Preliminary Geotechnical Engineering Report
26035 Williamson Lane
Kasilof, Alaska

June 2015

Submitted To:
Alaska Department Transportation & Public Facilities
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32-1-17731

TABLE OF CONTENTS

FIGURES

APPENDIX

PRELIMINARY GEOTECHNICAL ENGINEERING REPORT
26035 WILLIAMSON LANE
ANCHORAGE, ALASKA

1.0 INTRODUCTION

This report presents the results of subsurface explorations, laboratory testing, and preliminary geotechnical engineering studies conducted by Shannon & Wilson, Inc. for proposed parking area and boat launch improvements at 26035 Williamson Lane in Kasilof, Alaska. According to conceptual drawings available at the time of this report, the project is known as the Lower Kasilof Drift Boat Retrieval, Project No. 72039-1. The purpose of this geotechnical study was to explore subsurface conditions and provide preliminary foundation and pavement engineering considerations needed to plan future development. To accomplish this, six geotechnical borings were advanced throughout the project area. Soil samples recovered from the borings were tested in our geotechnical laboratory. Presented in this report are descriptions of the site and project, subsurface explorations and laboratory test procedures, an interpretation of subsurface conditions, and conclusions and preliminary recommendations from our engineering studies.

As part of this effort, Shannon & Wilson also performed Phase I and Limited Phase II Environmental Site Assessments (ESA) at the site. The results of that work are provided under separate cover in our June 2015 report, *Phase I and Limited Phase II Environmental Site Assessment, 26035 Williamson Lane, Kasilof, Alaska*.

Authorization to proceed with this work was provided by the Alaska Department of Transportation & Public Facilities (ADOT&PF) in the form of Notice to Proceed Number 8a, dated My 6, 2015 and signed by Mr. David Kemp, P.E., PMP, Chief of Statewide Public Facilities. Our work was conducted in general accordance with our April 27, 2015 proposal.

Note that the current concept includes improvements that are also located on the adjoining parcel to the south at 25951 Williamson Lane. Shannon & Wilson conducted geotechnical explorations on this adjoining parcel in October 2014. Since the subject properties are still under private ownership we have not included the results of our explorations at 25951 Williamson Lane in this report. The results of those explorations are included under separate cover in our November 2014 *Preliminary Geotechnical Engineering Report, 25951 Williamson Lane, Kasilof Alaska.*

2.0 SITE AND PROJECT DESCRIPTION

The project is located at 26035 Williamson Lane in Kasilof, Alaska. According to the Kenai Peninsula Borough (KPB) Assessors office, the legal description of the property is Lot 4B, Coal

Creek Country Estates Trujillo Addition, Kasilof, Alaska. The parcel comprises approximately 6.55 acres bounded by the Kasilof River to the west and Williamson Lane to the east. At the time of our explorations the property was largely undeveloped with the exception of a two-story residential structure located in the central portion of the property and a commercial structure used for seafood processing that is located northeast of the residential structure. The structures are accessed via two gravel driveways from Williamson Lane. The northern driveway also provides access to a parking area and existing boat launch on the Kasilof River at the property's western edge. Topography at the site is naturally terraced with two terrace levels between Williamson Lane and the Kasilof River. Based on topographic contours shown on USGS quadrangle maps, there is approximately 60 to 70 feet of relief from east to west across the site. Except for the developed areas, most of the property is vegetated with moderately dense stands of spruce and birch and the ground is covered with moss, leaves, and grasses. Tree cover in the western portion of the property, on a lower terrace, is sparse and the ground is primarily covered by grasses. The general location of the site is shown on the vicinity map presented as Figure 1 and a site plan showing the approximate locations of our borings and other site features is included as Figure 2.

At the time of this report the project was in a conceptual phase and several alternatives were being considered. Based on conceptual sketches provided by ADOT&PF we understand that future improvements at the site generally consist of constructing paved access roads and parking, a boat launch, one or two small toilet structures, information kiosks, and a caretakers cabin. When a final project design and layout is available additional geotechnical explorations, evaluation, and/or analysis may be needed to provide subsurface data and foundation recommendations for specific structures.

3.0 SUBSURFACE EXPLORATIONS

Subsurface explorations for the project consisted of advancing six borings, designated Borings GB-1 through GB-6, at the site on May 19, 2015. The general boring locations were selected by Shannon & Wilson to provide coverage in the general vicinity of the proposed site features shown on the conceptual drawings that were available at the time of our explorations. Approximate boring locations are shown on the site plan included as Figure 2. The borings were located using a handheld GPS with an estimated accuracy of +/- 20 feet. The surface elevations shown on the boring logs were estimated from the topographic contours shown on USGS quadrangle maps. Therefore the boring locations shown on the site plan and the elevations reported on the boring logs should be considered approximate. An experienced representative from our firm was present continuously during drilling to locate the borings, observe drill action, collect soil samples, log subsurface conditions, and observe groundwater levels.

Drilling services for this project were provided by Discovery Drilling of Anchorage, Alaska, using a truck mounted CME-75 drill rig. The borings were advanced with $3^1/_4$-inch inner diameter (ID), continuous flight, hollow-stem augers to depths ranging between approximately 16.5 and 27 feet below ground surface (bgs). As the borings were advanced, samples were typically recovered using standard penetration test (SPT) or modified penetration test (MPT) methods at 2.5-foot intervals in the top 10 feet and at 5-foot intervals thereafter. In the SPT method, samples are recovered by driving a 2-inch outer diameter (OD) split-spoon sampler into the bottom of the advancing hole with blows of a 140-pound hammer free falling 30 inches onto the drill rod. In the MPT method, samples are recovered by driving a 3-inch OD split-spoon sampler into the bottom of the advancing hole with blows of a 340-pound hammer free falling 30 inches onto the drill rod. For each sample, the number of blows required to drive the sampler the final 12 inches of an 18-inch penetration, or the middle 12 inches of a 24-inch penetration, into undisturbed soil is recorded. Blow counts are shown graphically on the boring logs as “penetration resistance” and are displayed adjacent to sample depth. The penetration resistance values give a measure of the relative density (compactness) or consistency (stiffness) of cohesionless or cohesive soils, respectively. In addition to the SPT/MPT samples, a grab sample of the near-surface soils was collected from the auger cuttings in the upper 2 feet of each boring.

The soil samples recovered during drilling were observed and described in the field in general accordance with the classification system described by ASTM International (ASTM) D2488. Selected samples recovered during drilling were tested in our laboratory to refine our soil descriptions in general accordance with ASTM D2487 and the Unified Soil Classification System (USCS) included in Figure 3. Frost classifications were estimated for samples based on laboratory testing (sieve analyses and P-200). The frost classification system is presented as Figure 4. Summary logs of the borings are presented in Figures 5 through 10.

Soil samples that were recovered from above the groundwater table were periodically "screened" for volatile organic vapors using a photoionization detector (PID) and an ADEC-approved headspace screening technique. The PID was calibrated before screening activities with 100 parts per million (ppm) isobutylene standard gas. The field screening samples were collected in re-sealable plastic bags and tested within 60 minutes of collection. Headspace screening results are presented on the boring logs in Figures 5 through 10.

After drilling, the borings were backfilled with auger cuttings produced during drilling and the surface was restored to match the existing grade.

4.0 LABORATORY TESTING

Laboratory tests were performed on selected soil samples recovered from the borings to confirm our field classifications and to estimate the index properties of the typical materials encountered at the site. The laboratory testing was formulated with emphasis on determining gradation properties, natural water content, and frost characteristics.

Water content tests were performed on each sample recovered from the borings. The tests were generally conducted according to procedures described in ASTM D2216. The results of the water content measurements are presented on the boring logs in Figures 5 through 10.

Grain size classification (gradation) tests were conducted to estimate the particle size distribution of selected samples from the borings. The gradation testing generally followed the mechanical sieve procedures described in ASTM C136/117. The grain size testing results are presented in Figure 11 and summarized on the boring logs as percent gravel, percent sand, and percent fines. We also conducted several tests to estimate the amount of material passing the Number 200 sieve (P-200) following the procedures described in ASTM C117. Percent fines is equal to the sum of the silt and clay fractions indicated by the percent passing the No. 200 sieve. Plasticity characteristics (Atterberg Limits results) are required to differentiate between silt and clay soils under USCS.

5.0 SUBSURFACE CONDITIONS

The subsurface conditions encountered at the site are depicted graphically on the boring logs in Figures 5 through 10. In general our borings at the site encountered approximately 2 to 2.5 feet of silty sand with organics which was underlain by complexly interbedded sand and gravel with variable fine content to the bottom of the borings. A layer of sandy silt was encountered below 13.5 feet bgs in Boring GB-6. In undeveloped areas a thin mantle, approximately 6 inches, of organics (grass, leaves, roots, and moss) was present at the ground surface. According to our laboratory tests, fines contents in the near surface (upper 2.5 feet), predominantly granular soils ranged between 21 and 39 percent and fines contents in deeper, granular soils ranged between 2 and 15 percent. Moisture contents within the predominantly granular soils typically ranged from about 14 to 37 percent near the surface and between 2 and 14 percent in deeper granular soils above the water table. The silt soils encountered below about 13 feet in Boring GB-6 had fines contents around 50 percent and moisture contents around 13 percent. Based on typical SPT penetration resistance values ranging between about 15 and 50 blows per foot (bpf) the materials encountered by our borings were typically medium dense to dense.

Groundwater was encountered at depths of approximately 10.5 and 7.5 feet bgs in Borings GB-1 and GB-2 during drilling, respectively, but was not encountered in the remaining geotechnical borings at the site. Groundwater was also encountered during drilling at approximately 58 feet bgs in Environmental Boring EB5. After drilling, groundwater was measured at 55.9 feet bgs in the temporary monitoring well installed in this boring. A log of Boring EB5 and details regarding the temporary monitoring well are included in our June 2015 report, *Phase I and Limited Phase II Environmental Site Assessment, 26035 Williamson Lane, Kasilof, Alaska*. Based on the topography of the site it appears that the groundwater elevation is closely related to the water level in the Kasilof River. It should be noted that groundwater levels may fluctuate by several feet seasonally or during periods of high precipitation and runoff.

6.0 PRELIMINARY ENGINEERING CONSIDERATIONS

According to conceptual sketches, proposed improvements at the site generally include construction of paved access roads and parking areas, a boat launch, one or two small toilet structures, information kiosks, and a caretakers cabin. From a geotechnical perspective, design of these improvements must consider the bearing support capabilities of the soils, expected settlements, seismic conditions, and the effects of seasonal frost action. Site development will also require demolition of the existing structures which should be accomplished in a manner that will provide a firm, uniform base for supporting new structures and pavements. In general, our borings encountered approximately 2 feet of silty soil overlying medium dense to dense sands and gravels. In our opinion, these soil conditions are generally suitable for supporting the proposed improvements provided the site is properly prepared prior to construction.

Note that the geotechnical opinions in this report are preliminary and do not comprise engineering recommendations. Additional analyses are needed to support the final design. The scope/extent of the additional work will depend on the design of the improvements and the site layout.

6.1 Site Preparation

Surface soils across the site were variable due to site development and organic soils were present on the ground surface in undeveloped portions of the site. In areas where roadway, sidewalks, or structures will be constructed, all organic soils should be removed prior to construction. The resultant ground surface should be flat, firm, and consistent across the site and it should not contain organic material such as wood, grass, or other debris. Where excavations are required, excavation grade should be proof-rolled to detect zones of loose or soft material. Proof rolling should be observed by a qualified geotechnical engineer and a contingency should be maintained to locally subcut and replace portions of the site that are unstable under the roller. In areas of the site that need to be brought up to grade we recommend using compacted Selected Material Type B or better structural fill. Gradation requirements for typical ADOT&PF fill materials are shown in Figure 12. Fill placed beneath pavements or structures should be compacted to at least 95 percent of its maximum dry density as determined by the Modified Proctor compaction procedure (ASTM D 1557).

6.2 Pavement Considerations

Development of pavements at the site should consider the support capabilities and frost susceptibility of the soils beneath the pavements. The performance of pavement is controlled by the details of construction and by the quality (gradation characteristics) of the materials placed and compacted to develop the needed structural section. Based on the conditions observed in our borings, the site soils should provide adequate support for the anticipated vehicle volumes and loading generally associated with this type of development. Laboratory testing of selected samples from our borings indicates that the site soils, with the exception of silty near surface soils, in the expected frost zone are generally low to moderately frost susceptible with frost classifications of F1 to F2. Design of the pavement structural sections will need to consider the owner's performance goals for the new pavements, which may include their tolerance for seasonal movements and maintenance requirements.

Assuming some seasonal frost related movements are tolerable, a typical section based on projects with similar subsurface conditions would consist (in descending order) of 2 inches of asphalt, 4 inches of D-1 Base, and 18 inches of Selected Material Type A Subbase. If the subgrade consists of soils containing significant fines (20 percent or more), a non-woven geotextile separation fabric may be incorporated into the design. This structural section is also appropriate for use beneath concrete pavements at the site.

6.3 Boat Launch

A new boat launch ramp is expected to be constructed as part of the project. We envision that the ramp will generally consist of a concrete surface that is constructed of poured-in-place or pre-cast concrete pads. Geotechnical design of the launch ramp will largely need to consider the strength, frost susceptibility and drainage characteristics of the support soils. We were not able to advance borings in the immediate area of the proposed launch ramp. Based on visual observations of the ground surface, it appears that the surface soils in the vicinity of the launch ramp consist of fine sand or silt. Depending on the expected loading, we believe that these native subgrade materials should be capable of supporting the expected loads imparted by moderately loaded, slow moving vehicles and trailers.

For planning purposes, we recommend that the minimum structural section for the launch ramp consist of 6 inches of D-1 Base Course over 24 inches of Selected Material Type A. This section should be extended as far as practical for constructability purposes, or to MLLW, whichever achieves the lowest elevation. Concrete thickness should be designed by the structural engineer based on the load requirements. The structural section may also need to incorporate geotextile fabric and/or geogrid layers depending on the expected design usage and loading. Structural section requirements and materials should be verified before final design.

6.4 Foundation Considerations

New structures and other appurtenances may be constructed as part of the new development. According to conceptual sketches these structures will consist of relatively lightly loaded buildings (restrooms, kiosks, and a caretakers cabin) that would typically be supported on conventional shallow foundations. For preliminary design purposes, the minimum footing width should be assumed to be 16 inches for continuous strip footings and 24 inches for spread footings. We recommend assuming that perimeter footings in heated buildings be placed a minimum of 4 feet below the ground surface. For interior footings in heated areas, footings may be placed directly below the floor slab such that embedment is 12 inches or more below the finished floor elevation. For unheated structures or if portions of heated structures are to be unheated, the minimum burial depth for footings should be increased to 5 feet bgs for frost protection. We recommend assuming that footings bear directly on native, firm, unyielding mineral soils, or on imported Selected Material Type A structural fill, as defined by the ADOT&PF in the 2004 *Standard Specifications for Highway Construction* (SSHC).

The site is located in a seismically active area and consideration should be given to the effects that seismic activity may have on the proposed improvements at the site. Based on the soil conditions encountered by our borings and the topography of the site, localized slope failures may occur during a large magnitude seismic event. Based on our explorations at this site, and prior explorations on the adjoining parcel to the south, soils below the water table may be susceptible to liquefaction during a seismic event. However, given the relatively deep water table, it is our opinion that the effects of liquefaction, if it occurs, will consist of widespread surface settlement or lateral spreading near sloped ground closest to the river banks.

6.5 Drainage and Groundwater

Groundwater was encountered during drilling in Borings GB-1 and GB-2 at depths ranging between about 7 and 11 feet bgs but was not encountered in the remaining geotechnical borings advanced at the site. Groundwater was also encountered in Environmental Boring EB5 at about 58 feet bgs during drilling. Therefore, we anticipate that groundwater will generally not be encountered during excavations needed for construction, except possibly when working on the river banks for the proposed boat launch. It should be noted that groundwater levels are subject to variation and may fluctuate by several feet seasonally. We recommend that the site be carefully graded such that surface water and roof run-off are directed away from structures, off the pavement surfaces, and into ditches or subdrains that convey the water off-site so that it cannot pond against or infiltrate the soils near the structure walls or in the pavement structural section.

7.0 CLOSURE/LIMITATIONS

This report was prepared for the exclusive use of our client and their representatives for evaluating the site as it relates to the geotechnical aspects discussed herein. The conclusions and recommendations contained in this report are based on information provided from the observed site conditions and other conditions described herein. The analyses, conclusions and preliminary recommendations contained in this report are based on site conditions as they presently exist. It is assumed that the exploratory borings are representative of the subsurface conditions throughout the site, i.e., the subsurface conditions everywhere are not significantly different from those disclosed by the explorations.

The recommendations contained in this report are intended to be preliminary and should not be used for final design of the project. The preliminary recommendations may be used for conceptual design and preliminary cost estimating purposes. Additional explorations and/or engineering analyses and evaluations may be needed in support of final design of this project. Once a preferred site layout and conceptual design has been developed, we can provide an assessment of additional geotechnical work that should be conducted in support of final design.

Unanticipated soil conditions are commonly encountered and cannot fully be determined by merely taking soil samples or advancing borings. Such unexpected conditions frequently require that additional expenditures be made to attain a properly constructed project. Therefore, some contingency fund is recommended to accommodate such potential extra costs. Shannon & Wilson has prepared the attachments in Appendix A *Important Information About Your*

Geotechnical/Environmental Report to assist you and others in understanding the use and limitations of the reports.

Copies of documents that may be relied upon by our client are limited to the printed copies (also known as hard copies) that are signed or sealed by Shannon & Wilson with a wet, blue ink signature. Files provided in electronic media format are furnished solely for the convenience of the client. Any conclusion or information obtained or derived from such electronic files shall be at the user's sole risk. If there is a discrepancy between the electronic files and the hard copies, or you question the authenticity of the report please contact the undersigned.

We appreciate this opportunity to be of service. Please contact the undersigned at (907) 561-2120 with questions or comments concerning the contents of this report.

SHANNON & WILSON, INC.

Ryan Collins
Senior Geotechnical Professional

STATE OF ALASKA
49TH
Kyle Brennan
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6-12-15
REGISTERED PROFESSIONAL ENGINEER

Kyle Brennan, P.E
Vice President

Elevation in Meters
Contour Interval 5 Meters
Taken from Kenai B-4 SE
U.S. Geological Survey Quadrangle
(1986)

0 0.5 1
APPROXIMATE SCALE IN MILES

26035 Williamson Lane Kasilof, Alaska	
VICINITY MAP	
June 2015	32-1-17731
SHANNON & WILSON, INC. Geotechnical & Environmental Consultants	**FIG. 1**

Map adapted from aerial imagery provided by Google Earth Pro, reproduced by permission granted by Google Earth TM Mapping Service.

LEGEND

GB-I Approximate Location of Boring GB-1, Advanced by Shannon & Wilson, May 2015

EBI Approximate Location of Environmental Boring EB1, Advanced by Shannon & Wilson, May 2015. Boring logs included in separate report.

0 50 100 200
APPROXIMATE SCALE IN FEET

N

26035 Williamson Lane
Kasilof, Alaska

SITE PLAN

June 2015 32-1-17731

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FIG. 2

Shannon & Wilson, Inc. (S&W), uses a soil identification system modified from the Unified Soil Classification System (USCS). Elements of the USCS and other definitions are provided on this and the following pages. Soil descriptions are based on visual-manual procedures (ASTM D2488) and laboratory testing procedures (ASTM D2487), if performed.

S&W INORGANIC SOIL CONSTITUENT DEFINITIONS

CONSTITUENT[2]	FINE-GRAINED SOILS (50% or more fines)[1]	COARSE-GRAINED SOILS (less than 50% fines)[1]
Major	***Silt, Lean Clay, Elastic Silt,*** or ***Fat Clay***[3]	***Sand*** or ***Gravel***[4]
Modifying (Secondary) Precedes major constituent	30% or more coarse-grained: ***Sandy*** or ***Gravelly***[4]	More than 12% fine-grained: ***Silty*** or ***Clayey***[3]
Minor Follows major constituent	15% to 30% coarse-grained: ***with Sand*** or ***with Gravel***[4]	5% to 12% fine-grained: ***with Silt*** or ***with Clay***[3]
	30% or more total coarse-grained *and* lesser coarse-grained constituent is 15% or more: ***with Sand*** or ***with Gravel***[5]	15% or more of a second coarse-grained constituent: ***with Sand*** or ***with Gravel***[5]

[1]All percentages are by weight of total specimen passing a 3-inch sieve.
[2]The order of terms is: *Modifying Major with Minor*.
[3]Determined based on behavior.
[4]Determined based on which constituent comprises a larger percentage.
[5]Whichever is the lesser constituent.

MOISTURE CONTENT TERMS

Dry	Absence of moisture, dusty, dry to the touch
Moist	Damp but no visible water
Wet	Visible free water, from below water table

STANDARD PENETRATION TEST (SPT) SPECIFICATIONS

Hammer:	140 pounds with a 30-inch free fall. Rope on 6- to 10-inch-diam. cathead 2-1/4 rope turns, > 100 rpm NOTE: If automatic hammers are used, blow counts shown on boring logs should be adjusted to account for efficiency of hammer.
Sampler:	10 to 30 inches long Shoe I.D. = 1.375 inches Barrel I.D. = 1.5 inches Barrel O.D. = 2 inches
N-Value:	Sum blow counts for second and third 6-inch increments. Refusal: 50 blows for 6 inches or less; 10 blows for 0 inches.

NOTE: Penetration resistances (N-values) shown on boring logs are as recorded in the field and have not been corrected for hammer efficiency, overburden, or other factors.

PARTICLE SIZE DEFINITIONS

DESCRIPTION	SIEVE NUMBER AND/OR APPROXIMATE SIZE
FINES	< #200 (0.075 mm = 0.003 in.)
SAND	
Fine	#200 to #40 (0.075 to 0.4 mm; 0.003 to 0.02 in.)
Medium	#40 to #10 (0.4 to 2 mm; 0.02 to 0.08 in.)
Coarse	#10 to #4 (2 to 4.75 mm; 0.08 to 0.187 in.)
GRAVEL	
Fine	#4 to 3/4 in. (4.75 to 19 mm; 0.187 to 0.75 in.)
Coarse	3/4 to 3 in. (19 to 76 mm)
COBBLES	3 to 12 in. (76 to 305 mm)
BOULDERS	> 12 in. (305 mm)

RELATIVE DENSITY / CONSISTENCY

COHESIONLESS SOILS		COHESIVE SOILS	
N, SPT, BLOWS/FT.	RELATIVE DENSITY	N, SPT, BLOWS/FT.	RELATIVE CONSISTENCY
< 4	Very loose	< 2	Very soft
4 - 10	Loose	2 - 4	Soft
10 - 30	Medium dense	4 - 8	Medium stiff
30 - 50	Dense	8 - 15	Stiff
> 50	Very dense	15 - 30	Very stiff
		> 30	Hard

WELL AND BACKFILL SYMBOLS

Bentonite Cement Grout	Surface Cement Seal
Bentonite Grout	Asphalt or Cap
Bentonite Chips	Slough
Silica Sand	Inclinometer or Non-perforated Casing
Perforated or Screened Casing	Vibrating Wire Piezometer

PERCENTAGES TERMS [1, 2]

Trace	< 5%
Few	5 to 10%
Little	15 to 25%
Some	30 to 45%
Mostly	50 to 100%

[1]Gravel, sand, and fines estimated by mass. Other constituents, such as organics, cobbles, and boulders, estimated by volume.

[2]Reprinted, with permission, from ASTM D2488 - 09a Standard Practice for Description and Identification of Soils (Visual-Manual Procedure), copyright ASTM International, 100 Barr Harbor Drive, West Conshohocken, PA 19428. A copy of the complete standard may be obtained from ASTM International, www.astm.org.

26035 Williamson Lane
Kasilof, Alaska

SOIL DESCRIPTION AND LOG KEY

June 2015 32-1-17731

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FIG. 3
Sheet 1 of 3

2013_BORING_CLASS1 17731 GEOTECH BORING LOGS.GPJ SWNEW.GDT 6/7/15

UNIFIED SOIL CLASSIFICATION SYSTEM (USCS)
(Modified From USACE Tech Memo 3-357, ASTM D2487, and ASTM D2488)

MAJOR DIVISIONS			GROUP/GRAPHIC SYMBOL	TYPICAL IDENTIFICATIONS
COARSE-GRAINED SOILS *(more than 50% retained on No. 200 sieve)*	Gravels *(more than 50% of coarse fraction retained on No. 4 sieve)*	Gravel *(less than 5% fines)*	GW	Well-Graded Gravel; Well-Graded Gravel with Sand
			GP	Poorly Graded Gravel; Poorly Graded Gravel with Sand
		Silty or Clayey Gravel *(more than 12% fines)*	GM	Silty Gravel; Silty Gravel with Sand
			GC	Clayey Gravel; Clayey Gravel with Sand
	Sands *(50% or more of coarse fraction passes the No. 4 sieve)*	Sand *(less than 5% fines)*	SW	Well-Graded Sand; Well-Graded Sand with Gravel
			SP	Poorly Graded Sand; Poorly Graded Sand with Gravel
		Silty or Clayey Sand *(more than 12% fines)*	SM	Silty Sand; Silty Sand with Gravel
			SC	Clayey Sand; Clayey Sand with Gravel
FINE-GRAINED SOILS *(50% or more passes the No. 200 sieve)*	Silts and Clays *(liquid limit less than 50)*	Inorganic	ML	Silt; Silt with Sand or Gravel; Sandy or Gravelly Silt
			CL	Lean Clay; Lean Clay with Sand or Gravel; Sandy or Gravelly Lean Clay
		Organic	OL	Organic Silt or Clay; Organic Silt or Clay with Sand or Gravel; Sandy or Gravelly Organic Silt or Clay
	Silts and Clays *(liquid limit 50 or more)*	Inorganic	MH	Elastic Silt; Elastic Silt with Sand or Gravel; Sandy or Gravelly Elastic Silt
			CH	Fat Clay; Fat Clay with Sand or Gravel; Sandy or Gravelly Fat Clay
		Organic	OH	Organic Silt or Clay; Organic Silt or Clay with Sand or Gravel; Sandy or Gravelly Organic Silt or Clay
HIGHLY-ORGANIC SOILS	Primarily organic matter, dark in color, and organic odor		PT	Peat or other highly organic soils (see ASTM D4427)

NOTE: No. 4 size = 4.75 mm = 0.187 in.; No. 200 size = 0.075 mm = 0.003 in.

NOTES

1. Dual symbols *(symbols separated by a hyphen, i.e., SP-SM, Sand with Silt)* are used for soils with between 5% and 12% fines or when the liquid limit and plasticity index values plot in the CL-ML area of the plasticity chart. Graphics shown on the logs for these soil types are a combination of the two graphic symbols (e.g., SP and SM).

2. Borderline symbols *(symbols separated by a slash, i.e., CL/ML, Lean Clay to Silt; SP-SM/SM, Sand with Silt to Silty Sand)* indicate that the soil properties are close to the defining boundary between two groups.

26035 Williamson Lane
Kasilof, Alaska

SOIL DESCRIPTION AND LOG KEY

June 2015 32-1-17731

SHANNON & WILSON, INC.
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FIG. 3
Sheet 2 of 3

GRADATION TERMS

Poorly Graded	Narrow range of grain sizes present or, within the range of grain sizes present, one or more sizes are missing (Gap Graded). Meets criteria in ASTM D2487, if tested.
Well-Graded	Full range and even distribution of grain sizes present. Meets criteria in ASTM D2487, if tested.

CEMENTATION TERMS[1]

Weak	Crumbles or breaks with handling or slight finger pressure
Moderate	Crumbles or breaks with considerable finger pressure
Strong	Will not crumble or break with finger pressure

PLASTICITY[2]

DESCRIPTION	VISUAL-MANUAL CRITERIA	APPROX. PLASITICTY INDEX RANGE
Nonplastic	A 1/8-in. thread cannot be rolled at any water content.	< 4
Low	A thread can barely be rolled and a lump cannot be formed when drier than the plastic limit.	4 to 10
Medium	A thread is easy to roll and not much time is required to reach the plastic limit. The thread cannot be rerolled after reaching the plastic limit. A lump crumbles when drier than the plastic limit.	10 to 20
High	It take considerable time rolling and kneading to reach the plastic limit. A thread can be rerolled several times after reaching the plastic limit. A lump can be formed without crumbling when drier than the plastic limit.	> 20

ADDITIONAL TERMS

Mottled	Irregular patches of different colors.
Bioturbated	Soil disturbance or mixing by plants or animals.
Diamict	Nonsorted sediment; sand and gravel in silt and/or clay matrix.
Cuttings	Material brought to surface by drilling.
Slough	Material that caved from sides of borehole.
Sheared	Disturbed texture, mix of strengths.

PARTICLE ANGULARITY AND SHAPE TERMS[1]

Angular	Sharp edges and unpolished planar surfaces.
Subangular	Similar to angular, but with rounded edges.
Subrounded	Nearly planar sides with well-rounded edges.
Rounded	Smoothly curved sides with no edges.
Flat	Width/thickness ratio > 3.
Elongated	Length/width ratio > 3.

ACRONYMS AND ABBREVIATIONS

ATD	At Time of Drilling
Diam.	Diameter
Elev.	Elevation
ft.	Feet
FeO	Iron Oxide
gal.	Gallons
Horiz.	Horizontal
HSA	Hollow Stem Auger
I.D.	Inside Diameter
in.	Inches
lbs.	Pounds
MgO	Magnesium Oxide
mm	Millimeter
MnO	Manganese Oxide
NA	Not Applicable or Not Available
NP	Nonplastic
O.D.	Outside Diameter
OW	Observation Well
pcf	Pounds per Cubic Foot
PID	Photo-Ionization Detector
PMT	Pressuremeter Test
ppm	Parts per Million
psi	Pounds per Square Inch
PVC	Polyvinyl Chloride
rpm	Rotations per Minute
SPT	Standard Penetration Test
USCS	Unified Soil Classification System
q_u	Unconfined Compressive Strength
VWP	Vibrating Wire Piezometer
Vert.	Vertical
WOH	Weight of Hammer
WOR	Weight of Rods
Wt.	Weight

STRUCTURE TERMS[1]

Interbedded	Alternating layers of varying material or color with layers at least 1/4-inch thick; singular: bed.
Laminated	Alternating layers of varying material or color with layers less than 1/4-inch thick; singular: lamination.
Fissured	Breaks along definite planes or fractures with little resistance.
Slickensided	Fracture planes appear polished or glossy; sometimes striated.
Blocky	Cohesive soil that can be broken down into small angular lumps that resist further breakdown.
Lensed	Inclusion of small pockets of different soils, such as small lenses of sand scattered through a mass of clay.
Homogeneous	Same color and appearance throughout.

[1]Reprinted, with permission, from ASTM D2488 - 09a Standard Practice for Description and Identification of Soils (Visual-Manual Procedure), copyright ASTM International, 100 Barr Harbor Drive, West Conshohocken, PA 19428. A copy of the complete standard may be obtained from ASTM International, www.astm.org.
[2]Adapted, with permission, from ASTM D2488 - 09a Standard Practice for Description and Identification of Soils (Visual-Manual Procedure), copyright ASTM International, 100 Barr Harbor Drive, West Conshohocken, PA 19428. A copy of the complete standard may be obtained from ASTM International, www.astm.org.

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SOIL DESCRIPTION AND LOG KEY

June 2015 32-1-17731

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FIG. 3
Sheet 3 of 3

2013 BORING CLASS3 17731 GEOTECH BORING LOGS.GPJ SWNEW.GDT 6/7/15

SHANNON & WILSON, INC.

FROST CLASSIFICATION

(after Municipality of Anchorage, 2007)

GROUP		0.02 Mil.	P-200	USC SYSTEM (based on P-200 results)
NFS	Sandy Soils	0 to 3	0 to 6	SW, SP, SW-SM, SP-SM
	Gravelly Soils	0 to 3	0 to 6	GW, GP, GW-GM, GP-GM
F1	Gravelly Soils	3 to 10	6 to 13	GM, GW-GM, GP-GM
F2	Sandy Soils	3 to 15	6 to 19	SP-SM, SW-SM, SM
	Gravelly Soils	10 to 20	13 to 25	GM
F3	Sands, except very fine silty sands**	Over 15	Over 19	SM, SC
	Gravelly Soils	Over 20	Over 25	GM, GC
	Clays, PI>12			CL, CH
F4	All Silts			ML, MH
	Very fine silty sands**	Over 15	Over 19	SM, SC
	Clays, PI<12			CL, CL-ML
	Varved clays and other fined grained, banded sediments			CL and ML CL, ML, and SM; SL, SH, and ML; CL, CH, ML, and SM

P-200 = Percent passing the number 200 sieve
0.02 Mil. = Percent material below 0.02 millimeter grain size

PI = Plasticity Index

*Approximate P-200 value equivalent for frost classification.
Value range based on typical, well-graded soil curves.

** Very fine sand : greater than 50% of sand fraction passing the number 100 sieve

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FROST CLASSIFICATION LEGEND

June 2015 32-1-17731

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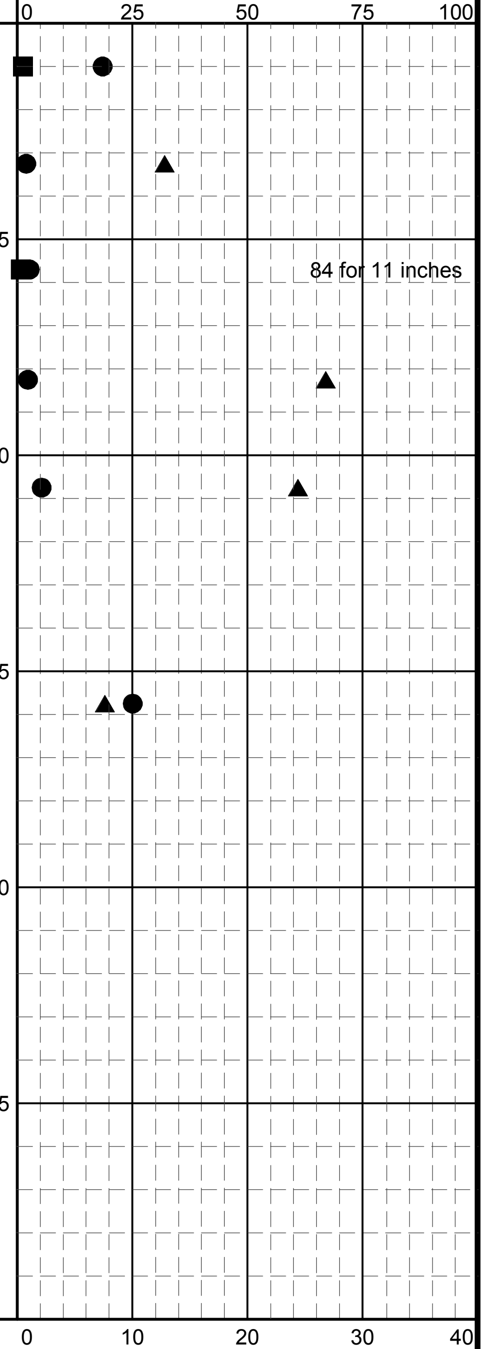
FIG. 4

MATERIAL DESCRIPTION Approx. Elevation: 8 Ft.	Depth, Ft.	Symbol	Samples	Ground Water	Depth, Ft.
Medium dense, brown, *Silty Sand (SM)*; moist S1: 21.1% Fines (F3)			S1		
Dense, brown, *Well Graded Sand with Silt and Gravel (SW-SM)*; moist S3: 41% Gravel, 48% Sand, 11% Fines (F2)	2.5		S2 S3 S4		5
Very dense, dark brown, *Poorly Graded Gravel with Sand (GP)*; wet	9.5		S5	5/19/2015	10
Medium dense, brown, *Silty Sand (SM)*; wet	13.5		S6		15
Bottom of Boring Boring Completed 5/19/2015	16.5				20 25

Penetration Resistance
(140 lb. weight, 30" drop)
▲ Blows per foot
● Water Content (%)



■ PID Reading (ppm)
Plastic Limit |—●—| Liquid Limit
Natural Water Content

LEGEND

* Sample Not Recovered
Grab Sample
2" O.D. Split Spoon Sample
3" O.D. Split Spoon Sample
Ground Water Level At Time Of Drilling

NOTES

1. The stratification lines represent the approximate boundaries between soil types, and the transition may be gradual.
2. The discussion in the text of this report is necessary for a proper understanding of the nature of subsurface materials.
3. Water level, if indicated above, is for the date specified and may vary.

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LOG OF BORING GB-1

June 2015 32-1-17731

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FIG. 5

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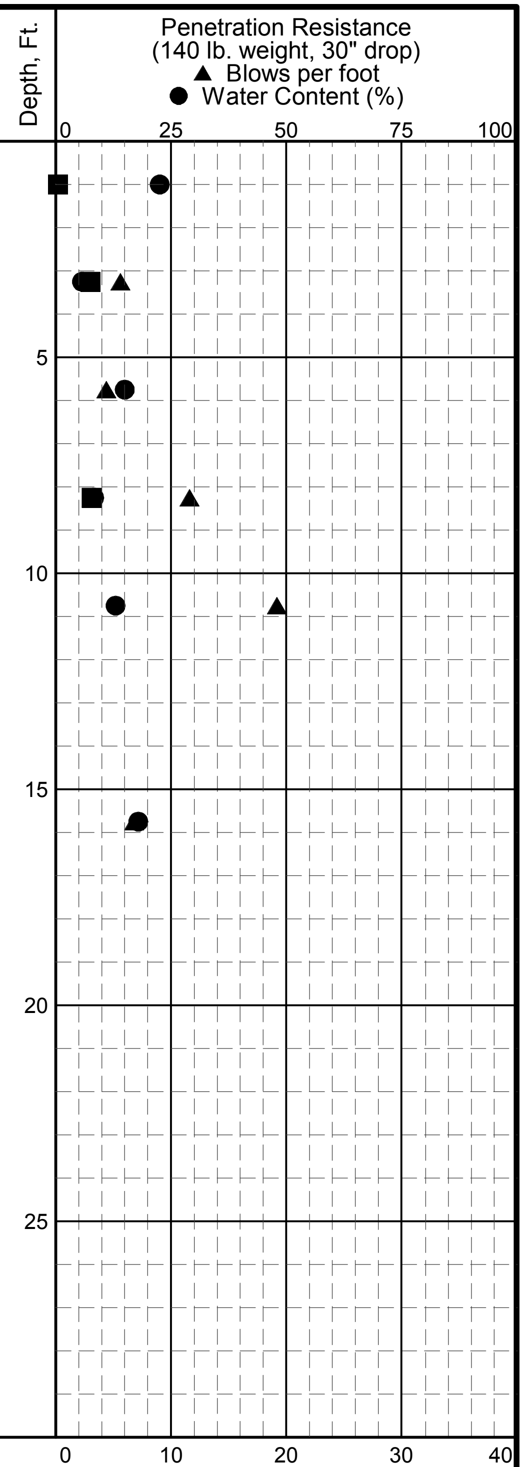
GEOTECHNICAL LOG 17731 GEOTECH BORING LOGS.GPJ S&W GEO1.GDT 6/12/15

MATERIAL DESCRIPTION Approx. Elevation: 33 Ft.	Depth, Ft.	Samples	Ground Water
Medium dense, dark brown, *Silty Sand with Gravel (SM)*; moist		S1	
Medium dense, brown, *Poorly Graded Sand with Silt and Gravel (SP)*; moist S2: 29% Gravel, 64% Sand, 7% Fines (F2)	2.5	S2	
Medium dense, brown, *Silty Sand (SM)*; moist S3: 14.5% Fines (F2)	4.5	S3	
Medium dense, brown, *Poorly Graded Sand with Silt and Gravel (SP-SM)*; wet	7.5	S4	5/19/2015
Medium dense to dense, gray, *Silty Sand (SM)*; moist to wet	9.5	S5 S6	
Bottom of Boring Boring Completed 5/19/2015	16.5		



LEGEND

* Sample Not Recovered
Grab Sample
2" O.D. Split Spoon Sample
3" O.D. Split Spoon Sample
Ground Water Level At Time Of Drilling

■ PID Reading (ppm)
Plastic Limit ●── Liquid Limit
Natural Water Content

NOTES

1. The stratification lines represent the approximate boundaries between soil types, and the transition may be gradual.
2. The discussion in the text of this report is necessary for a proper understanding of the nature of subsurface materials.
3. Water level, if indicated above, is for the date specified and may vary.

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LOG OF BORING GB-2

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FIG. 6

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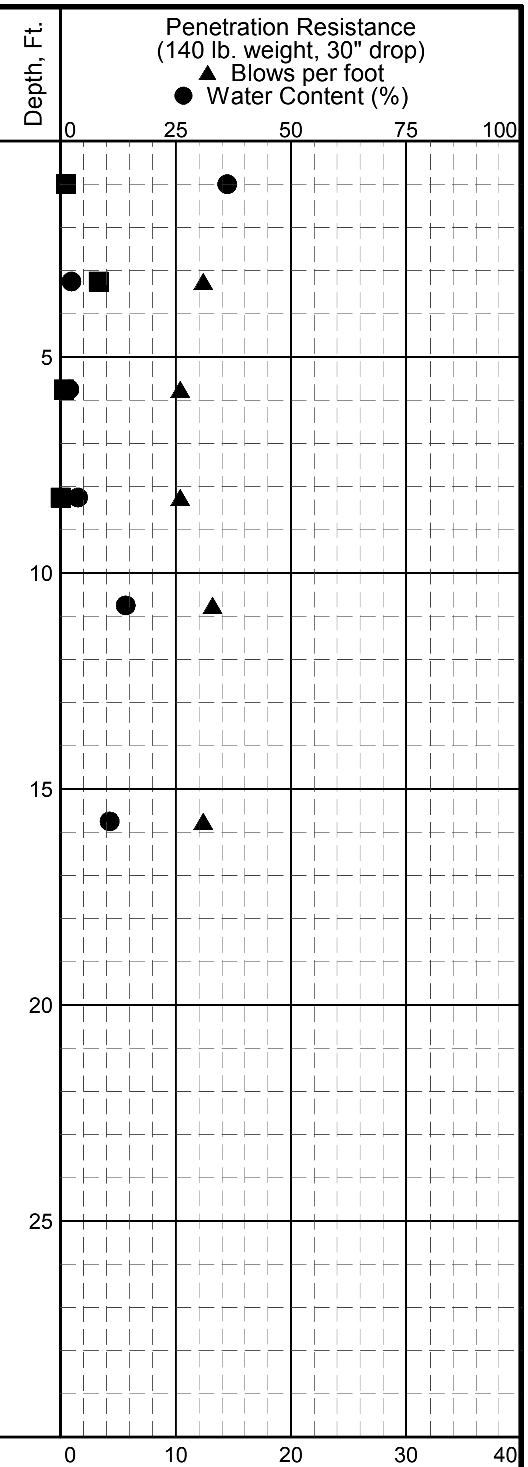
GEOTECHNICAL LOG 17731 GEOTECH BORING LOGS.GPJ S&W GEO1.GDT 6/12/15

MATERIAL DESCRIPTION Approx. Elevation: 72 Ft.	Depth, Ft.	Symbol	Samples	Ground Water
Medium dense, dark brown, *Silty Sand (SM)*; moist; some fine organics [Topsoil]			S1	Groundwater not encountered during drilling on 5/19/2015
Medium dense to dense, brown, *Poorly Graded Sand with Silt and Gravel (SP-SM)*; moist S2: 44% Gravel, 50% Sand, 6% Fines (F2)	2.5		S2, S3	
Medium dense, gray, *Sand with Silt (SP-SM)*; moist	7.5		S4	
Dense, gray, *Silty Sand (SM)*; moist;	9.5		S5, S6	
Bottom of Boring Boring Completed 5/19/2015	16.5			



■ PID Reading (ppm)
Plastic Limit ⊢—●—⊣ Liquid Limit
Natural Water Content

LEGEND

- * Sample Not Recovered
- Grab Sample
- 2" O.D. Split Spoon Sample
- 3" O.D. Split Spoon Sample

NOTES

1. The stratification lines represent the approximate boundaries between soil types, and the transition may be gradual.
2. The discussion in the text of this report is necessary for a proper understanding of the nature of subsurface materials.
3. Water level, if indicated above, is for the date specified and may vary.

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LOG OF BORING GB-3

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FIG. 7

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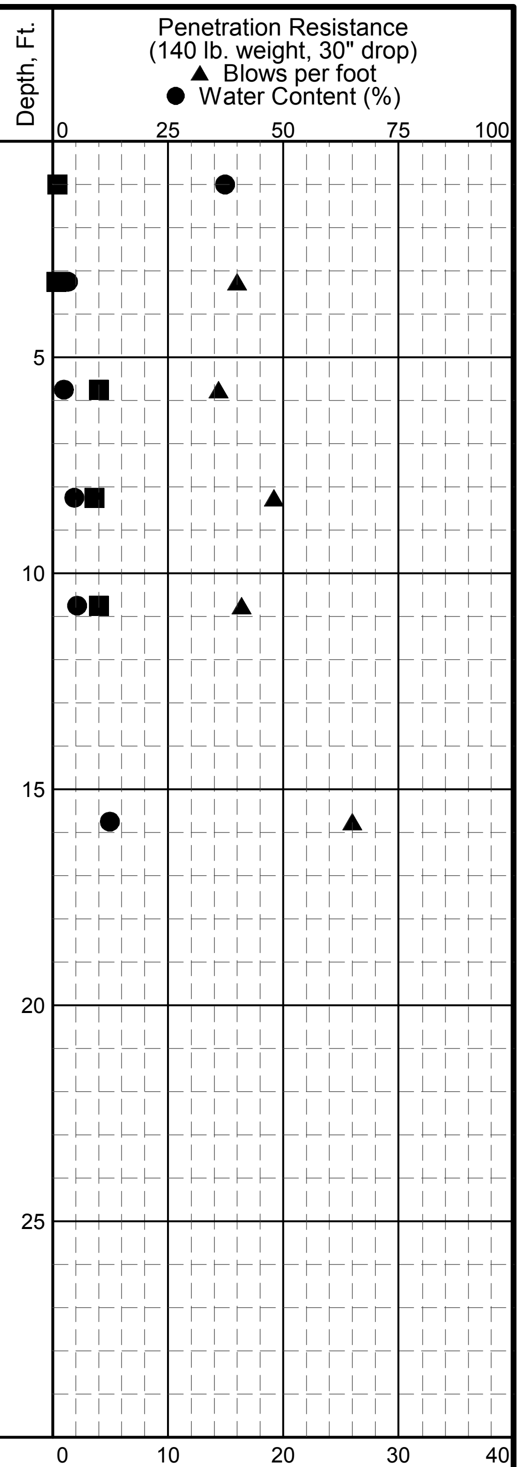
GEOTECHNICAL LOG 17731 GEOTECH BORING LOGS.GPJ S&W GEO1.GDT 6/12/15

MATERIAL DESCRIPTION Approx. Elevation: 70 Ft.	Depth, Ft.	Symbol	Samples	Ground Water
Medium dense, dark brown, *Silty Sand (SM)*; moist; some fine organics [Topsoil] S1: 38.6% Fines (F3)			S1	Groundwater not encountered during drilling on 5/19/2015
Dense, brown, *Poorly Graded Sand with Silt and Gravel (SP-SM)*; moist	2.5		S2	
Dense, brown, *Poorly Graded Gravel with Silt and Sand (GP-GM)*; moist	4.5		S3	
Dense, gray, *Well-Graded Sand with Silt (SP-SM)*; moist S4: 1% Gravel, 88% Sand, 11% Fines (F2)	7.5		S4, S5	
Very dense, brown, *Silty Sand (SM)*; moist; trace gravel	13.5		S6	
Bottom of Boring Boring Completed 5/19/2015	16.5			



■ PID Reading (ppm)

Plastic Limit |—●—| Liquid Limit
Natural Water Content

LEGEND

- * Sample Not Recovered
- Grab Sample
- 2" O.D. Split Spoon Sample
- 3" O.D. Split Spoon Sample

NOTES

1. The stratification lines represent the approximate boundaries between soil types, and the transition may be gradual.
2. The discussion in the text of this report is necessary for a proper understanding of the nature of subsurface materials.
3. Water level, if indicated above, is for the date specified and may vary.

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LOG OF BORING GB-4

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FIG. 8

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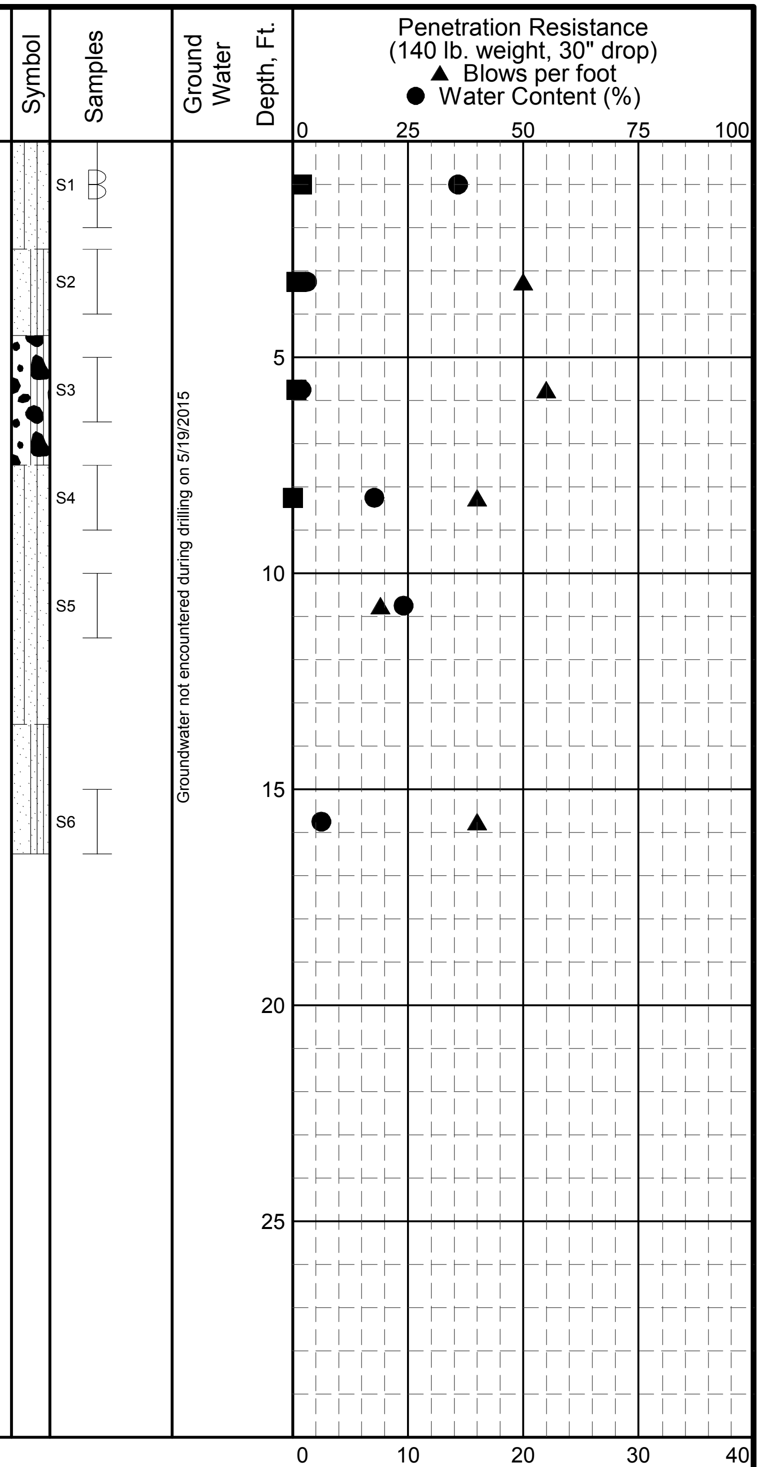
MATERIAL DESCRIPTION	Depth, Ft.
Approx. Elevation: 72 Ft.	
Medium dense, dark brown, *Silty Sand (SM)*; moist; little fine organics	
Dense, brown, *Poorly Graded Sand with Silt and Gravel (SP-SM)*; moist S2: 9.5% Fines (F2)	2.5
Very dense, brown, *Well Graded Gravel with Silt and Sand (GW-GM)*; moist S3: 53% Gravel, 39% Sand, 8% Fines (F1)	4.5
Medium dense to dense, brown, *Silty Sand (SM)*; moist Pockets of black and red sand at approximately 8.5 to 9 feet bgs and 11 feet bgs	7.5
Dense, brown, *Poorly Graded Sand with Silt (SP-SM)*; moist	13.5
Bottom of Boring Boring Completed 5/19/2015	16.5



■ PID Reading (ppm)

Plastic Limit ├──●──┤ Liquid Limit

Natural Water Content

LEGEND

- * Sample Not Recovered
- Grab Sample
- 2" O.D. Split Spoon Sample
- 3" O.D. Split Spoon Sample

NOTES

1. The stratification lines represent the approximate boundaries between soil types, and the transition may be gradual.
2. The discussion in the text of this report is necessary for a proper understanding of the nature of subsurface materials.
3. Water level, if indicated above, is for the date specified and may vary.

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LOG OF BORING GB-5

June 2015 32-1-17731

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FIG. 9

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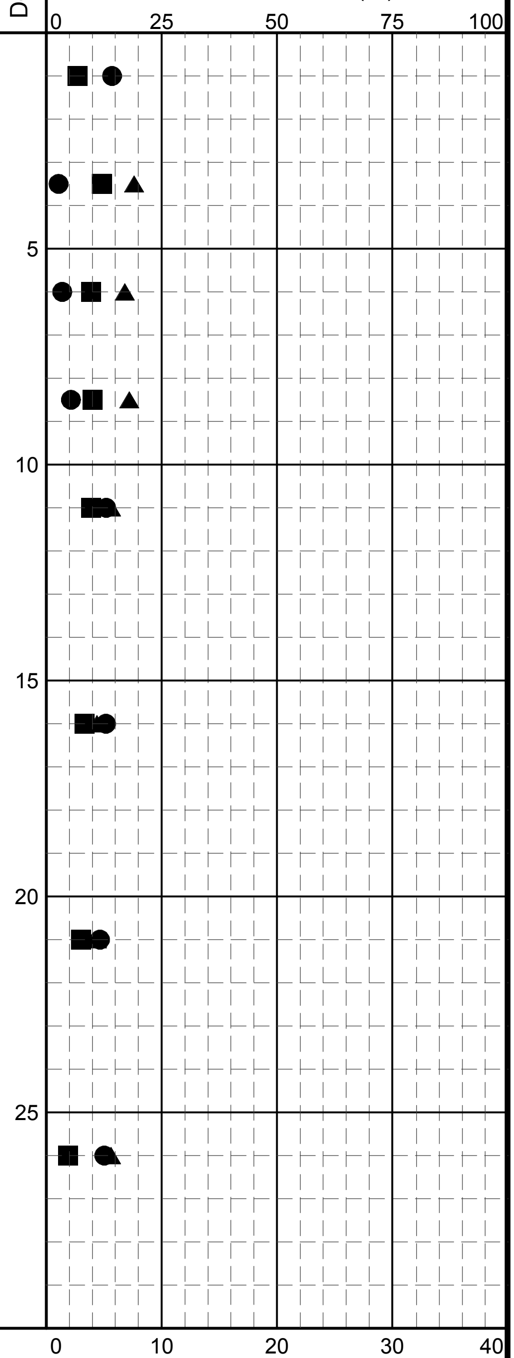
GEOTECHNICAL LOG 17731 GEOTECH BORING LOGS.GPJ S&W GEO1.GDT 6/12/15

MATERIAL DESCRIPTION Approx. Elevation: 72 Ft.	Depth, Ft.	Symbol	Samples	Ground Water
Medium dense, brown, *Silty Sand with Gravel (SM)*; moist			S1	
Medium dense, brown, *Poorly Graded Sand with Gravel (SP)*; moist	2.5		S2	
S3: 2% Fines (NFS)			S3	Groundwater not encountered during drilling on 5/19/2015
Medium dense, gray, *Poorly Graded Sand with Silt (SP-SM)*; moist	7.5		S4	
Medium dense, brown, *Silty Sand (SM)*; moist	9.5		S5	
Medium dense, brown, *Sandy Silt (ML)*; moist S6: 6% Gravel, 44% Sand, 50% Fines (F4)	13.5		S6 S7 S8	
Bottom of Boring Boring Completed 5/19/2015	27.0			

Penetration Resistance
(340 lb. weight, 30" drop)
▲ Blows per foot
● Water Content (%)



■ PID Reading (ppm)
Plastic Limit |—●—| Liquid Limit
Natural Water Content

LEGEND

- * Sample Not Recovered
- Grab Sample
- 2" O.D. Split Spoon Sample
- 3" O.D. Split Spoon Sample

NOTES

1. The stratification lines represent the approximate boundaries between soil types, and the transition may be gradual.
2. The discussion in the text of this report is necessary for a proper understanding of the nature of subsurface materials.
3. Water level, if indicated above, is for the date specified and may vary.

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LOG OF BORING GB-6

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FIG. 10

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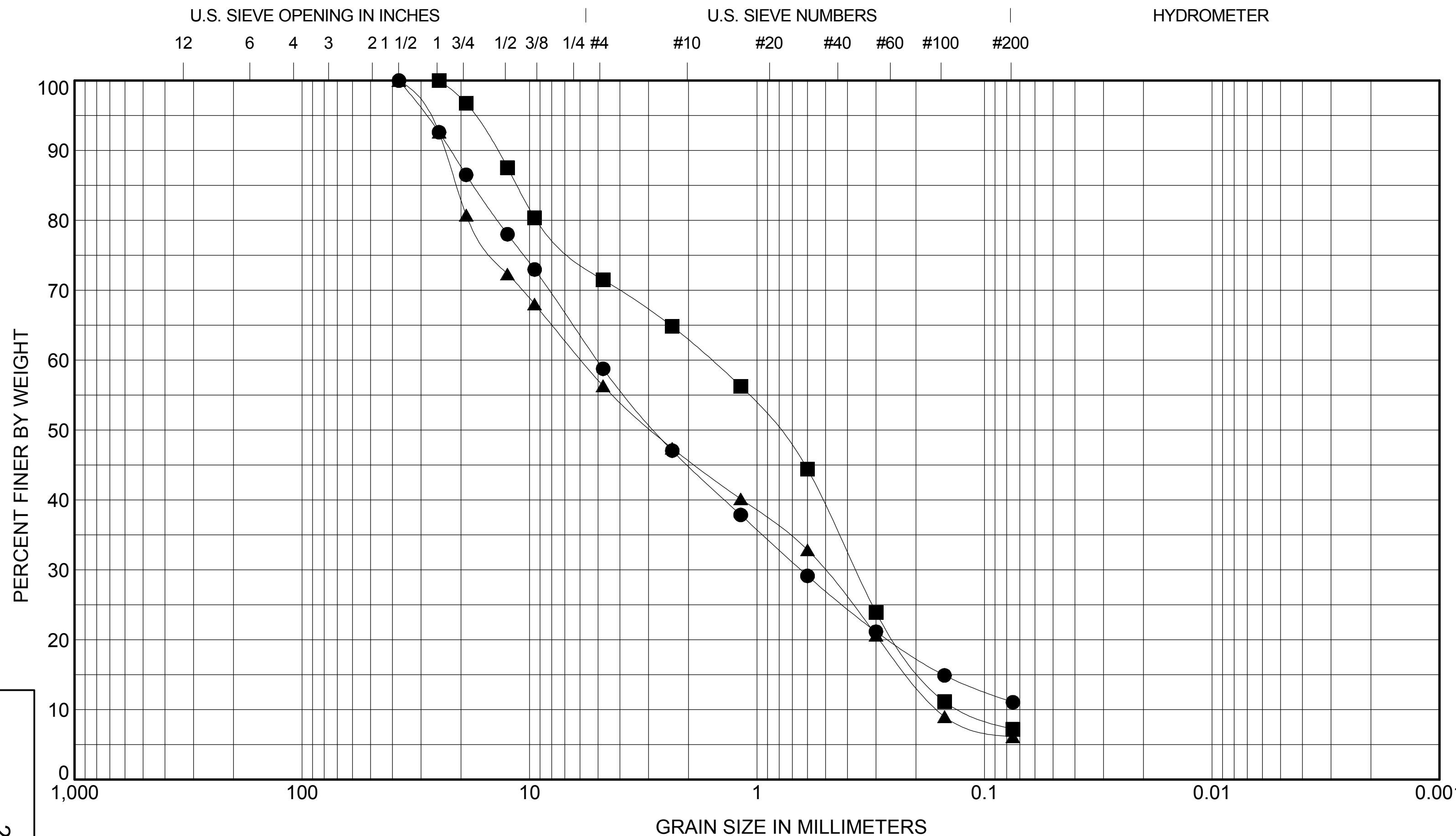
GEOTECHNICAL LOG 17731 GEOTECH BORING LOGS.GPJ S&W GEO1.GDT 6/12/15



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Sample	Depth, Ft	Classification	LL	PL	PI	Cc	Cu
●	**GB-1 S3**	**5.0 - 6.5**	**Well-Graded Sand with Silt and Gravel (SW-SM)**				**1.3**	**81.2**
■	**GB-2 S2**	**2.5 - 4.0**	**Poorly Graded Sand with Silt and Gravel (SP-SM)**				**0.7**	**13.0**
▲	**GB-3 S2**	**2.5 - 4.0**	**Poorly Graded Sand with Silt and Gravel (SP-SM)**				**0.3**	**37.1**

	Sample	Depth, Ft	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**GB-1 S3**	**5.0 - 6.5**	**37.5**	**5.04**	**0.64**		**41**	**48**	**11**	
■	**GB-2 S2**	**2.5 - 4.0**	**25**	**1.6**	**0.37**	**0.12**	**29**	**64**	**7**	
▲	**GB-3 S2**	**2.5 - 4.0**	**37.5**	**5.91**	**0.51**	**0.16**	**44**	**50**	**6**	

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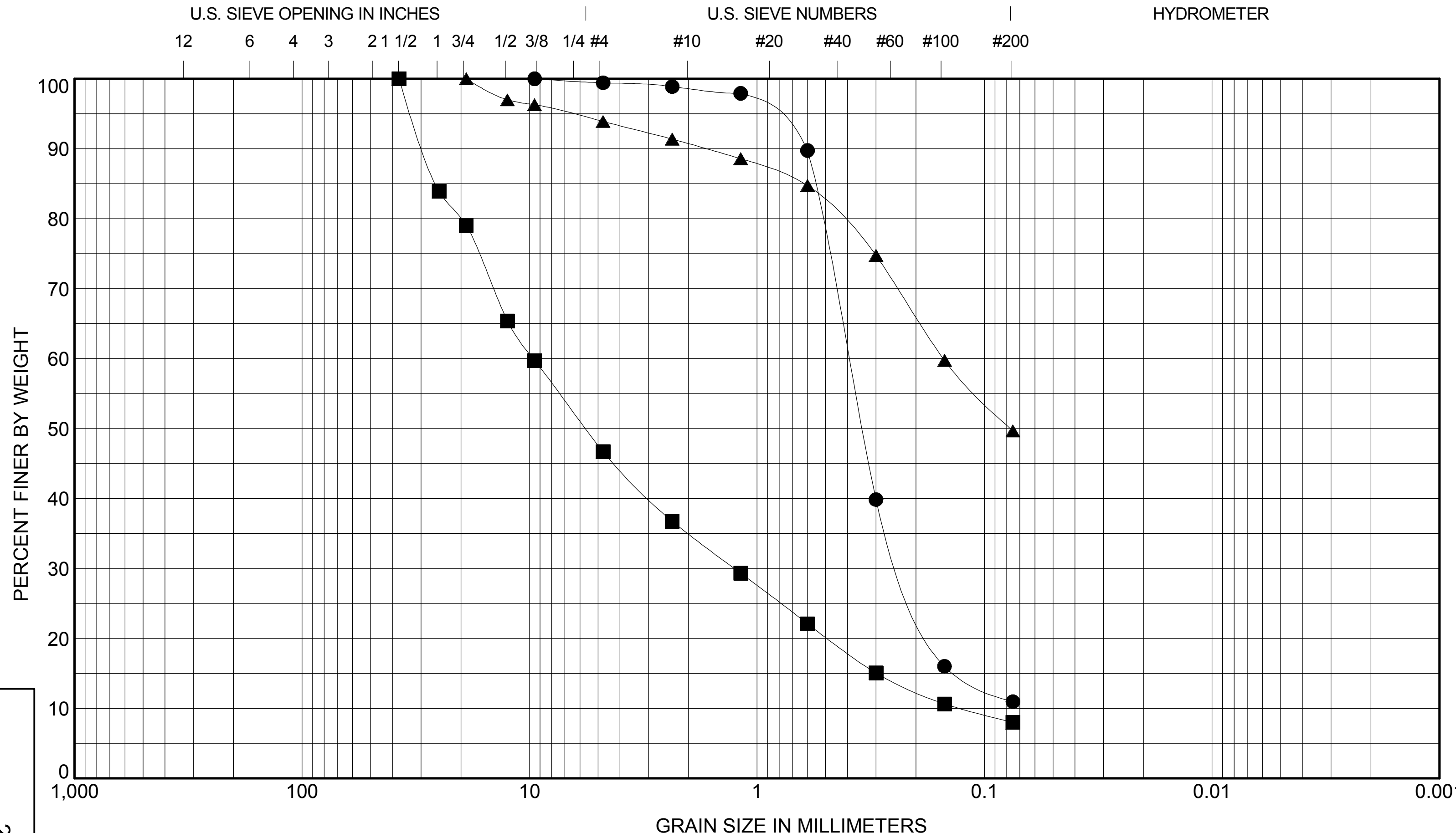
June 2015

GRAIN SIZE CLASSIFICATION

26035 Williamson Lane
Kasilof, Alaska

32-1-17731

FIG. 11
Sheet 1 of 2



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Sample		Depth, Ft	Classification	LL	PL	PI	Cc	Cu
●	**GB-4 S4**	**7.5 - 9.0**	**Well-Graded Sand with Silt (SW-SM)**				**1.9**	**6.0**
■	**GB-5 S3**	**5.0 - 6.5**	**Well-Graded Gravel with Silt and Sand (GW-GM)**				**1.3**	**76.0**
▲	**GB-6 S6**	**15.0 - 16.5**	**Sandy Silt (ML)**					

Sample		Depth, Ft	D100	D60	D30	D10	%Gravel	%Sand	%Silt / %Clay
●	**GB-4 S4**	**7.5 - 9.0**	**9.5**	**0.4**	**0.23**		**1**	**88**	**11**
■	**GB-5 S3**	**5.0 - 6.5**	**37.5**	**9.63**	**1.26**	**0.13**	**53**	**39**	**8**
▲	**GB-6 S6**	**15.0 - 16.5**	**19**	**0.15**			**6**	**44**	**50**

26035 Williamson Lane
Kasilof, Alaska

GRAIN SIZE CLASSIFICATION

June 2015

32-1-17731

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FIG. 11
Sheet 2 of 2

GRADATION AND DURABILITY REQUIREMENTS

After: Alaska Department of Transportation
Standard Specifications for Highway Construction, 2015

D-1

U.S. STANDARD SIEVE SIZE English	Metric	PERCENT PASSING BY WEIGHT
1 in.	25 mm	100
3/4 in.	19 mm	70 - 100
3/8 in.	9.5 mm	50 - 80
No. 4	4.75 mm	35 - 65
No. 8	2.36 mm	20 - 50
No. 50	0.300 mm	8 - 30
No. 200	0.075 mm	0 - 6

Selected Material Type A

U.S. STANDARD SIEVE SIZE English	Metric	PERCENT PASSING BY WEIGHT
No. 4	4.75 mm	20 - 55
No. 200	0.075 mm	6 Max. on minus 3-in. portion

Aggregate containing no muck, frozen material, roots, sod or other deleterious matter and with a plasticity index not greater than 6 as tested by WAQTC FOP for AASHTO T 89/T 90. Meet the gradation as tested by WAQTC FOP for AASHTO T 27/T 11.

Selected Material Type B

U.S. STANDARD SIEVE SIZE English	Metric	PERCENT PASSING BY WEIGHT
No. 200	0.075 mm	10 Max. on minus 3-in. portion

Aggregate containing no muck, frozen material, roots, sod or other deleterious matter and with a plasticity index not greater than 6 as tested by WAQTC FOP for AASHTO T 89/T 90. Meet the gradation as tested by WAQTC FOP for AASHTO T 27/T 11.

Coarse Aggregate Durability

Retained on #4 Sieve

Test Type	Percent Loss
L.A. Abrasion	45 - 50 max. *
Sulfate Soundness	9 max.

* Asphalt and Surface Course = 45% max
Base Course = 50% max

26035 Williamson Lane
Kasilof, Alaska

GRADATION REQUIREMENTS

June 2015 32-1-17731

SHANNON & WILSON, INC.
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FIG. 12

APPENDIX A

IMPORTANT INFORMATION ABOUT YOUR GEOTECHNICAL/ENVIRONMENTAL REPORT

Attachment to 32-1-17731

Date: June 2015
To: ADOT&PF
Re: 26035 Williamson Lane, Kasilof, Alaska

Important Information About Your Geotechnical/Environmental Report

CONSULTING SERVICES ARE PERFORMED FOR SPECIFIC PURPOSES AND FOR SPECIFIC CLIENTS.

Consultants prepare reports to meet the specific needs of specific individuals. A report prepared for a civil engineer may not be adequate for a construction contractor or even another civil engineer. Unless indicated otherwise, your consultant prepared your report expressly for you and expressly for the purposes you indicated. No one other than you should apply this report for its intended purpose without first conferring with the consultant. No party should apply this report for any purpose other than that originally contemplated without first conferring with the consultant.

THE CONSULTANT'S REPORT IS BASED ON PROJECT-SPECIFIC FACTORS.

A geotechnical/environmental report is based on a subsurface exploration plan designed to consider a unique set of project-specific factors. Depending on the project, these may include: the general nature of the structure and property involved; its size and configuration; its historical use and practice; the location of the structure on the site and its orientation; other improvements such as access roads, parking lots, and underground utilities; and the additional risk created by scope-of-service limitations imposed by the client. To help avoid costly problems, ask the consultant to evaluate how any factors that change subsequent to the date of the report may affect the recommendations. Unless your consultant indicates otherwise, your report should not be used: (1) when the nature of the proposed project is changed (for example, if an office building will be erected instead of a parking garage, or if a refrigerated warehouse will be built instead of an unrefrigerated one, or chemicals are discovered on or near the site); (2) when the size, elevation, or configuration of the proposed project is altered; (3) when the location or orientation of the proposed project is modified; (4) when there is a change of ownership; or (5) for application to an adjacent site. Consultants cannot accept responsibility for problems that may occur if they are not consulted after factors, which were considered in the development of the report, have changed.

SUBSURFACE CONDITIONS CAN CHANGE.

Subsurface conditions may be affected as a result of natural processes or human activity. Because a geotechnical/environmental report is based on conditions that existed at the time of subsurface exploration, construction decisions should not be based on a report whose adequacy may have been affected by time. Ask the consultant to advise if additional tests are desirable before construction starts; for example, groundwater conditions commonly vary seasonally.

Construction operations at or adjacent to the site and natural events such as floods, earthquakes, or groundwater fluctuations may also affect subsurface conditions and, thus, the continuing adequacy of a geotechnical/environmental report. The consultant should be kept apprised of any such events, and should be consulted to determine if additional tests are necessary.

MOST RECOMMENDATIONS ARE PROFESSIONAL JUDGMENTS.

Site exploration and testing identifies actual surface and subsurface conditions only at those points where samples are taken. The data were extrapolated by your consultant, who then applied judgment to render an opinion about overall subsurface conditions. The actual interface between materials may be far more gradual or abrupt than your report indicates. Actual conditions in areas not sampled may differ from those predicted in your report. While nothing can be done to prevent such situations, you and your consultant can work together to help reduce their impacts. Retaining your consultant to observe subsurface construction operations can be particularly beneficial in this respect.

A REPORT'S CONCLUSIONS ARE PRELIMINARY.

The conclusions contained in your consultant's report are preliminary because they must be based on the assumption that conditions revealed through selective exploratory sampling are indicative of actual conditions throughout a site. Actual subsurface conditions can be discerned only during earthwork; therefore, you should retain your consultant to observe actual conditions and to provide conclusions. Only the consultant who prepared the report is fully familiar with the background information needed to determine whether or not the report's recommendations based on those conclusions are valid and whether or not the contractor is abiding by applicable recommendations. The consultant who developed your report cannot assume responsibility or liability for the adequacy of the report's recommendations if another party is retained to observe construction.

THE CONSULTANT'S REPORT IS SUBJECT TO MISINTERPRETATION.

Costly problems can occur when other design professionals develop their plans based on misinterpretation of a geotechnical/environmental report. To help avoid these problems, the consultant should be retained to work with other project design professionals to explain relevant geotechnical, geological, hydrogeological, and environmental findings, and to review the adequacy of their plans and specifications relative to these issues.

BORING LOGS AND/OR MONITORING WELL DATA SHOULD NOT BE SEPARATED FROM THE REPORT.

Final boring logs developed by the consultant are based upon interpretation of field logs (assembled by site personnel), field test results, and laboratory and/or office evaluation of field samples and data. Only final boring logs and data are customarily included in geotechnical/environmental reports. These final logs should not, under any circumstances, be redrawn for inclusion in architectural or other design drawings, because drafters may commit errors or omissions in the transfer process.

To reduce the likelihood of boring log or monitoring well misinterpretation, contractors should be given ready access to the complete geotechnical engineering/environmental report prepared or authorized for their use. If access is provided only to the report prepared for you, you should advise contractors of the report's limitations, assuming that a contractor was not one of the specific persons for whom the report was prepared, and that developing construction cost estimates was not one of the specific purposes for which it was prepared. While a contractor may gain important knowledge from a report prepared for another party, the contractor should discuss the report with your consultant and perform the additional or alternative work believed necessary to obtain the data specifically appropriate for construction cost estimating purposes. Some clients hold the mistaken impression that simply disclaiming responsibility for the accuracy of subsurface information always insulates them from attendant liability. Providing the best available information to contractors helps prevent costly construction problems and the adversarial attitudes that aggravate them to a disproportionate scale.

READ RESPONSIBILITY CLAUSES CLOSELY.

Because geotechnical/environmental engineering is based extensively on judgment and opinion, it is far less exact than other design disciplines. This situation has resulted in wholly unwarranted claims being lodged against consultants. To help prevent this problem, consultants have developed a number of clauses for use in their contracts, reports and other documents. These responsibility clauses are not exculpatory clauses designed to transfer the consultant's liabilities to other parties; rather, they are definitive clauses that identify where the consultant's responsibilities begin and end. Their use helps all parties involved recognize their individual responsibilities and take appropriate action. Some of these definitive clauses are likely to appear in your report, and you are encouraged to read them closely. Your consultant will be pleased to give full and frank answers to your questions.

The preceding paragraphs are based on information provided by the
ASFE/Association of Engineering Firms Practicing in the Geosciences, Silver Spring, Maryland