June 15, 2022

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DEWATERING DESIGN - 4529 SAND POINT WAY NE, SEATTLE, WASHINGTON

Dear Steven:

This letter presents our dewatering design recommendations for construction dewatering at the 4529 Sand Point Way NE development in Seattle, Washington. This letter is intended to provide the basis of design, and design recommendations for site groundwater control. This letter does not detail the specific equipment intended for construction of the system, specific dewatering component cut sheets, layout, or schedule. This plan has been prepared based on the project geotechnical report, the plans, our experience, and our conversations with you.

PROJECT DESCRIPTION

The site is located at 4529 Sand Point Way NE in Seattle, Washington. The site is somewhat triangular-shaped bordered by 39th Avenue NE to the north and Sand Point Way NE to the south. The site slopes to the south and southwest with the highest existing site grades above elevation 90 feet sloping down to about elevation 73 feet in the southwest part of the property.

The shoring design was prepared by Ground Support PLLC, dated June 2, 2022. The excavation will be shored by a soldier pile and lagging wall along the south, west, and part of the north sides of the excavation; pile spacings will generally be 8-feet. A tangent pile wall will be constructed on the east end of the site.

On the eastern half of the site there will be a deeper excavation between the Lower North Wall and the Interior South Wall that will have a subgrade elevation of about 54 feet; the pile spacings for these walls will also be about 8 feet. This part of the overall excavation will require construction dewatering.

We understand that the work will begin in the fall of 2022.

SOIL CONDITIONS

The soil conditions for the site are provided in a April 2020 geotechnical report provided by PanGEO, Inc. titled Geotechnical Report, Proposed Mixed Use Development, 4529 Sand Point Way Northeast, Seattle Washington, 98105. PanGEO also performed two additional borings in February 2022 and installed a monitoring well in boring PG-3.

Based on the geotechnical report and explorations, the soil conditions appear to consist of thin till generally overlying advance outwash sands. Boring PG-3, and some off-site borings indicate the

presence of hard silt, immediately below the till; these may be pre-Fraser deposits or more fine-grained deposits in the advance outwash. The coarse phase of the outwash has a variable silt percentages between about 5 and 26 percent, and silt interlayers were encountered within.

The fundamental variable for dewatering designs is hydraulic conductivity, also referred to as soil permeability. Hydraulic testing of the soils was not performed at the site. Grain size analyses were performed on samples from the borings and these can be used to estimate soil permeability. Based on the gradations and our experience we estimate the alluvium permeability to be on the order of 0.007 to 0.02 ft/min.

The groundwater elevation measured in PG-3 in February 2022 was 60.5 feet. PanGEO recommends a design groundwater elevation of 61 feet based on their work and review of borings completed in the vicinity.

DESIGN APPROACH AND CALCULATIONS

This section presents our interpretation of the soil and groundwater conditions, our approach to groundwater control, and design calculations for the excavation.

The primary structure that will require construction dewatering is the stormwater detention vault located in the deep portion of the building between the Lower North Wall and the Interior South Wall. Given a base of excavation elevation of 54 feet, groundwater should be drawn down about 9 feet to lower groundwater levels to a standard depth of 2 feet below base of excavation.

We recommend the use of well points to dewater the site. Vacuum-based well points are closely spaced small diameter wells that remove groundwater from the soils using vacuum pressures. They work well in soils with varying permeability such as at this site. One issue with well points is that since they operate under vacuum pressures generated from a single pump, any break in any component (main header, well point, vacuum hoses, valving) will immediately terminate operation of the entire system. Construction of the vault must be performed with care to prevent damage to the dewatering system.

Dewatering design calculations were performed to estimate well spacing, and to estimate the yield from the system. The design calculations were performed using analytical modeling based on the Theis and Jacob formulas and the principle of superposition. The calculations assumed that the well points will be drilled vertically from the top of the Interior South Wall at an elevation of 63 feet, and at an angle through the Lower North Wall also at an elevation of 63 feet. Since the east wall will be a tangent wall, which should be relatively impervious, no well points will be installed along that wall. The well points were spaced on 8-foot centers, located in the center of each shoring bay. 32 well points were modeled in the calculations for the excavation as shown in Figure 1, and an additional 6 well points were used to simulate the effects of the tangent pile wall.

Figure 2 provides a calculated groundwater elevation profile across about the center of the excavation after a period of 10 days of operation to achieve a dewatered elevation of about 52 feet. The calculated discharge rates for the system were between about 40 and 80 gpm, we would rely on the lower half of this range; rates may drop over 20 percent with time.

DESIGN RECOMMENDATIONS

Groundwater control for the deep vault excavation at the 4529 Sand Point Way NE project will be performed using vacuum based well points. 32 well points are anticipated, this number may change slightly based on access and configuration of the wall.

At this time, we suggest that the well points be drilled vertical along the Interior South Wall in the center of each shoring bay about 2 to 3 feet from the face of the wall. The top of the Lower North Wall will be at about elevation 71 feet; since vacuum-based well points only have a design head lift potential of about 18 feet, drilling from elevation 71 feet will be too high for an effective vacuum to dry the excavation. As such, the well points should be drilled from elevation 63 feet, the same elevation as those on the south interior wall, but be drilled through the wall at a 60-degree angle below horizontal. The header piping will wrap around the excavation; we suggest that the vacuum pump be located on the top of the interior south wall, likely near the east secant wall.

We recommend that the system be run, without interruption, for a minimum of four days before excavation. We also recommend that you plan for use of sump pumps to remove any water trapped on interlayered soils or the silt encountered in boring PG-3.

The following provides specific recommendations for construction and operation of the system.

Well Points: The well points should be installed similar to that shown in Figure 1 and should be drilled vertical on the south interior wall to a depth of 25 feet using a Klemm or similar. The well points installed along the Lower North Wall should be drilled at a 60-degree angle below horizontal for a boring length of 28 feet. Well points should be constructed of 2-inch-diameter PVC and have a 3-foot long 30-slot screen section and interior suction pipe to the bottom of the well point.

A Colorado Product 12-20, or equivalent, washed, rounded sand filter pack should be placed in the annular space between the borehole wall and well point casing up to the static water table. A bentonite pellet seal should be placed between the top of the sand pack and ground surface. The seal should be hydrated.

Well point swing hoses should be new or clean enough that the operator and site staff can clearly see the amount of air and water passing through the hose.

All well points should have valves placed in-line to control vacuum pressure and flow at each well point.

Well points should be installed in accordance with WAC 173-160.

Vacuum Pump: Vacuum pumps capable of creating at least 22-inches (Hg) of vacuum across each well point should be provided. The pumps should have a continuous power supply and be capable of providing continuous vacuum in the system throughout the length of the project.

Provide a vacuum gage on the end of the header pipe furthest from the pump. Vacuum pressures should be above 18-inches at the gage at all times.

Development: The well points should be developed immediately upon completion. Development methods should utilize flow surging. Development will improve the hydraulic connection with the aquifer and should provide a clean dewatering effluent with time. Development water should be discharged to a settling tank.

Piping and Discharge: The discharge piping from the pump should be minimum 6-inch diameter HDPE or PVC. The discharge piping will be routed to the discharge outfall. Air leaks in the piping and components must be minimized such that there is greater than 18-inches of vacuum at each well point at all times.

Flowmeter: A flowmeter should be installed on the mainline discharge from the dewatering system. The flowmeter should be installed such that there is a full pipe of water and that some backpressure is exerted on the meter. Flowmeters should be installed according to manufacturer's recommendations on distances to joints, elbows, etc.

Power: We understand that power will be supplied by line power or diesel driven pumps. A backup power source and automatic transfer switch should be installed to maintain system operation in the event of failure of the primary power system.

Sumps: Sumps may be required during excavation. Sumps should be cased in a perforated housing or well screen surrounded by a washed, rounded gravel pack to avoid pumping of fines.

Well Decommissioning: The well points should be decommissioned according to WAC 173-160.

Operation: The system should be operated continuously. Dewatering should commence a minimum of 4 days prior to excavation below the water table. The systems should be regularly inspected for piping leaks and pump malfunctions. Frequent tuning of the system may be required in the first week of operation.

Monitoring: We recommend that the monitoring well installed in boring PG-3 be maintained on-site until the performance of the dewatering system is assured and the excavation is dewatered; following achieving a near steady-state water elevation below subgrade the monitoring well can be decommissioned according to WAC 173-160. The static water levels in PG-3 and select well points along the perimeter of the system should be measured prior to operation of the system. Daily monitoring of the water levels in PG-3 should be performed and recorded. If necessary the operation of the vacuum system can be controlled based on the measurements in PG-3 to prevent excess drawdown at the site. The well point system can be tuned using the individual well point valves, control of pump speed, or other method determined by the dewatering subcontractor. Water levels should be drawn down a minimum of two feet below the base of excavation.

Discharge rates should be monitored daily and recorded in the project log.

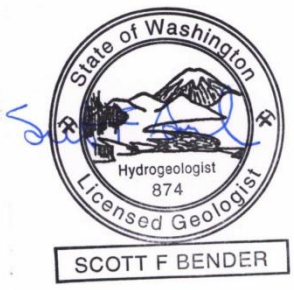
Monitoring of subgrade conditions for piping and boils should be performed at all times.

Closure: The dewatering design recommendations provided herein have been oriented to the various soil conditions observed at the site, further variations may exist. As such, we recommend that our staff be present during initial system installation and startup. Should well discharge rates and groundwater level drawdown not be similar than presented herein, we should be contacted so that we may observe the system performance and revise our design recommendations as necessary.

This design has been prepared to meet the groundwater drawdown levels required by the work. Potential impacts to off-site structures or facilities have not been considered as part of this work. If there are potential affects to structures, such as groundwater drawdown inducing ground settlement, then the Geotechnical Engineer should be contacted to identify these risks and what constraints they may have on operation of the dewatering system. This design has not considered the effects or liabilities associated with pumping or migration of contaminated groundwater; as stated above, the design has been provided only to meet the specified drawdown criteria and we hold no liability for adverse effects related to groundwater drawdown and soil contamination.

Thank you for the opportunity to be of service. Please call us at (360) 631-5600 should you have any questions or comments.

Sincerely,



Scott F. Bender L.H.G., P.G., C.G.W.P.

Enclosures: Figures 1 and 2. Well Point Locations and Calculation Results