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Supplemental Geotechnical Report
Small Scale Pit Infiltration Test
Parcel No. 5745001371
Site Address – 330 3rd St NW
LS&E Job No. 13637
Tests Performed: 12/22/2021, 12/23/2021

Project Description

The client intends to develop the site referenced above and is required to determine the seasonal high groundwater and the in-situ rate of infiltration for proposed stormwater facilities: seasonal high groundwater has been determined within existing geotechnical reports, as have preliminary, *conceptual* infiltration rates utilizing Grain Size Analysis. Per the 2012 Stormwater Manual for Western Washington (Manual), 2014 Revision, Volume III – Chapter 3; a Small-Scale Pilot Infiltration Test (PIT) is indicated for sites with less than one acre of drainage to proposed infiltration facility (see page 525). The existing geotechnical site investigations, referenced later in this document, confirmed highly variable subsurface characteristics within the expected infiltrative horizon with limited infiltration potential.

Scope of Work

The scope of work includes:

- Document Review: Review of existing geotechnical documents for the project site was necessary for understanding of past work accomplished and work to be conducted.
- Code Review: Review of pertinent stormwater code as adopted by the City of Puyallup was necessary to ensure a thorough and sufficient investigation.
- Design Infiltration Evaluation: Evaluation of in-situ infiltration rates of on-site soils within the expected infiltrative horizon was necessary for design calculation.
- Supplemental Geotechnical Report: A report with a defined in-situ infiltration rate for design calculation was required, as existing geotechnical documents either described the infiltration feasibility in general, conceptual terms or utilized testing that does not fulfill the City's feasibility criteria.

Work by Others

- Geotechnical Engineering Services, AOB Site Development, Puyallup, Washington (GeoEngineers, 2011): A preliminary geotechnical engineering study that was prepared for the City of Puyallup to provide feasibility analysis for future development of the project site. This report detailed soil borings conducted at the site, laboratory testing of in-situ soils from the borings, and thorough foundation, pavement, and seismic recommendations for the subsurface soils.

- Groundwater Level Monitoring and Preliminary Infiltration Feasibility Evaluation – City of Puyallup AOB Parking Lot (Aspect Consulting, 2021): A geotechnical engineering study that further describes the subsurface conditions of the project site, focusing on high winter water monitoring and preliminary, *conceptual* infiltration rates and feasibility. This document provides specific information not included in the previous geotechnical engineering document prepared by GeoEngineers.

Site Soils

Subsurface soils were investigated and described within the GeoEngineers report. The report describes a near surface soil horizon consisting of highly variable fill conditions (2 to 5 feet) throughout the project site. The fill is underlain by interbedded silts, sands, and mixes of both of differing densities to as much as 80 feet below ground surface (bgs). For the purposes of this report and for the determination of infiltration feasibility of the site, this near-surface soil horizon is the focus. We conducted our small-scale PIT in the vicinity of soil boring B-2. The boring log for B-2 illustrates fill to a depth of 3 feet. Our observations during preparation of the PIT agree with this determination to the extent of our excavations.

Infiltration Feasibility

Feasibility for stormwater infiltration facilities is primarily determined by the depth to groundwater and the infiltrative capacity of the in-situ soils. These are separate criteria, although they can be related in many ways. The size of an infiltration facility also determines feasibility but can be manipulated to work in some cases. The final design rate of infiltration will ultimately be determined through correction factors (from Ecology) based on the size of infiltration facilities. Therefore, the final design rate will be determined through calculations by others on a project-specific basis.

Groundwater Level Monitoring

Groundwater level monitoring was conducted by Aspect Consulting. Borings B-1 and B-2, conducted by GeoEngineers during the initial evaluation, were utilized as water logging wells by Aspect Consulting. Between December 8, 2020, and May 11, 2021, the seasonal high groundwater level was found to be 3.5 feet bgs within B-2. This location and associated data best represent our test location.

Design Infiltration Rate

Grain Size Analysis was conducted by Aspect Consulting utilizing the laboratory testing results from the GeoEngineers geotechnical engineering report. This is considered a preliminary, *conceptual* infiltration rate and does not satisfy the City's requirements for design infiltration testing or feasibility. A small-scale PIT is necessary to determine the infiltration rate of-situ soils in the expected location of possible infiltration facilities. The testing methods and results are found below.

Methodology

A Licensed Geologist and representative from our firm oversaw the preparation of the site and conducted the test. An excavation measuring 4-feet wide by 4-feet long (16 square feet) advanced approximately 20 inches into the soil underlying the existing pavement. This depth was chosen to represent the approximate infiltrative horizon for permeable pavement, if utilized for the project. The spoils were set back from the excavation. A water table review pit was advanced adjacent to, and deeper than, the small-scale PIT location for observation of groundwater mounding.

- We installed a vertical measuring stake marked in half inch increments.
- We used a PVC pipe with bell-shaped base and small perforations within the test pit to dissipate water energy and thus limit movement and deposition of silts.
- A large water tank was mobilized with a section of fire hose that reached the pit.
- We pre-soaked the pit by maintaining a standing water head of 12 inches for 6 hours.
- At the end of the soaking period, we added water to the extent we could maintain the level at 12 inches for 1 hour.
- We made a measurement every 15 minutes of the amount of water it took to maintain the water lever at the same point each time (we chose 12 inches). We determined the volume and instantaneous flow rate.
- After 1 hour, we turned off the water and recorded the drop rate in inches per hour until the pit was empty.
- Finally, we reviewed the nearby water table review pit (depth of ~30 inches) to determine if water was mounding laterally. This step is intended for sites with restrictive layers. This analysis of the nearby pit satisfies the requirement to over-excavate the test pit to look for groundwater mounding.

Figure 1: Infiltration Test (⬢) Location

Table 1 illustrates the cumulative volume and instantaneous flow rate in gallons per minute to maintain the water level in the pit at 12 inches (measured every 15 minutes).

Table 1: Cumulative Volume and Instantaneous Flow Rate and Influence on Nearby Pit

Period (each @15 min)	Cumulative Volume (gallons)	Instantaneous Flow Rate (gal/min)	Water Table Change in Adjacent Port?
1	0.935	0.06	None – dry (30 in.)
2	0.934	0.06	None – dry (30 in.)
3	0.935	0.06	None – dry (30 in.)
4	0.935	0.06	None – dry (30 in.)

At the conclusion of the test above for 1 hour, we discontinued application of water to the pit and prepared to record the drop in inches per hour until the pit emptied. Table 2 illustrates the results.

Table 2: Infiltration Test Results, Water Off, in Inches per Hour

Pit No.	Inches/Hour Drop Until Empty
1	0.5

As shown in Table 1 above, the nearby water table review pit was observed at points throughout the small-scale PIT, as well as after the PIT was completed. At no point during the on-site visit was water observed within the pit.

The calculated infiltration rates observed for each 15 minute period during the PIT are shown below in Table 3. All 4 periods of 15 minutes yielded the same value, with the average rate of infiltration for all four periods being 0.5 inches per hour. After shutting off the water and preparing to wait until the 4-foot by 4-foot pit was empty, the drop in water level was observed to be approximately 0.5 inches in the first hour. This rate would have taken 24 hours to empty the pit (and more with ongoing precipitation). Leaving a pit this size open in a location with public access, and with water within it, would be a safety concern. An engineering decision was made to end the test at that point in time. Thus, over the course of two hours of close observation, the consistent rate of infiltration was calculated to be 0.5 inches per hour.

Table 3: Infiltration Test Results for Each Period in Inches per Hour

Period (each @15 min)	Converted inches/hour
1	0.5
2	0.5
3	0.5
4	0.5
Average =	0.5

During excavation of soil for placement of the water table review pit and small-scale PIT, the soils were observed for further understanding of the site and ensuring proper depth for the PIT within the expected infiltrative horizon. The soil depths and descriptions agree with the existing reports in that a moist, very fine, silty fill exists beneath a layer of a gravelly, heterogeneous base course.

Figure 2: Small-Scale PIT Excavation

Conclusion

Infiltration infeasibility criteria is defined within the 2012 Ecology Manual, including depth to groundwater and rate of infiltration. Insufficient depth and/or infiltration render stormwater infiltration design as infeasible. As reported by Aspect Consulting, the depth to groundwater is approximately 3.5 feet bgs in the approximate location of boring B-2 and proposed parking (permeable pavement). This depth is sufficient to allow permeable pavement, thus not precluding testing for infiltration rate for design. However, infiltration testing utilizing the small-scale PIT yielded an in-situ rate of infiltration of 0.5 inches per hour which is virtually impermeable. This is insufficient for the use of permeable pavement with this project, in our opinion. Correction factors must be applied to the in-situ rate of infiltration for design per the Manual, which account for long-term maintenance and failure scenarios. This correction will result in a final design value well below our observed value of 0.5 inches per hour.

References

GeoEngineers, 2011, AOB Site Redevelopment, September 30, 2011

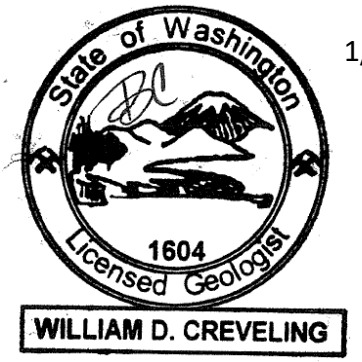
Aspect Consulting, 2021, Groundwater Level Monitoring and Preliminary Infiltration Feasibility Evaluation – City of Puyallup AOB Parking Lot, June 2, 2021

Washington State Department of Ecology (Ecology), 2014, 2012 Stormwater Management Manual for Western Washington, 2014 Revision

Closure

The information gathered for this report is standard practice and relevant for this type of project. The number and distribution of sampling locations is typical and reliable for obtaining an accurate understanding of the site of this size. The conclusions and recommendations presented in this letter are based on our observations, interpretations, and assumptions regarding shallow subsurface conditions. However, if any variations in the site conditions are discovered later, please contact our office to review and if necessary, modify this report accordingly. We appreciate the opportunity to be of service on this project. If you have any questions regarding this letter or any aspects of the project, please feel free to contact our office.

Respectfully submitted,
LeRoy Surveyors & Engineers, Inc.



1/6/2022

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