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April 20, 2011

Bellingham Parks and Recreation
3424 Meridian Street
Bellingham, Washington 98225

Attention: Jonathan Schilk

Subject: Geotechnical Engineering Services
Proposed Division Street Trail
Cordata Neighborhood
Bellingham, Washington
File No. 3125-029-00

INTRODUCTION AND SCOPE

This letter report presents the results of geotechnical services related to the proposed Division Street Trail to be constructed in the Cordata Neighborhood in Bellingham, Washington. Division Street is unimproved in this right-of-way (ROW). The location of the proposed trail site and Division Street corridor are shown in the attached Figures 1 and 2. Our services were verbally authorized by Jonathan Schilk of City of Bellingham Parks and Recreation on March 25, 2011. Our scope of services is presented in a task order dated March 17, 2011, in accordance with our on-call services agreement No. 2009-0303 with the City of Bellingham dated May 9, 2008.

The actual location of the proposed trail within the ROW had not been determined at the time of this report. The project is planned for construction in 2012. The trail will be 6 feet wide with 1 foot shoulders. The preliminary trail design provided by Parks and Recreation consists of 3 inches of crushed limestone or graywacke top course underlain by 6 inches of crushed surfacing base course (CSBC) with the exception of wetland areas, where 9 to 12-inches of shoulder ballast is proposed below the crushed surfacing base course. Access to constructing the site will be limited to the west end of the trail. The purpose of our services was to explore subsurface soil and groundwater conditions as a basis for providing conclusions and recommendations related to subgrade preparation, suitability of the proposed trail section and/or alternative design recommendations, stormwater management and construction considerations.

SITE CONDITIONS

We visited the site on March 28, 2011 with Jonathan Schilk to perform subsurface explorations to evaluate the conditions for the proposed Division Street Trail. The existing unimproved corridor is covered with grass, low-lying brush and has some wetlands along the route. The unimproved corridor is very flat with perched and ponded water.

We evaluated the subsurface conditions by completing three explorations (HA-1 through HA-3) at the approximate locations shown in the attached Figure 1. The explorations were excavated to depths ranging from 2 to 3.5 feet below the ground surface (bgs) using a shovel and hand auger. Relative soil density at each exploration was estimated using a ½-inch diameter hand probe and by level of effort with the hand auger. Moisture content determinations and a sieve analysis were performed on select samples in our soils laboratory. Table 1 below is a summary of subsurface conditions observed at the hand auger explorations:

TABLE 1. SUBSURFACE CONDITIONS

Exploration	Approximate Depth	Soil Type	Moisture Content %	Material Description
HA-1	0.0 – 1.0 ft	OL	58	Black organic silt with rootlets (very soft, wet) (topsoil)
	1.0 – 2.0 ft	ML	26	Gray and brown silt with sand and occasional gravel (medium stiff, moist) (weathered Bellingham [glaciomarine] Drift)
HA-2	0 – 1.0 ft	OL		Dark brown organic silt with sand and rootlets (very soft, wet) (topsoil)
	1.0 – 2.5 ft	ML	52	Brown clayey silt with sand (soft, wet) (weathered Bellingham [glaciomarine] Drift)
	2.5 – 3.0 ft	CL	19	Gray and brown sandy clay (medium stiff, moist) (weathered Bellingham [glaciomarine] Drift)
HA-3	0 – 0.5 ft	TS		Sod and Topsoil
	0.5 – 1.5 ft	CL	35	Brown silty clay with occasional rootlets and charcoal fragments (soft, moist) (fill)
	1.5 – 2.5	SM	15	Brown and reddish brown silty fine to coarse sand with gravel (medium dense, moist) (weathered Bellingham [glaciomarine] Drift)

Perched groundwater was observed at approximately 1 foot in HA-1, 1.8 feet in HA-2, and 1.6 feet in HA-3. Groundwater conditions should be expected to vary as a function of season and precipitation and other factors. The trail corridor is very flat such that the perched groundwater condition is quite static (no significant gradient).

CONCLUSIONS AND RECOMMENDATIONS

Trail Subgrade Preparation Recommendations

We recommend that any existing vegetation, forest duff, topsoil and organic soils be stripped from trail areas. Roots should be grubbed to a diameter less than 1-inch. Stripped material should be wasted from the site or used as landscaping materials if appropriate. We recommend a stripping depth of about 12 inches for planning purposes; however, some areas may require deeper stripping. We recommend that the trail section through the wetland areas, and any additional soft subgrades be overlain with a non-woven geotextile stabilization fabric with a minimum grab tensile strength (ASTM D 4632) of 200-pounds (e.g., Mirafi 180N or equivalent). This serves as subgrade stabilization and separation between the fine-

grained subgrade and the ballast material. We recommend that a representative of GeoEngineers observe stripped subgrades.

If possible, we recommend that this project proceed in the late summer and early fall when the perched ground water condition will either be absent or at its lowest level. We recommend using small, track-mounted construction equipment to perform the stripping and keeping construction equipment off the stripped subgrades as much as possible during the wet season or when the subgrade is wet. Based on our explorations, moisture sensitive soils will be exposed at the subgrade. Some localized perched groundwater could be encountered in the wetland areas. The subgrade will be very sensitive to disturbance such that repeated traffic will damage the subgrade and could require additional excavation of unsuitable soils. If the subgrade is dry, we recommend compacting to a firm and unyielding condition with vibratory compaction equipment. However, if the subgrade is significantly wet of optimum moisture conditions, we recommend using a smooth drum roller to level and compact subgrades as much as practical, or worst case, the subgrade should be probed and construction kept off the subgrade.

It is possible that the exposed inorganic subgrade may be very wet of optimum and yielding; for example, we would expect this condition to occur in the vicinity of HA-2 where soft, wet soils extend to 2.5 feet bgs. To minimize the risk of any long-term settlement or deformation of the trail, it would be necessary to remove this soft material. However, considering this is a pedestrian path that will have some very occasional light-weight maintenance equipment, it is our opinion that removal of soft inorganic soils is not necessary for the proposed fabric and trail section.

Trail Design

The proposed trail section for wetland areas included 9 to 12-inches of shoulder ballast below the CSBC. Washington State Department of Transportation (WSDOT) has changed the name of shoulder ballast to permeable ballast in the 2010 *Standard Specifications*. We observed topsoil to 12 inches, soft ground condition extending below that and perched groundwater at all our exploration locations. We understand that the trail will serve as the only access during construction. Therefore, we recommend that 12 inches of ballast over geotextile fabric be used along the entire trail alignment for construction access and better long term performance. To simplify construction and reduce cost, it is our opinion that CSBC can be substituted for the permeable ballast. This alternative will provide adequate trail support; however, in the soft ground areas, the permeable ballast will provide better construction support. The flat ground condition and very low gradient of the perched groundwater do not require the greater permeability of the permeable ballast to maintain present hydrology and wetland function of the area.

We recommend that CSBC meet Washington State Department of Transportation (WSDOT) *Standard Specification* 9-03.9(3) and permeable ballast meet WSDOT Specification 9-03.9(2). We recommend that the surfacing and CSBC be compacted to a firm and unyielding condition in accordance with standard parks department requirements. It is our opinion that the proposed trail section will provide adequate performance provided our subgrade preparation recommendations are followed.

Construction Considerations

The trail will be constructed by access from the west. To minimize impacts to the wetlands, the contractor will need to construct the trail by using the trail corridor as the only construction access. We suggest that BPD perform a reconnaissance including probing of the surficial conditions along the trail corridor in late summer 2010 to determine the stiffness of the subgrade soils and presence/absence of perched groundwater.

If the subgrade is sufficiently dry and firm, it may be possible to run rubber-tired equipment directly on the subgrade soils and allow the contractor to use whatever construction methods of their choosing. However, if the subgrade will be soft and wet, it would be appropriate to dictate some of the contractor means and methods in order to minimize damage to the subgrade. For example, it may be appropriate to not allow construction equipment on the subgrade and require constructing the entire ballast and fabric section as construction road support. In this case, the contractor would be instructed in the bid documents to strip, place fabric and ballast, and limit back-hauling of excavation material and trail materials to 6-foot wide dump equipment over the constructed ballast section incrementally as it would be constructed. This clearly slows production, but would be necessary to limit damage and difficult repairs during construction. We recommend BPD and/or the geotechnical engineer observe the ballast surface and performance prior to placing the CSBC and surfacing. The contractor would need to repair any severely damaged areas prior to placing the CSBC and surfacing after the ballast and fabric are placed along entire trail section.

STORMWATER MANAGEMENT CONSIDERATIONS

It is desirable to disperse/infiltrate the stormwater because no stormwater facilities are located along the project corridor. Installation of such facilities would add significant expense and much greater disturbance. To evaluate infiltration rates, we estimated a long term (design) infiltration rate for the sample obtained from 2.5 feet bgs from HA-3. The long term infiltration rate was estimated based on the recommendations in the 2005 Stormwater Management Manual (SMM) published by the Washington State Department of Ecology. The SMM allows for estimation of infiltration rates by determining USDA soil textural classification. Some physical properties of the soil were estimated based on a projection of the grain size distribution curve obtained during laboratory testing. According to the SMM an appropriate long term (design) infiltration rate of 0.25 inches per hour was estimated for the silty sand below the clay in HA-3. Based on the widely spaced explorations it appears that the silty sand is an isolated occurrence at the proposed trail site, but this rate has been assumed for some weathered soil profiles in order to allow infiltration from small projects in other jurisdictions such as City of Seattle. The high perched groundwater will limit vertical infiltration; however, the trail will have such a small footprint and using the CSBC/permeable ballast provides greater storage with the void ratio. Therefore, it is our opinion that using a small infiltration rate of 0.25 is reasonable to allow infiltration design to occur for this project.

LIMITATIONS

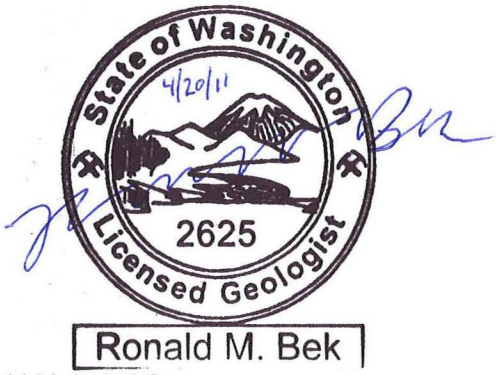
We have prepared this letter report for use by City of Bellingham and their authorized agents for use in evaluating trail design considerations for the proposed project. This report is not intended for use by others, and the information contained herein is not applicable to other sites.

Within the limitation of scope, schedule and budget, our services have been executed in accordance with generally accepted geotechnical practices in the area at the time the report was prepared. No warranty or other conditions, express or implied, should be understood.

Please refer to Attachment A titled “Report Limitations and Guidelines for Use” for additional information pertaining to use of this report.

We appreciate the opportunity to provide these services. Please call if you have any questions or require additional information.

Sincerely,



Ronald M. Bek, LG
Project Geologist

J. Robert Gordon, PE
Principal

RMB:JRG:ims
https://projects.geoengineers.com/sites/0312502900/Final

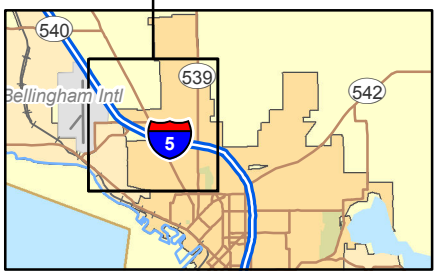
Attachments:

Figure 1 - Vicinity Map

Figure 2 - Site and Exploration Plan

Attachment A - Report Limitations and Guidelines for Use

Disclaimer: Any electronic form, facsimile or hard copy of the original document (email, text, table, and/or figure), if provided, and any attachments are only a copy of the original document. The original document is stored by GeoEngineers, Inc. and will serve as the official document of record.



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Feet

Notes:
1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. can not guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.
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Data Sources: ESRI Data & Maps, Street Maps 2005

Transverse Mercator, Zone 10 N North, North American Datum 1983
North arrow oriented to grid north

Vicinity Map

Division Street Trail
Bellingham, Washington

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Figure 1

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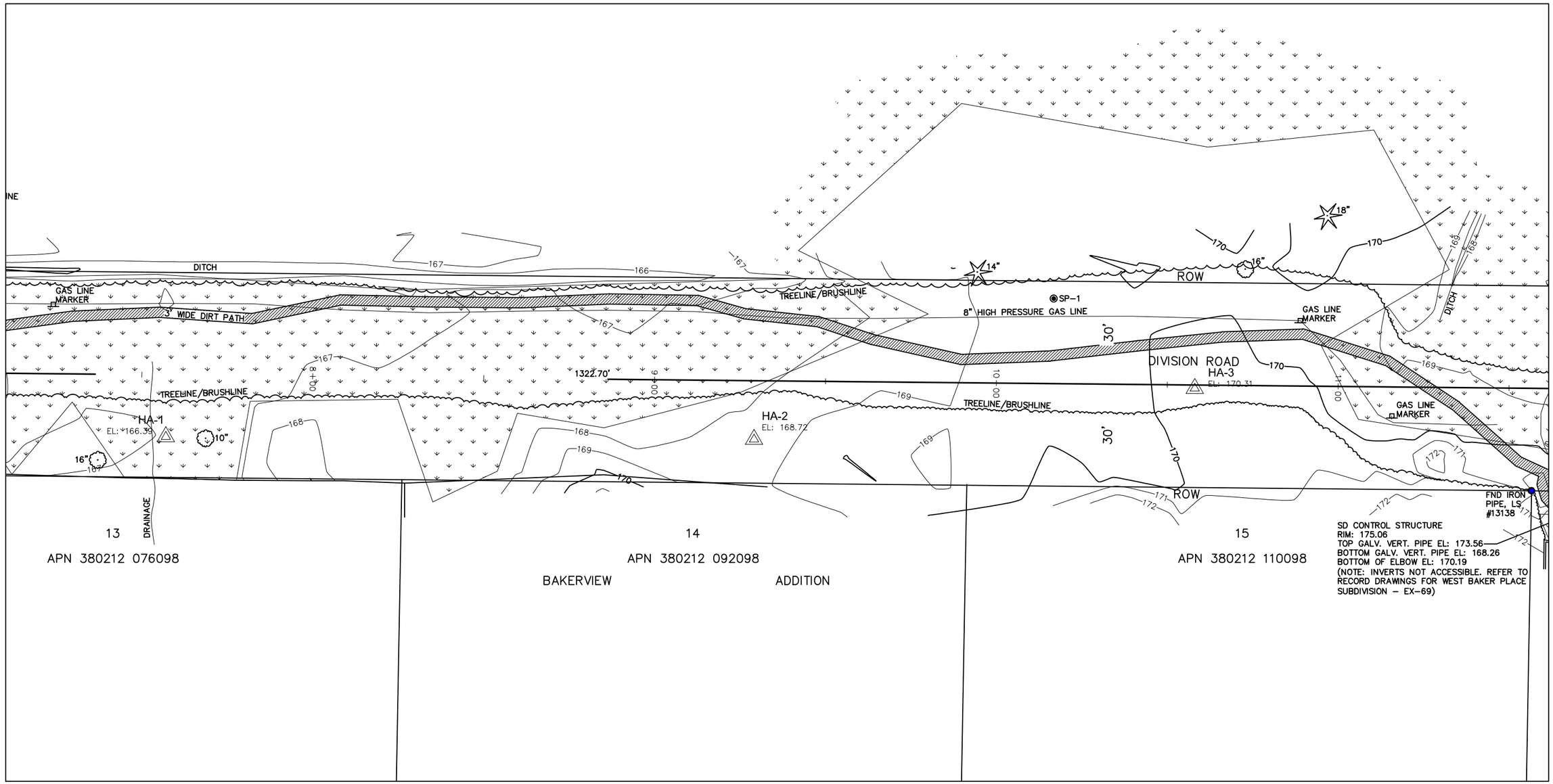

Legend

HA-1 = Hand auger number and approximate location

N W E S

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Feet

Notes:
1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. can not guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.

Reference: Base drawing provided by Larry Steele & Associates, Bellingham, Washington.

Site and Exploration Plan

Division Street Trail
Bellingham, Washington

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Figure 2

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Attachment
REPORT LIMITATIONS AND GUIDELINES FOR USE

This appendix provides information to help you manage your risks with respect to the use of this report.

Report Use and Reliance

This report has been prepared for City of Bellingham, their authorized agents and regulatory agencies. GeoEngineers structures our services to meet the specific needs of our clients. No party other than the City of Bellingham may rely on the product of our services unless we agree to such reliance in advance and in writing. This is to provide our firm with reasonable protection against open-ended liability claims by third parties with whom there would otherwise be no contractual limits to their actions. Within the limitations of scope, schedule and budget, our services have been executed in accordance with our On-call Services Agreement No. PW-2009-0303 dated May 9, 2008 and generally accepted geotechnical practices in this area at the time this report was prepared. Use of this report is not recommended for any purpose or project except the one originally contemplated.

This report should not be applied for any purpose or project except the one originally contemplated. If important changes are made to the project or property after the date of this report, we recommend that GeoEngineers be given the opportunity to review our interpretations and recommendations, and then we can provide written modifications or confirmation, as appropriate.

Information Provided by Others

GeoEngineers has relied upon certain data or information provided or compiled by others in the performance of our services. Although we used sources that are believed to be trustworthy, GeoEngineers cannot warrant or guarantee the accuracy or completeness of information provided or compiled by others.

Conditions Can Change

This report is based on conditions that existed at the time the study was performed. The findings and conclusions of this report may be affected by the passage of time, by events such as construction on or adjacent to the site, or by natural events such as floods, earthquakes, slope instability or groundwater fluctuations. If more than a few months have passed since issuance of our report or work product, or if any of the described events may have occurred, please contact GeoEngineers before applying this report for its intended purpose so that we may evaluate whether changed conditions affect the continued reliability or applicability of our conclusions and recommendations.

Professional Judgment

It is important to recognize that the geoscience practices (geotechnical engineering, geology and environmental science) are less exact than other engineering and natural science disciplines. By necessity, GeoEngineers uses its professional judgment in arriving at our conclusions and recommendations. GeoEngineers includes these explanatory "limitations' provisions in our reports to help reduce the risk of misunderstandings regarding the inexact nature of our professional services. Please confer with GeoEngineers if you need to know how these 'Report Limitations and Guidelines for Use' apply to your project or site.