Appendix A

PRELIMINARY GEOLOGIC/GEOTECHNICAL EVALUATION

SHANNON & WILSON, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

ALASKA
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COLORADO
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August 24, 2010

Mr. Allen de Steiguer
Carollo Engineers
1218 Third Avenue, Suite 1600
Seattle, WA 98101

RE: PRELIMINARY GEOLOGIC/GEOTECHNICAL EVALUATION OF NORTH BEACH ALTERNATIVES, SEATTLE, WASHINGTON

Dear Mr. de Steiguer:

At your request, we have performed a preliminary evaluation of three potential alternatives for a proposed Combined Sewer Overflow (CSO) project in the North Beach neighborhood of Seattle; the project is called the North Beach CSO. The purposes of our preliminary study are to understand the geologic conditions in this area and to determine the geotechnical limitations and opportunities for the three potential sites for the CSO project.

The scope of our preliminary study included a literature review consisting of Shannon & Wilson and City of Seattle files, review of the GeoMap Northwest website, a site reconnaissance, a meeting with you to discuss our preliminary findings, and preparation of this report.

SITE AND PROJECT DESCRIPTIONS

The North Beach CSO project is primarily focused on the area at and adjacent to an existing sewer pump station at North Beach, as shown in Figure 1. The site is located at the confluence of five streets as they all converge on the lowest point of elevation in a large, semi-circular basin in the Blue Ridge neighborhood. The top of the basin is at about elevation 340 feet (440 feet Metro Datum) and the elevation of the existing pump station is about elevation 35 feet (135 feet Metro Datum). Slope inclinations in the basin range from about 20 to 50 percent and the entire area is covered with residential development. All of the streets are paved and drainage consists of a combination of open ditches and buried culverts.

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From the existing pump station and adjacent Blue Ridge Park to its north, the ground surface drops down steeply (about 70 percent) to the west about 10 feet to the BNSF Railway (BNSF) drainage ditch and double-track alignment. At the western edge of the railroad bench, the rock seawall drops near vertically down about 8 to 10 feet to the Puget Sound beach. Water flows through culverts in the seawall at two locations; one from the stormwater collection system in the Olympia Terrace neighborhood and the other from the creeks that flows through the North Beach neighborhood.

Alternative 1A includes a 60-foot- by 40-foot- by 35-foot-deep storage tank in Blue Ridge Park and a one-story aboveground odor control and electrical facility in the park (40-foot by 20-foot). Alternative 1B includes a 12-foot-diameter storage pipeline in the NW Blue Ridge Drive right-of-way (ROW), a buried Diversion Structure (10-foot- by 10-foot- by 15-foot-deep) and a one-story above grade odor control and electrical facility in the pump station site (40-foot by 20-foot). The proposed storage pipe is approximately 250 feet long and 25 feet deep. Alternative 1D includes a 40-foot- by 30-foot- by 35-foot-deep storage tank and a 60-foot by 50-foot- by 20-foot-deep pump station in Blue Ridge Park, twin 8-inch force mains, about 5 feet deep, from the pump station to a one-story at-grade odor control facility and drop structure (20-foot by 15-foot) near the intersection of Holman Road NW and 14th Avenue NW, and a 12-inch gravity main to the 8th Avenue Interceptor.

GEOLOGIC CONDITIONS

The geologic map for Seattle indicates that the surface deposits in the area of the proposed storage tank would be Vashon recessional outwash, typically consisting of a medium dense, slightly silty to silty, gravelly sand or sandy gravel. This deposit appears to be underlain by glaciolacustrine silt and clay, commonly called the Lawton Clay. Typically, the Lawton Clay is 50 feet or more thick and contains interbeds of fine sand. The depth to groundwater is unknown, but it is probably perched close to the ground surface because of the likelihood that the shallow surface water in this basin is focused toward the park/pump station site. There is no site-specific subsurface information for this site. Borings performed nearby for residential purposes are very shallow and are unlikely to represent conditions at the proposed structure locations.

The slope between the western edge of Blue Ridge Park and the BNSF tracks did not appear to contain in situ soil. Because this slope was uneven and contained construction debris and other deleterious materials, it is probably artificial fill placed to make a level park surface. This fill of unknown thickness may overlie the recessional outwash.

Street grade profiles obtained from the City of Seattle's records indicate that the streets leading into the convergence just east of the park have minor cuts and fills, mostly plus or minus 2 feet, but with a maximum of 4 feet. Therefore, it is likely that the original ground surface sloped down from the street to the railroad property at a gentle gradient. Moving northward and southward from the street intersection, cuts or fills were less than 2 feet.

As discussed above, the slope between the park and the railroad tracks is only about 10 feet high. To the north and south of the site, the height of that slope increases quickly to 30 to 40 feet high. These slopes have suffered shallow instability many times. There are no records of slope instability at the park or pump station.

No records of subsurface exploration were found in Shannon & Wilson files or on the GeoMap Northwest website for the Holman Road NW/14th Avenue NW site. The Geologic Map of Seattle indicates that the site is underlain by Vashon till; however, exposures of soil in a nearby drainage ditch indicate that a thin layer of recessional outwash may overlie the till.

GEOTECHNICAL APPLICATIONS

As discussed previously, only very limited subsurface and groundwater data are available. Explorations would be required to determine the subsurface conditions, including the depth to groundwater, relative densities of the soils, and soil types.

Storage Tanks, Pump Station, and Diversion Structure Excavation

The excavations in Blue Ridge Park for a storage tank (Alternatives 1A and 1D) and pump station (Alternative 1D) and at the North Beach Pump Station for the diversion structure (Alternative 1B) will require temporary shoring to reduce the overall impact to the sites. The proposed depths of the storage tanks and the pump station, about 35 and 25 feet for Alternatives 1A/D and 1B, respectively, will likely require a tieback or internally braced shoring system. The

excavation for the proposed diversion structure, about 15 feet deep, could likely be constructed with stacked trench boxes or cantilevered shoring.

The groundwater conditions at the Blue Ridge Park and North Beach Pump Station sites are not currently known. The need for relatively impermeable or watertight shoring will depend on possible permit limitations on groundwater disposal volumes, the ability to perform groundwater recharge, and whether settlement-sensitive structures, utilities or other improvements are identified during design. The groundwater disposal volumes will be a function of the depth to groundwater and the thickness and hydraulic conductivity of the overlying recessional outwash. The relatively impermeable shoring could consist of pre-drilled sheet piles, a secant pile, and soil-mixed or slurry wall system. If very loose soils are identified in the explorations, and depending on the proximity of existing structures, utilities, and other improvements, driven or vibrated sheet pile shoring systems could result in unacceptable vibrations and settlements. A variable moment or vibration damping hammer could reduce, but would not eliminate, the potential for unacceptable vibrations and settlement.

Depending on the groundwater conditions and thickness and extent of the fill and recessional outwash at the site, liquefaction may be a concern for some of the structures. Liquefaction could result in undesirable settlement of the proposed structures. If liquefaction is an issue, ground improvement or deep foundation elements may be required.

The buried structures will also need to be checked for uplift. Uplift piles, tiedown anchors, and/or an extended perimeter slab could be used to resist uplift. In addition, if relatively impermeable shoring is required and secant piles are the selected shoring system, the secant piles could be incorporated into the final design of the uplift resistance system.

Storage Pipe

The storage pipe alternative in the NW Blue Ridge Drive ROW (Alternative 1B) could likely be constructed as an open trench. The proposed 25-foot-deep excavation could likely be supported by a braced, soldier pile and lagging shoring system in conjunction with dewatering and possible groundwater recharge. However, if drawdown-induced settlement sensitive soils are present and

groundwater recharge is not feasible, then relatively impermeable or watertight shoring systems similar to those discussed earlier may be required.

Depending on the groundwater conditions and thickness and extent of the fill and recessional outwash at the site, liquefaction may be a concern. Liquefaction could result in undesirable settlement of the proposed structures. Depending on the allowable limits on settlement, ground improvement or deep foundation elements may be required to mitigate potential liquefaction.

The buried storage pipeline will also need to be checked for uplift. A pipe sled could be used to resist uplift.

Force Mains and Gravity Line

We do not anticipate any significant geotechnical challenges for the open trenching of the force mains or gravity line (Alternative 1D). Trench boxes in combination with sumps and pumps would likely be sufficient for supporting the excavation and controlling groundwater.

Above-grade Structures

The one-story above-grade structures at the Blue Ridge Park and North Beach Pump Station sites (Alternatives 1A and 1B) and the one-story at-grade odor control facility and drop structure near the intersection of Holman Road NW and 14th Avenue NW (Alternative 1D), could likely be supported on spread footings or mat foundations. Minor overexcavation may be required if soft or loose soils are present at or below the foundation grade elevation. The potential for liquefaction at the North Beach Pump Station site would need to be evaluated after explorations are completed to determine if ground improvement or deep foundations would be required.

LIMITATIONS

This preliminary evaluation is intended for use in comparing alternatives for the North Beach CSO project. No subsurface explorations were performed for this project. After selection of the

preferred alternative, explorations will be completed for preliminary design of the chosen facilities.

Sincerely,

SHANNON & WILSON, INC.

David C. Ward, P.E., L.E.G.
Senior Principal Engineer

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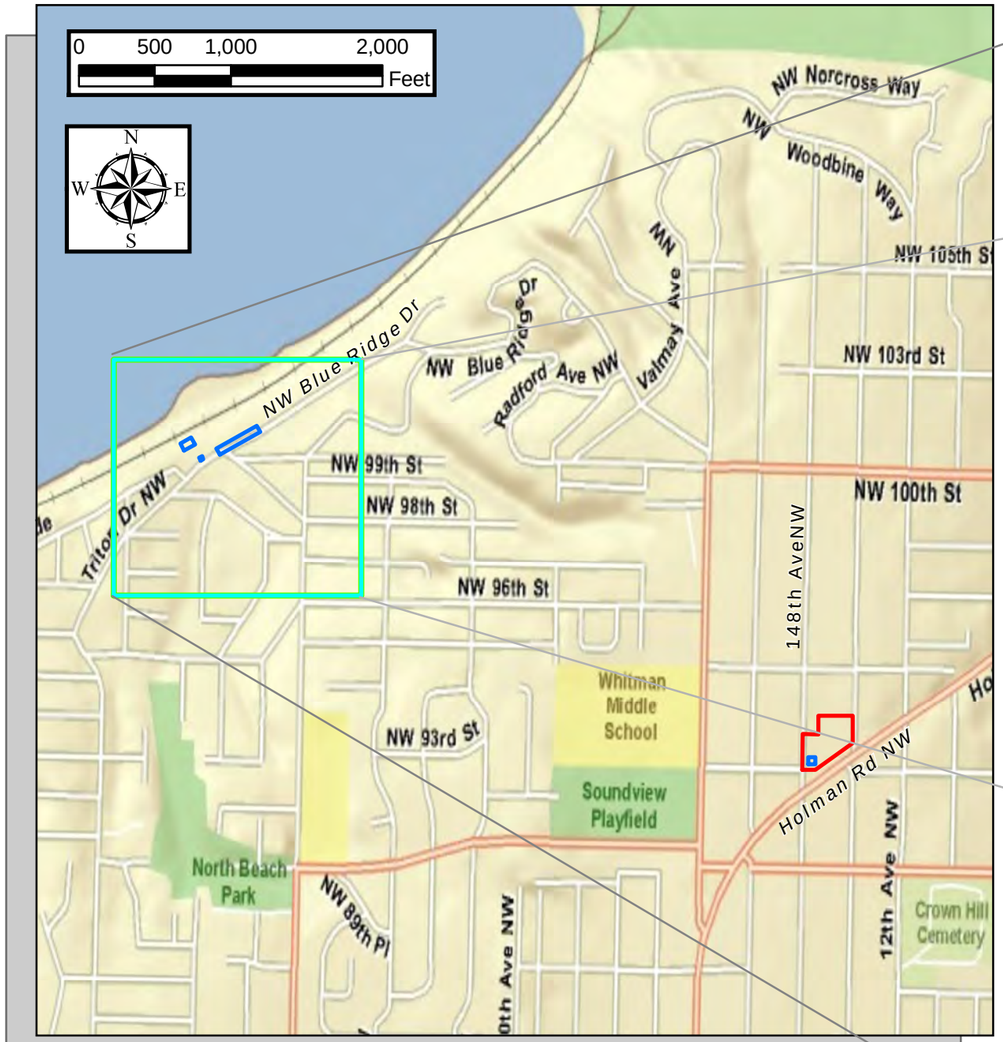
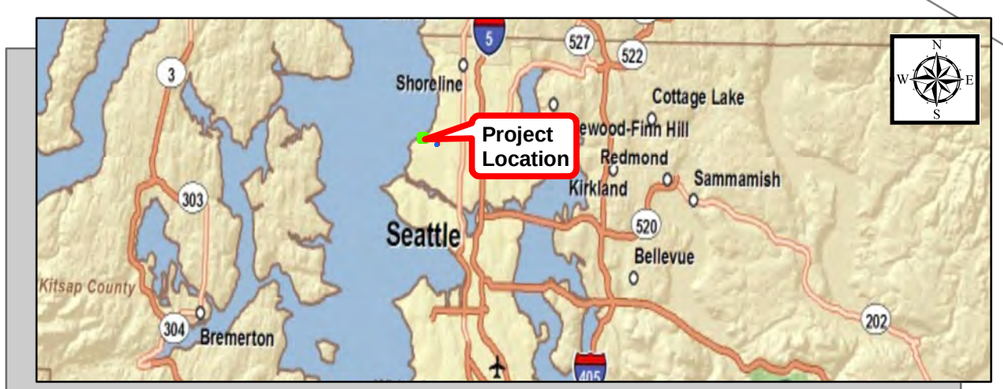
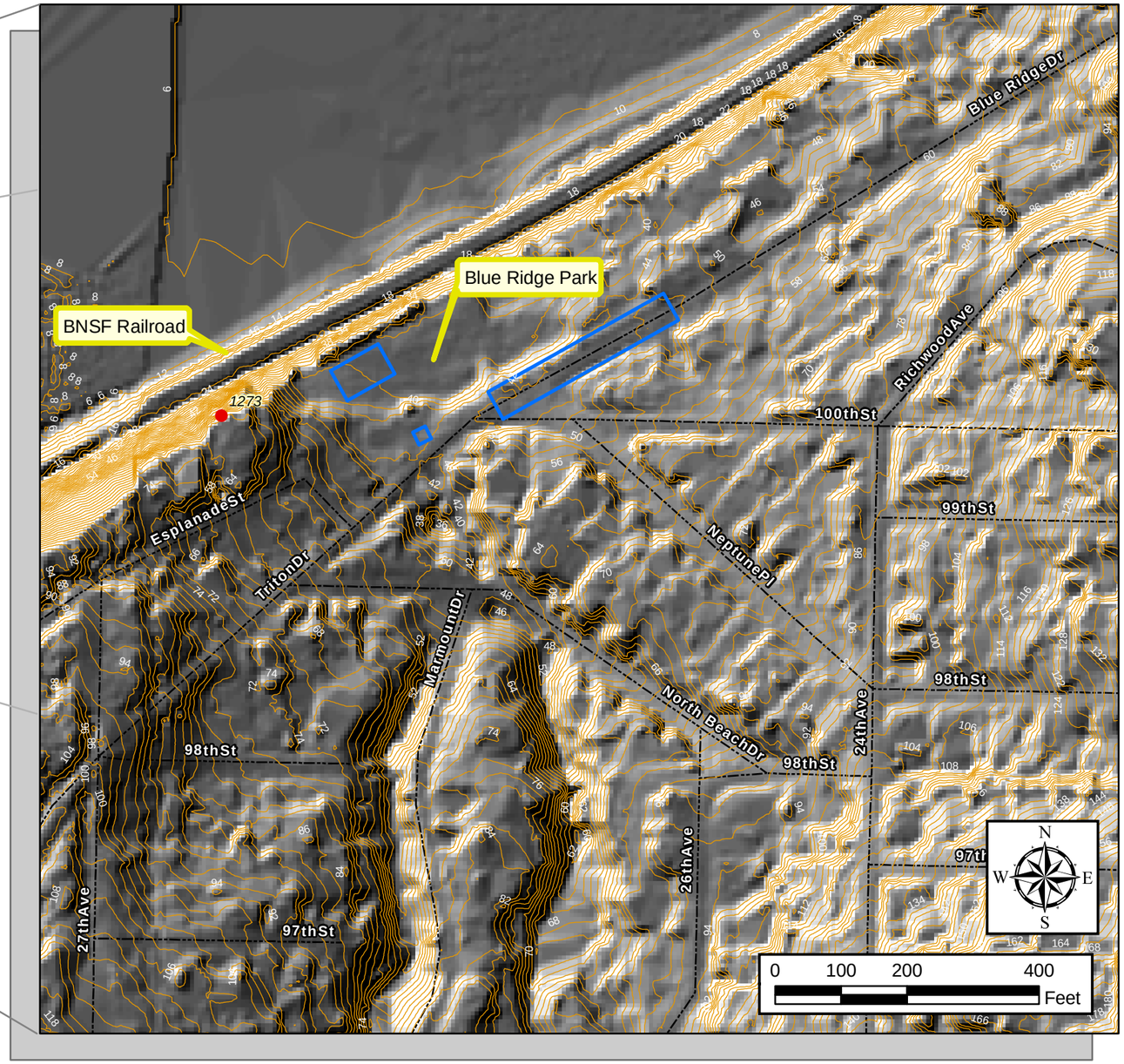
DC:MSK:WTL/dcw

Enc: Figure 1 – North Beach CSO Site Plan







Legend

- Project Location
- Drop Structure Site
- Potential Structure Excavations
- Streets
- Contours (2 ft)
- Shallow Colluvial Landslide

Carollo Engineers
North Beach CSO

SITE PLAN

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FIG. 1

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