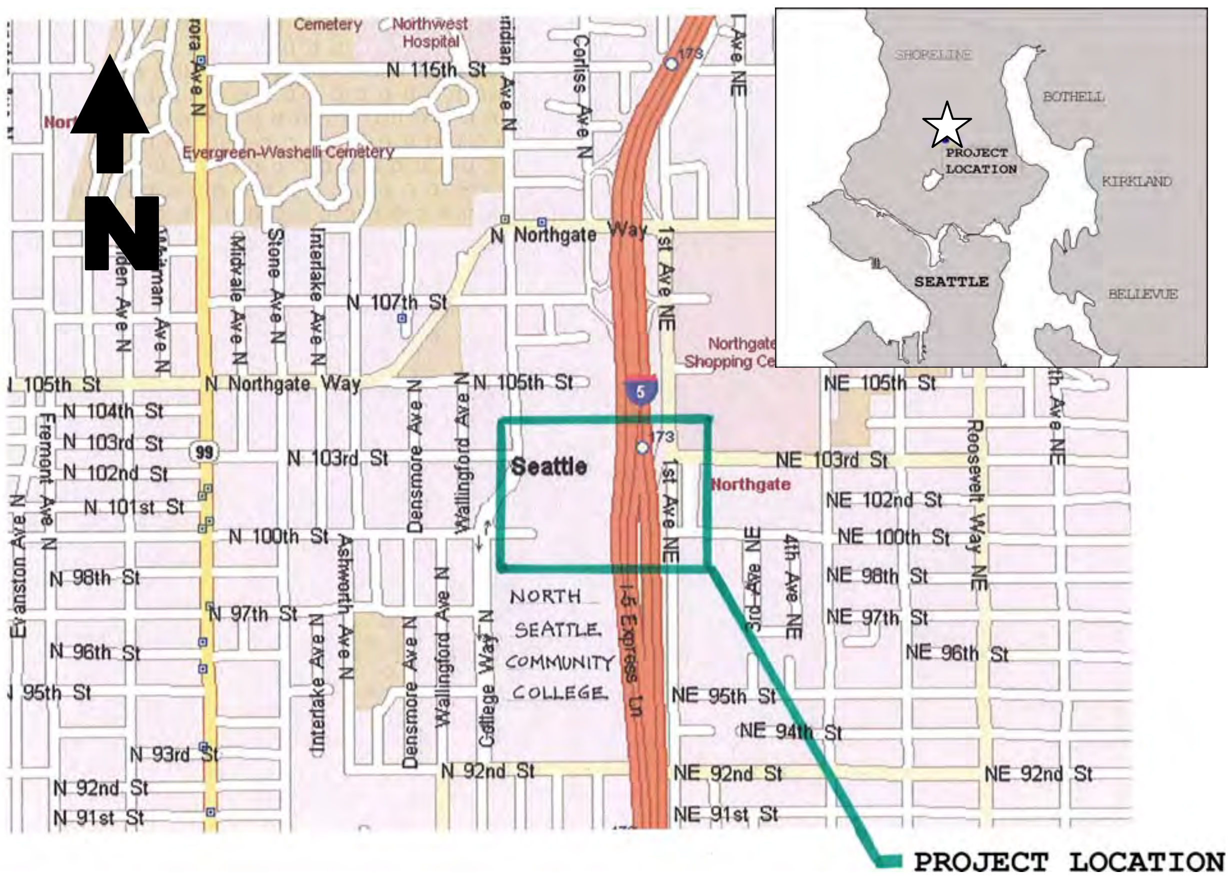


Figure 1 – Project Location

4. DATA RESEARCH AND REFERENCES

Information providing the basis of this study was obtained in part from the following sources and/or documents:

4.1 Northgate TOD Catalyst Project Description and Project Diagram

This information was obtained early in the study and shows a conceptual layout for the proposed bridge location and the proposed location for the future Sound Transit North Link station.

4.2 Washington State Department of Transportation (WSDOT)

WSDOT provided ROW plans for the I-5 corridor showing northbound and south-bound lanes and express lanes. WSDOT has provided the following information:

- Soil boring logs and foundation information for a bridge along I-5 northbound over-crossing I-5 off-ramp near NE 103rd Street.
- I-5 corridor topographic map between NE 103rd Street and NE 100th Street. The map also includes information of acceptable new bridge pier locations in the landscaped zones located between the I-5 north- and southbound lanes (Appendix H).
- Signal structure foundation and soils information for NE Northgate Way Overcrossing No. 5/588 E&W, and First Avenue NE and NE 103rd Street.
- Mountlake Terrace Freeway Station plans and cost data.
- WSDOT Design Manual M 22-01.07 regarding design guidelines for Pedestrian Bridge width, vertical clearance, and grade considerations.

In addition, Local Agency Guideline Section 14.3 states that "*it is the Federal Highway Administration's (FHWA) policy that all projects within Interstate Right-of-Way should be administrated by WSDOT. However, given the scope and extent of non-interstate projects within the interstate ROW, it is recognized that local agency administration of some projects may be acceptable, and all requests will be considered on a case-by-case basis. Whenever a local agency proposes a project within the Interstate R/W, they must develop an agreement with WSDOT that clearly outlines their duties and responsibilities to maintain the integrity of the Interstate facility, from both the safety and quality perspectives. The agreement should be executed prior to design approval and must be executed prior to advertising for bids.*"

We suggest an early consultation with the state for the local agency's design and construction administration on this project.

4.3 North Seattle Community College (NSCC)

NSCC provided information regarding preferred bridge alignment at school ROW. In addition, they have experienced an extent of soft soils and peat during the design and construction of the school buildings and advised likely presence of a lake at this general area sometime in the past.

4.4 City of Seattle

The Seattle Department of Transportation provided minimum lateral and vertical clearance dimensions to any proposed bridge and pier columns on city streets and obstructions such as light poles along 1st Avenue NE. They also provided a copy of the Seattle Right-of-Way Improvement Manual.

4.5 Sound Transit

Preliminary layout plans for the future Sound Transit North Link station were obtained from Sound Transit. These plans provided information regarding the location and elevation of the future connection between the pedestrian bridge and the station.

4.6 King County

A preliminary site survey was completed by King County survey crews to supplement I-5 corridor data provided by WSDOT. The survey establishes existing ground elevations along two initially studied alignments. In addition, a preliminary soil exploration and report were performed at school ROW west of I-5 along the North Bridge alignment. The soil report provides a preliminary understanding of soil conditions and possible foundation systems likely appropriate for bridge and wall structures.

4.7 Others

Case histories, plans, specifications, and cost estimates from several past pedestrian bridge projects were obtained to assist review of appropriate structure types and relative costs. Some of these references are:

- Sound Transit Canyon Park Pedestrian Bridge Overcrossing from Tetra Tech INCA, including project plans and cost estimates.
- Delta Ponds Pedestrian Bridge, City of Eugene, OR (OBEC Engineers).
- I-5 Gateway Pedestrian Bridge, Oregon Department of Transportation (OBEC Engineers).
- Steel Truss Pedestrian Bridges by Contech Construction Products, Inc. This information included various kinds of truss options for long-span pedestrian bridge structures. The data included fabrication costs and truss plans and sections for their Gateway Truss and Keystone Truss type structures.
- Interurban Trail 124th Street Bicycle/Pedestrian Overcrossing Bridge plans by ABKJ.
- Manufacturer’s data for prefabricated truss and cable-stayed bridges.

5. PROJECT DESIGN CONSIDERATIONS

5.1 Bridge Design Criteria

The design criteria provided by various agencies and design codes for the proposed pedestrian bridge includes the following:

Design Codes and General Requirements

- Design shall comply with the AASHTO LRFD Guide Specifications for Design of Pedestrian Bridges, 2nd Edition. The dynamic response of the bridge structure to pedestrian loads and to wind and seismic loads must be considered in the design.
- Seismic design shall be performed based on Guide Specifications for LRFD Seismic Bridge Design, 2nd Edition, with 2012 Interim Revisions.
- Where applicable, the design shall comply with the AASHTO LRFD Bridge Design Specifications, 6th Edition, 2012.
- International Building Code (IBC) latest edition.
- National Cooperative Highway Research Program (NCHRP) Synthesis 353, Inspection and Maintenance of Bridge Stay Cable Systems, Transportation Research Board, 2005.
- Federal Highway Administration Technical Advisory 5140.25, Cable Stays of Cable-Stayed Bridges, June 17, 1994.
- Washington State Department of Transportation (WSDOT) Bridge Design Manual (2012).
- Washington State Department of Transportation (WSDOT) Design Manual (M22-0.09) (2012).
- Fatigue and fracture resistance shall be considered, and for cable-stayed bridge types, the most current recommendations from the Federal Highway Administration, Post Tensioning Institute (PTI), and other recognized technical experts shall be considered for the design of the stay cables and for corrosion protection of the stay cables.
- Bridge profile grade and landing shall meet ADA requirements and shall be designed based on “Proposed Accessibility Guidelines for Pedestrian Facilities in the Public Right-of-Way”, 2011. This includes a maximum 5-percent slope without landings and a maximum 8.3-percent slope (6.25-percent is preferred) with landings spaced at 30 feet maximum. The length of landings shall be at least 60 inches and can be sloped at 2 percent maximum.
- Preferable 14-foot clear width for bridge deck for expected substantial use by both pedestrians and bicyclists and minimum 10-foot vertical clearance to any overhead obstructions in order to accommodate maintenance vehicles, bicycles, and equestrians per WSDOT Design Manual.
- For bridge over gravel pathway, minimum 10’ vertical clearance per Section 4.21.2 of City-of-Seattle Right-of-Way Improvement Manual is assumed.

WSDOT

- Suggests minimum 20-foot vertical clearance over I-5 traffic lanes due to long bridge span and light weight although at least 17’6” is recommended in WSDOT Design Manual.
- State bridge office shall be involved in review and determination of bridge superstructure system and bridge piers within I-5.
- No construction staging will be allowed on the freeways.
- Nighttime closure of lanes on the freeway between 10 PM and 5 AM could be considered as long as two lanes each way remain open at all times. For express lanes, short-term 2- to 3-hour closure or closure of one lane may be possible. Any planned construction methods, approaches, schedule, and traffic closure and control plans should be reviewed and approved by WSDOT.
- Consideration should be given to ease of bridge inspection and inspection frequency.
- All new bridge piers or abutments shall be located at least 15 feet away from existing traffic lanes and shall consider future additional lane and full shoulder in the southbound I-5 direction and allow for some widening of northbound off ramps.
- The bridge appearance and tall screens over I-5 traffic lanes should be reviewed and approved by the State Architect. Current criteria assumed for this study has handrail heights of 4’6" and a wire mesh screen height of 8 feet if straight up to 10 feet if curved at ends.
- Design loads should allow for sign structures to be placed on the bridge. Detail requirements should be discussed during project final design.

SDOT

- Minimum vertical clearance over city streets shall be at least 16’6”.
- All new bridge piers or abutments to be located adjacent to city streets shall comply with clearances as required by City of Seattle DOT. This includes minimum clearance of 3 feet from face of curb to face of column, and a minimum clear sidewalk width of 5 feet.

KCDOT

- Current design study shall include a stairway and elevator at the east end of the bridge near the WSDOT parking lot to allow access to and from street level. The design shall also allow for a future bridge section connecting to future light rail station.
- Design of the bridge shall include skidding resistance deck surface and shall allow for access by bicycles.
- Bridge alignment, type, and aesthetics shall be reviewed and approved by WSDOT, NSCC, and the City of Seattle.
- Selection of bridge alignment and bridge type shall consider minimum impacts to existing environment, existing facilities, and any sensitive areas.
- Design shall take into account constructability and material durability, and shall consider lower-cost alternatives as well as “signature type” structures.

- Design shall include a lighting system along the bridge for public nighttime access and safety.
- Bridge cover or canopy over I-5 traffic lanes is not required.
- Tunnel option under I-5 traffic lanes is excluded from further study due to public safety concern.

5.2 Alignment Selection Criteria

Factors considered during the alignment study included:

- Routes that could provide shortest overall bridge lengths and minimum costs for crossing the freeway. This involved researching potential locations for intermediate piers located on the State ROW.
- Routes that could minimize existing vegetation, tree, facility, street, and any sensitive area impacts and can accommodate future bridge extension to Sound Transit station and school future development.
- Routes that can provide construction access and staging and can facilitate erection of long-span structures such as steel trusses or pre-stressed girders with minimum interruptions to existing traffic.
- Consideration was given to the maximum slope of the walkway per ADA requirements without or with intermediate landings.
- At the east end bridge terminus, stair and elevator at WSDOT parking lot east of I-5 are assumed. Additional bridge section from WSDOT parking lot to future light rail station could be considered after final designed plans for light rail station are available and ownership and future maintenance responsibility of the bridge are determined.

5.3 Bridge Types and Approach Walls and Fills

5.3.1 Main Bridge Spans Over I-5

Bridge main spans over the freeway vary from about 140 feet to 240 feet depending on the alignment chosen and bridge type. Steel truss, cable-stayed, and cable-stayed with steel truss by various configurations, steel plate or box girders, spliced wide flange precast girders, and concrete box girders could be considered for long bridge spans.

However, this study report recommends a thin bridge deck system to reduce bridge profile and bridge approach lengths. Additionally, thin bridge deck provides better aesthetic for long bridge spans; it demands less sub-structural capacity due to lighter bridge weight. Bridges that have deep sections such as steel plate or box girders, and precast concrete deck bulb-tee or box girders are therefore not recommended. This study for the main spans is focusing on steel trusses with concrete deck surface and cable-stayed structures constructed with segmental precast thin deck units.

The cable-stayed sections include post-tensioning of the segmental deck units that will provide added durability and resistance to cracking. Corrugated steel decking should not be used to support a cast-in-place concrete deck slab due to corrosion concerns after the galvanized coating of the corrugated steel deck loses effectiveness and because of inspection difficulties for the deck slab. If steel truss is selected, structural steel should be coated with a high-quality paint system to provide corrosion resistance. As an alternate, the steel truss members could be hot-dipped galvanized and then painted; a double protection system to corrosion could be considered to minimize future maintenance efforts.

5.3.2 Approach Bridge Spans

Approach bridge spans were generally assumed to be about 70 feet in length for this report although shorter or longer span lengths are also viable and economical.

Many types of bridge sections are available for the approach bridge spans. This includes precast voided slab, cast-in-place box girder, pre-stressed precast concrete bulb-tee, I, or trapezoidal tub girders, and steel plate or box girders. Thin cast-in-place concrete slab with shorter span length could be considered if compatibility to main span thin bridge deck from any signature type bridge over I-5 is desirable. Approach spans could be made continuous for live loads depending on the selected bridge type for final design. This will increase the efficiency and eliminate expansion joints which will make the structure more durable and less maintenance.

5.3.3 Approach Walls and Soil Filled Sections

Walls at the west end of the bridge approaches are shown on the bridge elevation views. Walls such as Structural Earth Walls (SEW), gravity block wall, or reinforced steepened landscaped slope may be considered to support the soil-filled sections. As an alternate, asphalt paved or concrete slab on elevated soil fills with landscaped 2:1 maximum soil slopes along the sides of walkway without walls could be considered if it is acceptable to NSCC.

5.4 Right-of-Way

The current proposed alignments are located entirely on public property. The west portion of the bridge and the approaches are located on property owned by NSCC. The remaining portions of the bridge over the freeway and terminating in the parking lot just east of the freeway are located on State-owned (WSDOT) property. We expect the ROW for the new pedestrian bridge to be donated by these public agencies, with no ROW needing to be obtained from private lands. This will result in considerable time and cost savings for the project.

5.5 Utilities

Based on the initial information provided by the State DOT, it is expected that no major utilities are located along the proposed bridge alignments or at the proposed locations for pier and abutment foundations. However, a detailed investigation should be made once final bridge alignment and bridge type and pier locations are determined.

5.6 Permits and Environmental Impacts

The current proposed alignments are intended to avoid impacts to wetlands and any sensitive areas. The area just north of the north parking lot for NSCC contains wetlands, trees, and vegetation. The proposed alignments are intended to skirt these wetland areas and to minimize tree removal. Other environmental impacts that will need to be considered include the following:

- The effect of lighting along the bridge alignment. This may affect the surrounding residential areas and also the traffic on I-5.
- Potential for increased traffic and parking west of I-5 due to the access provided by the new bridge.
- Safety of aviation if tall bridge elements are involved. Air space lease from FHWA may be required.
- Additional studies and permitting that will likely be required before project construction include the following preliminary list:

State Environmental Policy Act of 1971 (SEPA) Environmental Review
Environmental Checklist (ECL)
Determination of Non Significance (DNS)
Notice of Action Taken (NAT)

National Environmental Policy Act of 1969 (NEPA) Environmental Review
Documented Catagorical Exclusion (CE)
Endangered Species Act of 1973 (ESA) Evaluation
4(f)/6(f)
Cultural (Section 106)
Air
Environmental Justice (EJ)

Permits and Approvals
Ecology National Pollutant Discharge Elimination System (NPDES)
Stormwater Pollution Prevention Plan (SWPPP)
Seattle Building Permit
ROW Permits
Clearing and Grading Permit

Environmental Studies
Aquatic Environment
Wetland
Stream

Geotechnical Review
Air Quality Review
Noise Review

At the present time environmental studies have not been completed that address the environmental impacts of the proposed alignments. City of Seattle will lead the project's next phase environmental and type, size and location (TS&L) studies prior to project final design.

5.7 Bridge Foundation

The study included a preliminary geotechnical investigation and soil report of north alignment at NSCC ROW. The purpose of the investigation was to verify site-specific soil conditions near the bridge piers and along the wall alignment. A total of seven soil borings were made. Two were 101 feet deep, and five were 21 to 26 feet deep. Standard Penetration Tests (SPTs) were taken at 2.5-foot or 5-foot increments at each boring to assist the engineer's assessment of soil stiffness. At the locations close to bridge piers, we encountered medium dense to dense silty sand with gravel fills up to 30 or 35 feet. Below that, we observed hard silt to silty clay or silty sand with trace of gravel to a depth of about 70 to 75 feet followed by very dense silty sand with trace of gravel to the termination depth of the boring at about 101 feet below the ground surface. Along the wall locations, we encountered approximately 4 to 10 feet of medium dense to dense silty sand with gravel fill. Below the fill, we observed dense to very dense deposits of silty sand with gravel to the termination depth at about 21 feet below the ground surface.

The soil report also reviewed soil data provided by WSDOT for the existing bridge along I-5 northbound lanes over the I-5 northbound off-ramp in the vicinity of NE 103rd Street. WSDOT soil data indicates dense glacial till underlies 10- to 30-foot loose fill or soft wetland deposits below the ground surface.

A copy of the soil report can be found in Appendix J.

Based on the above limited information, it is expected that bridge piers for the main spans over I-5 will require deep foundations such as drilled shafts. Drilled shafts are commonly used by bridges in this area due to its effectiveness to transfer bridge loads into the hard soils below. It can support larger vertical loads and can provide better lateral soil resistance to wind or seismic loads. The shafts are drilled and cased with steel casing if necessary to avoid collapse of the side walls during excavation. After the shafts are completely cleaned of soft material at the bottom of the excavation, a cage of reinforcing steel is installed and is extended the full depth of each shaft. The shafts will then be filled with concrete to complete the installation. The diameter of the shafts can vary depending on the loading demands of the structure. We anticipate one large 8- to 10-foot shaft or two 6- to 8-foot shafts for each main span bridge pier or abutment.

Spread footings are feasible for bridge and wall footings west of I-5 due to relatively dense soils found during the preliminary soil exploration study.

We suggest a final soil report that includes additional soil boring at each bridge pier, soil samples and testing and a confirmation of preliminary findings as soon as bridge final alignment and pier locations are determined.

5.8 Seismic Hazard Areas

The seismic hazard at the bridge site can be characterized by the acceleration response spectrum for the site and the site factors for the relevant site class. The acceleration response spectrum can be determined per the American Association of State Highway and Transportation Officials (AASHTO) Load and Resistance Factor Design (LRFD) Bridge Design Specifications by either a General Procedure or a Site-Specific Procedure. A Site-Specific Procedure is required if any of the following conditions exist:

- Site is within 6 miles of an active fault.
- Site is classified as Site Class F (this applies if the depth of peat at the site exceeds 10 feet).
- Long-duration earthquakes are expected at the site.
- If the bridge is an important one requiring a lower probability of exceedance than normally used for typical design.

The General Procedure requires an analysis for earthquake ground motions that have a 7-percent probability of exceedance in 75 years. Bridges that are designed and detailed in accordance with these provisions may suffer damage, but should have a low probability of collapse due to seismically induced ground shaking. The geotechnical investigation will determine the Site Class and if any of the above conditions exist that will require a Site-Specific Procedure. In addition, the investigation will determine if there is a potential for liquefaction to occur during a strong earthquake. The Site-Specific Procedure is more involved and requires the development of ground motions that are more accurate for the local seismic and site conditions than can be obtained from national ground-motion maps.

The City of Seattle has mapped the area associated with the Seattle Fault Zone. The location for the proposed pedestrian bridge does not fall within the mapped area of the Seattle Fault Zone. In addition, the City has mapped areas that may be subject to settlement from peat deposits. The proposed location for the bridge does fall within the predicted zone subject to peat settlement. However, the preliminary soil exploration at the area west of I-5 along the north bridge alignment did not reveal significant peat soil contents. We suggest more detail and refined soil investigation to confirm this preliminary finding once bridge alignment and pier locations are defined.

5.9 Traffic Impact

Impact to traffic on I-5, city streets, school, and business during construction of the new bridge must be kept to a minimum. Per discussions with WSDOT representatives regarding construction impact on I-5 traffic, the following criteria must be met:

- No construction staging will be allowed on the freeways.
- Nighttime or weekend closure of lanes on the freeway between 10 PM and 5 AM could be considered as long as two lanes each way remain open at all times.
- For express lanes, closure of one lane may be acceptable. Short-term (2 to 3 hours) closures are possible but should be reviewed.

WSDOT, City of Seattle, and NSCC should review and approve construction activities including construction access, staging, schedule, and any proposed traffic lane closures and durations and temporary traffic-control signs and signals. In addition, the project should coordinate with Sound Transit for their light rail line construction and with the state and city to see if Traffic Analysis is needed.

5.10 Future Maintenance and Inspections

5.10.1 Maintenance

Maintenance needs vary depending on the type of structure selected and the materials used to construct the bridge. In general, a steel structure will require more maintenance than a concrete structure. This is particularly true for precast prestressed concrete structures where maintenance requirements are usually minimal due to added prestressing or post-tensioning forces and where serviceability and sustainability have been well documented. Structural steel elements generally require painting at intervals determined by the type of coating system and the environmental conditions at the site. Stay cables may be vulnerable to corrosion unless they are protected. A variety of systems have been developed in recent years by cable suppliers that usually involve multiple barrier systems. One system employs epoxy coated and filled strands where the interstices of the strand are filled with epoxy, and then the strands may be sheathed in high-density polyethylene (HDPE) pipe. Another system uses a corrosion-resistant barrier such as grease or wax combined with individually sheathed strands and finally enclosed in HDPE pipe. Cables protected by these multiple-barrier systems have shown superior performance over previous single-barrier systems.

5.10.2 Inspections

Future bridge inspections after the structure has been completed may disrupt traffic to enable the inspection crews to accomplish their work. The type of bridge superstructure selected for the final design and construction can affect the frequency of required inspections, particularly if the structure is classified as “fracture critical”. A “fracture-critical” structure generally needs to be inspected twice as often as a non-fracture-critical structure. A vehicular bridge with a steel truss superstructure with two main trusses would likely be classified as “fracture critical”; however, since the live loads on a pedestrian bridge are generally smaller relative to the dead loads than for a vehicular bridge, it is unlikely that the steel truss alternate would be considered "fracture critical". A cable-stayed superstructure that has been designed so that one of the stays can be removed without affecting the load-carrying ability of the bridge may not be considered as “fracture critical”.

5.11 Future Light Rail Station and Mezzanine

The future light rail station is being planned at the intersection of 1st Avenue NE and NE 103rd Street with the mezzanine location some distance south of NE 103rd Street. In addition to the rail platform, the station will have a mezzanine midway between the street level and the platform level. The station 60% designed plans indicate the mezzanine level to be at an elevation of about 280 feet. This elevation locates the mezzanine approximately 27 feet above 1st Avenue NE.

At the time of this study, it is assumed that the east end of the pedestrian bridge will terminate by an elevator and a stair tower at the WSDOT parking lot east of I-5 to provide street access. Additional bridge section between the elevator and stair terminus and the future light rail station could be considered after final designed plans for the station are available and ownership and future maintenance responsibility are determined.

6. BRIDGE ALIGNMENT AND TYPE EVALUATIONS

6.1 Alignments

6.1.1 Alignments Studied

Three alignments were initially reviewed as shown on Figure 2 that assumed the bridge ending at the mezzanine level at a future light rail station close to NE 103rd Street.

Figure 2 – Initial Alignment Study

Alignment 1 is at the extreme north shown in Figure 2 above. This alignment has longest bridge spans over the freeway and requires a pier at a location that is not recommended by WSDOT. In addition, it impacts more existing trees at the school ROW and the deck elevation at the first pier east of I-5 is close to 50' above the existing road, requiring taller stair and elevator due to a relatively short distance to the light rail station. For these reasons Alignment 1 was eliminated for further review and the study concentrated on Alignment 2 and Alignment 3.

Alignment 3 is generally along NE 100th Street. It turns north toward the future light rail station once the bridge crosses over I-5. Three separated north-turned extensions were studied as shown in Figure 2. The north extension located farthest east which parallels the east side of 1st Avenue NE was eliminated from further consideration because it is too close to the planned light rail line. Another north extension was considered just west of 1st Avenue NE. However, this extension was also eliminated due to an existing drainage system that runs along the street. The third north extension is located between the freeway and the WSDOT parking lot. This extension is considered viable and has been kept for further study. Alignment 3 will require a bridge pier between I-5 northbound lanes and off-ramp. This study assumed the pier location in one of two areas recommended by state (Appendix H). However, the location of this pier may not allow future widening of I-5 northbound off-ramp. We suggest more detailed review and confirmation with the state during the project's next phase design.

Alignment 2 is located halfway between Alignment 1 and Alignment 2 mentioned above. This alignment provides shorter bridge sections and has more room for a bridge pier between the I-5 southbound express lane and northbound I-5 lanes. This alignment is considered feasible and has been kept for further study.

6.1.2 Alignments Recommended for Further Consideration

Alignment 2 and Alignment 3 with north-turned alignment close to I-5 (as shown in Figure 2 above) are recommended for further consideration. For clarity, Alignment 2 has been renamed as the North Alignment and Alignment 3 has been renamed as the South Alignment.

Two issues were later discovered during this report study. One is related to the location of the mezzanine at Sound Transit station. In the 60% designed plans provided by Sound Transit, the mezzanine location is located about 200 feet south of NE 103rd Street. In the initial study, we assumed the mezzanine was close to NE 103rd Street. The second issue concerns who will be responsible for future operation and maintenance of a possible bridge gate at the Sound Transit station. Sound Transit has said the station will be operated with limited operation hours; however, the City of Seattle would like to see the bridge open 24 hours daily without any restriction.

Due to the two issues mentioned above, this study has tentatively assumed both alignments will terminate with an elevator and a stairway once they cross I-5 to enable access to the street level.

The initial three alignments have been reviewed and studied based on very limited survey data. There is no topographic data at the school ROW area west of I-5. The profile for Alignment 2 especially was interpreted from the initial survey results along Alignments 1 and 3 and could contain errors. We expect a comprehensive aerial survey early during the next phase project design to facilitate future designs and decisions.

This study assumed 1’6” bridge deck for a cable-stayed bridge and 3’0” for a steel truss bridge over I-5 traffic lanes and 2’6” precast pre-stressed voided slab for approach bridge spans. The bridge pier just west of I-5 was located about 40’ or more away from the existing I-5 on-ramp. The distance includes space for future I-5 on-ramp expansion and at least 15’ clearance between a new pier and the I-5 on-ramp. In addition, the pier for the South Alignment was adjusted to avoid impact to the existing ditch. For all alignments, the first pier east of I-5 was assumed to be at the toe of I-5 bank slope.

The North Alignment and the South Alignment are discussed in more detail in the following sections.

a. North Alignment (Option 1)

The North Alignment was modified from Alignment 2 in the initial study phase based on new learned information mentioned above. The west end of the North Alignment begins close to the east paved end of NE 100th Street at an elevation close to 257.7 feet for a steel truss bridge and to 262.1 for a cable-stayed bridge.

The alignment follows a curving path up the gentle hillside to a high point about 240 feet west of the freeway at an elevation of about 276.3 feet. The first section of the alignment is to be built on-grade with minimum fill sections where required. The curving path maintains a maximum grade of 5 percent per ADA requirements. From the high point at the top of the hill, the alignment turns northeast, runs straight over the freeway and terminates with an elevator and a stairway at the WSDOT parking lot east of the freeway. This section of the alignment is entirely elevated on the bridge structure. For a cable-stayed bridge, the highest point on the bridge deck occurs at Pier 5 with an elevation of about 299.4 feet. For a steel truss bridge, the highest point occurs at Pier 5 with an elevation of about 300.9 feet. From the high point, the bridge deck slopes downward with a 1-percent grade to a final elevation at the east end of approximately 299.4 feet for a steel truss and 297.8 for a cable-stayed bridge. The total length of the alignment is approximately 1,124 feet for a steel truss bridge and 984 feet for a cable-stayed bridge. The approach bridge is comprised of three 70-foot spans. The main spans crossing the freeway are 200 feet and 168 feet in length for either bridge type. Pier No. 5 is located in the landscaped zone between the express lanes and the northbound lanes of the freeway suggested by WSDOT. The attached Figure 3 shows an aerial view of the North Alignment.

Plan, Elevation, and Section views can be found in Appendices C-1 and C-2. Rendering views of North Alignments with cable-stayed and steel truss bridges over I-5 can be seen in Appendix D.

Figure 3 - North Alignment (Option 1)

b. South Alignment (Option 2)

The South Alignment was renamed from Alignment 3 shown in the initial study. The west end of the South Alignment begins at about the same area as the North Alignment. From this beginning point, the alignment proceeds directly east on a tangent alignment for approximately 982 feet for steel truss and 957 feet for cable-stayed type bridges. The alignment generally follows North 100th Street, but can offset from the street to provide room for a pathway on grade. The same tangent alignment is maintained for crossing the freeway lanes to a point just east of the I-5 northbound lanes.

The beginning elevation at the west end of the South Alignment is approximately 257.9 feet. The first 165 to 192 feet of the alignment will be constructed with fill that is retained by walls on each side. In order to meet ADA requirements and minimize impacts to the existing roads, a maximum eight percent slope with 5’0” landing spaced 30 feet is assumed at the wall and filled sections. On the bridge sections, five percent slope was assumed from the wall to the highest point at Pier 7 for a cable-stayed bridge and Pier 8 for a steel truss bridge. One percent is assumed for the remaining bridge until the east-end bridge terminus.

Depending on the type of bridge structure, there will be either four or six approach spans of roughly 70 feet each at the west end of the elevated portion. The main spans over the freeway are approximately 240 feet and 140 feet for either bridge type. The deck elevation at the high point will be approximately 302.7 feet for the cable-stayed superstructure and 304.2 feet for the steel truss superstructure.

Bridge Pier 7 for a cable-stayed bridge or Pier 8 for a steel truss bridge is located in the landscaped area suggested by WSDOT. However, we suggest a further review and confirmation of this location due to insufficient space to accommodate any future I-5 off-ramp expansion.

The attached Figure 4 shows an aerial view of the South Alignment.

Plan, Elevation, and Section views can be found in Appendices C-3 and C-4. Rendering views of South Alignments with cable-stayed and steel truss bridges over I-5 can be seen in Appendix D.

Figure 4 - South Alignment (Option 2)

6.2 Structure Types

6.2.1 Bridge Types on the North Alignment

6.2.1.1 North Alignment with Steel Truss Bridge over I-5

For the main spans over I-5 on this alignment we investigated a steel truss superstructure fabricated from steel tube or build-up plate girder sections. There are several companies that specialize in steel truss pedestrian bridge structures, and for this feasibility study we have used information provided by CONTECH Construction Products, Inc. This company has recommended their “Gateway” or “Continental” type trusses for the long bridge spans crossing I-5. The depth-to-span ratio of the trusses will be approximately 0.05 for structural needs. The height of truss for the shorter truss span will be controlled by 10’ minimum vertical clearance between the top transverse bracing member or any light feature and the bridge deck. It is expected that longer span truss will control the truss height if a uniform truss height for all spans over I-5 is desirable for aesthetic reasons.

Steel trusses can be assembled by several methods. Smaller truss segments can be shipped, and assembled with false-work outside of I-5 traffic lanes if approved by WSDOT, or at the school ROW west of I-5 and WSDOT parking lot east of I-5. They can then be either launched from the approach bridge spans or lifted by two large cranes with one located west or east of I-5 and the other one on I-5 traffic lanes. Alternatively, the trusses can be assembled at a nearby open area somewhere along I-5 and shipped and lifted by large cranes from I-5 directly. However, the shipping of the assembled trusses on I-5 could be restricted by existing bridge vertical clearances. The contractor shall carefully check this option and coordinate with WSDOT for oversize and overload permits.

6.2.1.2 North Alignment with Cable-Stayed Bridge Over I-5

The second type of structure we investigated for long bridge span on this alignment is a precast segmental concrete cable-stayed type bridge. For this structure we contacted OBEC Consulting Engineers in Eugene, Oregon; they have successfully designed and built at least two similar bridges. One bridge is owned by the Oregon DOT, and the other is owned by the City of Eugene. These bridges use a technology known as a cable-stayed stress ribbon deck which results in a very shallow thickness for the concrete deck. Because of the shallow structure depth, the deck can be located at a lower elevation relative to the freeway beneath the bridge and still provide the required vertical clearance. In addition, the thin deck reduces the dead weight of the structure which in turn reduces the demands on the substructure. The concrete deck segments are erected using a balanced cantilever method that does not require false-work for temporary support during construction since the deck panels are supported by the stays. The deck panels are supplied with adjustable connections that allow relatively quick erection. For the I-5 Pedestrian Bridge in Eugene, the panels were generally 10 feet in length. Approximately 18 panels were erected during three night shifts using a light crane to set the panels. Temporary lane closures were required during the erection of the panels. After the panels have been set, a topping slab is poured and full-length post-tensioning strands are placed in the topping slab. The bridge contains no deck joints, minimizing maintenance requirements.

For the North Alignment, only a single pylon was assumed with two cable-stayed spans, one at each side of the pylon. The span on the west side of the pylon is 200 feet, and the span on the east side of the pylon is 168 feet. Due to the restrictions on where piers can be located because of required clearance from the freeway lanes, the spans are of unequal length. This makes the design and construction slightly more complicated since the loading from the panels will not be symmetrical and balanced about the pylon unless additional weight is added on the shorter span to help resist the tension in the stay cables. However, this type of bridge is feasible for this location.

6.2.1.3 North Alignment with Cable-Stayed Truss Bridge Over I-5

Another option that can be considered would be to provide a cable-stayed truss bridge. The advantage of this type of structure would be to allow the truss to be erected in a single lift instead of segmental construction. This would speed up erection time and minimize disruption to traffic on I-5. In addition, the trusses could be much lighter since they would be supported by the stays for the dead weight of the deck and for live loads. The deck could be constructed after the trusses have been erected and supported by the stays.

6.2.1.4 Structural Modeling and Verification

In addition to researching the bridges designed by OBEC Engineers, preliminary modeling and investigation has been performed for a cable-stayed segmental concrete bridge. We found the dynamic response of this type of bridge to pedestrian live loads was in a satisfactory range. In addition to the response from pedestrian loads, the dynamic response due to wind and earthquake forces should also be investigated for any bridge alternate that is selected for final design.

Figure 5 below shows the alternate bridge types for the North Alignment.

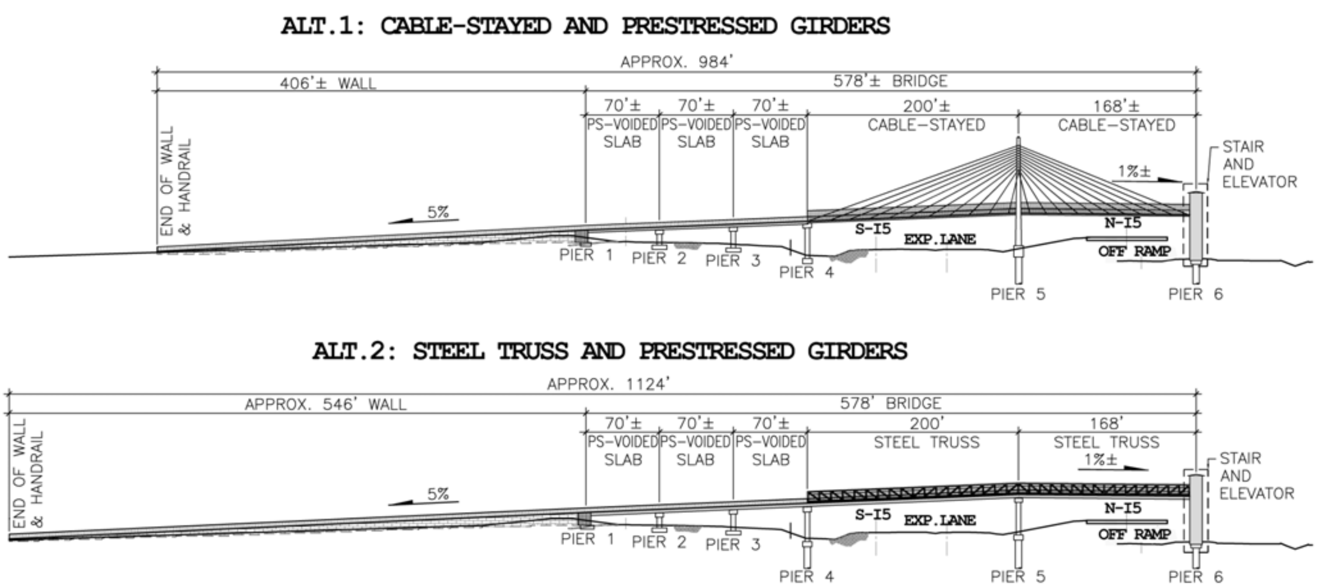


Figure 5 - Bridge Types at North Alignment

6.2.2 Bridge Types on the South Alignment

6.2.2.1 South Alignment with Steel Truss Bridge Over I-5

For the main spans on this alignment we investigated a steel truss superstructure similar to the one investigated for the North Alignment. The main spans are 240’ and 140'. The steel trusses for this alignment will be deeper and heavier than the trusses at the North Alignment due to the increase in span length. It is expected that the longer span truss will control the truss height if a uniform truss height over I-5 is desirable for aesthetic reasons. Steel truss assembly and erection can be performed with similar methods described in Section 6.2.1.1.

6.2.2.2 South Alignment with Cable-Stayed Bridge Over I-5

For the main spans on this alignment we investigated a segmental precast concrete cable-stayed bridge similar to the bridge for the North Alignment. For this alignment we were able to achieve a more symmetric arrangement of the spans relative to the pylons. Two pylons are preferable at this location, with a main span between the pylons equal to 240 feet, and end spans of 140 feet each. This arrangement allows a more balanced loading and erection of the panels; however, the overall number of panels will be larger. Figure 6 below shows the alternate bridge types for the South Alignment.

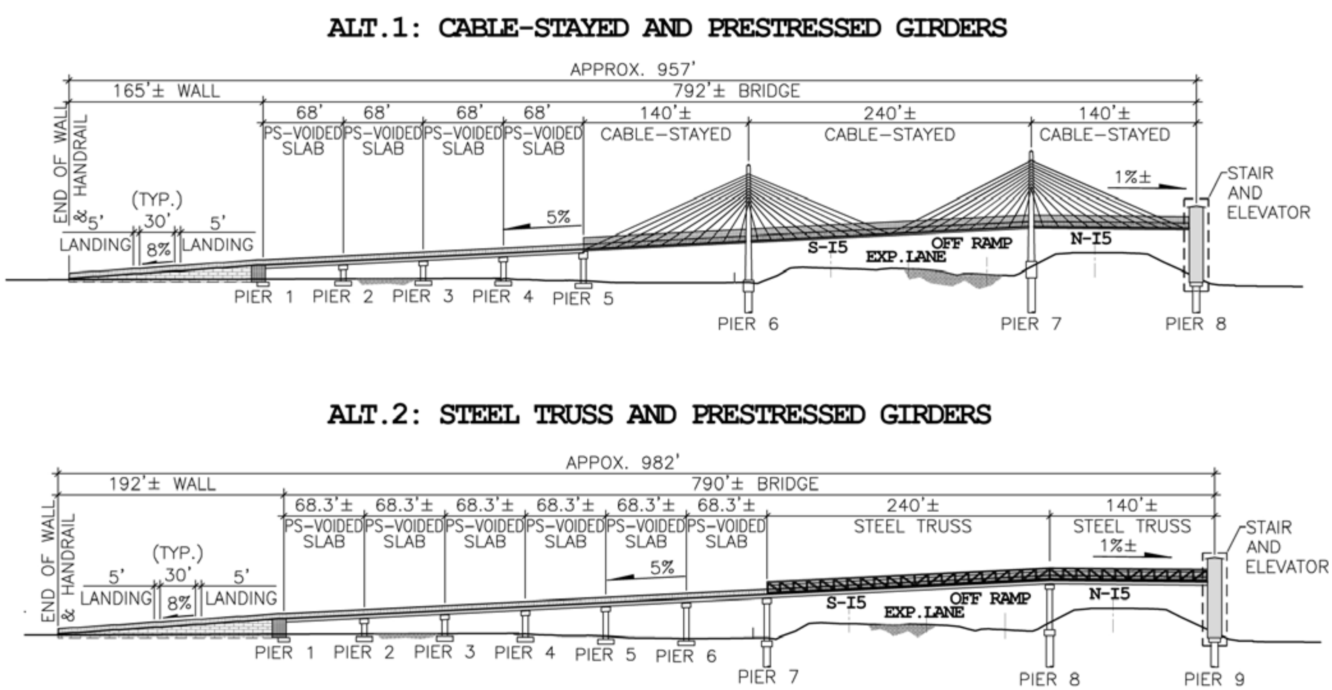


Figure 6 - Bridge Types at South Alignment

6.2.2.3 South Alignment with Cable-Stayed Truss Bridge Over I-5

As noted above, another option would be a cable-stayed truss bridge on this alignment. All the advantages of this type of structure as described for the North Alignment would also apply for the South Alignment.

6.2.3 Approach Bridge Spans

This study assumed approximately 70 feet for approach bridge spans although shorter or longer bridge spans are also feasible and economical. Many bridge sections are available for this span range. This includes prestressed voided slabs, prestressed I-girders, trapezoidal tub, and bulb-tee girders, and steel plate or steel box girders. For aesthetic reasons, precast prestressed voided slab, trapezoidal tub girders or cast-in-place thin slab on shorter spans with slightly higher costs may give a more desirable appearance.

Any of the above choices can be made continuous for live loads to reduce the required depth of the structure. In addition, the continuity will eliminate expansion joints and contribute to lower maintenance costs. From an aesthetics standpoint and also from a reduced maintenance standpoint, it will be desirable to set the girders on false-work and cast the pier cross beams at the same level as the girders.

Final selection on type of girder and the number of girders in the cross-section will depend on several factors including cost, aesthetics, constructability, continuity, and ease of erection.

For this study, we assumed the approach spans will be constructed from standard WSDOT precast voided slab with asphalt pavement without cast-in-place concrete deck.

6.3 Approach Wall and Fill Sections and Pathway Access

Both the North Alignment and the South Alignment will be constructed on fill sections from the west end of the alignments to a point where the fill approaches a height of about 15 feet. The fill will be contained on both sides of the path by a retaining wall. Several retaining wall types such as structural earth wall, gravity block wall, precast concrete crib-lock wall, or concrete wall can be considered for this application.

If it is acceptable to NSCC, soil fills with maximum 2:1 or steepened slopes on both sides of the approach or a combination of walls and fills could be considered for an economical solution. For the steepened sloped section, the soil fill would be reinforced with geogrid material at both sides of the fill. The steepened slopes can be constructed up to an angle of 70 degrees with respect to the horizontal line. All sloped fills can be landscaped with grass or plants. This approach might work better for the path on the North Alignment that is constructed on the existing hillside since the landscaped slope would blend in with the existing hillside.

7. CONSTRUCTION ACCESS, STAGING, ERECTION AND TRAFFIC IMPACTS

Construction accesses and staging areas for crane pads, prestressed girders, material shipping and hauling, construction equipment, and for on-site assembly of large sections of truss framework or pre-stressed girders are required on both sides of the freeway and between freeway landscaped areas and shoulders. On the east side of the freeway, the most desirable location for staging is the parking lot located adjacent to the freeway west of 1st Avenue NE. On the west side of the freeway, the spaces along NE 100th Street north of the school parking lot and existing gravel path are ideal locations for construction accesses and staging. The tree-covered areas adjacent to the proposed alignments will need to be cleared for crane access and for assembly and lay-down. For example, an approximately 50-foot-wide area along the alignment would need to be cleared for providing large construction equipment access, operation, and girder or truss swing and erection, etc. A similar area would be required for approach spans on the North Alignment.

For the long-span truss structures, it is also possible to field-assemble the sections with false-work outside of I-5 traffic lanes if approved by WSDOT. The contractor can also field-assemble the sections at the parking lot east of the freeway, then load the truss onto a truck positioned on I-5, and subsequently position the truck on the freeway where two cranes can lift the truss into place during the night or on weekends. Alternatively, the contractor can assemble steel trusses or long-span girders at a nearby open area somewhere along I-5 and ship and lift them by large crane(s) from I-5 directly. However, shipping of assembled trusses or long-span girders could be restricted by the vertical clearance along the exiting I-5 bridges. The contractor shall carefully check this option and coordinate with WSDOT for oversize and overload permits.

Detail reviews and approvals from WSDOT, City of Seattle, and NSCC on construction methods, approaches, and staging areas could start as soon as final bridge alignment and type and location of piers are determined. Additionally, we anticipate some overlap of construction activities between this project and Sound Transit light rail line; therefore, an early coordination for construction activities east of I-5 is suggested.

8. STAIR AND ELEVATOR

8.1 Stair and Elevator at East End of Bridge

For this study we have assumed the bridge would be built from NSCC to WSDOT's parking lot area east of I-5. The bridge extension between the WSDOT parking lot and the future light rail station can be considered in the future once final plans for the light rail station are available and ownership and future maintenance responsibility of this extension can be determined.

The east end of the bridge for this project will terminate at an elevation that is approximately 44 feet above the street level based on the North Alignment preliminary profile. An elevator and a stairway will be required at this point to provide public street access. Several types of stair and elevator can be considered during the project final design. Some photos of stair and elevator towers from other similar projects are included in the Appendix for reference.

8.2 Stair at West End of Bridge

Near the west end of the bridge along the North Alignment, an improvement to the existing gravel path and a stairway could be considered. This provides an extra bridge access to the on-grade pathway that connects to the parking lot for the Medical Center buildings just north of NSCC. However, since there is an existing sidewalk close to College Way North, the need for the stairway and on-grade pathway improvement for access to or from the Medical Center Buildings should be reviewed and agreed upon by the school during the project's next phase design.

9. COST ESTIMATES

Construction cost estimates in 2012 $ for the various bridge types at both the North and South Alignments are shown in the table below. The estimated total project costs are provided to aid project budget planning and preparation.

Refined details for construction cost estimates can be found in the Appendix.

Northgate Pedestrian Bridge Project Cost Estimates Summary

Alignment Options	North Alignment		South Alignment	
Main span structure over I-5	Cable-Stayed	Steel Truss	Cable-Stayed	Steel Truss
Approach span structure	Precast Voided Slab	Precast Voided Slab	Precast Voided Slab	Precast Voided Slab
Approach wall structure	Structural Earth Wall	Structural Earth Wall	Structural Earth Wall	Structural Earth Wall
Construction Costs	$8,677,983	$8,777,697	$9,880,584	$8,840,468
9.5% Tax	$824,408	$833,881	$938,656	$839,844
Contingency/Conceptual (30%)	$2,603,395	$2,633,309	$2,964,175	$2,652,141
Inspection (20%)	$1,735,597	$1,755,539	$1,976,117	$1,768,094
Designs (30% Cable-S., 25% Truss)	$2,603,395	$2,194,424	$2,964,175	$2,210,117
Estimated Project Total =	**$16,444,778**	**$16,194,850**	**$18,723,707**	**$16,310,664**

Costs have been assumed based on the following:

1. Drilled shafts for bridge spans over I-5 and spread footing for approach bridge spans.
2. No costs for ROW.
3. Future bridge extension from WSDOT parking lot to light rail station is not included.
4. Estimated in 2012 $.
5. Minimum lighting and architectural features.
6. No cover or canopy on bridge.
7. No historical significance and contaminated material or soils along the construction site.

10. COMPARISON OF ALTERNATIVES

10.1 Bridge Alignment Options and Comparisons

Alignments (See Figures 3 & 4)	North Alignment	South Alignment
Overall length	984' to 1124'	957' to 982'
Critical bridge span over I-5	200’ ⬆	240'
Overall bridge length	578’ ⬆	790’
Environmental impacts (existing trees, vegetation, & sensitive areas)	Moderate	Minimum ⬆
Bridge construction access, staging and constructability	Average	Better ⬆
Location of main span bridge pier between I-5 north & south lanes	More Space ⬆	Limited space*
Public preference - public meeting survey July-2011	42 (78%) ⬆	12 (22%)
Future bridge extension to light rail station	180’ ⬆	550'

**: Space may be limited for future I-5 northbound off-ramp expansion*

⬆*: Preferred*

10.2 Bridge Type Options and Comparisons

Type of bridge over I-5	Pre-Stressed Girders	Steel Truss or Tube	Cable-Stayed
Approach bridge spans	Pre-Stressed Voided Slabs or Girders	Pre-Stressed Voided Slabs or Girders	CIP Slabs or Pre-Stressed Voided Slabs or Girders
Approach walls & fills	SEW & fills	SEW & fills	SEW & fills
Est'd construction costs	N/A	\$8.7 M - \$8.8 M	\$8.7 M - \$10.8 M
Est'd total project costs	N/A	\$16.2 M - \$16.3 M	\$16.4 M - \$18.7 M
Bridge designs	Conventional bridge designs	Conventional bridge designs	Needs specialty for bridge models and designs.
Bridge depth (deck surface to bottom of girder) - *assumed 200' span*	About 7'-0" to 7'-6"	About 2'-6" to 3'-0"	About 1'-2" to 2'-0"
Main span erections over I-5	Conventional methods	Conventional methods	Requires special contractor and equipment
Bridge weight	Heaviest. Higher substructure demands	Likely lightest. Less substructure demand	Weight to be between pre-stressed girder and steel truss bridges
Traffic impacts during construction	Same	Same	Likely more depending on construction approach & method
Environmental impacts	Same	Same	Same
Aesthetic	Conventional structure with deep girders	Conventional structure with truss system	Signature structure
Future maintenance and inspection	Minimum	More future inspection & maintenance efforts	Special equipment is required for tall bridge pier and cable inspections

Notes:

1. SEW = Structural Earth Wall system, CIP = Cast-In-Place
2. Depending on construction method and approach, construction time for cable-stayed bridge might be slightly longer than the other two options. Construction schedule will be developed during the project's next phase designs.

11. CONCLUSIONS

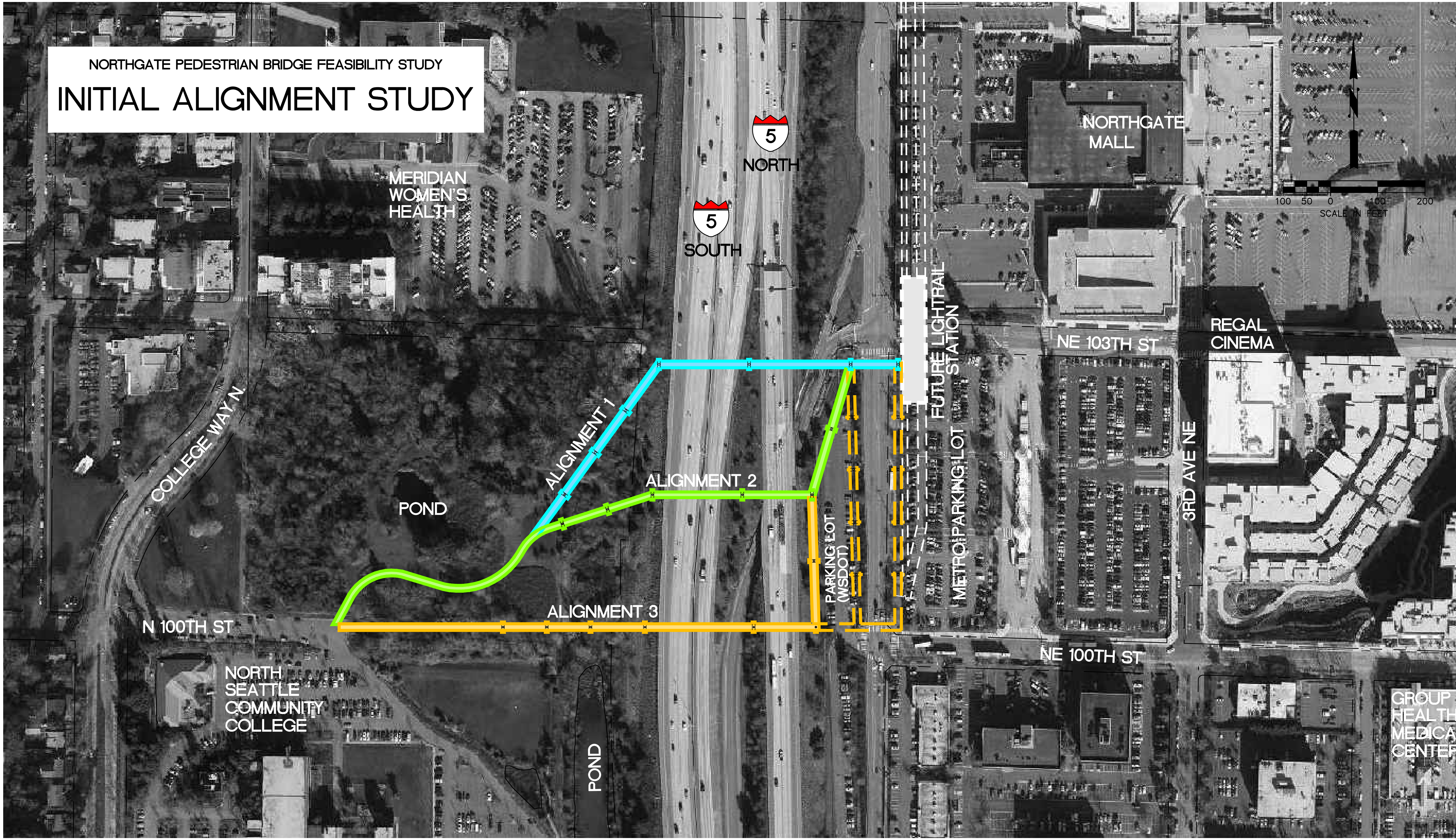
The proposed location for the new bridge is just north of NSCC on the west end and between NE 100th Street and NE 103rd Street on the east end. Three alternative alignments were initially studied and two of them were chosen for more detailed evaluation. Consideration was given to potential bridge span lengths, horizontal and vertical clearance from I-5 lanes and city streets, ADA requirements, impacts to traffic on I-5 during construction, street access via stairways and elevators, aesthetics, economics, environmental impacts, constructability, future inspection and maintenance, and durability.

Various bridge structures and their configurations have been reviewed and evaluated. For the main bridge spans over I-5 that require long bridge spans, thin bridge deck systems such as cable-stayed or steel truss structures are more desirable in order to minimize superstructure depth over I-5 and approach length demand due to ADA requirements. A steel truss bridge provides a more traditional appearance while cable-stayed is a landmark-type structure that is visually pleasing and can blend well with the area's surrounding environment. Additionally, the cable-stayed bridge can provide lighter weight that can reduce the bridge pier and its sub-structural capacity demands. However, higher costs requiring specialization in cable-stayed bridge designs and construction are expected. Rendering views of these two bridge types along with two recommended alignments can be seen in the Appendix.

For the approach bridge spans, more conventional-type structures including precast concrete box girders, I-girders, bulb-tee girders, voided slab, and steel-plate girders are viable and economical solutions. Precast concrete slab or girders in particular can offer good durability and extreme low maintenance over the course of their lifetimes. At the bridge approaches, a flexible retaining wall system or a combination of wall and sloped fill can be considered to minimize project construction costs.

It is recommended that the typical bridge cross section have a skidding resistance deck surface with a minimum width of 14 feet. The minimum clear height for the bridge has been assumed at 20'0" over I-5 traffic lanes and 16'6" over city streets per WSDOT and City of Seattle recommendation. The current criteria assumed for this study is 4'6" handrail height for pedestrian and cycle users along entire bridge and wall sections and 8- to 10-foot-high screens on each side of the bridge over I-5 traffic lanes.

Tables that compare various bridge alignments and structural types are included in Section 10 of this report. These tables are useful for project further consideration and determination of a final bridge alignment and structural type considering a balance among cost, function, and aesthetics. The estimated cost for the project, including design costs and construction costs, is in the range of $16,200,000 to $18,700,000.



KING COUNTY DEPT. OF TRANSPORTATION

HAROLD TANIGUCHI, DIRECTOR

NORTHGATE PEDESTRIAN BRIDGE FEASIBILITY STUDY

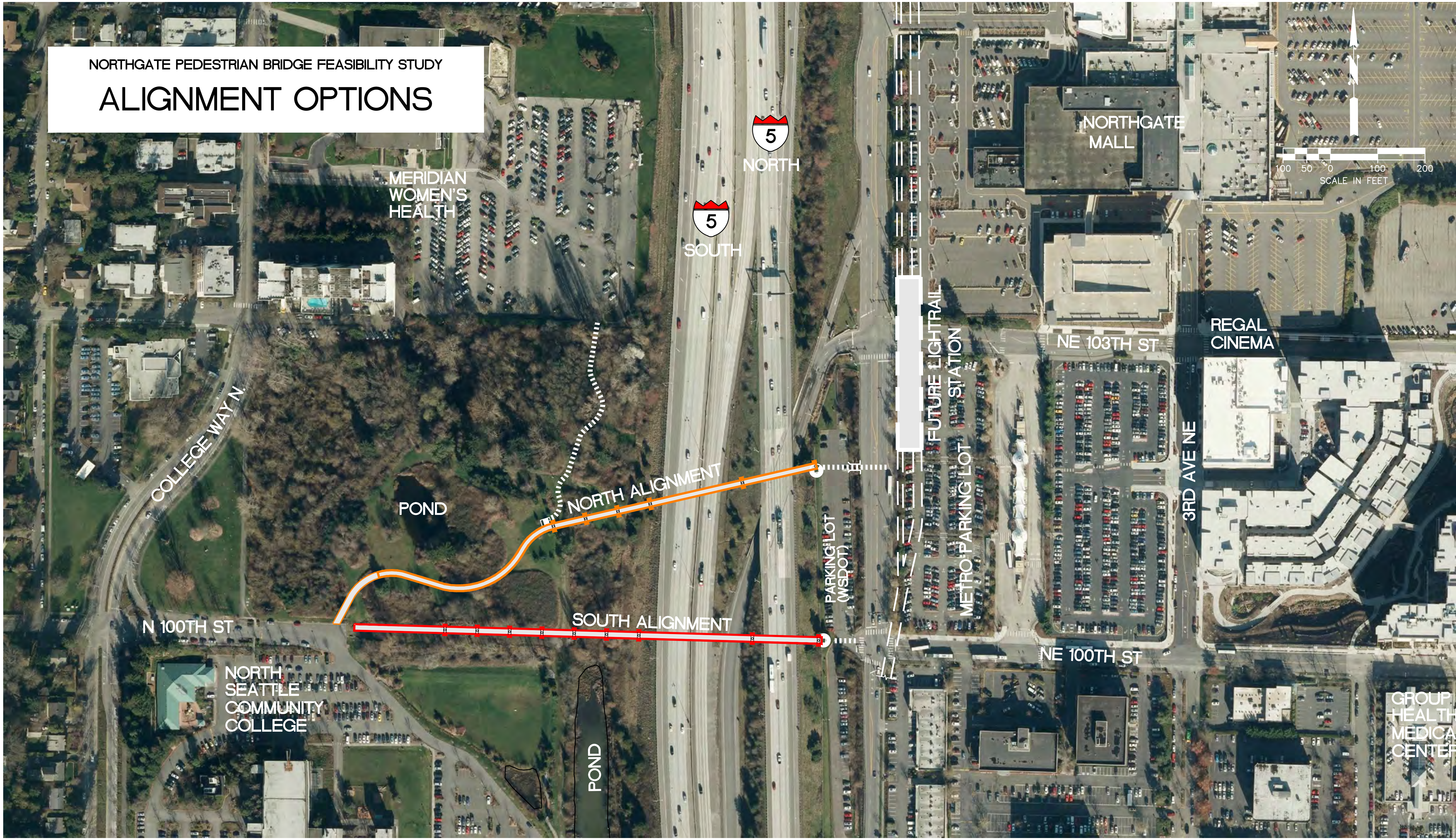
INITIAL ALIGNMENT STUDY

APPENDIX A

King County

NORTHGATE PEDESTRIAN BRIDGE FEASIBILITY STUDY

ALIGNMENT OPTIONS



KING COUNTY DEPT. OF TRANSPORTATION
HAROLD TANIGUCHI, DIRECTOR

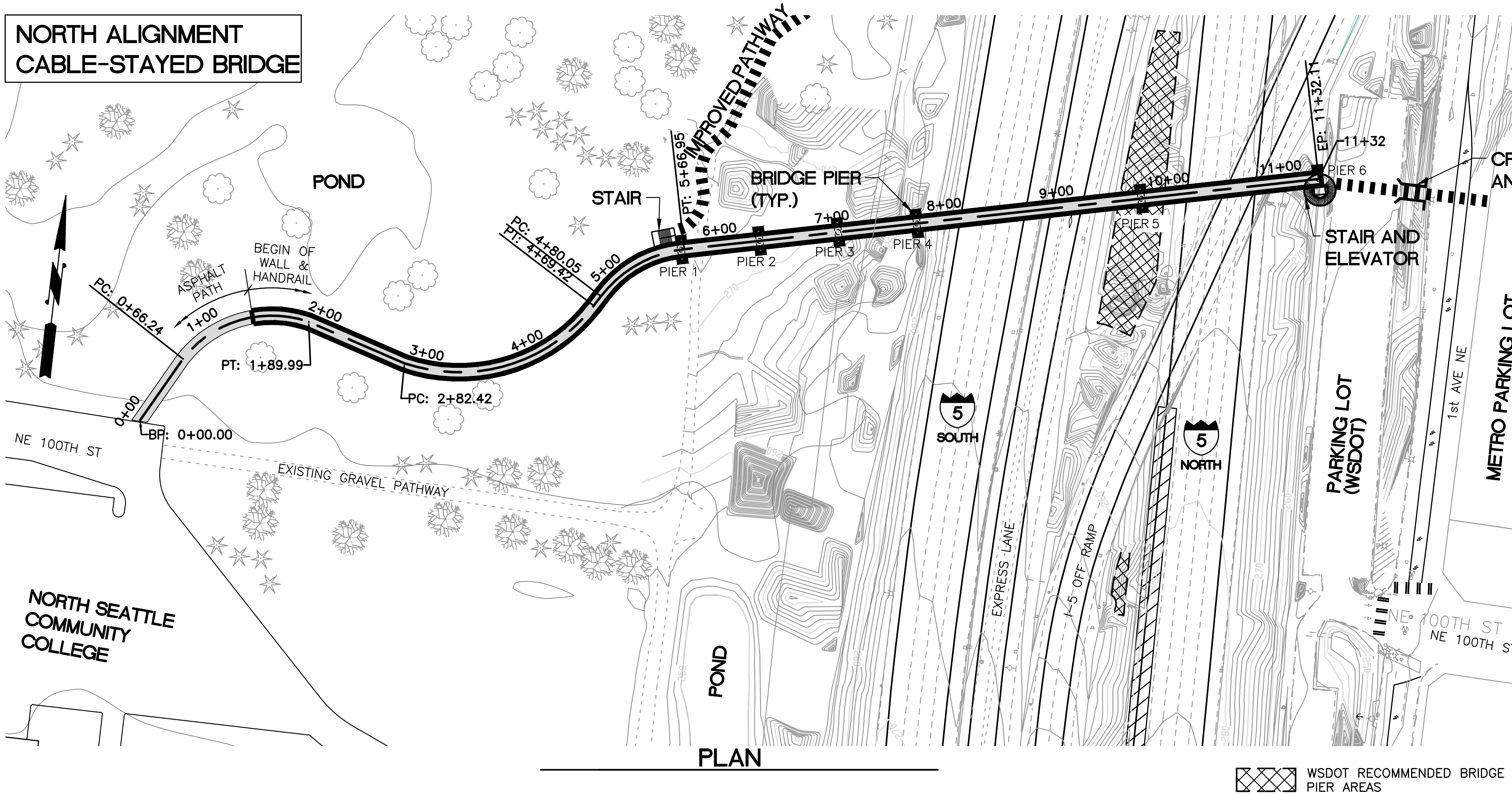
NORTHGATE PEDESTRIAN BRIDGE FEASIBILITY STUDY

RECOMMENDED ALIGNMENTS FOR FURTHER CONSIDERATIONS

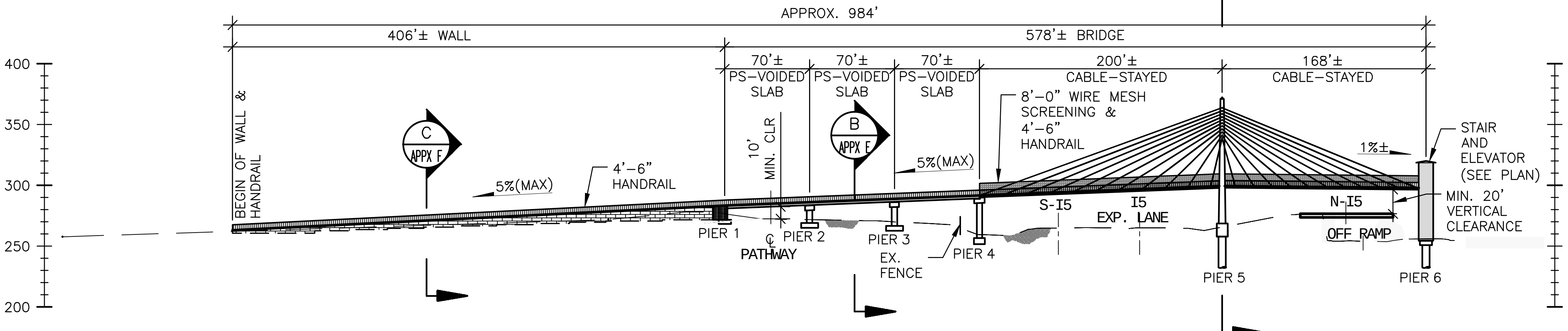
APPENDIX B

King County

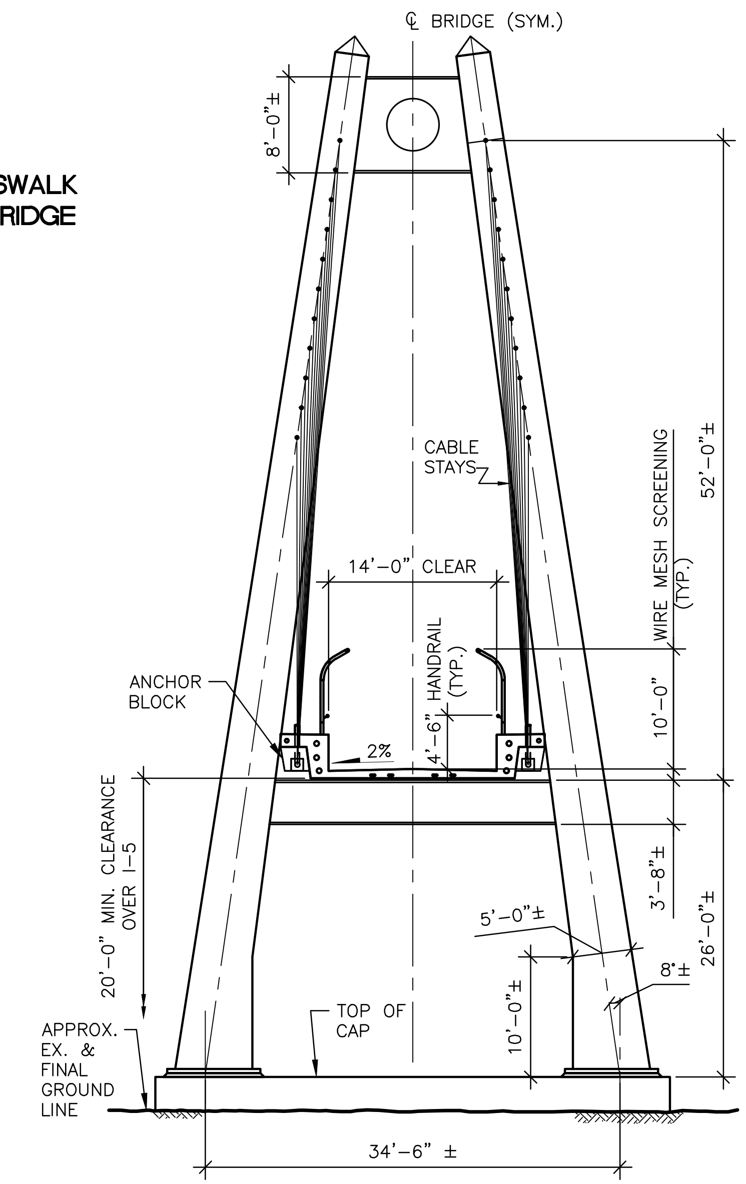
NORTH ALIGNMENT CABLE-STAYED BRIDGE



PLAN



ELEVATION



SECTION
NTS

A

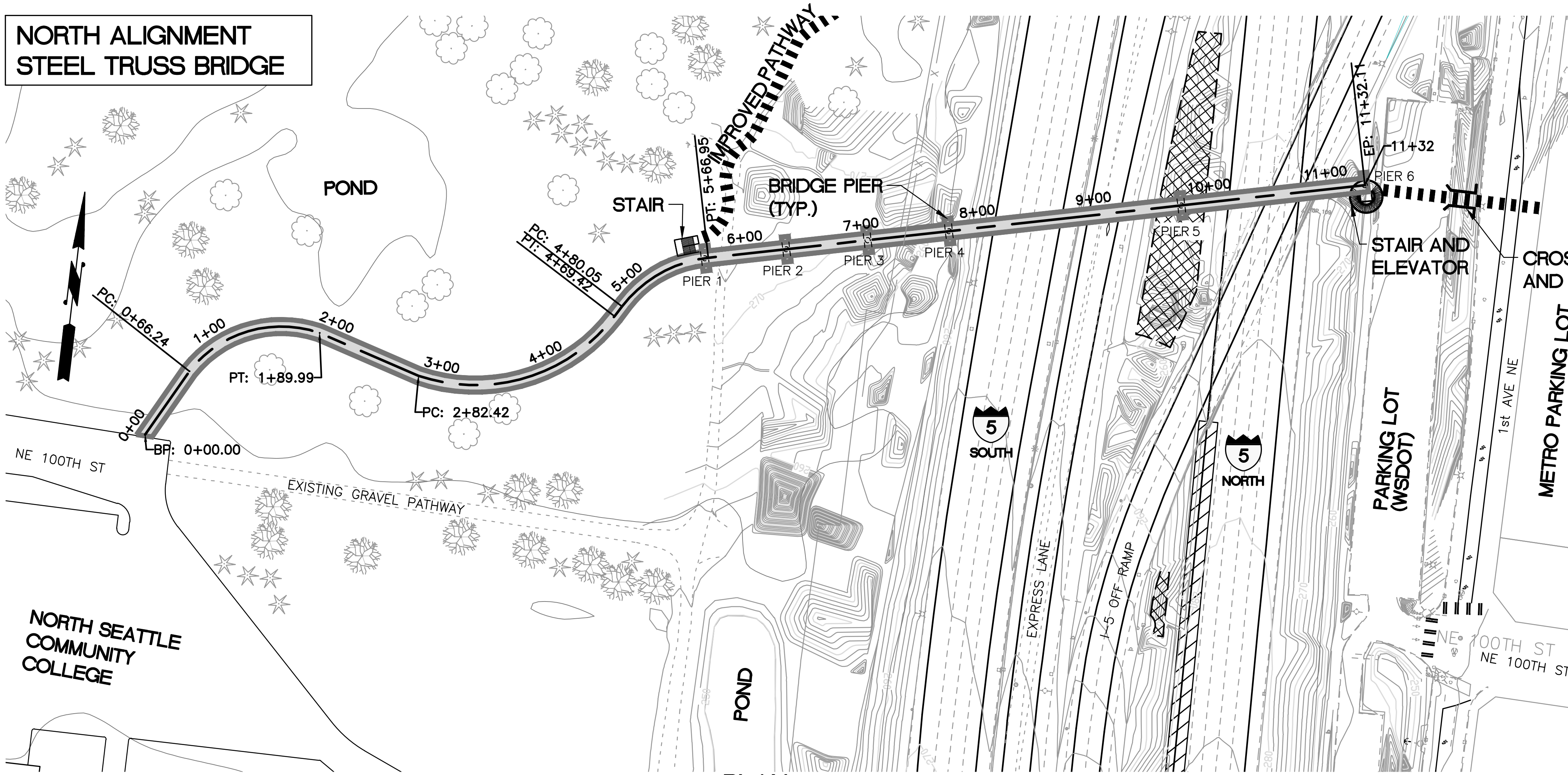
KING COUNTY DEPT. OF TRANSPORTATION
HAROLD TANIGUCHI, DIRECTOR

NORTHGATE PEDESTRIAN BRIDGE FEASIBILITY STUDY

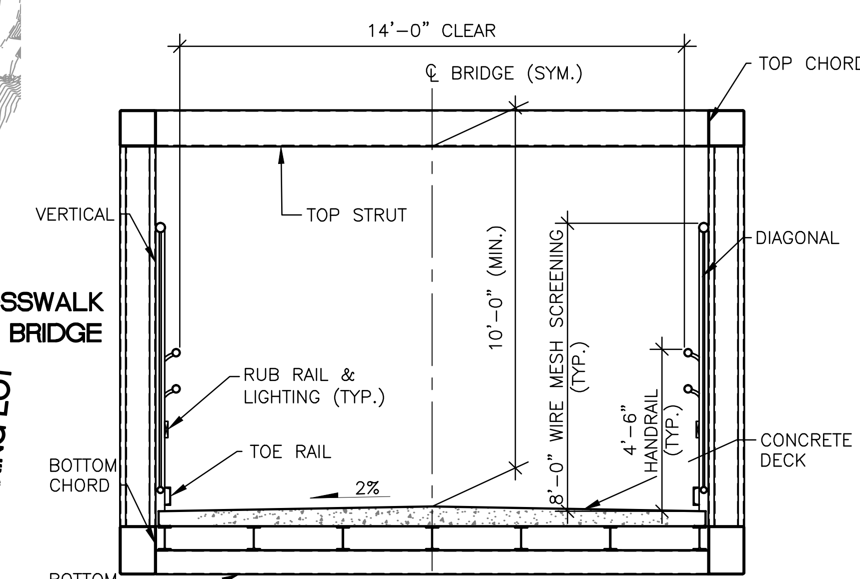
NORTH ALIGNMENT
(CABLE-STAYED BRIDGE OPTION)

APPENDIX C-1

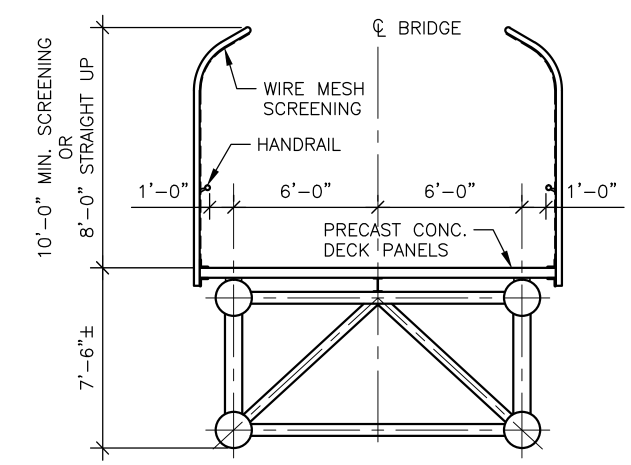
King County



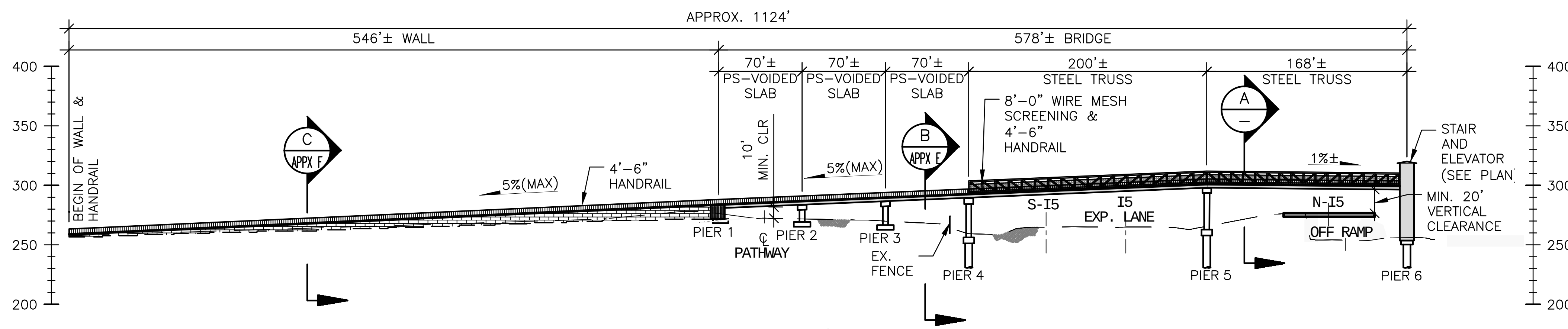
PLAN



SECTION A
NTS



PIPE TRUSS BRIDGE SECTION A
(ALTERNATIVE TO PRE-STRESSED GIRDER SECTION)
NTS



ELEVATION

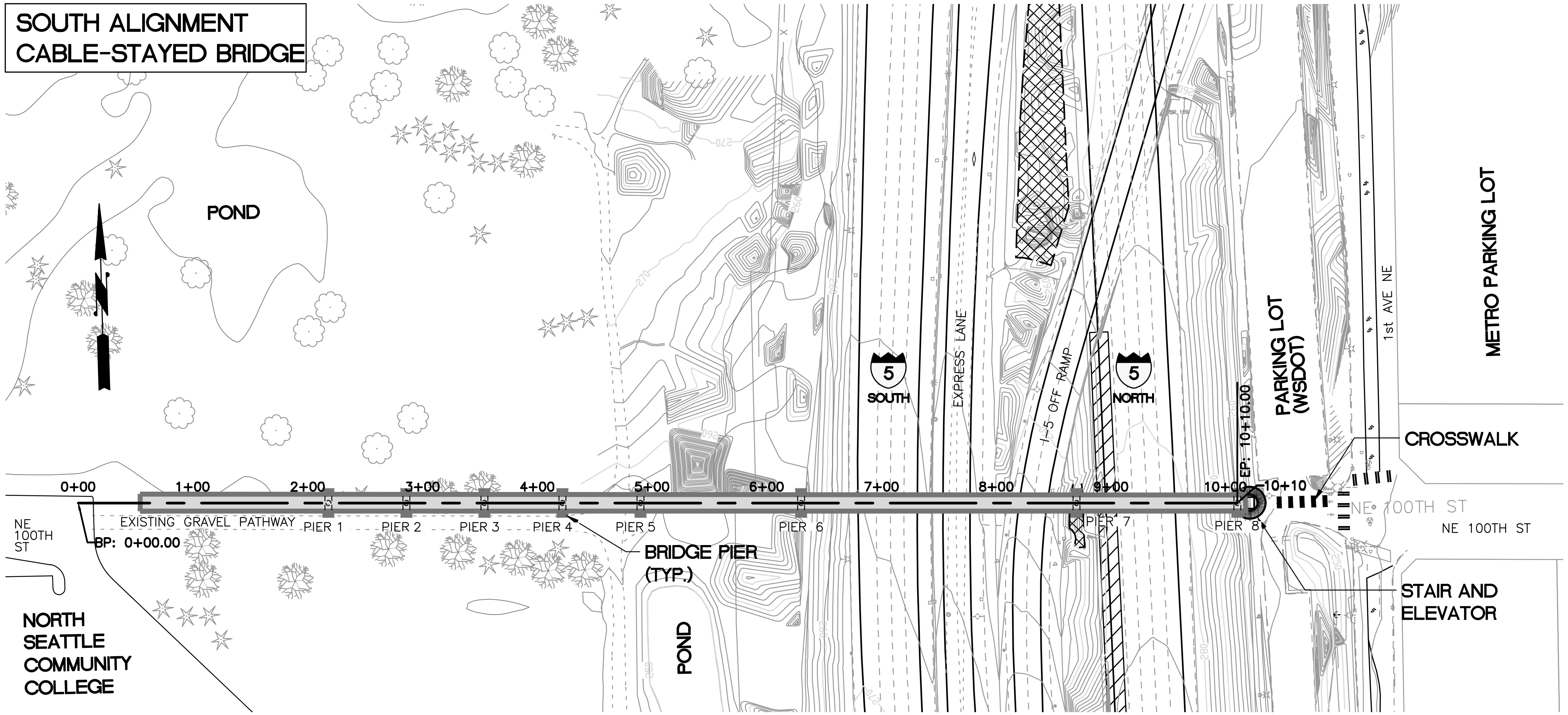
KING COUNTY DEPT. OF TRANSPORTATION
HAROLD TANIGUCHI, DIRECTOR

NORTHGATE PEDESTRIAN BRIDGE FEASIBILITY STUDY

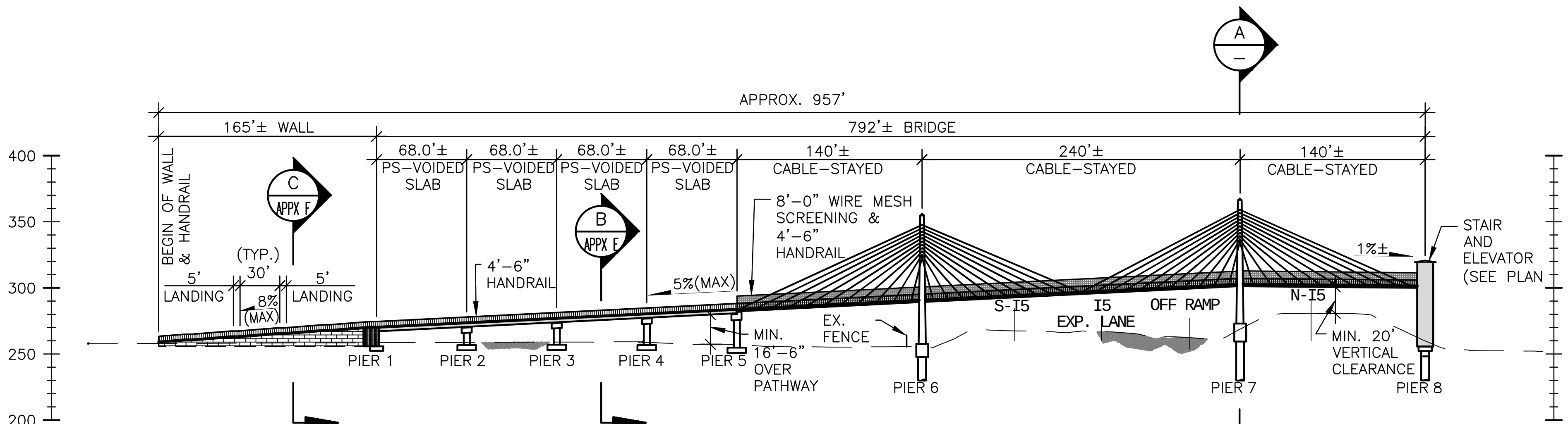
NORTH ALIGNMENT
(STEEL TRUSS BRIDGE OPTION)

APPENDIX C-2

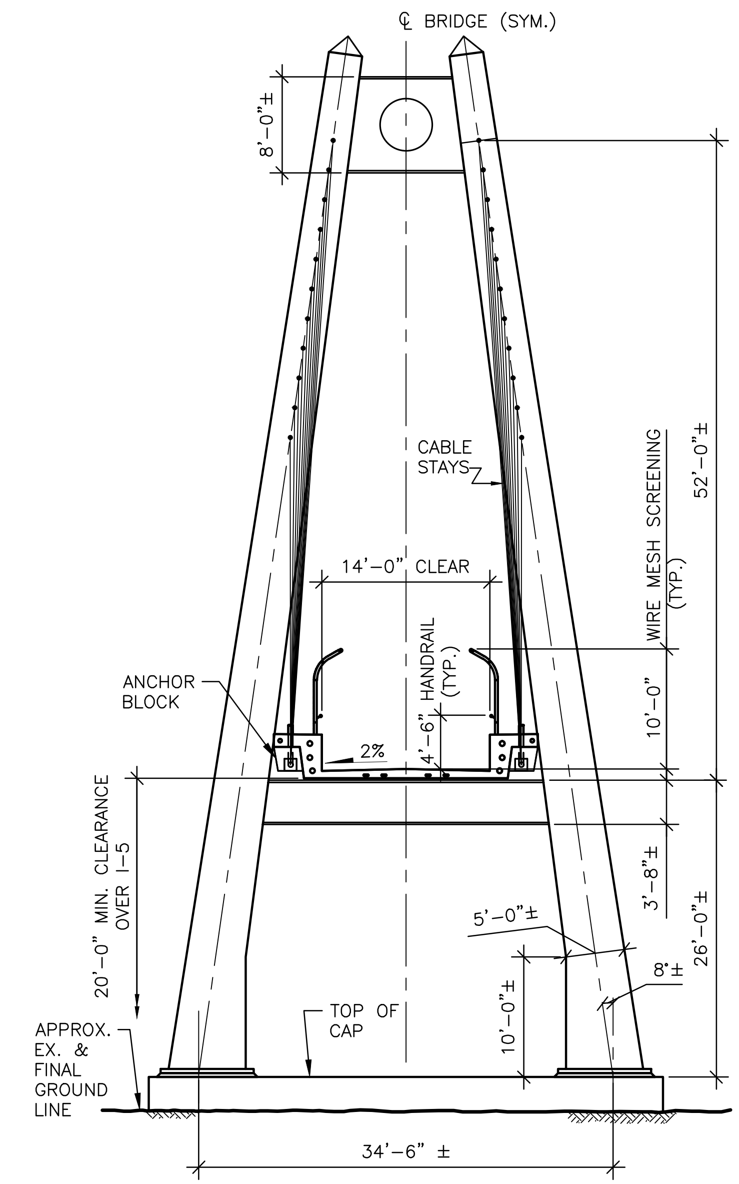
King County



PLAN



ELEVATION



SECTION
NTS

KING COUNTY DEPT. OF TRANSPORTATION
HAROLD TANIGUCHI, DIRECTOR

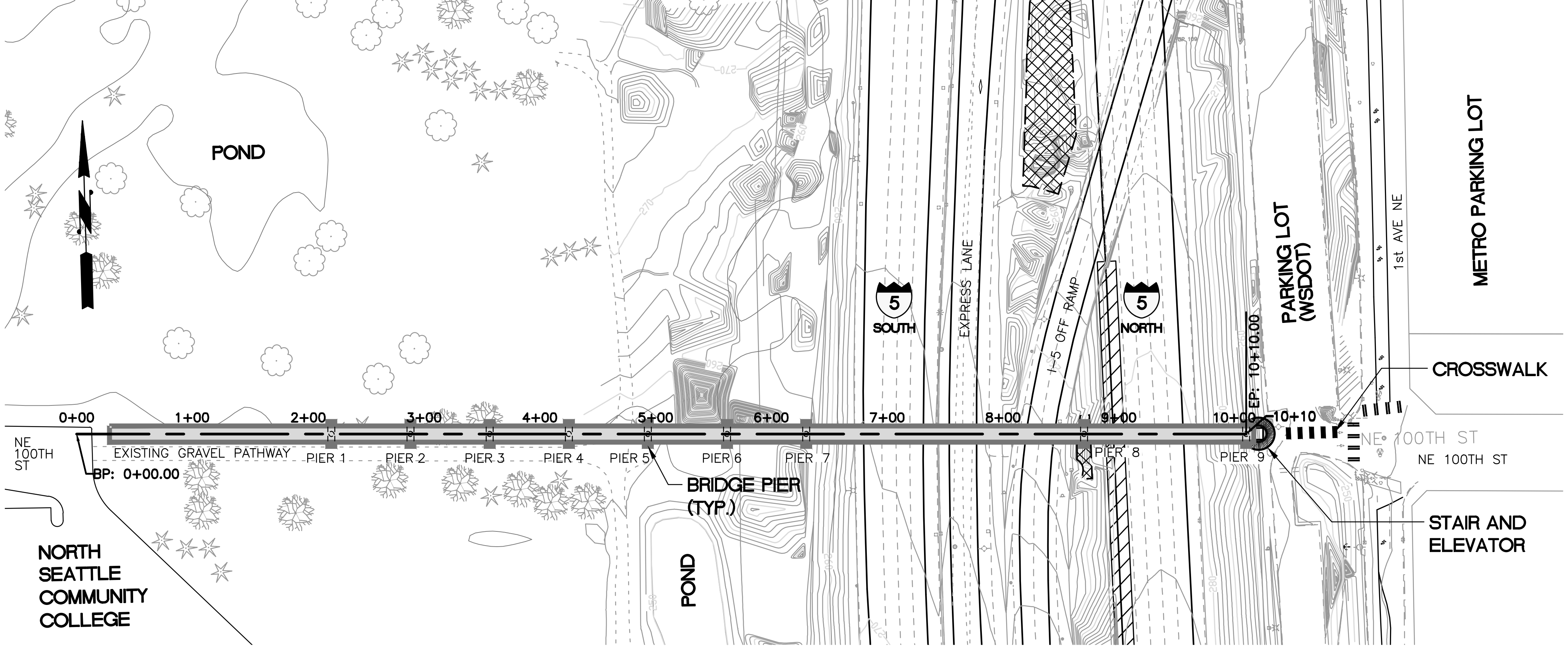
NORTHGATE PEDESTRIAN BRIDGE FEASIBILITY STUDY

SOUTH ALIGNMENT
(CABLE-STAYED BRIDGE OPTION)

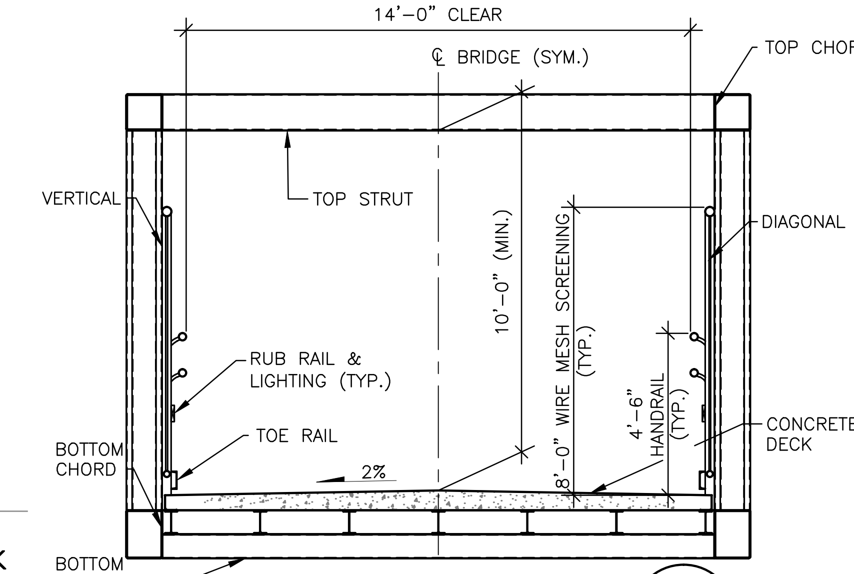
APPENDIX C-3

King County

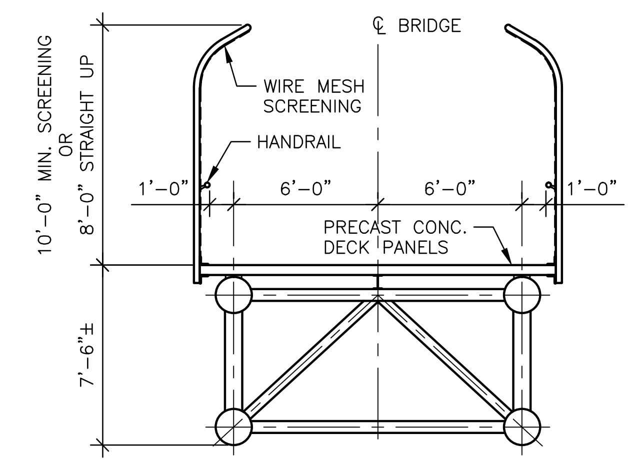
SOUTH ALIGNMENT STEEL TRUSS BRIDGE



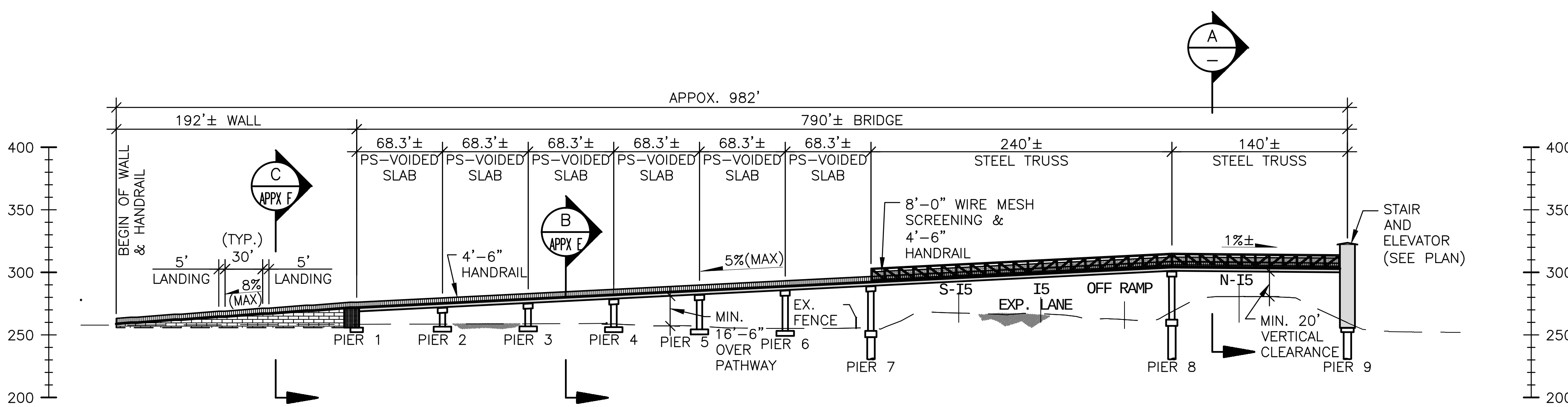
PLAN



SECTION
A
NTS



PIPE TRUSS BRIDGE SECTION
A
(ALTERNATIVE TO PRE–STRESSED GIRDER SECTION)
NTS



ELEVATION

KING COUNTY DEPT. OF TRANSPORTATION
HAROLD TANIGUCHI, DIRECTOR

NORTHGATE PEDESTRIAN BRIDGE FEASIBILITY STUDY

SOUTH ALIGNMENT
(STEEL TRUSS BRIDGE OPTION)

APPENDIX C-4

King County

NORTH ALIGNMENT
MAIN SPAN CABLE-STAYED BRIDGE
(WITH A-TYPE PYLON SHOWN)

COURTESY OF:

SOUTH ALIGNMENT
MAIN SPAN CABLE-STAYED BRIDGE
(WITH A-TYPE PYLON SHOWN)

COURTESY OF:

KING COUNTY DEPT. OF TRANSPORTATION
HAROLD TANIGUCHI, DIRECTOR

NORTHGATE PEDESTRIAN BRIDGE FEASIBILITY STUDY

BRIDGE RENDERING
(CABLE-STAYED)

APPENDIX D-2

King County

MAIN SPAN STEEL TRUSS BRIDGE

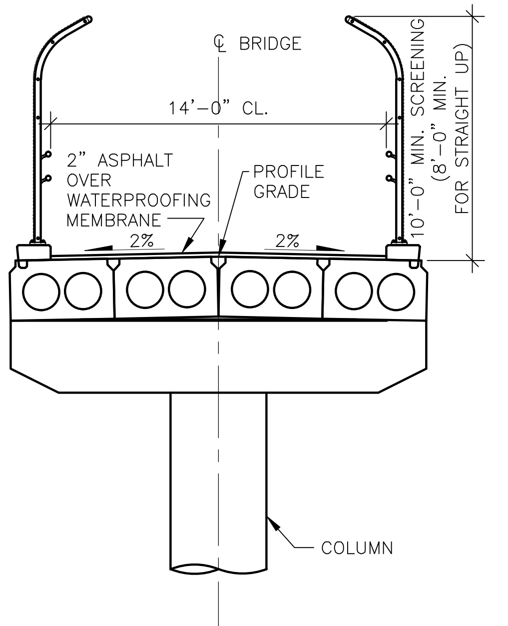
KING COUNTY DEPT. OF TRANSPORTATION
HAROLD TANIGUCHI, DIRECTOR

NORTHGATE PEDESTRIAN BRIDGE
FEASIBILITY STUDY

BRIDGE RENDERING
(STEEL TRUSS)

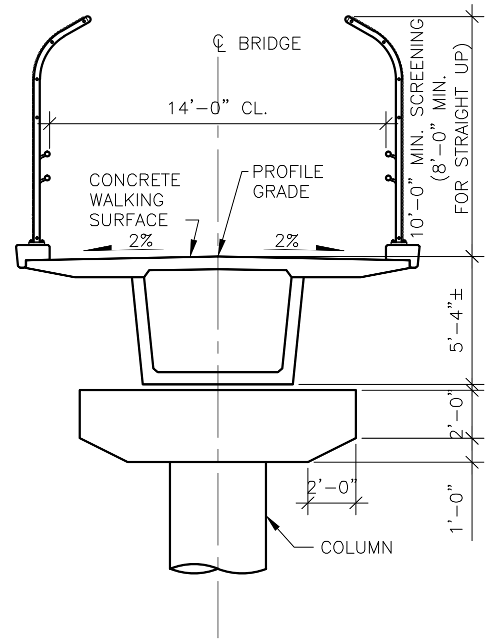
APPENDIX D-3

King County



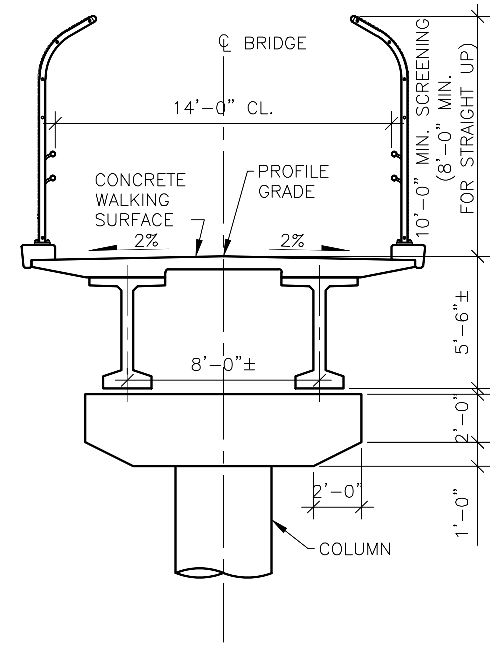
CONCRETE SLAB GIRDER B–1

SECTION (NTS)



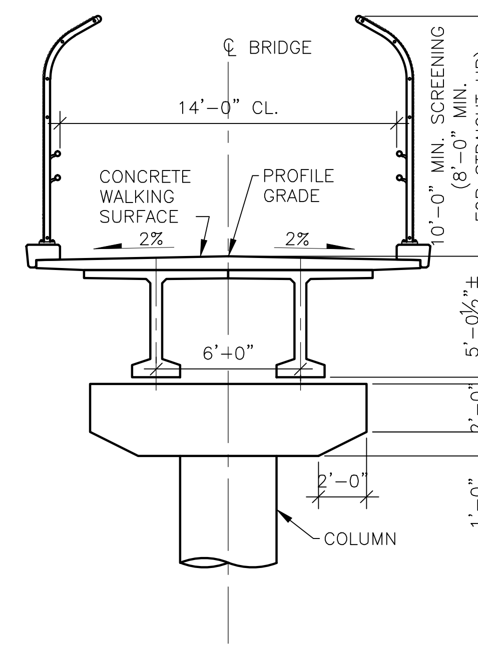
CONCRETE BOX GIRDER B–2

SECTION (NTS)



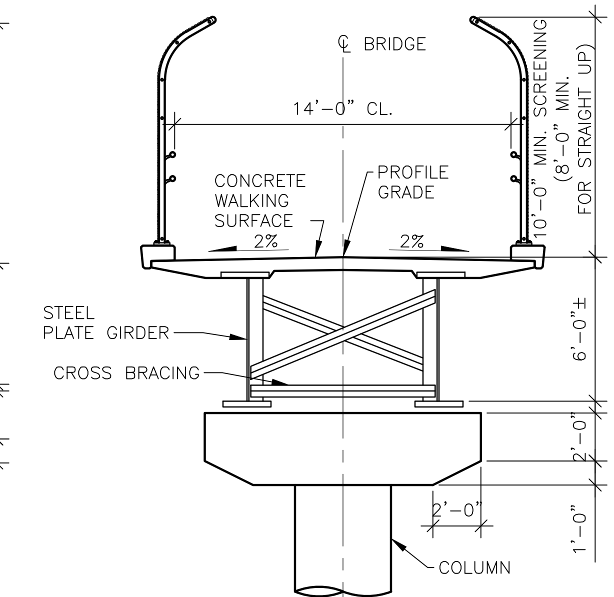
CONCRETE I-GIRDER B–3

SECTION (NTS)



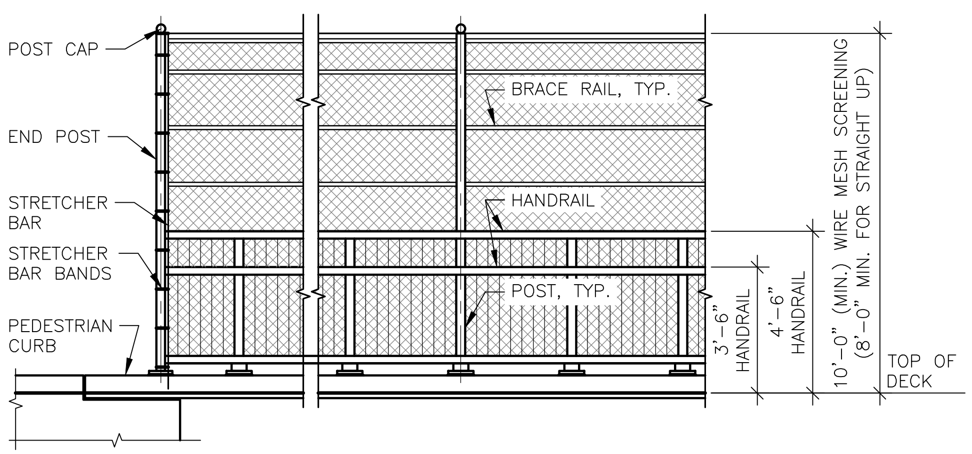
CONCRETE BULB-TEE GIRDER B–4

SECTION (NTS)



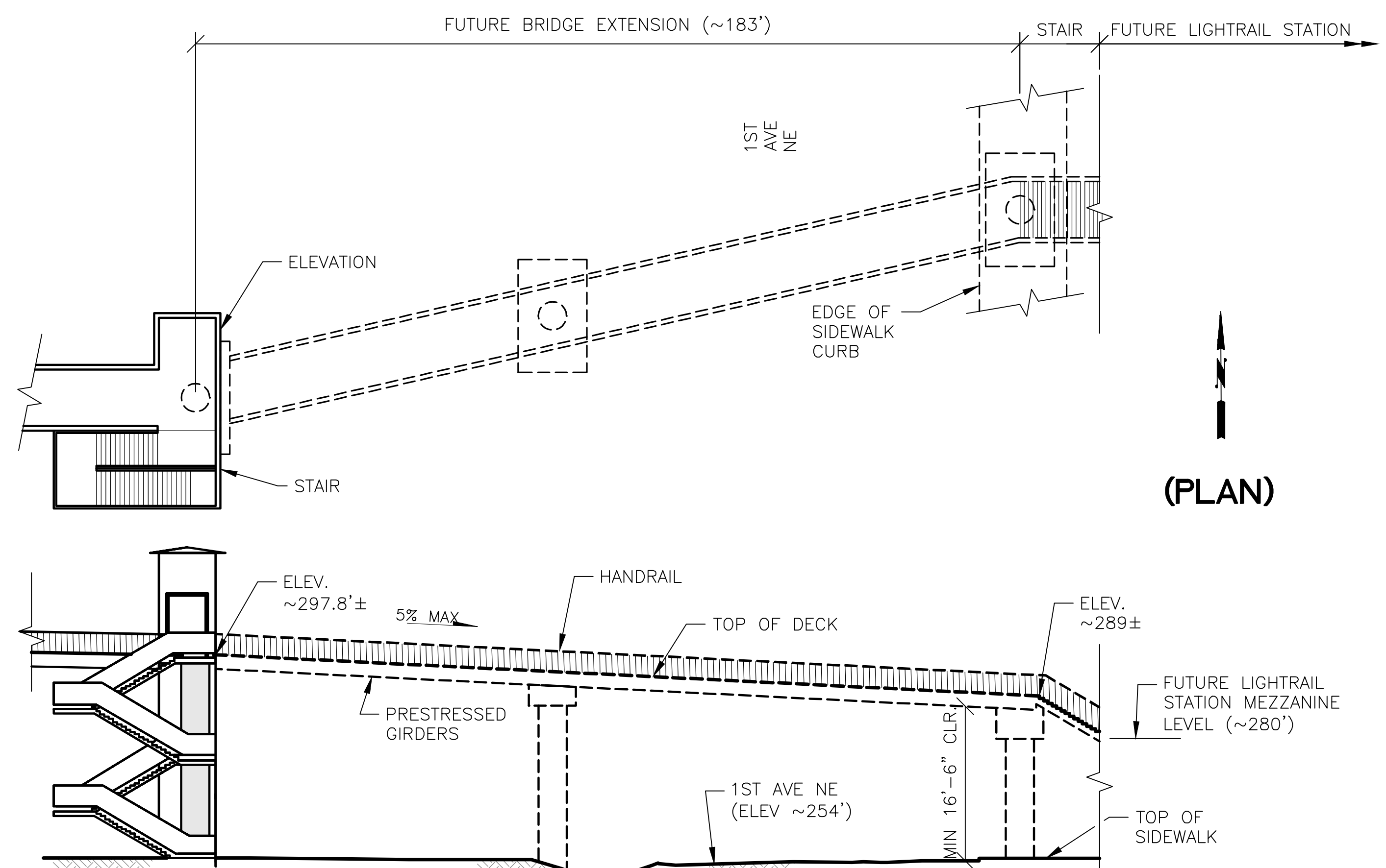
STEEL PLATE GIRDER B–5

SECTION (NTS)



FENCE NAD HANDRAIL ELEVATION

NTS



FUTURE BRIDGE EXTENSION TO LIGHTRAIL STATION (ELEVATION)

(NORTH ALIGNMENT – CABLE-STAYED OPTION)
NTS

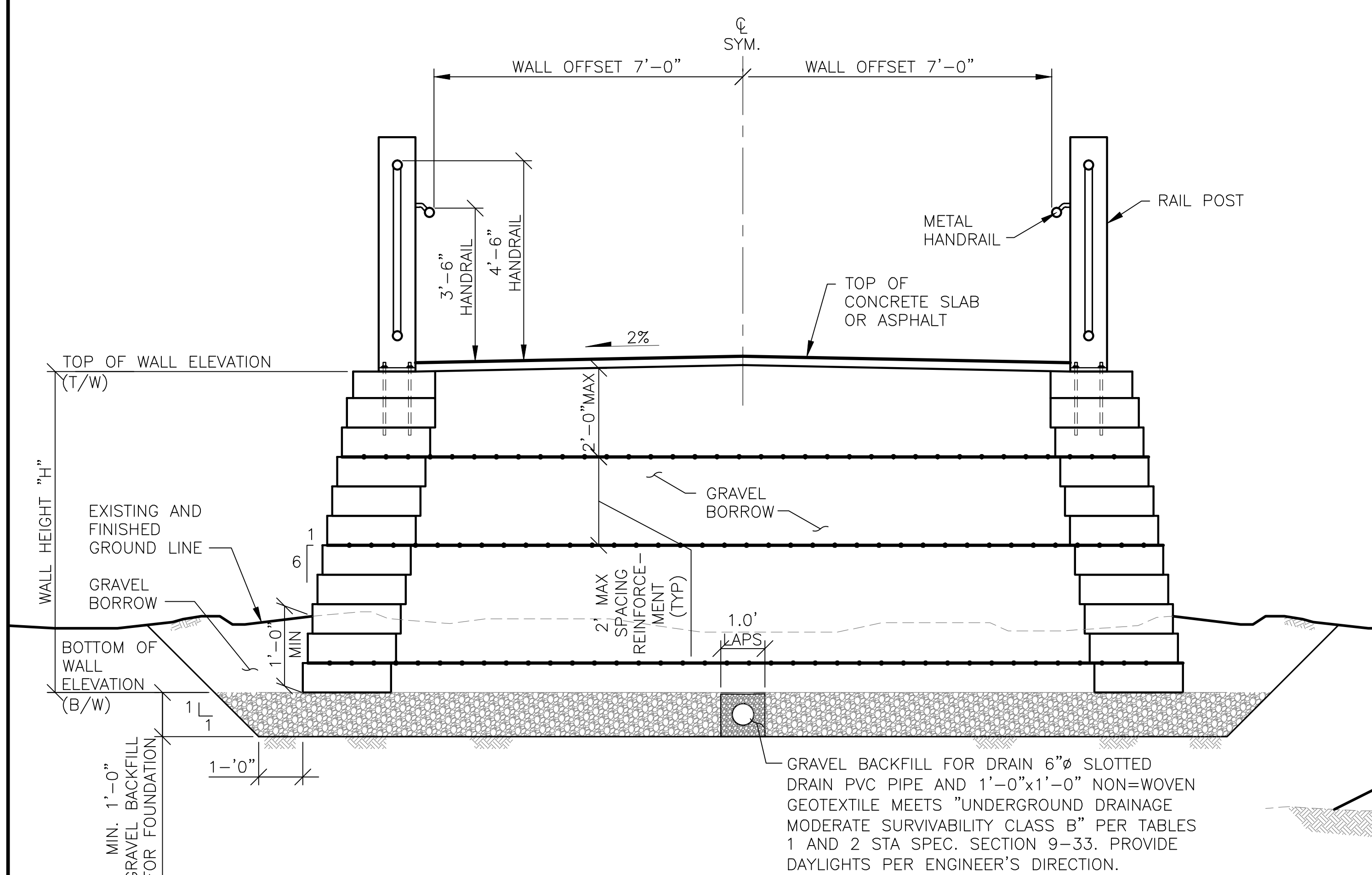
KING COUNTY DEPT. OF TRANSPORTATION
HAROLD TANIGUCHI, DIRECTOR

NORTHGATE PEDESTRIAN BRIDGE FEASIBILITY STUDY

TYPICAL BRIDGE OPTIONS FOR APPROACH SPAN AND FUTURE BRIDGE EXTENSION

APPENDIX E

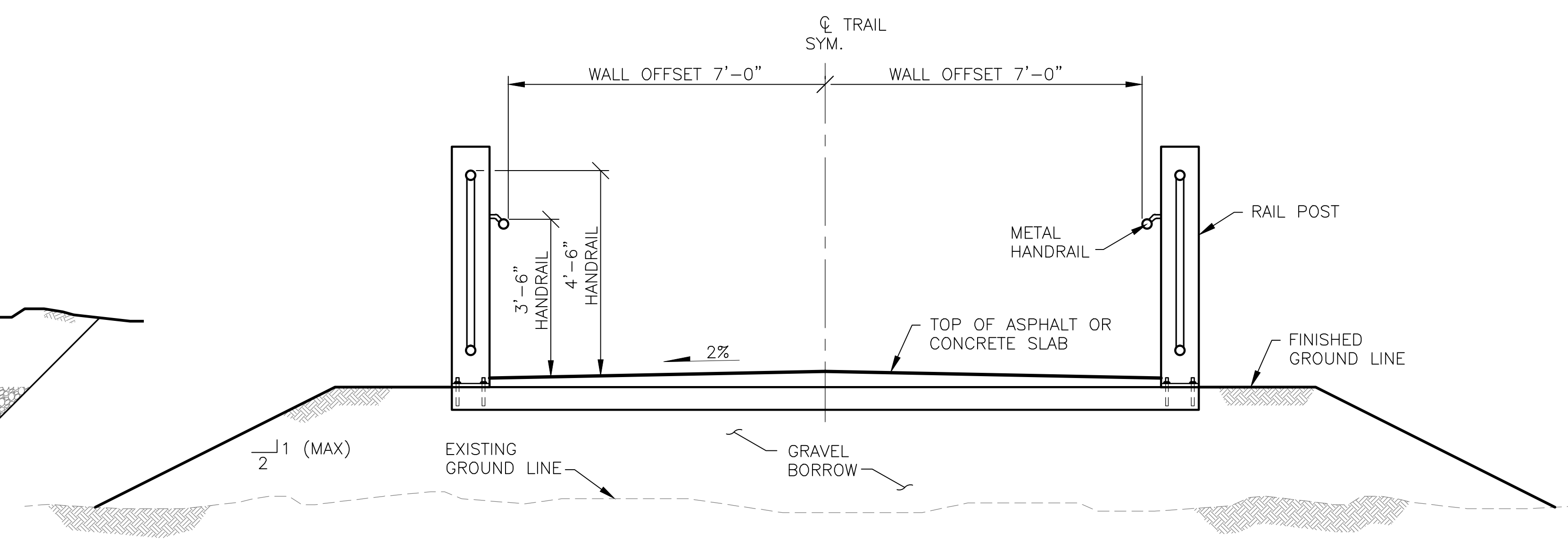
King County



TYPICAL SECTION
STRUCTURAL EARTH WALL (SEW)

NTS

C-1
–



TYPICAL FILL SECTION

NTS

C-2
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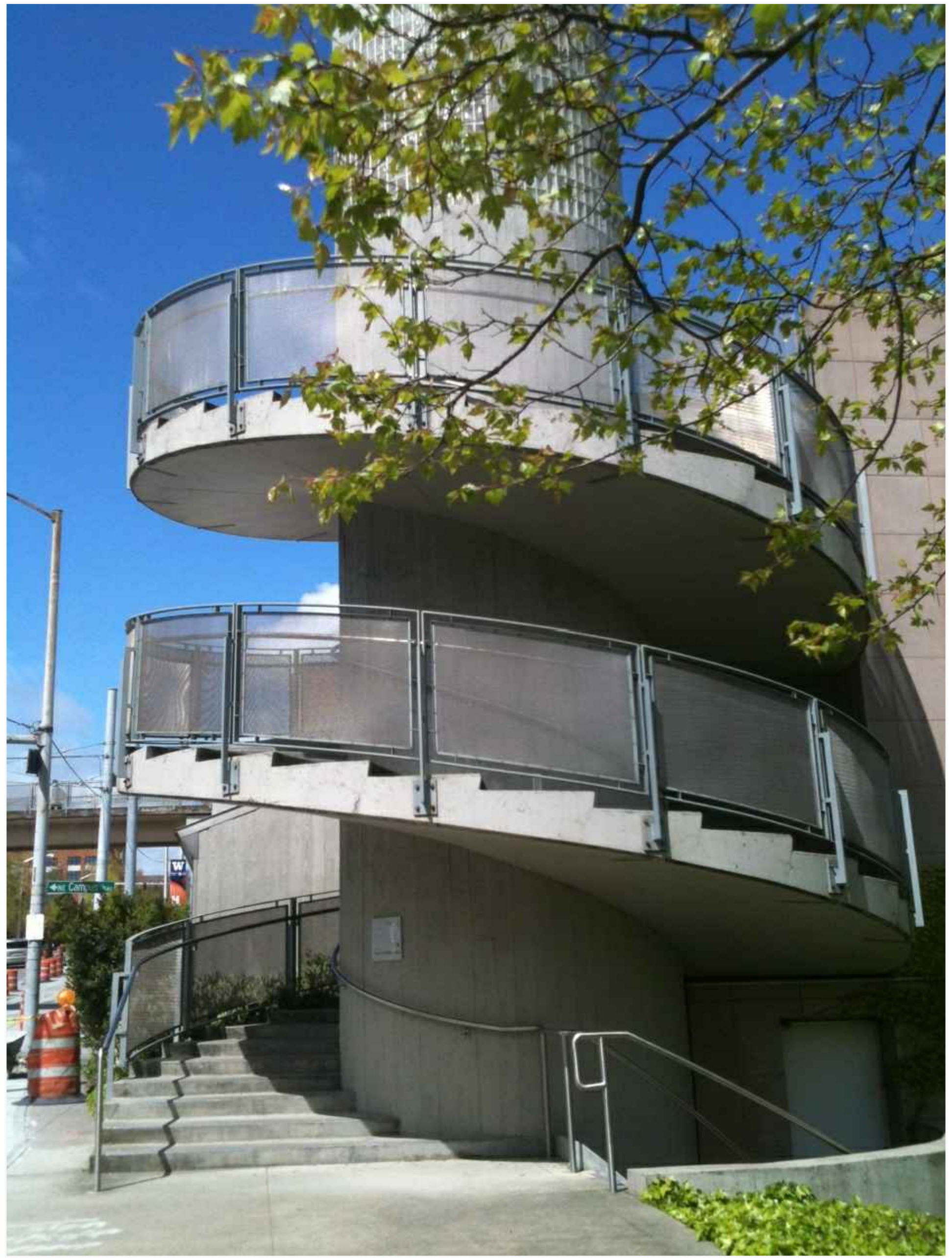
KING COUNTY DEPT. OF TRANSPORTATION
HAROLD TANIGUCHI, DIRECTOR

NORTHGATE PEDESTRIAN BRIDGE FEASIBILITY STUDY

TYPICAL WALL AND/OR FILL SECTIONS

APPENDIX F

King County



SPIRAL STAIR AND AND ELEVATOR
(OPTION 1)

CONVENTIONAL STAIR AND ELEVATOR
(OPTION 2)

KING COUNTY DEPT. OF TRANSPORTATION
HAROLD TANIGUCHI, DIRECTOR

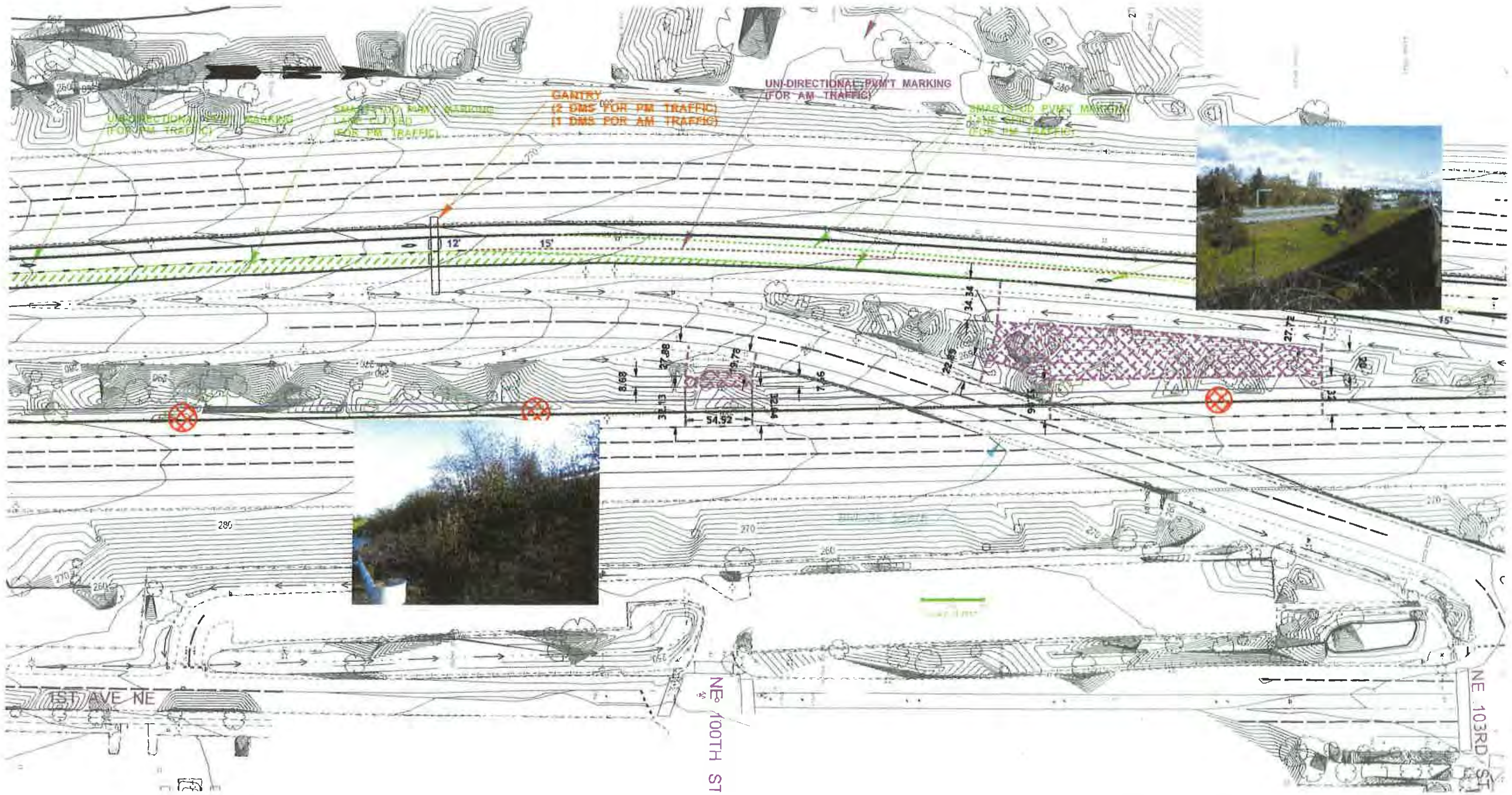
NORTHGATE PEDESTRIAN BRIDGE FEASIBILITY STUDY

STAIR AND ELEVATOR OPTIONS

APPENDIX G

King County

T 26 N, R 4 E, SECTION 32



NEW TWO-LANE ROADWAY

BRIDGE WIDENING

MEDIAN SHOULDER WIDENING

ROADWAY REALIGNMENT

ROADWAY REALIGNMENT

CONCRETE BARRIER REPLACEMENT

GUARDRAIL REPLACEMENT

SIGN STRUCTURE REPLACEMENT

ILLUMINATION REPLACEMENT

LANE CLOSED (BY SMARTSTUD DEVICE)

LEGEND

RECOMMENDED BRIDGE PIER LOCATIONS BETWEEN I-5 LANES (PROVIDED BY WSDOT)

APPENDIX H

FILE NAME	C:\Documents and Settings\leec\My Documents\CF - WORKING FOLDER\I-5 Pedestrian Skybridge\I-5 Pedestrian Bridge Plan Drawings.dgn
TIME	7:16:15 AM
DATE	3/29/2011
PLOTTED BY	leec
DESIGNED BY	C. LEE
ENTERED BY	C. LEE
CHECKED BY	C. LEE
PROJ. ENGR.	
REGIONAL ADM.	

REVISION | DATE | BY

REGION NO. 10 | STATE WASH | FED.AID PROJ.NO.

JOB NUMBER

CONTRACT NO. | LOCATION NO.

P.E. STAMP BOX DATE | P.E. STAMP BOX DATE

Washington State Department of Transportation

I-5
REVERSIBLE EXPRESS LANE
GP EXPRESS LANE MERGE REVISION

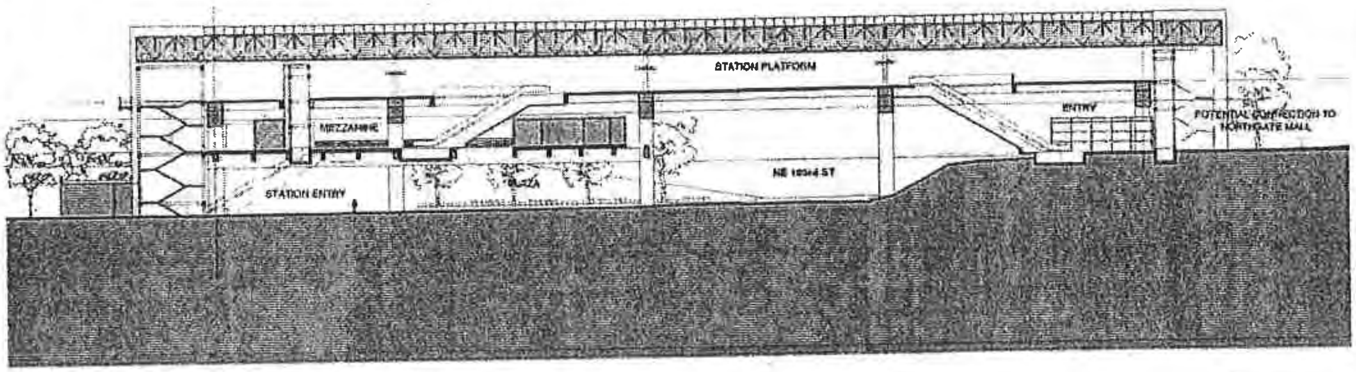
ALTERNATIVE 4

Plot 38

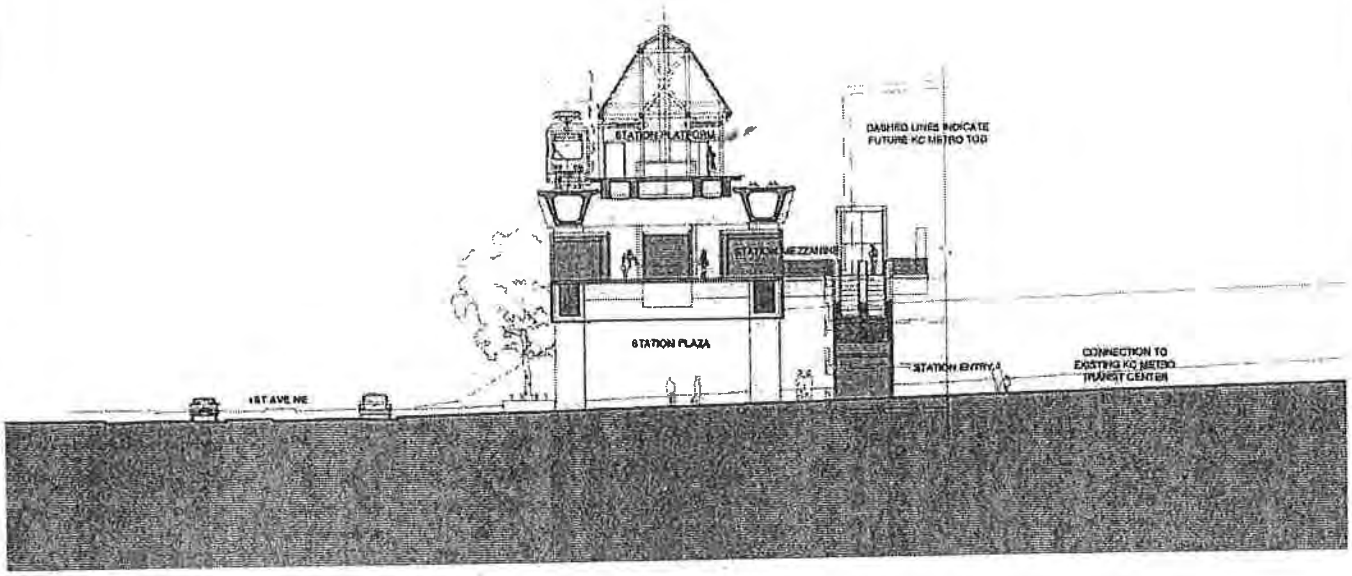
PLAN REF NO

SHEET 3 OF 4 SHEETS

NORTHGATE STATION
STATION SPANNING NE 103RD ST/ ALIGNMENT EAST OF 1ST AVE
NORTH LINK LIGHT RAIL



LONGITUDINAL SECTION (FACING WEST)



SECTION AT PLATFORM CENTER

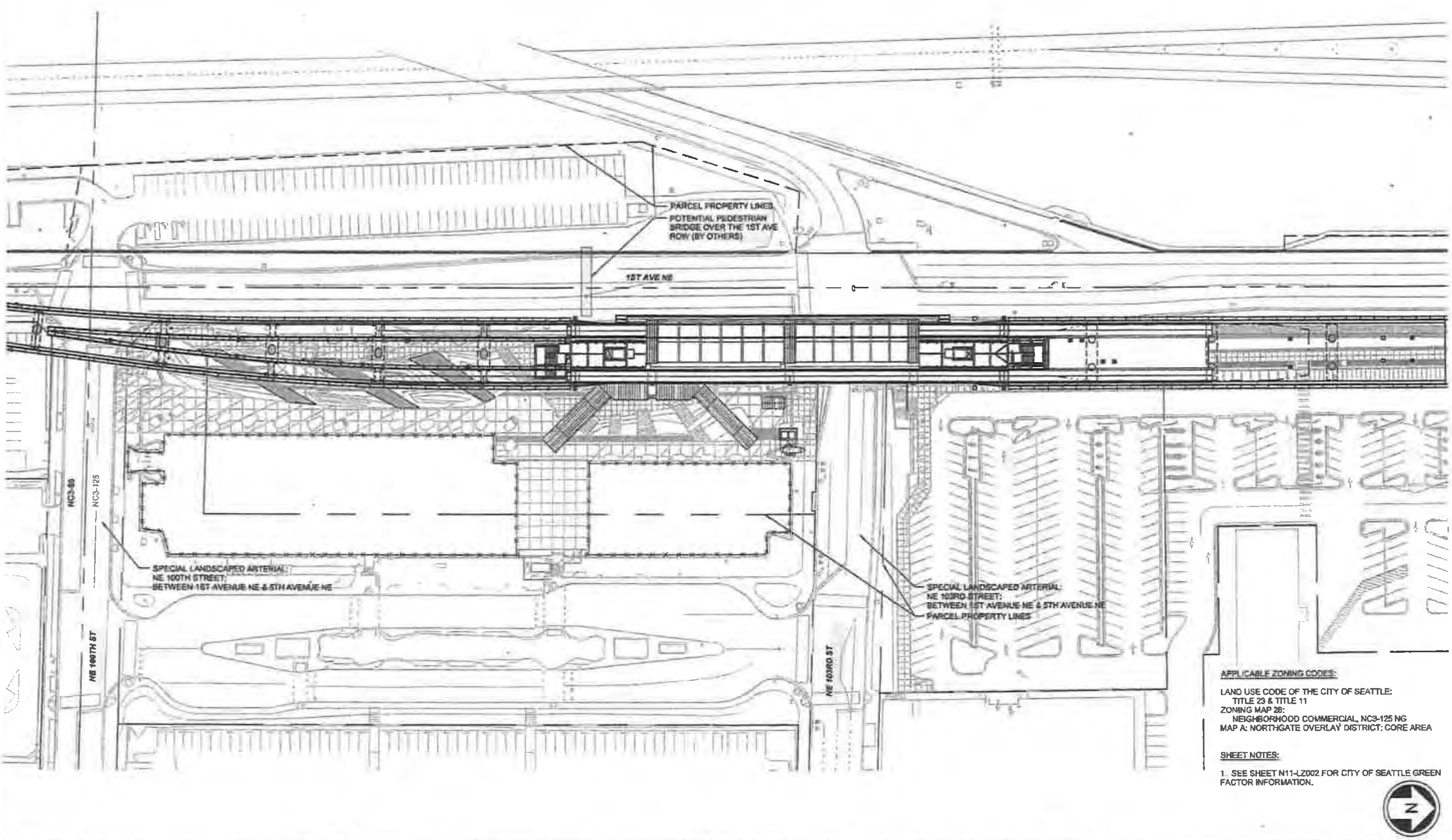
FEB-03

SOUNDTRANSIT

HEWITT ARCHITECTS

APPENDIX I

10-18-12
(Received)



APPLICABLE ZONING CODES:

LAND USE CODE OF THE CITY OF SEATTLE:
TITLE 23 & TITLE 11
ZONING MAP 28:
NEIGHBORHOOD COMMERCIAL, NC3-125 NG
MAP A: NORTHGATE OVERLAY DISTRICT: CORE AREA

SHEET NOTES:

1. SEE SHEET N11-LZ002 FOR CITY OF SEATTLE GREEN FACTOR INFORMATION.

City of Seattle

Designed By: J. EKLUND
Drawn By: J. EKLUND
Checked By: A. ENGEL
Approved By: D. HEWITT

REGISTERED ARCHITECT
DAVID M. HEWITT
STATE OF WASHINGTON

60% SUBMITTAL

JACOBS ASSOCIATES
Engineers/Consultants

HEWITT

Submitted: I. LAME Date: 10/12/12
Approved: S. AL-TAMIMI Date: 10/12/12

SOUND TRANSIT

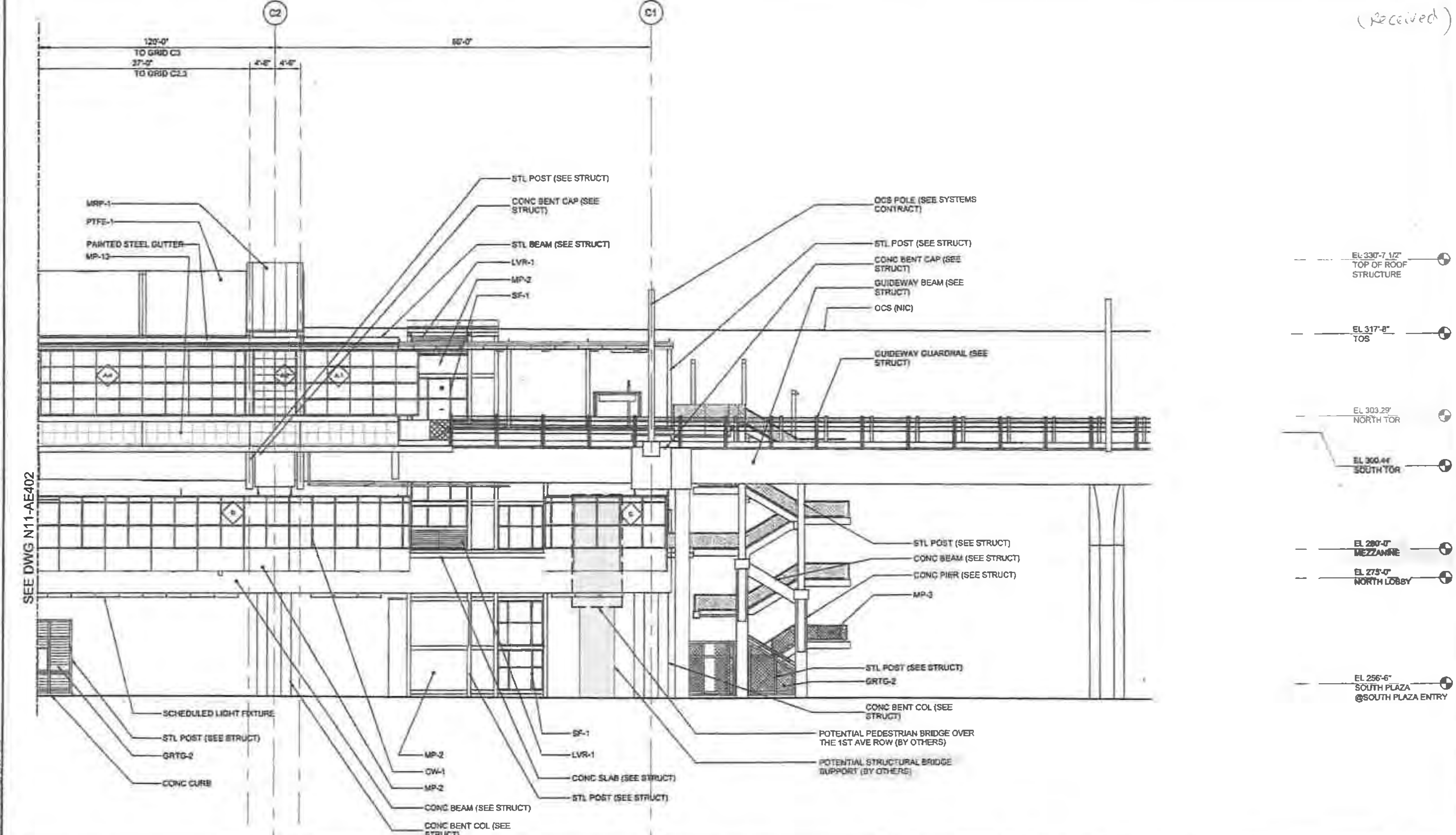
Scale: 1"=40'
Filename: N60_N11_AZ010.dwg
Contract No: N160
Date: 10/12/12

LINK CONTRACT N160
NORTHGATE STATION & ELEVATED GUIDEWAY

MUNICIPAL CODE INFORMATION
ZONING CODE DIAGRAM
SITE PLAN

Drawing No. N11-AZ010
Sheet No. 671
Rev No. 0

10-18-12
(Received)



City of Seattle

Designed By: I. WITHERS
Drawn By: I. WITHERS
Checked By: A. ENGEL
Approved By: D. HEWITT

REGISTERED ARCHITECT
DAVID M. HEWITT
STATE OF WASHINGTON

60% SUBMITTAL

JACOBS ASSOCIATES
Engineers/Consultants

HEWITT

Submitted: I. LAMB — Date: 10/05/12
Approved: S. AL-TAMIMI — Date: 10/05/12

SOUNDTRANSIT

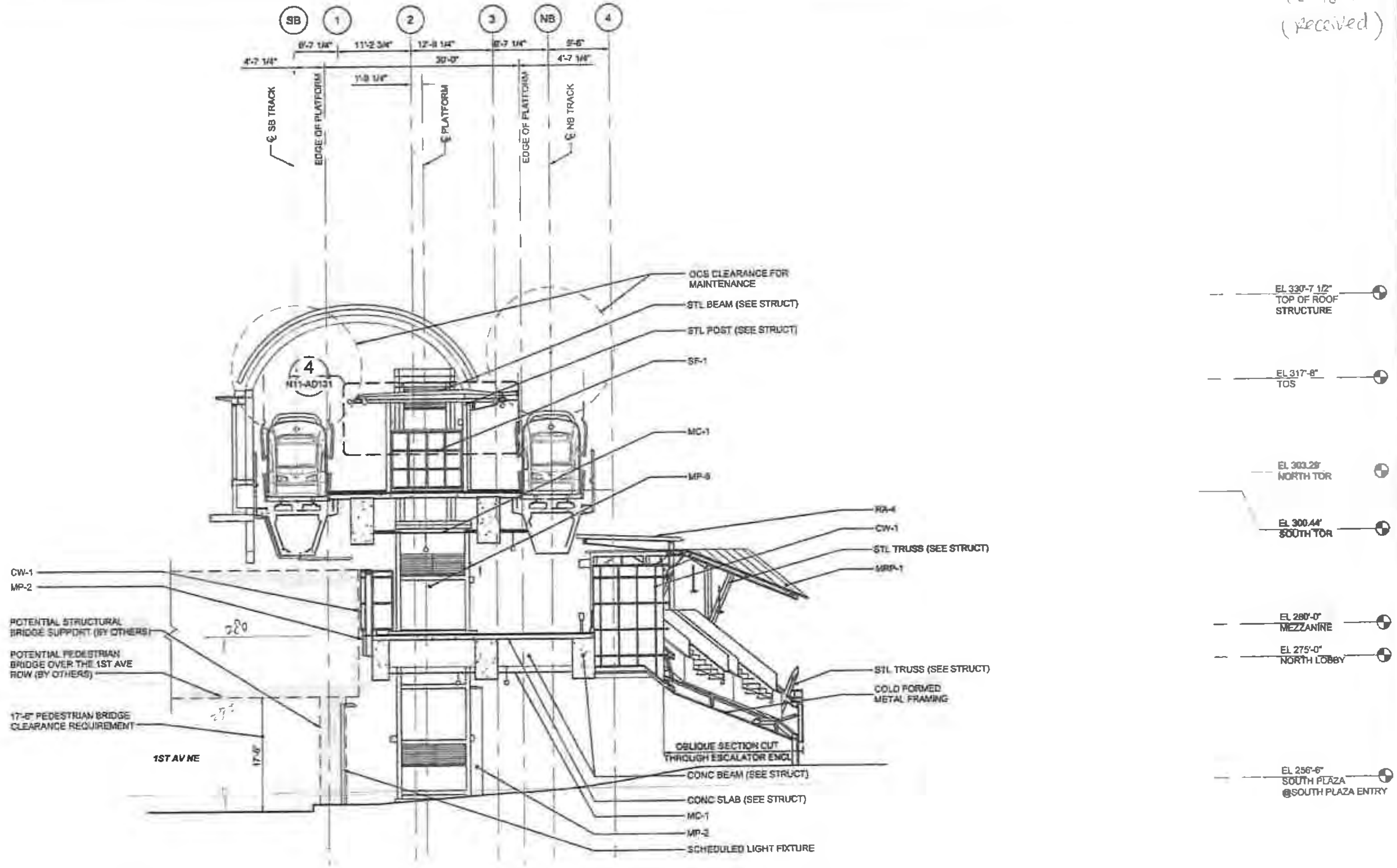
Scale: 1/8"=1'-0"
Filename: N60_N11_AE401.dwg
Contract No: N160
Date: 10/05/12

LINK CONTRACT N160
NORTHGATE STATION & ELEVATED GUIDEWAY

EXTERIOR ELEVATIONS
WEST ELEVATION
SOUTH

Drawing No. N11-AE401
Sheet No. 727
Rev No. 0

10-18-12
(Received)



No.	Date	Dsn	Chk	App	Revision

City of Seattle

Work Order No:	Approved:	Designed By:	J. BUSBY
Permit No:	Inspector's Book:	Drawn By:	J. BUSBY
	Reviewed:	Checked By:	A. ENGEL
SDOT:	Revised As Built:	Approved By:	D. HEWITT

REGISTERED ARCHITECT
DAVID M. HEWITT
STATE OF WASHINGTON

60% SUBMITTAL

JACOBS ASSOCIATES
Engineers/Consultants

HEWITT

Submitted:	Date:	Approved:	Date:
J. LAMB	10/05/12	S. AL-TAMIMI	10/05/12

SOUNDTRANSIT

Scale:	1/8"=1'-0"
Filename:	M80_N11_AX710.dwg
Contract No:	N160
Date:	10/05/12

LINK CONTRACT N160
NORTHGATE STATION & ELEVATED GUIDEWAY

CROSS SECTION

Drawing No.	N11-AX710
Vault Plan No.	
Sheet No.	720
Rev No.	0

APPENDIX J

Preliminary Soil Report

(Along North Bridge Alignment in North Seattle Community College Right-of-Way)

King County
Department of Transportation
Engineering Services Section
Materials Laboratory
155 Monroe Avenue NE, Bldg. D
Renton, WA 98056-4199

October 5, 2012

TO: Stephen Jiang, P.E., Engineer IV, Bridge and Structural Design Unit
Engineering Services Section

VIA: Alan Corwin, P.E., Materials Engineer, Materials Laboratory,
Project Support Services

FM: Doug Walters, P.E., Engineer III, Materials Laboratory,
Project Support Services

RE: **Northgate Pedestrian Bridge Preliminary Geotechnical Investigation**

1.0 INTRODUCTION

The proposed Pedestrian and Bicycle Bridge is part of a Transit-Oriented Development (TOD) plan that is designed to maximize access to public transportation and encourage transit ridership. The first phase of the project will design and construct a pedestrian bridge that crosses Interstate 5 (I-5) just north of the North Seattle Community College campus, and terminates along 1st Avenue NE, between NE 100th Street and NE 103rd Street. The second phase will extend the bridge to connect to the future Sound Transit North Link light rail station. The general project location is shown on the Vicinity Map, Figure 1, following the text.

Two alternative alignments (north and south) have been proposed for the pedestrian bridge. Our investigation only covered the north alternative alignment. For the north bridge alignment west of I-5, the bridge substructure will consist of an abutment/pier with three mid-span piers. In addition, several hundred feet of retaining walls are anticipated for the western bridge approach. For the main bridge span over I-5, a central pier will be located between the northbound and southbound lanes. Finally, the east abutment/pier for the main bridge span will be located east of I-5 at the location of an existing Metro Park and Ride lot, near 1st Avenue NE between NE 100th Street and NE 103rd Street. A preliminary layout of the proposed bridge alignment is provided in Figure 2.

As requested, our office has completed a preliminary geotechnical investigation of the proposed westernmost three piers and western approach retaining wall. The purpose of this investigation was to verify the site-specific soil conditions near these piers and along the wall alignment. Based on our subsurface exploration and literature review of the general area, we have made preliminary foundation recommendations that may be suitable for the various pier and wall locations.

2.0 SUBSURFACE CONDITIONS

2.1 Geologic Map Review

We reviewed the *Seattle Composite Geologic Map* available online from the Pacific Northwest Center for Geologic Mapping Studies, scale of 1:24,000. Surficial geologic units in the project area were generally mapped as Vashon glacial till, Wetland Deposits, or Modified Land (Figure 3). However, we did not encounter any surficial soils that we would interpret as wetland deposits at our boring locations. Based on borings completed for this investigation, Vashon glacial till and modified land (fill) would be the predominant surficial geologic unit in the general project area west of I-5. A brief description of the surficial geologic units is as follows:

2.1.1 Pleistocene: Vashon Stade of Fraser Glaciation Deposits

Vashon glacial till (Qvt): Vashon glacial till deposits generally consist of a thin blanket of ablation till ranging from two to ten feet in thickness overlying a much thicker layer of denser lodgment till. Ablation till is chiefly comprised of a loose to medium dense, unsorted mixture of sand, silt, clay, and gravel, deposited by the retreating glacier. Lodgment till, commonly referred to as "hardpan," is similar in composition to the ablation till. However, it is much denser since the material was deposited in front of, and overridden by, the advancing glacier.

2.1.2 Holocene Postglacial Deposits

Wetland Deposits (Qw): Very soft to medium stiff and very loose to medium dense peat and alluvium or organic rich sediment, poorly drained and intermittently wet. Wetland deposits range from 1 to 22 feet in thickness with layers often 7 to 11 feet in thickness.

Modified Land (Cross Hatching on Map): Modified land is generally granular fill or extensively graded native deposits that substantially alter the original geologic deposit. Based on document review and on geographic conditions, extensive fills from 10 to 30 feet deep underlie the project area within and east of the I-5 corridor. West of I-5, fill typically ranges from about 3 to 10 feet in thickness along the proposed north pedestrian bridge alignment. The fill west of I-5 generally consists of medium dense to dense silty sand with gravel. In the area near Pier 1 (Figure 2), there is a large mound of fill material approximately 40 feet in diameter and up to 10 feet in height. Based on a conversation between Doug Walters and Michael Brokaw (Head Grounds Supervisor for North Seattle Community College), the mound may be composed primarily of concrete debris. However, the material makeup of the mound has not been confirmed during this investigation.

2.2 Geotechnical Test Borings

Seven borings were drilled adjacent potential pier and wall locations. KCB-1 through KCB-3 were drilled to a depth of about 21 feet utilizing a Mobile B-59 drill equipped with hollow stem auger. KCB-4 and KCB-6 were drilled to a depth of 101 feet using a BK-81 truck mounted drill utilizing mud rotary methodology. Finally, KCB-5 and KCB-7 were drilled to depths of about 21 and 26.5 feet using a Diedrich B-50 track mounted drill with hollow stem auger. Standard Penetration Tests (SPT) were taken at 2.5 foot or 5-foot increments as each boring was advanced. The SPT provides a measure of compaction or relative density of granular soils, and consistency or stiffness of cohesive fine-grained soils. Representative soil samples were collected and returned to our laboratory for identification. Due to budget constraints, no laboratory testing was performed at this time. However, soil samples will be stored in sealed plastic bags for later testing if requested. Approximate boring locations are shown in Figure 4 following the text, along with copies of the borehole logs (Plates A1 to A7).

2.2.1 Approach Walls (KCB-1 through KCB-3)

KCB-1 through KCB-3 were drilled at three different locations along the western approach wall alignment. In general, we encountered approximately 4 to 5 feet of medium dense to dense silty sand with gravel fill in KCB-1 and KCB-2 respectively. Fill in KCB-3 extended to about 10 feet below the ground surface and generally consisted of medium dense silty sand with gravel. Below the fill, we observed dense to very dense deposits of silty sand with gravel, to the termination depth of all three borings, at about 21 feet below the ground surface. Seepage was encountered in KCB-1 and KCB-2 at 14 and 15 feet respectively. No groundwater was observed in KCB-3 at the time of drilling.

2.2.2 Pier 1 (KCB-4)

KCB-4 was drilled near the proposed location of Pier 1. In general, we encountered 3 feet of medium dense silty sand fill overlying very dense silty sand to sandy silt with gravel to a depth of 35 feet. Below 35 feet, we observed a one foot layer of very dense organic silt overlying hard silt to silty clay to about 40 feet. At 40 feet, we encountered very dense silty sand with trace gravel to 65 feet below the ground surface. Hard silt to silty clay was then observed to 75 feet followed by very dense silty sand with trace gravel to the termination depth of the boring at about 101 feet below the ground surface. We were unable to determine the presence of groundwater in KCB-4 due to the use of drilling mud associated with mud rotary drilling.

2.2.3 Pier 2 (KCB-5)

KCB-5 was located near the proposed location of Pier 2. In general, we encountered approximately 3 feet of medium dense to dense silty sand with gravel fill overlying medium dense to very dense silty sand with gravel to the termination of KCB-5 at 21 feet below the ground surface. No groundwater was observed in KCB-5 at the time of drilling.

2.2.4 Pier 3 (KCB-6 and KCB-7)

KCB-6 was drilled near the proposed location of Pier 3. In general, we encountered 3 feet of medium dense silty sand fill overlying very dense silty sand to sandy silt with gravel to a depth of 30 feet. Below 30 feet, we observed hard silt to silty clay to a depth of about 70 feet below the ground surface. Very dense silty sand with trace gravel was then encountered to the termination depth of the boring at about 101 feet below the ground surface. We were unable to determine the presence of groundwater in KCB-6 due to the use of drilling mud associated with mud rotary drilling.

KCB-7 was drilled east and south of the proposed Pier 3 location. In general, we encountered approximately 5 feet of loose silty sand with gravel fill overlying dense to very dense silty sand to the termination depth of the boring at about 26 feet below the ground surface. Groundwater was observed in KCB-7 at 15 feet below the ground surface at the time of drilling.

2.3 Literature Review

No borings were drilled as part of this investigation for Pier 5, proposed to be located between north and southbound I-5, and Pier 6, proposed to be sited within the Metro Park and Ride lot near 1st Avenue NE (Figure 2). Therefore, we reviewed the following reports in order to gain understanding of the potential subsurface conditions at these pier locations.

Hart Crowser & Associates Inc., June 15, 1980, *Subsurface Exploration and Geotechnical Engineering, Proposed 72-inch Diameter Storm Sewer, Northgate Transit Center, Seattle, Washington.*

Hart Crowser & Associates Inc., January 31, 1989, *Results of Soil Sampling and Analysis, METRO Northgate Transit Center/Park- and-Ride, Seattle, Washington.*

Seattle Engineering Department Materials Laboratory, March 1974, Log of Test Borings, 1st Avenue NE and NE 103rd Street.

Washington State Highway Commission Department of Highways, October 30, 1962, *Seattle Freeway103rd Overcrossing Foundation Investigation*

Zipper Zeman Associates, Inc., May 5, 2004, *Geotechnical Engineering Design Study Proposed Northgate Commons Development Seattle Washington*

Available subsurface information in the general project area within and east of the I-5 corridor indicates dense glacial till underlies fill or wetland deposits. The loose fill or soft wetland deposits typically range in depth from 10 to 30 feet below the ground surface.

3.0 RECOMMMENDATIONS AND CONCLUSIONS

3.1 General Bridge and Wall Design

We recommend the design and seismic analysis of the bridge and walls be in general conformance with the current edition of the American Association of State Highway and Transportation Officials (AASHTO) LRFD Bridge Design Specifications and the current Washington State Department of Transportation (WSDOT) Bridge Design Manual. At this time, the seismic provisions of the AASHTO Manual are based on a design earthquake having a seven percent probability of exceedence within a 75-year period. An earthquake event with this probability of exceedence has a return period of about 1000 years.

3.2 Bridge Pier Foundations

3.2.1 Spread Footing

The subsurface investigation west of I-5 reveals dense to very dense silty sands and sandy silt with gravel, and hard silt and silty clay underlie the proposed piers at shallow depths. Therefore, we recommend utilizing spread footings for support of the pedestrian bridge at Piers 1, 2, and 3. Based on preliminary plans, Pier 3 may be placed on or near a slope. Once the final location of Pier 3 has been determined, an additional subsurface investigation along with a global stability analysis will be needed to ensure stability of the slope and pier.

3.2.2 Drilled Shaft

Based on assumed soft soil conditions up to 30 feet in depth, and to minimize the footprint required for excavation, we recommend utilizing drilled shaft foundations for Piers 4, 5, and 6. To better understand soil and groundwater conditions for design, we recommend drilling additional test borings and installing groundwater monitoring wells at each of the pier locations once the final bridge layout has been determined. We also recommend automated level loggers be installed in all monitoring wells for long term monitoring of the fluctuating groundwater levels.

3.3 Retaining Walls

We recommend considering mechanically stabilized earth (MSE) walls for approach fill walls west of I-5. MSE walls are a cost-effective alternative to retain engineered fills. Many are proprietary wall systems from manufacturers such as Hilfiker, Tensar, and Keystone. To ensure a consistent design methodology in accordance with national standards, we recommend using only WSDOT preapproved proprietary wall systems.

MSE walls are constructed by placing either metal or geosynthetic tensile members horizontally between lifts of compacted granular backfill to form a self-supporting gravity structure. These walls are well suited for areas of expected settlement due to their relatively large tolerance for differential settlement. Wide ranges of facing units are adaptable to most of the various MSE wall systems. The choice of facing is dependent on aesthetics and economic requirements.

Design values for the various wall systems must be based on specific site conditions, geotechnical parameters, and manufacturer specifications. The reinforcement generally extends horizontally back behind the face of the wall between 70 and 100 percent of the total wall height.

4.0 LIMITATIONS

No subsurface testing was completed with this preliminary investigation for Piers 4, 5 and 6. In addition, we understand the alignment of the wall and bridge has not been finalized. Therefore, additional drilling and geotechnical analyses will be required once the final bridge and wall alignment has been approved.

5.0 CONTINUING GEOTECHNICAL SERVICES

As the design develops, when needed, we are available to provide additional geotechnical analysis, design parameters, and construction recommendations for specific aspects of the project.

We appreciate the opportunity to have been of service on this project and trust this report addresses your current needs. Please call Alan Corwin at (206) 296-7711 or Doug Walters at (206) 296-7708, should you have any questions, concerns, or if we may be of further assistance.

Respectfully Submitted,
King County Materials Laboratory

10/5/2012

exp: 01/17/2013

Alan D. Corwin, P.E.
King County Materials Engineer

Northgate Pedestrian Bridge Figure 1: Vicinity Map

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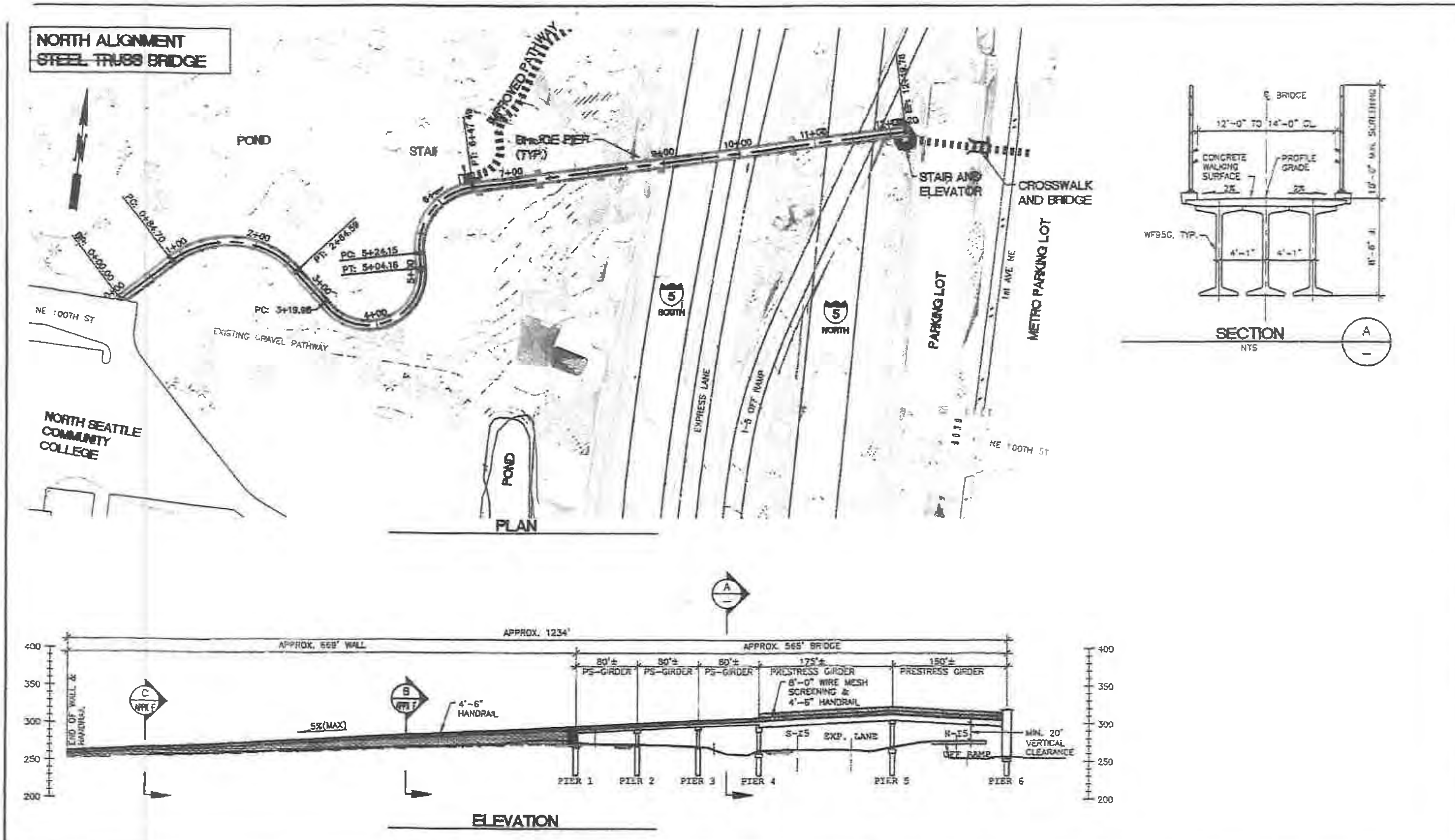
King County

Date: 10/2/2012 Source: King County IMAP - Property Information (http://www.metrokc.gov/GIS/IMAP)



KING COUNTY _PT. OF TRANSPORTATION
HAROLD TANIGUCHI, DIRECTOR

NORTHGATE PEDESTRIAN BRIDGE FEASIBILITY STUDY

NORTH ALIGNMENT
(PRESTRESS GIRDER OPTION)

Figure 2

King County

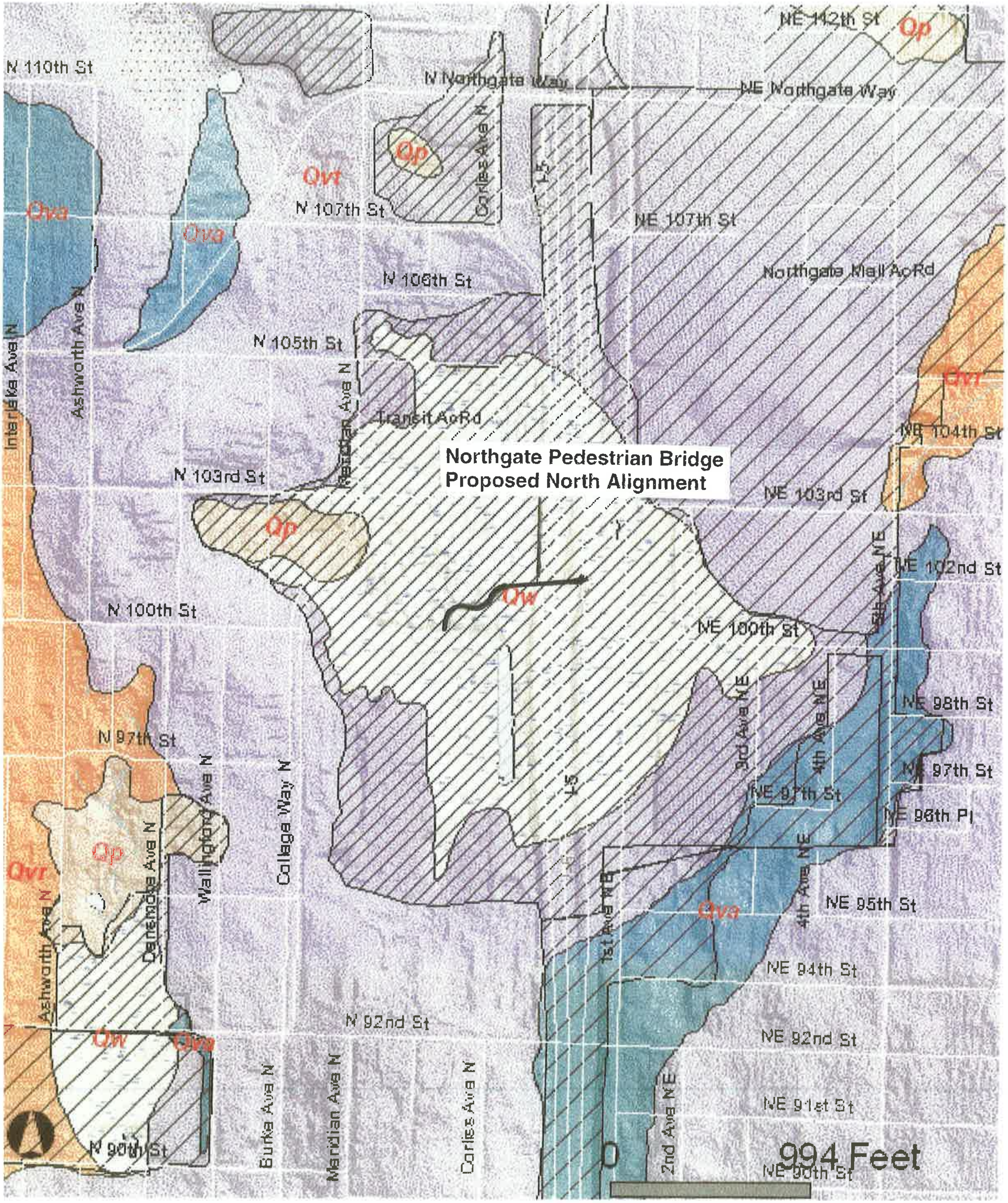


Figure 3: Geologic Map

Northgate Pedestrian Bridge Figure 4: Boring Map

King County

Date: 10/2/2012 Source: King County iMAP - Property Information (http://www.metrokc.gov/GIS/iMAP)

BORING LOG
BORING KCB-1

PROJECT: **Northgate Pedestrian Bridge**
BORING LOCATION: **See Location Map**
DRILL METHOD: **Truck Mounted Hollow Stem Auger**
DRILLER: **Holocene Drilling**
DEPTH TO - Water: **14'** Caving: **N/A**

DATE: **9/28/2012**
START: **N/A**
FINISH: **N/A**
LOGGER: **DW**
DATE CHECKED: **N/A**

ELEVATION/ DEPTH	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Description	Moist (%)	-200 (%)	Remarks
100 — 0	13,14,17	SM	Sod/Topsoil Brown silty sand with gravel, mottled, dry, medium dense to dense. (fill)			
95 — 5	16,50/6		Same?			Pounded on rock? Blow count may be overstated. No sample recovery.
	8,12,20	SM	Brown silty sand to sandy silt, trace gravel, moist to wet, dense.			
90 — 10	9,19,27					
	20,22,28	SM	Brown gray silty sand to sandy silt with gravel, intermmittent seams of iron stained fine sand, moist to wet, dense to very dense.			
85 — 15	8,15,31					
	13,30,50/6	SM	Gray silty sand to sandy silt with gravel, slightly cemented, wet, very dense.			
80 — 20	15,50/6"					
75 — 25						
70 — 30						
65 — 35						

Driller noted a heavy seepage zone at about 14 feet below the ground surface.

PLATE NUMBER 1

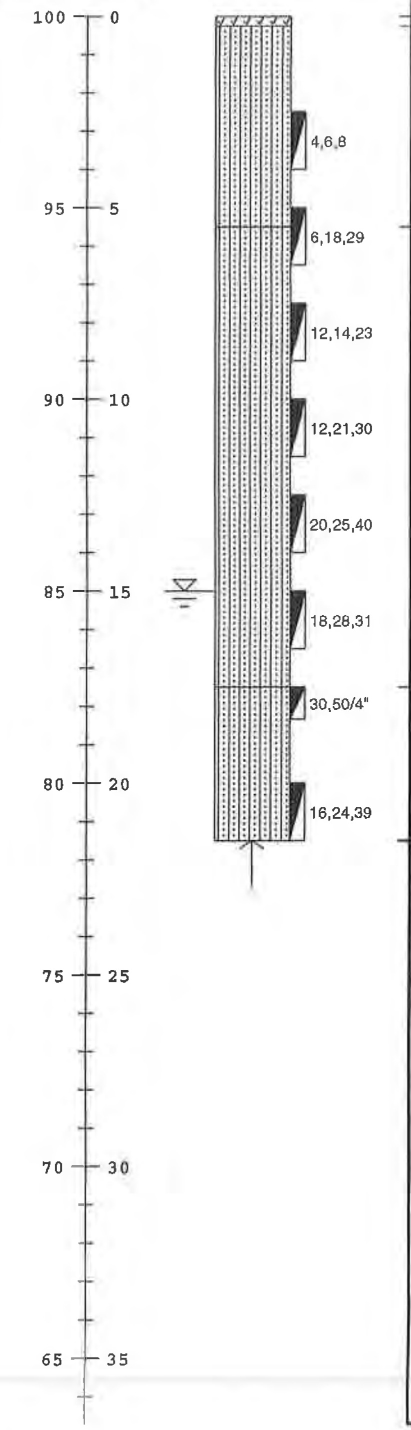
KING COUNTY MATERIALS LABORATORY

BORING LOG
BORING KCB-2

PROJECT: **Northgate Pedestrian Bridge**
BORING LOCATION: **See Location Map**
DRILL METHOD: **Truck Mounted Hollow Stem Auger**
DRILLER: **Holocene Drilling**
DEPTH TO - Water: **15'** Caving: **N/A**

DATE: **9/28/2012**
START: **N/A**
FINISH: **N/A**
LOGGER: **DW**
DATE CHECKED: **N/A**

ELEVATION/ DEPTH	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Description	Moist (%)	-200 (%)	Remarks
		SM	Sod/Topsoil Brown silty sand with gravel, trace charcoal, mottled, dry, medium dense. (fill)			
		SM	Brown gray silty sand with gravel, moist to wet, dense to very dense.			
		SM	Gray silty sand to sandy silt with gravel, wet, very dense.			



Seepage was encountered at 15 feet below the ground surface at the time of drilling.

PLATE NUMBER **2**

BORING LOG
BORING KCB-3

PROJECT: **Northgate Pedestrian Bridge**
BORING LOCATION: **See Location Map**
DRILL METHOD: **Truck Mounted Hollow Stem Auger**
DRILLER: **Holocene Drilling**
DEPTH TO - Water: **N/A** Caving: **N/A**

DATE: **9/28/2012**
START: **N/A**
FINISH: **N/A**
LOGGER: **DW**
DATE CHECKED: **N/A**

ELEVATION/ DEPTH	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Description	Moist (%)	-200 (%)	Remarks
100 — 0		SM	Sod/Topsoil Brown silty sand with gravel, trace orgainics, mottled, dry, medium dense. (fill)			
	4,8,11	SM	Brown gray silty sand with gravel, mottled, iron stained, moist to wet, medium dense. (fill)			
95 — 5	6,6,11					
	4,4,10					
90 — 10	11,11,16	SM	Brown gray silty sand with gravel, trace organics, slightly mottled, wet, medium dense. (fill?)			
	3,11,16					
85 — 15	6,18,25	SM	Brown gray silty sand to sandy silt, trace gravel, wet, medium dense to dense.			
	3,8,17					
80 — 20	8,30,50/3"	SM	Gray silty sand to sandy silt with gravel, slightly cemented, wet, very dense.			
75 — 25						
70 — 30						
65 — 35						

No groundwater was observed during drilling.

PLATE NUMBER **3**

BORING LOG
BORING KCB-4

PROJECT: **Northgate Pedestrian Bridge**
BORING LOCATION: **See Location Map**
DRILL METHOD: **Truck Mounted Mud Rotary**
DRILLER: **Holocene Drilling**
DEPTH TO - Water: **N/A** Caving: **N/A**

DATE: **9/6/2012 and 9/7/2012**
START: **N/A**
FINISH: **N/A**
LOGGER: **DW**
DATE CHECKED: **N/A**

ELEVATION/ DEPTH	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Description	Moist (%)	-200 (%)	Remarks
100 — 0		SM	Sod/Topsoil Brown silty sand with gravel, occasional cobble, moist to wet, dense to very dense. (fill)			
		SM	Brown silty sand with gravel, occasional cobble, moist to wet, dense to very dense.			
95 — 5	40,50/6"					
90 — 10	16,20,30					
85 — 15	41,50/3"	SM	Brown gray to gray silty sand to sandy silt with gravel, slightly cemented, moist, very dense.			
80 — 20	27,42,50/4					
75 — 25	24,37,43	SM	Gray silty sand to fine poorly graded sand with silt, trace gravel, slightly iron stained, wet, very dense.			
70 — 30	50/3"	SM	Gray silty sand with gravel, slightly cemented, wet, very dense.			
65 — 35	18,26,43	OL	Dark brown gray organic silt, wet, very			

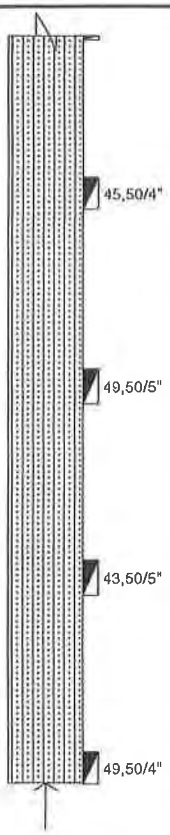
PLATE NUMBER **4**

LOG OF Boring
BORING KCB-4
(continued)

ELEVATION/ DEPTH	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Description	Moist (%)	-200 (%)	Remarks
			dense.			
		CL-ML	Gray silty clay, wet, hard.			
60 / 40	18,27,40	SM	Gray silty sand, wet, very dense.			
55 / 45	23,42,50/4					
50 / 50	24,30,50/5					
45 / 55	28,45,50/6	SM	Dark gray silty sand to fine poorly graded sand with silt, trace gravel, wet, very dense.			
40 / 60	49,39,50/5					
35 / 65	28,39,50/4	CL-ML	Gray silty clay, no visible bedding, moist to wet, hard.			
30 / 70	20,38,50/5					
25 / 75	27,50/6"	SM	Dark gray silty sand to fine poorly graded sand with silt, trace gravel, wet, very dense.			
20 / 80	26,28,50/5					

LOG OF Boring
BORING KCB-4
(continued)

ELEVATION/ DEPTH	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Description	Moist (%)	-200 (%)	Remarks
15 — 85	45,50/4"					
10 — 90	49,50/5"					
5 — 95	43,50/5"					
0 — 100	49,50/4"					
-5 — 105						
-10 — 110						
-15 — 115						
-20 — 120						
-25 — 125						



BORING LOG
BORING KCB-5

PROJECT: **Northgate Pedestrian Bridge**
BORING LOCATION: **See Location Map**
DRILL METHOD: **Track Mounted Hollow Stem Auger**
DRILLER: **Holocene Drilling**
DEPTH TO - Water: **15'** Caving: **N/A**

DATE: **9/27/2012**
START: **N/A**
FINISH: **N/A**
LOGGER: **DW**
DATE CHECKED: **N/A**

ELEVATION/ DEPTH	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Description	Moist (%)	-200 (%)	Remarks
100 — 0		SM	Sod/Topsoil Brown silty sand with gravel, occasional cobble, dry, medium dense to dense. (fill)			
	8,20,50/3	SM	Brown silty sand with gravel, occasional cobble, dry, dense to very dense.			
95 — 5	14,25,18					
		SM	Brown gray silty sand with gravel, wet, medium dense.			
90 — 10	8,10,12					
	50/6"	SM	Brown gray silty sand to sandy silt with gravel, wet, dense to very dense.			
85 — 15	17,18,27					
		SM	Gray silty sand, trace gravel, wet, very dense.			
80 — 20	30,50/6"					
75 — 25						
70 — 30						
65 — 35						

No groundwater was encountered during drilling.

PLATE NUMBER **5**

BORING LOG
BORING KCB-6

PROJECT: **Northgate Pedestrian Bridge**
BORING LOCATION: **See Location Map**
DRILL METHOD: **Truck Mounted Mud Rotary**
DRILLER: **Holocene Drilling**
DEPTH TO - Water: **N/A** Caving: **N/A**

DATE: **9/5/2012 and 9/6/2012**
START: **N/A**
FINISH: **N/A**
LOGGER: **DW**
DATE CHECKED: **N/A**

ELEVATION/ DEPTH	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Description	Moist (%)	-200 (%)	Remarks
100 / 0			Sod/Topsoil			
		SM	Brown silty sand with gravel, occasional cobble, moist to wet, dense to very dense. (fill)			
		SM	Brown silty sand with gravel, occasional cobble, moist to wet, dense to very dense.			
95 / 5	28,44,41					
90 / 10	16,18,19					
85 / 15	50/5"	SM	Gray silty sand to sandy silt with gravel, slightly cemented, moist, very dense.			
80 / 20	50/6"					
75 / 25	44,36,45	SM	Dark gray silty sand to fine poorly graded sand with silt, occasional gravel, wet, very dense.			
70 / 30	16,29,45	CL-ML	Gray silty clay, no visible bedding, moist to wet, hard.			
65 / 35	16,35,50/3					

PLATE NUMBER **6**

LOG OF Boring
BORING KCB-6
(continued)

ELEVATION/ DEPTH	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Description	Moist (%)	-200 (%)	Remarks
60 — 40	26,25,36		Same-1/2" dark brown organic seam @ 40.5 feet.			
55 — 45	15,26,35	ML	Gray silt to sandy silt with interbedded silty sand layers, wet, hard.			
50 — 50	18.27.37	CL-ML	Gray silty clay, trace organics, wet, hard.			
45 — 55	14,23,29					
40 — 60	16,25,36	ML	Brown gray silt with interbedded seams of fine silty sand, wet, hard.			1/2-inch peat seam at 60.5 feet.
35 — 65	41,50/5					No sample recovery. Pounded sample on rock?
30 — 70	22,34,48	SM	Gray fine silty sand to sandy silt, trace gravel, wet, very dense.			
25 — 75	20,34,46					
20 — 80	30,50/5"					Intermittent gravel

LOG OF Boring
BORING KCB-6
(continued)

ELEVATION/ DEPTH	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Description	Moist (%)	-200 (%)	Remarks
						from 82 to 85 feet based on action of drill rig during drilling.
15 85	32,46,50/5					
10 90	50/5.5"					
5 95	44,50/5"	SM	Dark gray silty sand to fine poorly graded sand with silt, trace gravel, wet, very dense.			
0 100	45,50/5"					
-5 105						
-10 110						
-15 115						
-20 120						
-25 125						

BORING LOG
BORING KCB-7

PROJECT: **Northgate Pedestrian Bridge**
BORING LOCATION: **See Location Map**
DRILL METHOD: **Track Mounted Hollow Stem Auger**
DRILLER: **Holocene Drilling**
DEPTH TO - Water: **15'** Caving: **N/A**

DATE: **9/27/2012**
START: **N/A**
FINISH: **N/A**
LOGGER: **DW**
DATE CHECKED: **N/A**

ELEVATION/ DEPTH	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Description	Moist (%)	-200 (%)	Remarks
100 — 0			Sod/Topsoil			
	2,3,4	SM	Brown silty sand with gravel, mottled, dry, loose. (fill)			Iron stained at 3.5' below the ground surface.
95 — 5	6,11,13	SM	Brown silty sand with gravel, dry, medium dense. (fill?)			
90 — 10	18,28,33 12,16,27	SM	Brown gray silty sand with gravel, iron stained, moist to wet, dense to very dense.			
85 — 15	12,18,29 12,17,28	SM	Gray silty sand to fine poorly graded sand with silt, wet, dense.			Water bearing sand at 15'.
80 — 20 75 — 25	28,50/3" 27,37,50/4	SM	Gray silty sand to sandy silt, trace gravel, slightly cemented, wet, very dense.			Hard drilling from 20 to 25 feet according to driller.
70 — 30						
65 — 35						

Groundwater was encountered at 15 feet below the ground surface during drilling.

KEY TO SYMBOLS

Symbol Description

<u>Strata symbols</u>

Topsoil

Silty sand

Low plasticity organic silts

Silty low plasticity clay

Silt

<u>Misc. Symbols</u>

End of boring

Boring continues

Water table during drilling

<u>Soil Samplers</u>

Standard penetration test

No recovery

<u>Notes:</u>

1. KCB-1 through KCB-3 weere drilled on 9/28/2012 using a truck mounted Mobile B-59 drill equipped with hollow stem auger. KCB-4 and KCB-6 were drilled between 9/5/2012 and 9/7/2012 utilizing a BK-81 truck mounted drill with mud rotary methodology. Finally, KCB-5 and KCB-7 were drilled on 9/27/2012 using a track mounted Diedrich D-50 drill equipped with hollow stem auger.

2. An elevation of 100 feet was chosen for logging purposes only. The boring locations have not been surveyed and so should be considered approximate at this time.

3. These logs are subject to the limitations, conclusions, and recommendations in this report.

North Alignment Option:
Cable-Stayed, Precast Voided Slab, and SEW (wall)

Description	Unit	Unit Cost	Quantity	Cost
Mobilization		10%	1	$788,908
Clearing and Grubbing	LS	$85,000	1	$85,000
Removing Obstructions	LS	$60,000	1	$60,000
Construction Surveying	LS	$70,000	1	$70,000
			sum =	***$1,003,908***

Structures
Cable-Stayed Bridge Spans (one pylon with spans 200' & 168'= 368')

Construction Access & Staging	LS	$85,000	1	$85,000
Erosion & Water Pollution Control	LS	$15,000	1	$15,000
High Visibility Fence	LF	$8	500	$4,000
Silt Fence	LF	$6	500	$3,000
False Work Bridge Pylon	LS	$108,000	1	$108,000
Concrete Class 5000 for Bridge Deck	CY	$1,200	62	$74,880
Steel Reinforcing Bar for Bridge (epoxy coated)	LBS	$1.25	12,267	$15,333
Precast Concrete Deck Panels	EA	$14,950	37	$553,150
Precast Concrete Delta Pylon Legs	EA	$149,500	2	$299,000
Post-tensioning (precast deck panel w/CIP slab)	LBS	$5.2	16,170	$83,678
Structural Steel (at towers and panels)	LBS	$5.2	16,727	$86,564
Structural Bridge Strands - Galv. & Coated (1.5" diam.)	LBS	$8.6	41,261	$355,873
Structure Excavation Incl Haul	CY	$35	723	$25,305
Gravel Backfill for Footing	CY	$45	318	$14,310
Concrete Class 4000 for Shaft Cap (pylons)	CY	$650	405	$263,250
Reinforcing Steel for Shaft Cap	LBS	$1.10	101,250	$111,375
Throw Fence and Pedestrian Handrails (lighted)	LF	$775	736	$570,400
Soil Excavation for Shaft Incl. Haul	CY	$650	816	$530,400
Shoring or Extra Excavation Class A	LS	$25,000	1	$25,000
Remove Shaft Obstructions	Est	$53,040	1	$53,040
Casing Shoring	LF	$450	80	$36,000
Furnishing 10'-0" f Permanent Casing	LF	$850	240	$204,000
Placing Permanent 10'-0" Casing	EA	$6,000	4	$24,000
Concrete Class 4000P for Shaft	CY	$350	696	$243,600
Steel Reinforcing Bar for Shaft	LBS	$1.00	208,800	$208,800
CSL Access Tube	LF	$8	2,600	$20,800
CSL Testing	EA	$1,200	4	$4,800
Bridge Drain (stainless steel pipe 6")	LF	$250	368	$92,000
Temp Barrier	LF	$35	250	$8,750
Traffic Control (flaggers, safety measures, signs, etc.)	LS	$250,000	1	$250,000
Roadway & Parking Lot Pavement Repairs	LS	$35,000	1	$35,000
Construction Storm Water Erosion Control	LS	$15,000	1	$15,000
SPCC Plan	LS	$10,000	1	$10,000
Wiring	LS	$20,000	1	$20,000

Conduit (2" dim.)	LF	$15	736	$11,040
Light Contactor Controller	EA	$20,000	1	$20,000
Special Lighting (for decorative stay/pylon)	LS	$85,000	1	$85,000
			sum=	$4,565,348

***Approach Bridge Spans** (3 spans x 70' precast voided slabs = 210')*

Construction Access & Staging	LS	$35,000	1	$35,000
Erosion & Water Pollution Control	LS	$10,000	1	$10,000
High Visibility Fence	LF	$8	620	$4,960
Silt Fence	LF	$6	620	$3,720
Pre-Stressed Voided Slabs (30"x4'x70')	LF	$250	856	$214,000
Structure Excavation Incl Haul	CY	$35	495	$17,325
Gravel Backfill for Footing	CY	$45	374	$16,830
Concrete Class 4000 for Piers	CY	$1,000	144	$144,000
Reinforcing Steel for Piers	LBS	$1.20	32,400	$38,880
Concrete Class 4000 for Bridge (abutment)	CY	$750	67	$50,250
Reinforcing Steel for Bridge (abutment)	LBS	$1.20	13,400	$16,080
Pedestrian Railing and Handrail (lighted)	LF	$500	420	$210,000
Shoring or Extra Excavation Class A	LS	$25,000	1	$25,000
Bridge Drain (stainless steel pipe 6")	LF	$250	210	$52,500
Traffic Control (flaggers, safety measures, signs, etc.)	LS	$25,000	1	$25,000
Roadway & Parking Lot Pavement Repairs	LS	$20,000	1	$20,000
Construction Storm Water Erosion Control	LS	$15,000	1	$15,000
SPCC Plan	LS	$10,000	1	$10,000
Wiring	LS	$10,000	1	$10,000
Conduit (2" dim.)	LF	$15	420	$6,300
Light Contactor Controller	EA	$15,000	1	$15,000
			sum=	$939,845

***Retaining Walls** (406' SEW)*

Erosion & Water Pollution Control	LS	$15,000	1	$15,000
High Visibility Fence	LF	$8	912	$7,296
Silt Fence	LF	$6	912	$5,472
Structure Excavation Class A Incl Haul	CY	$30	1,353	$40,600
Structural Earth Wall (SEW)	SF	$35	7,308	$255,780
Perforated 6" Drain	LF	$25	912	$22,800
Concrete Class 4000 for Slab	CY	$650	150	$97,741
Reinforcing Bar (EC)	LBS	$1.25	24,811	$31,014
Pedestrian Railing and Handrail (lighted)	LF	$500	812	$406,000
Traffic Control (flaggers, safety measures, signs, etc.)	LS	$20,000	1	$20,000
Roadway, Sidewalk and Pavement Repairs	LS	$10,000	1	$10,000
Construction Storm Water Erosion Control	LS	$10,000	1	$10,000
SPCC Plan	LS	$10,000	1	$10,000
Wiring	LS	$10,000	1	$10,000
Conduit (2" dim.)	LF	$15	812	$12,180
			sum =	$953,883

Misc. Items

Stair and Elevator	LS	$750,000	1	$750,000
1st Ave. crosswalk (signs & traffic lights, etc.)	LS	$50,000	1	$50,000
Offsite Disposal	LS	$35,000	1	$35,000
Stormwater Treatment	LS	$120,000	1	$120,000
Approach Pathway Improvement (if needed)	LS	$100,000	1	$100,000
Site Restoration (vegetation and planting)	LS	$75,000	1	$75,000
Existing traffic signs removal and relocation	LS	$50,000	1	$50,000
VE Study (if required)	LS	$35,000	1	$35,000
Street Cleaning, Artwork, & Force Account	LS	$100,000	1	$100,000
Mitigation (buffer zone)	LS	$75,000	1	$75,000
			sum =	***$1,215,000***

Estimated Construction Costs =	**$8,677,983**
9.5% tax =	$824,408
Conceptual Plan - Contingency (30%) =	$2,603,395
Inspection (20%) =	$1,735,597
Design (30%)=	$2,603,395

Est'd Project Total = $16,444,778

North Alignment Option:

Gateway Steel Truss, Precast Voided Slab, and SEW (wall)

Description	Unit	Unit Cost	Quantity	Cost
Mobilization		10%	1	$797,972
Clearing and Grubbing	LS	$85,000	1	$85,000
Removing Obstructions	LS	$60,000	1	$60,000
Construction Surveying	LS	$65,000	1	$65,000
			sum =	*$1,007,972*

Structures

Gateway Truss Spans (200' & 168' = 368')

Construction Access & Staging	LS	$85,000	1	$85,000
Erosion & Water Pollution Control	LS	$15,000	1	$15,000
High Visibility Fence	LF	$8	500	$4,000
Silt Fence	LF	$6	500	$3,000
CONTECK 200'x14' wide Gateway Truss (delivered)	EA	$608,018	1	$608,018
CONTECK 168'x14' wide Gateway Truss (delivered)	EA	$463,400	1	$463,400
Truss Erection	LS	$125,000	1	$125,000
Concrete Class 4000D for Bridge Deck	CY	$1,200	129	$154,560
Deck Slab Reinforcement (Epoxy Coated)	LBS	$1.25	25,760	$32,200
Structure Excavation Incl Haul	CY	$35	561	$19,635
Gravel Backfill for Footing	CY	$45	261	$11,745
Concrete Class 4000 for Bridge (col. & col.&shaft caps)	CY	$850	465	$395,250
Reinforcing Steel for Bridge (column & col. cap)	LBS	$1.10	104,625	$115,088
Throw Fence and Pedestrian Handrails (lighted)	LF	$775	736	$570,400
Soil Excavation for Shaft Incl. Haul	CY	$650	780	$507,000
Shoring or Extra Excavation Class A	LS	$25,000	1	$25,000
Remove Shaft Obstructions	Est	$50,700	1	$50,700
Casing Shoring	LF	$250	120	$30,000
Furnishing 8'-0" f Permanent Casing	LF	$650	360	$234,000
Placing Permanent 8'-0" Casing	EA	$5,000	6	$30,000
Concrete Class 4000P for Shaft	CY	$350	672	$235,200
Steel Reinforcing Bar for Shaft	LBS	$1.00	168,000	$168,000
CSL Access Tube	LF	$8	3,120	$24,960
CSL Testing	EA	$1,200	6	$7,200
Bridge Drain (stainless steel pipe 6")	LF	$250	368	$92,000
Temp Barrier	LF	$35	250	$8,750
Traffic Control (flaggers, safety measures, signs, etc.)	LS	$225,000	1	$225,000
Roadway & Parking Lot Pavement Repairs	LS	$35,000	1	$35,000
Construction Storm Water Erosion Control	LS	$15,000	1	$15,000
SPCC Plan	LS	$10,000	1	$10,000
Wiring	LS	$20,000	1	$20,000
Conduit (2" dim.)	LF	$15	736	$11,040
Light Contactor Controller	EA	$20,000	1	$20,000
Special Lighting	LS	$65,000	1	$65,000
			sum=	*$4,416,145*

Approach Bridge Spans (3 spans x 70' precast voided slabs = 210')

Construction Access & Staging	LS	$35,000	1	$35,000
Erosion & Water Pollution Control	LS	$10,000	1	$10,000
High Visibility Fence	LF	$8	620	$4,960
Silt Fence	LF	$6	620	$3,720
Pre-Stressed Voided Slabs (30"x4'x70')	LF	$250	856	$214,000
Structure Excavation Incl Haul	CY	$35	367	$12,845
Gravel Backfill for Footing	CY	$45	275	$12,375
Concrete Class 4000 for Piers	CY	$1,000	144	$144,000
Reinforcing Steel for Piers	LBS	$1.20	32,400	$38,880
Concrete Class 4000 for Abutment	CY	$750	67	$50,250
Reinforcing Steel for Abutment	LBS	$1.20	13,400	$16,080
Pedestrian Railing and Handrail (lighted)	LF	$500	420	$210,000
Shoring or Extra Excavation Class A	LS	$25,000	1	$25,000
Bridge Drain (stainless steel pipe 6")	LF	$250	210	$52,500
Traffic Control (flaggers, safety measures, signs, etc.)	LS	$25,000	1	$25,000
Roadway & Parking Lot Pavement Repairs	LS	$20,000	1	$20,000
Construction Storm Water Erosion Control	LS	$15,000	1	$15,000
SPCC Plan	LS	$10,000	1	$10,000
Wiring	LS	$10,000	1	$10,000
Conduit (2" dim.)	LF	$15	420	$6,300
Light Contactor Controller	EA	$15,000	1	$15,000
			sum=	***$930,910***

Retaining Walls (546' SEW walls)

Erosion & Water Pollution Control	LS	$20,000	1	$20,000
High Visibility Fence	LF	$8	1,192	$9,536
Silt Fence	LF	$6	1,192	$7,152
Structure Excavation Class A Incl Haul	CY	$30	1,820	$54,600
Structural Earth Wall (SEW)	SF	$30	9,828	$294,840
Perforated 6" Drain	LF	$25	1,192	$29,800
Concrete Class 4000 for Slab	CY	$650	202	$131,444
Reinforcing Bar (EC)	LBS	$1.25	30,333	$37,917
Pedestrian Railing and Handrail (lighted)	LF	$500	1,092	$546,000
Traffic Control (flaggers, safety measures, signs, etc.)	LS	$20,000	1	$20,000
Roadway, Sidewalk and Pavement Repairs	LS	$10,000	1	$10,000
Construction Storm Water Erosion Control	LS	$10,000	1	$10,000
SPCC Plan	LS	$10,000	1	$10,000
Wiring	LS	$10,000	1	$10,000
Conduit (2" dim.)	LF	$15	1,092	$16,380
			sum =	***$1,207,669***

Misc. Items

Stair and Elevator	LS	$750,000	1	$750,000
1st Ave. crosswalk (signs & traffic lights, etc.)	LS	$50,000	1	$50,000

Offsite Disposal	LS	$35,000	1	$35,000
Stormwater Treatment	LS	$120,000	1	$120,000
Approach Pathway Improvement (if needed)	LS	$100,000	1	$100,000
Site Restoration (vegetation and planting)	LS	$75,000	1	$75,000
Existing traffic signs removal and relocation	LS	$50,000	1	$50,000
VE Study (if required)	LS	$35,000	1	$35,000
Street Cleaning, Artwork, & Force Account	LS	$100,000	1	$100,000
Mitigation (buffer zone)	LS	$75,000	1	$75,000
			sum =	***$1,215,000***

Estimated Construction Costs =	**$8,777,697**
9.5% tax =	$833,881
Conceptual Plan - Contingency (30%) =	$2,633,309
Inspection (20%) =	$1,755,539
Design (25%)=	$2,194,424

Est'd Project Total = $16,194,850

South Alignment Option:

Cable-Stayed, Precast Voided Slab, and SEW (wall)

Description	Unit	Unit Cost	Quantity	Cost
Mobilization		10%	1	$898,235
Clearing and Grubbing	LS	$75,000	1	$75,000
Removing Obstructions	LS	$50,000	1	$50,000
Construction Surveying	LS	$65,000	1	$65,000
			sum =	*$1,088,235*

Structures

***Cable-Stayed Bridge Spans** (with two pylons, spanned 140'-240'-140'= 520')*

Construction Access & Staging	LS	$75,000	1	$75,000
Erosion & Water Pollution Control	LS	$20,000	1	$20,000
High Visibility Fence	LF	$8	500	$4,000
Silt Fence	LF	$6	500	$3,000
False Work Bridge Pylon	LS	$84,000	2	$168,000
Concrete Class 5000 for Bridge Deck	CY	$1,200	88	$105,809
Steel Reinforcing Bar for Bridge (epoxy coated)	LBS	$1.25	16,391	$20,489
Precast Concrete Deck Panels	EA	$14,950	52	$777,400
Precast Concrete Delta Pylon Legs	EA	$86,250	4	$345,000
Post-tensioning (precast deck panel w/CIP slab)	LBS	$5.2	19,783	$102,375
Structural Steel (at towers and panels)	LBS	$5.2	29,391	$152,100
Structural Bridge Strands - Galv. & Coated (1.5" diam.)	LBS	$8.6	45,217	$390,000
Structure Excavation Incl Haul	CY	$35	723	$25,305
Gravel Backfill for Footing	CY	$45	318	$14,310
Concrete Class 4000 for Bridge (shaft cap)	CY	$650	405	$263,250
Reinforcing Steel for Bridge (shaft cap)	LBS	$1.10	101,250	$111,375
Throw Fence and Pedestrian Handrails (lighted)	LF	$775	1,040	$806,000
Soil Excavation for Shaft Incl Haul	CY	$650	1,224	$795,600
Shoring or Extra Excavation Class A	LS	$25,000	1	$25,000
Remove Shaft Obstructions	Est	$79,560	1	$79,560
Casing Shoring	LF	$450	120	$54,000
Furnishing 10'-0" f Permanent Casing	LF	$850	360	$306,000
Placing Permanent 10'-0" Casing	EA	$6,000	6	$36,000
Concrete Class 4000P for Shaft	CY	$350	1,044	$365,400
Steel Reinforcing Bar for Shaft	LBS	$1.00	313,200	$313,200
CSL Access Tube	LF	$8	3,900	$31,200
CSL Testing	EA	$1,200	6	$7,200
Bridge Drain (stainless steel pipe 6")	LF	$250	520	$130,000
Temp Barrier	LF	$35	250	$8,750
Traffic Control (flaggers, safety measures, signs, etc.)	LS	$250,000	1	$250,000
Roadway & Parking Lot Pavement Repairs	LS	$35,000	1	$35,000
Construction Storm Water Erosion Control	LS	$15,000	1	$15,000
SPCC Plan	LS	$10,000	1	$10,000
Wiring	LS	$20,000	1	$20,000
Conduit (2" dim.)	LF	$15	1,040	$15,600

Light Contactor Controller	EA	$20,000	1	$20,000
Special Lighting (for decorative stay/pylon)	LS	$85,000	1	$85,000
			sum=	***$5,985,923***

Approach Bridge Spans ***(4 spans x 68' precast voided slabs = 272')***

Construction Access & Staging	LS	$35,000	1	$35,000
Erosion & Water Pollution Control	LS	$10,000	1	$10,000
High Visibility Fence	LF	$8	744	$5,952
Silt Fence	LF	$6	744	$4,464
Pre-Stressed Voided Slabs (30"x4'x70')	LF	$250	1,104	$276,000
Structure Excavation Incl Haul	CY	$35	623	$21,805
Gravel Backfill for Footing	CY	$45	473	$21,285
Concrete Class 4000 for Piers	CY	$1,000	204	$204,000
Reinforcing Steel for Piers	LBS	$1.20	45,900	$55,080
Concrete Class 4000 for Abutment	CY	$750	67	$50,250
Reinforcing Steel for Abutment	LBS	$1.20	13,400	$16,080
Pedestrian Railing and Handrail (lighted)	LF	$500	544	$272,000
Shoring or Extra Excavation Class A	LS	$25,000	1	$25,000
Bridge Drain (stainless steel pipe 6")	LF	$250	272	$68,000
Traffic Control (flaggers, safety measures, signs, etc.)	LS	$25,000	1	$25,000
Roadway & Parking Lot Pavement Repairs	LS	$20,000	1	$20,000
Construction Storm Water Erosion Control	LS	$15,000	1	$15,000
SPCC Plan	LS	$10,000	1	$10,000
Wiring	LS	$10,000	1	$10,000
Conduit (2" dim.)	LF	$15	544	$8,160
Light Contactor Controller	EA	$15,000	1	$15,000
			sum=	***$1,168,076***

Retaining Walls ***(165' SEW walls)***

Erosion & Water Pollution Control	LS	$10,000	1	$10,000
High Visibility Fence	LF	$8	430	$3,440
Silt Fence	LF	$6	430	$2,580
Structure Excavation Class A Incl Haul	CY	$30	550	$16,500
Structural Earth Wall (SEW)	SF	$35	2,970	$103,950
Perforated 6" Drain	LF	$25	430	$10,750
Concrete Class 4000 for Slab	CY	$650	61	$39,722
Reinforcing Bar (EC)	LBS	$1.25	9,167	$11,458
Pedestrian Railing and Handrail (lighted)	LF	$500	330	$165,000
Traffic Control (flaggers, safety measures, signs, etc.)	LS	$15,000	1	$15,000
Roadway, Sidewalk and Pavement Repairs	LS	$10,000	1	$10,000
Construction Storm Water Erosion Control	LS	$10,000	1	$10,000
SPCC Plan	LS	$10,000	1	$10,000
Wiring	LS	$10,000	1	$10,000
Conduit (2" dim.)	LF	$15	330	$4,950
			sum =	***$423,351***

Misc. Items

Stair and Elevator	LS	$750,000	1	$750,000
1st Ave. Crosswalk (signs & traffic lights, etc.)	LS	$50,000	1	$50,000
Offsite Disposal	LS	$35,000	1	$35,000
Stormwater Treatment	LS	$120,000	1	$120,000
Approach Pathway Improvement (if needed)	LS	$100,000	1	$100,000
Site Restoration (vegetation and planting)	LS	$75,000	1	$75,000
Existing traffic signs removal and relocation	LS	$50,000	1	$50,000
VE Study (if required)	LS	$35,000	1	$35,000
Street Cleaning, Artwork, & Force Account	LS	$100,000	1	$100,000
Mitigation (buffer zone)	LS	$75,000	1	$75,000
			sum =	***$1,215,000***

Estimated Construction Costs =	**$9,880,584**
9.5% tax =	$938,656
Conceptual Plan - Contingency (30%) =	$2,964,175
Inspection (20%) =	$1,976,117
Design (30%)=	$2,964,175

Est'd Project Total = $18,723,707

South Alignment Option:
Gateway Steel Truss, Precast Voided Slab, and SEW (wall)

Description	Unit	Unit Cost	Quantity	Cost
Mobilization		10%	1	$803,679
Clearing and Grubbing	LS	$75,000	1	$75,000
Removing Obstructions	LS	$50,000	1	$50,000
Construction Surveying	LS	$60,000	1	$60,000
			sum =	*$988,679*

Structures
Gateway Steel Truss Spans (with 240' & 140' = 380')

Construction Access & Staging	LS	$75,000	1	$75,000
Erosion & Water Pollution Control	LS	$15,000	1	$15,000
High Visibility Fence	LF	$8	500	$4,000
Silt Fence	LF	$6	500	$3,000
CONTECK 240'x14' wide Gateway Truss (delivered)	EA	$846,209	1	$846,209
CONTECK 140'x14' wide Gateway Truss (delivered)	EA	$386,167	1	$386,167
Truss Erection	LS	$125,000	1	$125,000
Concrete Class 4000D for Bridge Deck	CY	$1,200	133	$159,600
Deck Slab Reinforcement (Epoxy Coated)	LBS	$1.25	26,600	$33,250
Structure Excavation Incl Haul	CY	$35	561	$19,635
Gravel Backfill for Footing	CY	$45	261	$11,745
Concrete Class 4000 for Bridge (col. & shaft & col caps)	CY	$850	465	$395,250
Reinforcing Steel for Bridge (column & col. cap)	LBS	$1.10	104,625	$115,088
Throw Fence and Pedestrian Handrails (lighted)	LF	$775	760	$589,000
Soil Excavation for Shaft Incl. Haul	CY	$650	780	$507,000
Shoring or Extra Excavation Class A	LS	$25,000	1	$25,000
Remove Shaft Obstructions	Est	$50,700	1	$50,700
Casing Shoring	LF	$250	120	$30,000
Furnishing 8'-0" f Permanent Casing	LF	$650	360	$234,000
Placing Permanent 8'-0" Casing	EA	$5,000	6	$30,000
Concrete Class 4000P for Shaft	CY	$350	672	$235,200
Steel Reinforcing Bar for Shaft	LBS	$1.00	168,000	$168,000
CSL Access Tube	LF	$8	3,120	$24,960
CSL Testing	EA	$1,200	6	$7,200
Bridge Drain (stainless steel pipe 6")	LF	$250	380	$95,000
Temp Barrier	LF	$35	250	$8,750
Traffic Control (flaggers, safety measures, signs, etc.)	LS	$225,000	1	$225,000
Roadway & Parking Lot Pavement Repairs	LS	$35,000	1	$35,000
Construction Storm Water Erosion Control	LS	$15,000	1	$15,000
SPCC Plan	LS	$10,000	1	$10,000
Wiring	LS	$20,000	1	$20,000
Conduit (2" dim.)	LF	$15	760	$11,400
Light Contactor Controller	EA	$20,000	1	$20,000
Special Lighting	LS	$65,000	1	$65,000
			sum=	*$4,595,153*

Approach Bridge Spans (6 spans x 68.3' precast voided slabs = 410')

Construction Access & Staging	LS	$35,000	1	$35,000
Erosion & Water Pollution Control	LS	$10,000	1	$10,000
High Visibility Fence	LF	$8	1,020	$8,160
Silt Fence	LF	$6	1,020	$6,120
Pre-Stressed Voided Slabs (30"x4'x70')	LF	$250	1,656	$414,000
Structure Excavation Incl Haul	CY	$35	751	$26,285
Gravel Backfill for Footing	CY	$45	572	$25,740
Concrete Class 4000 for Piers	CY	$1,000	255	$255,000
Reinforcing Steel for Piers	LBS	$1.20	57,375	$68,850
Concrete Class 4000 for Bridge (abutment)	CY	$750	67	$50,250
Reinforcing Steel for Bridge (abutment)	LBS	$1.20	13,400	$16,080
Pedestrian Railing and Handrail (lighted)	LF	$500	820	$410,000
Shoring or Extra Excavation Class A	LS	$25,000	1	$25,000
Bridge Drain (stainless steel pipe 6")	LF	$250	410	$102,500
Traffic Control (flaggers, safety measures, signs, etc.)	LS	$25,000	1	$25,000
Roadway & Parking Lot Pavement Repairs	LS	$20,000	1	$20,000
Construction Storm Water Erosion Control	LS	$15,000	1	$15,000
SPCC Plan	LS	$10,000	1	$10,000
Wiring	LS	$10,000	1	$10,000
Conduit (2" dim.)	LF	$15	820	$12,300
Light Contactor Controller	EA	$15,000	1	$15,000
			sum=	***$1,560,285***

Retaining Walls (192' SEW walls)

Erosion & Water Pollution Control	LS	$10,000	1	$10,000
High Visibility Fence	LF	$8	484	$3,872
Silt Fence	LF	$6	484	$2,904
Structure Excavation Class A Incl Haul	CY	$30	640	$19,200
Structural Earth Wall (SEW)	SF	$35	3,456	$120,960
Perforated 6" Drain	LF	$25	484	$12,100
Concrete Class 4000 for Slab	CY	$650	71	$46,222
Reinforcing Bar (EC)	LBS	$1.25	10,667	$13,333
Pedestrian Railing and Handrail (lighted)	LF	$500	384	$192,000
Traffic Control (flaggers, safety measures, signs, etc.)	LS	$15,000	1	$15,000
Roadway, Sidewalk and Pavement Repairs	LS	$10,000	1	$10,000
Construction Storm Water Erosion Control	LS	$10,000	1	$10,000
SPCC Plan	LS	$10,000	1	$10,000
Wiring	LS	$10,000	1	$10,000
Conduit (2" dim.)	LF	$15	384	$5,760
			sum =	***$481,352***

Misc. Items

Stair and Elevator	LS	$750,000	1	$750,000
1st Ave. crosswalk (signs & traffic lights, etc.)	LS	$50,000	1	$50,000
Offsite Disposal	LS	$35,000	1	$35,000

Stormwater Treatment	LS	$120,000	1	$120,000
Approach Pathway Improvement (if needed)	LS	$100,000	1	$100,000
Site Restoration (vegetation and planting)	LS	$75,000	1	$75,000
Existing traffic signs removal and relocation	LS	$50,000	1	$50,000
VE Study (if required)	LS	$35,000	1	$35,000
Street Cleaning, Artwork, & Force Account	LS	$100,000	1	$100,000
Mitigation (buffer zone)	LS	$75,000	1	$75,000
			sum =	***$1,215,000***

Estimated Construction Costs =	**$8,840,468**
9.5% tax =	$839,844
Conceptual Plan - Contingency (30%) =	$2,652,141
Inspection (20%) =	$1,768,094
Design (25%)=	$2,210,117

Est'd Project Total = $16,310,664