Geotechnical Data Report
Wastewater Treatment Plant Improvements
Additional Wells
Wasilla, Alaska

June 2018

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32-1-02452-003

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1.0 INTRODUCTION

This report presents the results of subsurface explorations and laboratory testing by Shannon & Wilson, Inc. for the proposed improvements to the existing Wastewater Treatment Plant in Wasilla, Alaska. The purpose of this geotechnical study was to supplement existing subsurface data in the pilot study area adjacent to the existing wastewater treatment plant (WWTP) in Wasilla, Alaska. To accomplish this, a total of eight borings were drilled and completed with monitoring wells. Soil samples recovered from the borings were tested in our geotechnical laboratory. Presented in this report are descriptions of the site and project, subsurface exploration and laboratory test procedures, and an interpretation of subsurface conditions. Shannon & Wilson has provided support during prior phases of this project which were submitted in our May 2008 *Geotechnical Report, Wastewater Treatment Plant Percolation Cell, Wasilla, Alaska*, June 2016 *Revised Geotechnical Data Report*, and October 2016 *Revised Geotechnical Engineering and Hyrdogeologic Assessment*. We have included the June 2016 data report in this deliverable for ease of review.

Authorization to proceed with this work was received in the form of a Subconsultant Agreement, signed by Mr. Dean Syta, P.E. of Stantec on February 9, 2018. Our work was conducted in general accordance with our January 4, 2018 proposal.

2.0 SITE AND PROJECT DESCRIPTION

The existing Wastewater Treatment Plant is located on Jude Drive in Wasilla, Alaska. The existing facility consists of several buildings, a four-cell aerated lagoon system, and nine percolation beds. The proposed improvements include an overland percolation and wetland/bioswale-type treatment area in a 70 acre parcel to the west of the existing facility.

Generally, the developed portion of the facility slopes down to the west and south with an approximately 90-foot tall bluff on the west side of the wetlands. The existing buildings and facilities are at an approximate elevation of 250 feet and directly west of the facility lies the

existing sewage lagoons which are at an approximate elevation of 245 feet. The elevation drops to the west to approximately 208 feet in the wetland treatment area, which also slopes down to the south toward a stream and the proposed new point of compliance. The tall bluff is west of the wetland area and rises steeply up with an elevation increase of approximately 90 feet. A residential neighborhood is located atop the bluff and to the west of the project area. At the time of explorations, the project area was thick with vegetation including mature trees and brush (with the exception of the existing developed wastewater facility buildings and lagoons). The low lying proposed wetland treatment area was frozen with snow accumulation of six inches to one foot.

We understand that these additional monitoring wells will support subsurface water sampling to be conducted by Stantec. In addition to the explorations conducted for this field effort, which are included in Appendix A, the results of our previous work are presented in our report entitled *Revised Geotechnical Data* Report dated June 2016, provided in Appendix B.

3.0 SUBSURFACE EXPLORATIONS

Subsurface explorations for this additional monitoring well installation effort consisted of drilling and sampling eight soil borings, designated Borings MW-2B, MW-10, MW-12, MW-13, MW-15 through MW-17, and MW-20 (boring designations provided by Stantec). Borings MW-2B and MW-13, are replacing borings advanced in 2015 due to damage to the piezometers. They were drilled adjacent to the original borings (Borings B-2 and B-13). The remaining borings were at new locations, with three in the lowlying wetland area, two in the upland area to the north, and one on the bluff along the western edge of the project area. The borings were advanced and the monitoring wells were installed in March of 2018. The approximate locations of the additional monitoring wells (as well as the 2015 borings) are identified on Figure 2. Summary logs of the borings are provided in Appendix A.

The eight borings were advanced to depths ranging between 21.5 and 126.3 feet bgs. The boring locations were recorded using a handheld global positioning system (GPS) with an accuracy of ± 20 feet. Elevations were estimated from topographic contours provided by the Matanuska Susitna Borough (MSB) interactive map website. The locations shown on Figure 2 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 and water samples, log subsurface conditions, observe installation of monitoring wells, and observe groundwater levels.

Drilling services for this project were provided by Denali Drilling, of Anchorage, Alaska, using a track-mounted CME-850 drill rig. The borings were advanced with $4^1/_4$-inch inner diameter (ID) hollow stem auger, with the exception of Boring MW-20 which was advanced with an ODEX air hammer. Soil samples were generally collected at 2.5-foot intervals to 10 feet bgs and at 5-foot intervals thereafter using the Modified Penetration Test (MPT) method, with the exception of Boring MW-20 which had a 10-foot sample interval to 80 feet bgs and a 5-foot sample interval to the bottom of the boring. In the MPT method, samples are recovered by driving a 3-inch outer diameter (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 rods. For each sample, the number of blows required to drive the sampler the final 12 inches of an 18-inch penetration into undisturbed soil is recorded. When the sampler did not penetrate the full 18 inches, we reported the total blow count and corresponding penetration in inches on the boring logs. Blow counts are shown graphically on the boring log figures 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.

Samples recovered during drilling were visually classified according to the classification system presented in Appendix A, Figure A-1. The field soil classifications were verified through laboratory analysis for selected samples. Frost classifications included on the logs in Appendix A were based on sieve/P-200 data. The frost classification system is presented in Appendix A, Figure A-2. Summary logs of the borings are presented in Appendix A, Figures A-3 through A-10.

Borings were completed with monitoring wells, which were constructed from 2-inch diameter schedule 40, polyvinyl chloride (PVC) pipe with threaded connections and 10 feet of 0.010 slotted Schedule 40 PVC well screen. Silica sand was used to backfill around the well screen and hydrated bentonite chips were used to backfill above the sand. Gravel or drill cuttings were used to backfill from the sand to the ground surface. The PVC was allowed to stick up above ground level. The approximate boring locations (completed with monitoring wells) are shown on the site plan in Figure 2.

4.0 LABORATORY TESTING

Laboratory tests were performed on selected samples recovered from the borings to confirm field classifications and to estimate the index properties of the typical materials encountered in the borings. The laboratory testing was formulated with emphasis on estimating the material gradation and in-situ water content.

Water content tests were performed in general accordance with ASTM International (ASTM) D2216. The results of the water content measurements are presented graphically on the boring logs in Appendix A.

Grain size classification (gradation) testing was performed to estimate the particle size distribution of selected samples from the borings. The gradation testing generally followed the procedures described in ASTM C136/117 and D422. The test results are presented in Appendix A as Figure A-11 (4 sheets), and summarized on the boring logs as percent gravel, percent sand, and percent fines. Percent fines on the boring logs are equal to the sum of the silt and clay fractions indicated by the percent passing the No. 200 sieve.

In addition, we conducted tests on selected samples to estimate the amount of material passing the No. 200 sieve (P-200). The P-200 test provides an estimate of the fines (silt and clay) content. These tests were performed in general accordance with ASTM C117. The results of these tests are indicated as percent fines on the boring logs.

5.0 SUBSURFACE CONDITIONS

The subsurface conditions encountered at the site are depicted in detail on the boring logs in Appendix A. In general, subsurface conditions encountered during this effort of explorations are in agreement with the previous work by Shannon & Wilson in 2016. Generalized soil profiles are included as Figures 3 and 4.

Borings MW-2B, MW-12, MW-16, and MW-17 were advanced within the lowlying wetland area and generally encountered decomposed and fibrous organic material overlying granular material interbedded with occasional silt layers. The uppermost layer encountered was approximately 14 to 28 feet of very soft to soft brown decomposed organic soil. Blow counts were typically less than 5 blows per foot (bpf) while sampling within this layer and sample

recovery was difficult. Boring MW-2B encountered an approximately 6 foot thick ash layer from approximately 18 to 23.8 feet bgs. The ash was very loose with a moisture content of 278 percent.

Borings MW-10 and MW-15 were advanced in the upland area north of the lowlying wetland area. Boring MW-10 encountered 5 feet of organic soil at the surface overlying interbedded silt and silty sand. Boring MW-15 encountered silty sands and silty gravels. Occasional organics were observed in Boring MW-10 from approximately 13 to 15.7 feet bgs and in the upper 10 feet of Boring MW-15.

Boring MW-20 was advanced in the bluff area west of the wetland and encountered granular material with varying amounts of silt along with a dense to very dense silt layer from approximately 45 to 83 feet bgs.

All eight borings encountered 6 inches to 2 feet of frozen soil below the ground surface. Blow counts in the fine grained layers ranged from 0 to 25 bpf, with the average at approximately 8 bpf. Moisture content in the silt material ranged from 7 to 34 percent, with the average at approximately 18 percent moisture. Granular material found within our borings consisted of sand and gravel with varying amounts of silt. Granular material was generally medium dense to very dense with the exception of loose zones found between approximately 5.5 and 9.5 feet bgs and 23 and 26.5 feet bgs in Boring MW-10, between approximately 24 and 26 feet bgs in Boring MW-12, and between approximately 0 and 10 feet bgs and 18 and 21.5 feet bgs in Boring MW-15. Blow counts within the granular material ranged from 2 bpf to more than 85 bpf with the average at approximately 44 bpf, and moisture content ranged from 3 to 36 percent with the average at approximately 12 percent. Fines content within the granular soils ranged from 5 to 45 percent with the average at approximately 22 percent.

Groundwater was encountered during drilling between 0 (at the surface) and 0.5 feet bgs for the borings in the lowlying wetland area (Borings MW-2B, MW-12, MW-13, MW-16, and MW-17). Groundwater was encountered during drilling between 18 and 23 feet bgs for Borings MW-10 and MW-15 in the upland area north of the wetland. Boring MW-20 on the bluff west of the wetland encountered groundwater during drilling at 110 feet bgs. Borings MW-2, MW-10, and MW-15 encountered artesian flow during drilling. Boring MW-2 was abandoned due to the flow

and re-drilled as MW-2B, which completed with a monitoring well. Boring MW-10 was the only one that continued to experience flow after drilling and PVC placement was completed. Note that groundwater levels may fluctuate by several feet seasonally, or during periods of high precipitation or rapid snowmelt.

6.0 CLOSURE AND 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 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.

If, during construction, subsurface conditions different from those encountered in these are observed or appear to be present, Shannon & Wilson, Inc. should be advised at once so that these conditions can be reviewed where necessary. If there is a substantial lapse of time between the submittal of this report and the start of work at the site, or if conditions have changed due to natural causes or construction operations at or adjacent to the site, it is recommended that this report be reviewed to determine the applicability of the conclusions considering the changed conditions and time lapse.

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.

The scope of our geotechnical services did not include evaluating potential impacts to natural resources, including wetlands, endangered species, or environmentally critical areas.

Shannon & Wilson has prepared the attachments in Appendix C *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.

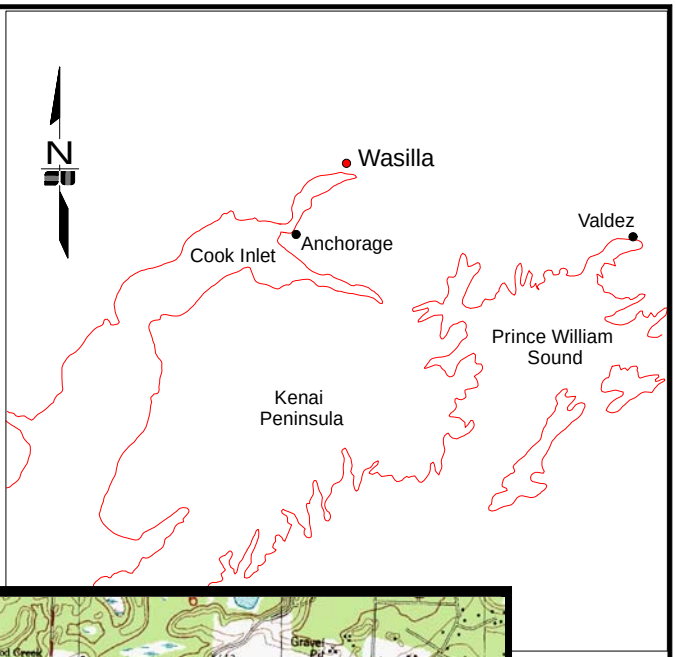
We appreciate this opportunity to be of service. Please contact the undersigned at (907) 561-2120 with questions or comments concerning the contents of this report.

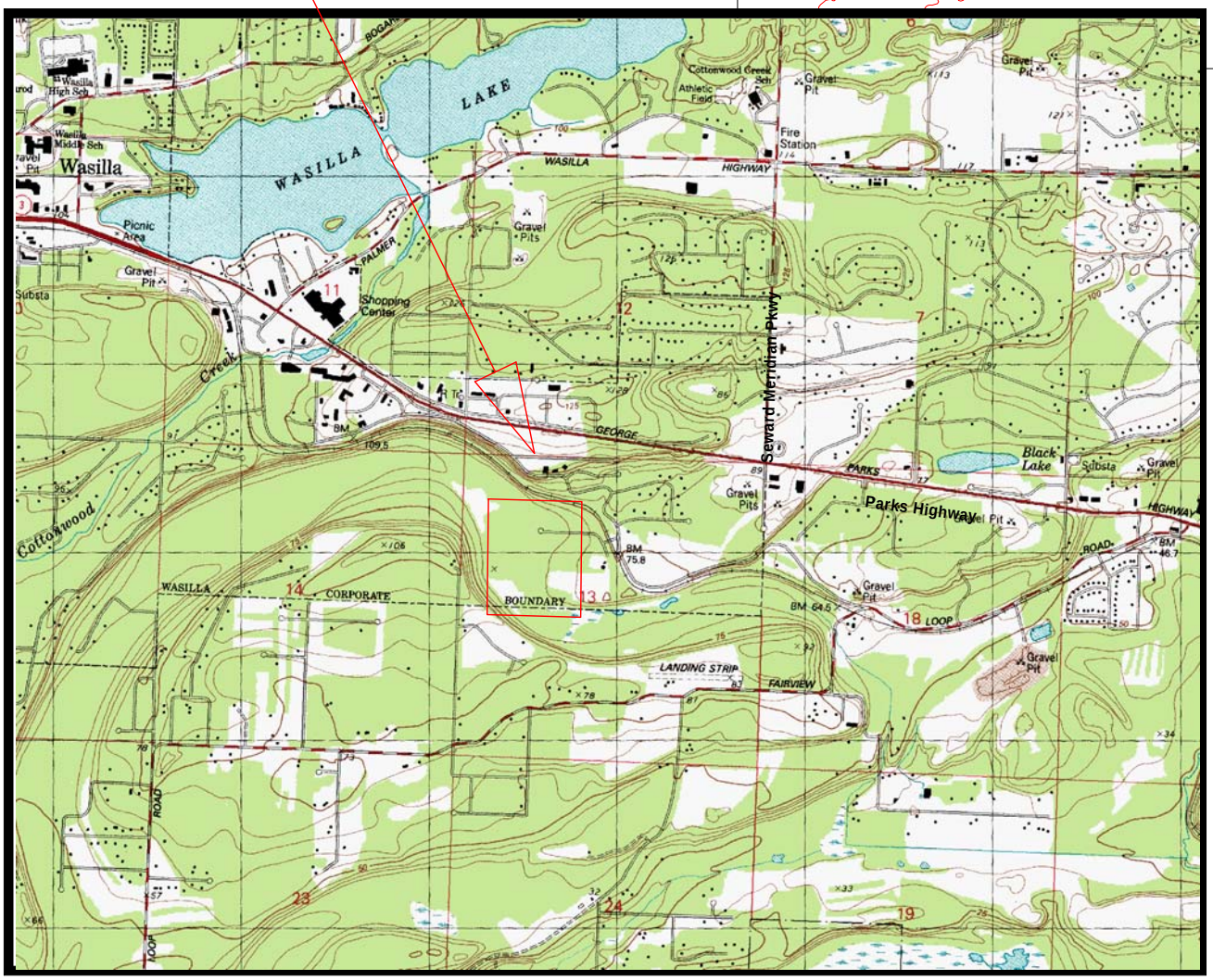
SHANNON & WILSON, INC.

for: Katra Wedeking, CPG
Senior Geologist

Kyle Brennan, P.E.
Vice President

Approximate Project Location





Taken from Anchorage C-7 SE
U.S. Geological Survey Quadrangle

0 2500 5000 10000
APPROXIMATE SCALE IN FEET

Wastewater Treatment Plant Improvements
Additional Wells
Wasilla, Alaska

VICINITY MAP

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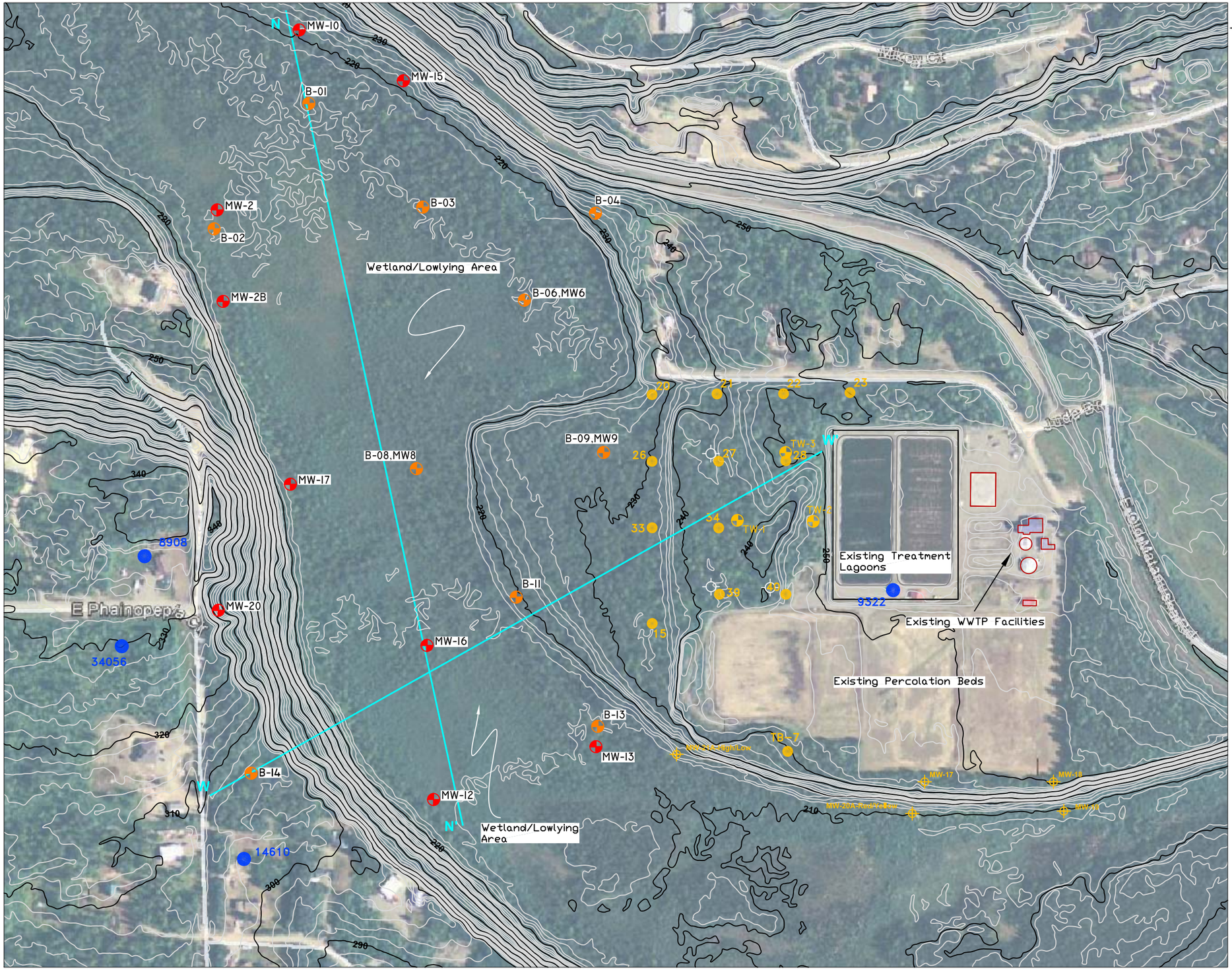
FIG. 1



LEGEND

MW-10 Approximate location of Monitoring Well MW-10 advanced by Shannon & Wilson, Inc., March 2018

B-01 Approximate location of Boring B-01 advanced by Shannon & Wilson, Inc., March/May 2015 and February 2016

TW-2 Approximate location of Boring and Monitoring Well TW-2 advanced by Shannon & Wilson, Inc., August 2007

15 Approximate location of Test Boring 15 by Gilfilian Engineering, Inc., May/October 1986

3908 Approximate location of private well 3908

Topographic Contours, 2-foot Interval

W W' Profile line W - W '. See Figures 3 and 4 for generalized soil profiles.

NOTES

1. Basemap imagery provided by Google Earth Pro, reproduced by permission granted by Google Earth™ Mapping Service.
2. Topographic contours from MatSu Borough GIS online database.

0 150 300 600

APPROXIMATE SCALE IN FEET

N

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Additional Monitoring Wells
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SITE PLAN

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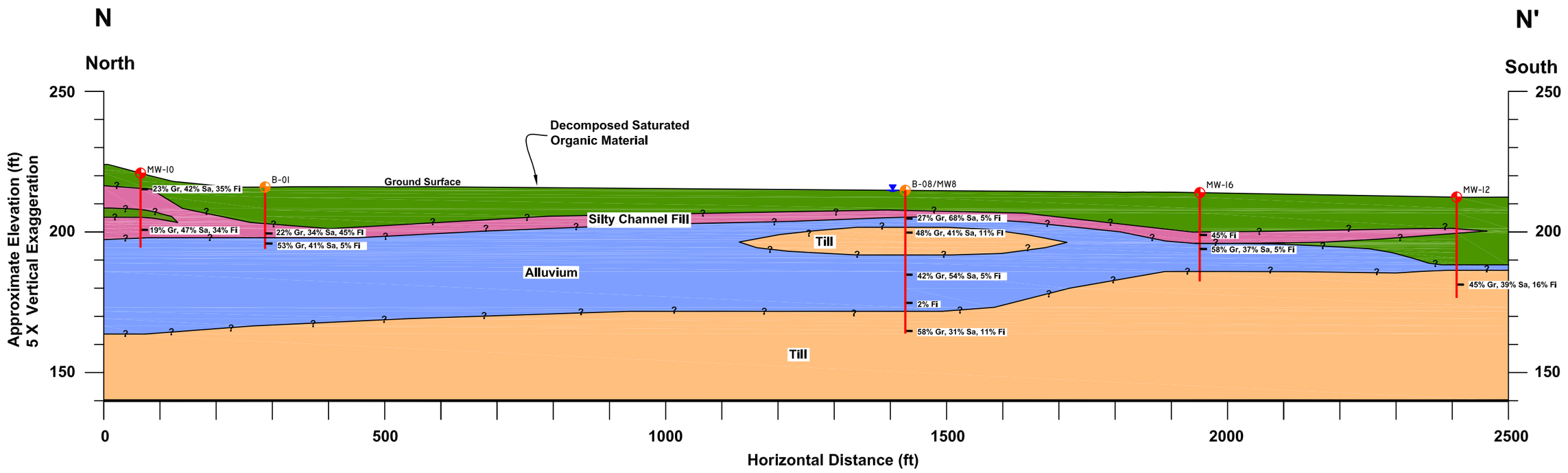
FIG. 2



LEGEND

MW-10	Approximate Location of Boring MW-10 advanced by Shannon & Wilson, March 2018.
B-01	Approximate Location of Boring B-01 advanced by Shannon & Wilson, March/May 2015 and February 2016.
— 20% Gr, 30% Sa, 50% Fi	Laboratory test results indicating 20 percent gravel, 30 percent sand, and 50 percent fines (silt and clay) by weight.
	Approximate static water level measured on June 2, 2015.

NOTES

1. Profile taken along the N - N' line as shown on the Site Plan, Figure 2.
2. Generalized layers interpreted from exploration observations and grouped based on our understanding of the site and its geologic conditions.
3. Contacts between layers on the profile are intended to be conceptual and should be considered approximate.
4. Borings shown above may not lie exactly on profile line as indicated on Figure 2. Subsurface conditions in some areas may be inferred from borings near the profile line.
5. Ground surface elevations from MatSu Borough GIS database and should be considered approximate.

Wastewater Treatment Plant Improvements
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GENERALIZED SOIL PROFILE
N - N'

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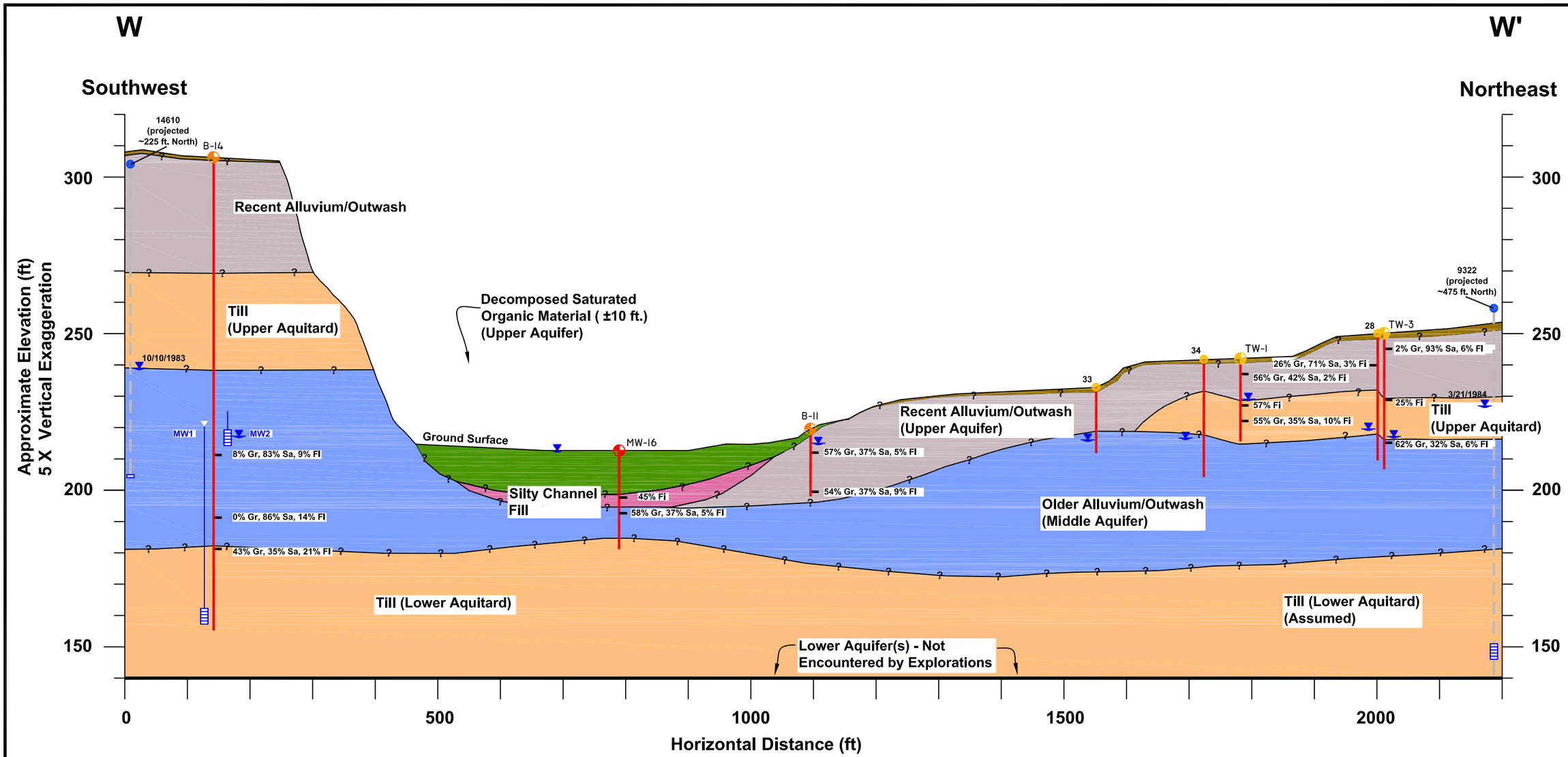
FIG. 3



LEGEND

MW-16	Approximate Location of Boring MW-16 advanced by Shannon & Wilson, March 2018.
B-11	Approximate Location of Boring B-11 advanced by Shannon & Wilson, March/May 2015 and February 2016.
TW-1	Approximate Location of Boring and Monitoring Well TW-1 advanced by Shannon & Wilson, August 2007
33	Approximate Location of Test Boring 15 by Gilfillian Engineering, Inc., May/October 1986.
14610	Approximate Location of Domestic Well 14610.
8% Gr, 83% Sa, 9% Fl	Laboratory test results indicating 8 percent gravel, 83 percent sand, and 9 percent fines (silt and clay) by weight.
	Approximate static water level measured on March 7, 2016, unless otherwise noted.

NOTES

1. Profile taken along the W - W' line as shown on the Site Plan, Figure 2.
2. Generalized layers interpreted from exploration observations and grouped based on our understanding of the site and its geologic conditions.
3. Contacts between layers on the profile are intended to be conceptual and should be considered approximate.
4. Borings shown above may not lie exactly on profile line as indicated on Figure 2. Subsurface conditions in some areas may be inferred from borings near the profile line.
5. Domestic wells included for presentation purposes only. Wells were projected various distances to the profile lines. Actual well locations, depths, and stratigraphy may differ from what is shown on this drawing.
6. Ground surface elevations from MatSu Borough GIS database and should be considered approximate.

Wastewater Treatment Plant Improvements
Additional Monitoring Wells
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GENERALIZED SOIL PROFILE
W - W'

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FIG. 4

APPENDIX A

BORING LOGS AND LABORATORY TEST RESULTS

FIGURES

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.

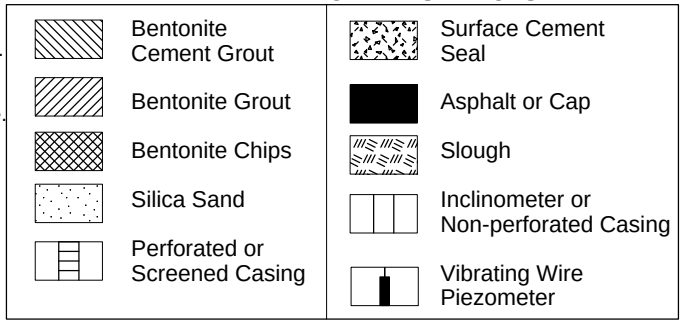
PARTICLE SIZE DEFINITIONS

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



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.

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SOIL DESCRIPTION AND LOG KEY

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FIG. A-1
Sheet 1 of 3

2013 BORING_CLASS1 GINT.GPJ SWNEW.GDT 5/2/18

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.

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SOIL DESCRIPTION AND LOG KEY

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FIG. A-1
Sheet 2 of 3

2013 BORING CLASS2 GINT.GPJ SWNEW.GDT 5/2/18

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.

Wastewater Treatment Plant Improvements
Additional Wells
Wasilla, Alaska

SOIL DESCRIPTION AND LOG KEY

June 2018 32-1-02452-003

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FIG. A-1
Sheet 3 of 3

2013 BORING_CLASS3 GINT.GPJ SWNEW.GDT 5/2/18

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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	Over 15	Over 19	ML, MH
	Very fine silty sands**			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

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

*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

Wastewater Treatment Plant Improvements
Additional Wells
Wasilla, Alaska

FROST CLASSIFICATION LEGEND

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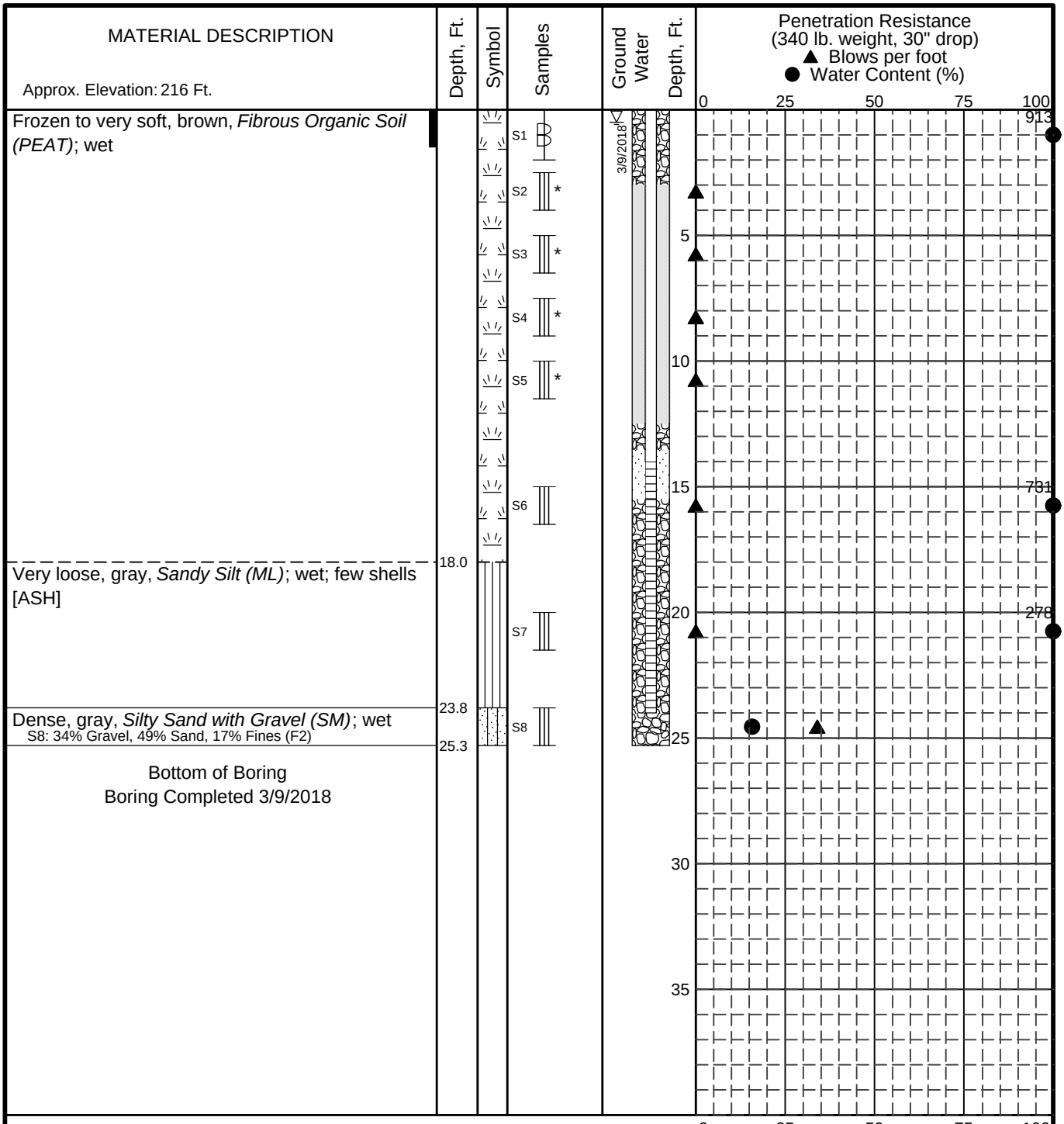
FIG. A-2



LEGEND

- * Sample Not Recovered
- Grab Sample
- 3" O.D. Split Spoon Sample
- Frozen
- Ground Water Level At Time Of Drilling
- Blank Section, Cuttings Backfill
- Slotted Section, Cuttings Backfill

● Water Content (%)

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.

Wastewater Treatment Plant Improvements
Additional Wells
Wasilla, Alaska

LOG OF BORING MW-2B

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FIG. A-3

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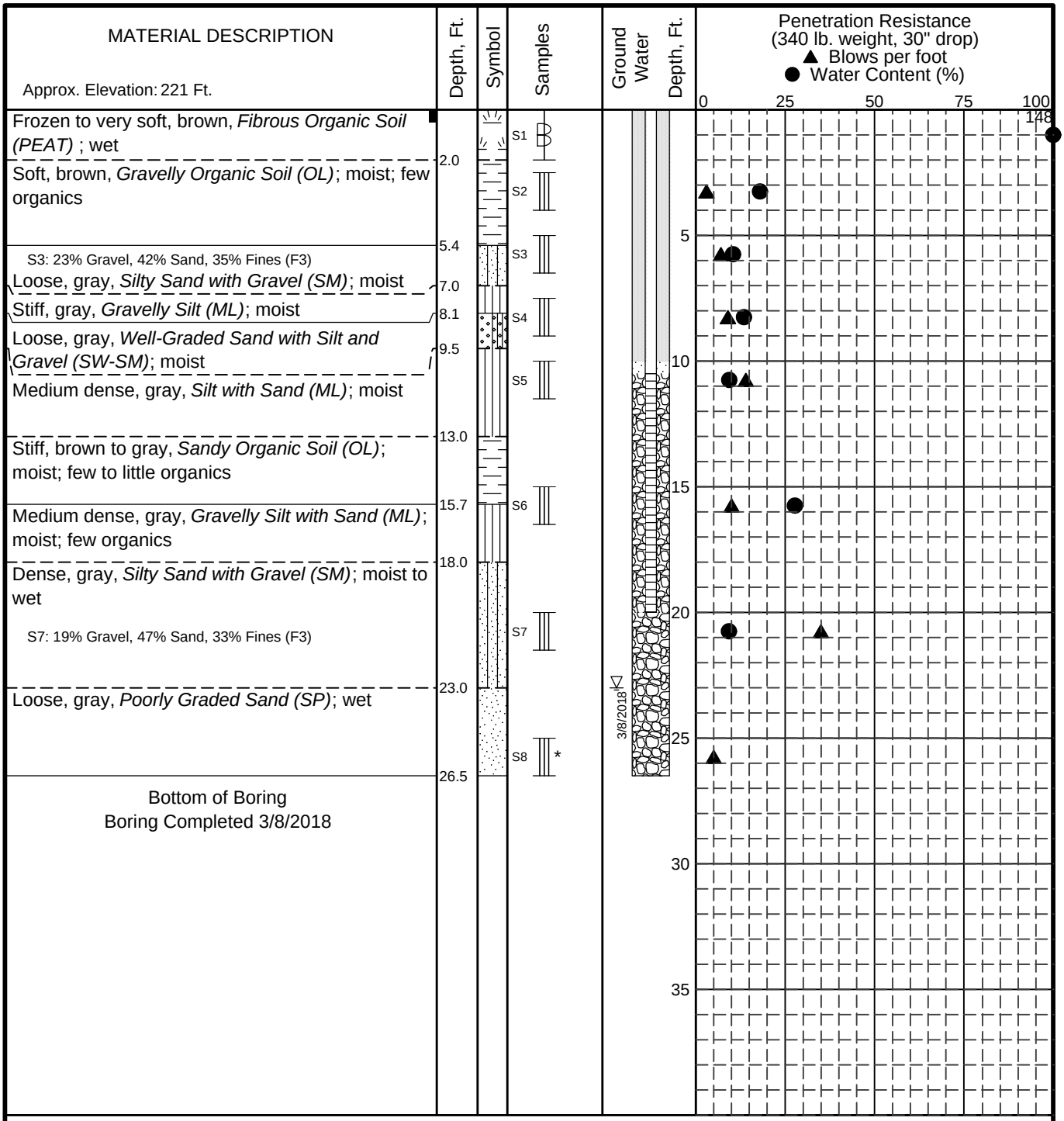
GEOTECHNICAL LOG GINT.GPJ S&W GEO1.GDT 6/4/18



LEGEND

* Sample Not Recovered
Grab Sample
3" O.D. Split Spoon Sample
Frozen
Ground Water Level At Time Of Drilling
Blank Section, Cuttings Backfill
Slotted Section, Cuttings Backfill

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.

Wastewater Treatment Plant Improvements
Additional Wells
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LOG OF BORING MW-10

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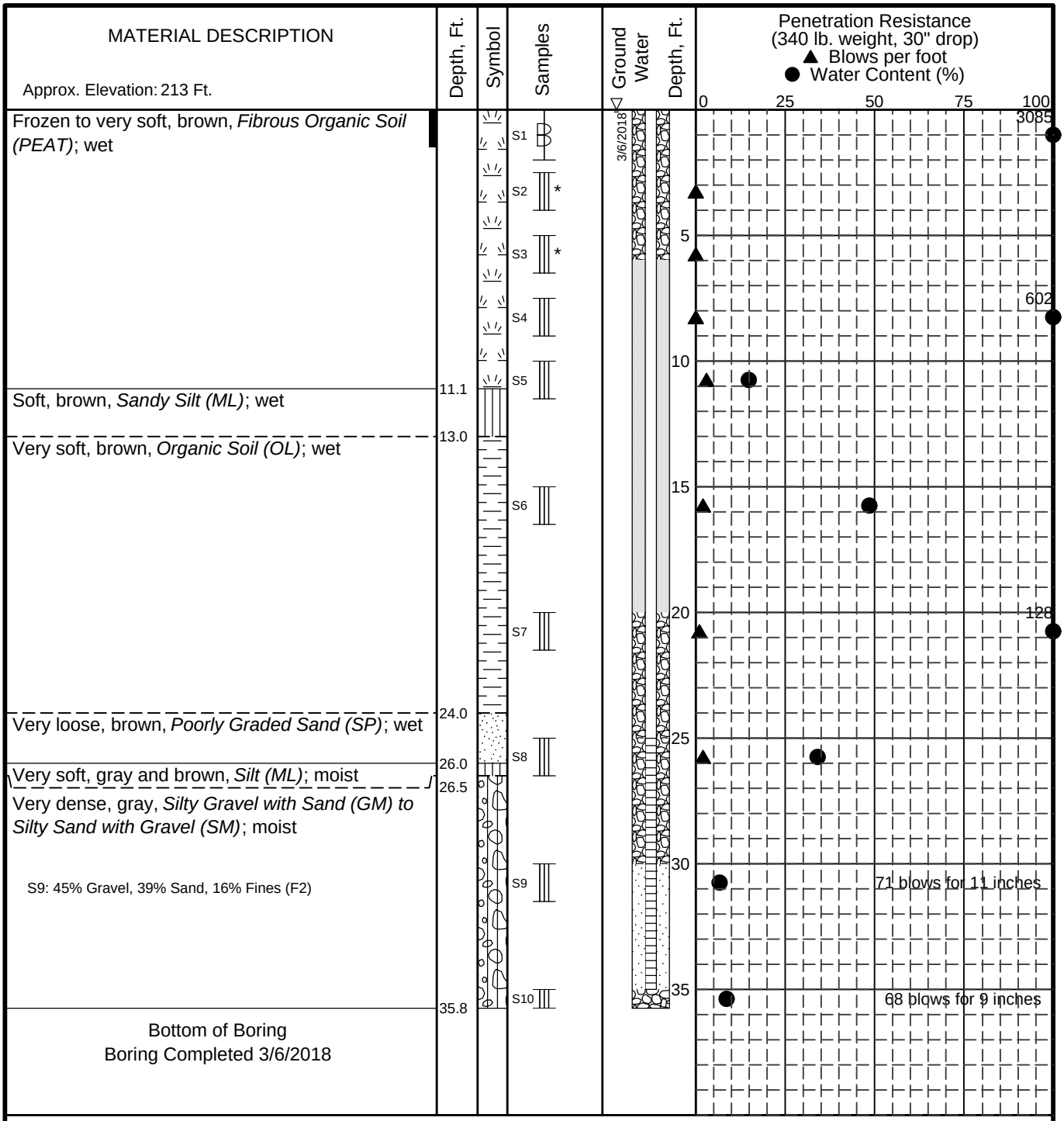
FIG. A-4

REV 3 - Approved for Submittal

GEOTECHNICAL LOG GINT.GPJ S&W GEO1.GDT 6/4/18



LEGEND

* Sample Not Recovered
Grab Sample
3" O.D. Split Spoon Sample
Frozen
Ground Water Level At Time Of Drilling
Blank Section, Cuttings Backfill
Slotted Section, Cuttings Backfill

● Water Content (%)
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.
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Wastewater Treatment Plant Improvements
Additional Wells
Wasilla, Alaska

LOG OF BORING MW-12

June 2018 32-1-02452-003

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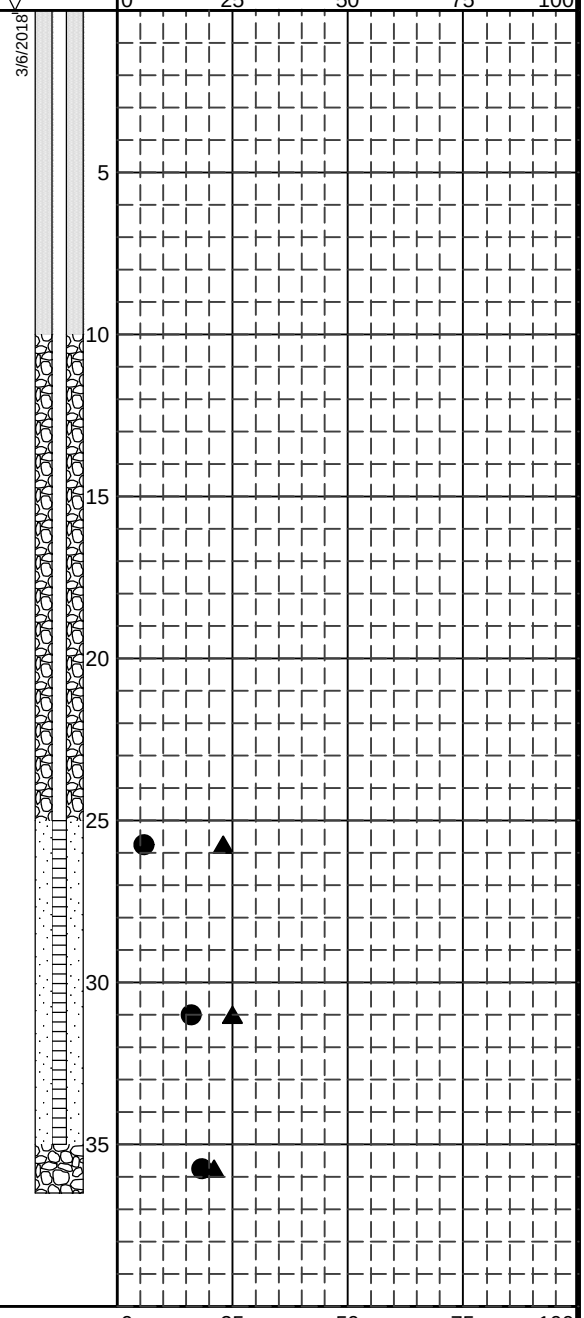
FIG. A-5

REV 3 - Approved for Submittal

GEOTECHNICAL LOG GINT.GPJ S&W GEO1.GDT 6/4/18

MATERIAL DESCRIPTION Approx. Elevation: 211 Ft.	Depth, Ft.	Symbol	Samples
See Boring Log B-13 included in June 2016 data report for details.			
Medium dense, gray, *Silty Gravel with Sand (GM)*; moist S1: 41% Gravel, 32% Sand, 26% Fines (F3)	25.0		S1
Medium dense, gray, *Silty Sand (SM) to Sandy Silt (ML)*; moist S2: 58% Fines (F4)	28.0		S2
			S3
Bottom of Boring Boring Completed 3/6/2018	36.5		



LEGEND

- * Sample Not Recovered
- Grab Sample
- 3" O.D. Split Spoon Sample
- Frozen
- Ground Water Level At Time Of Drilling
- Blank Section, Cuttings Backfill
- Slotted Section, Cuttings Backfill
- ● Water Content (%)
- 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.

Wastewater Treatment Plant Improvements
Additional Wells
Wasilla, Alaska

LOG OF BORING MW-13

June 2018 32-1-02452-003

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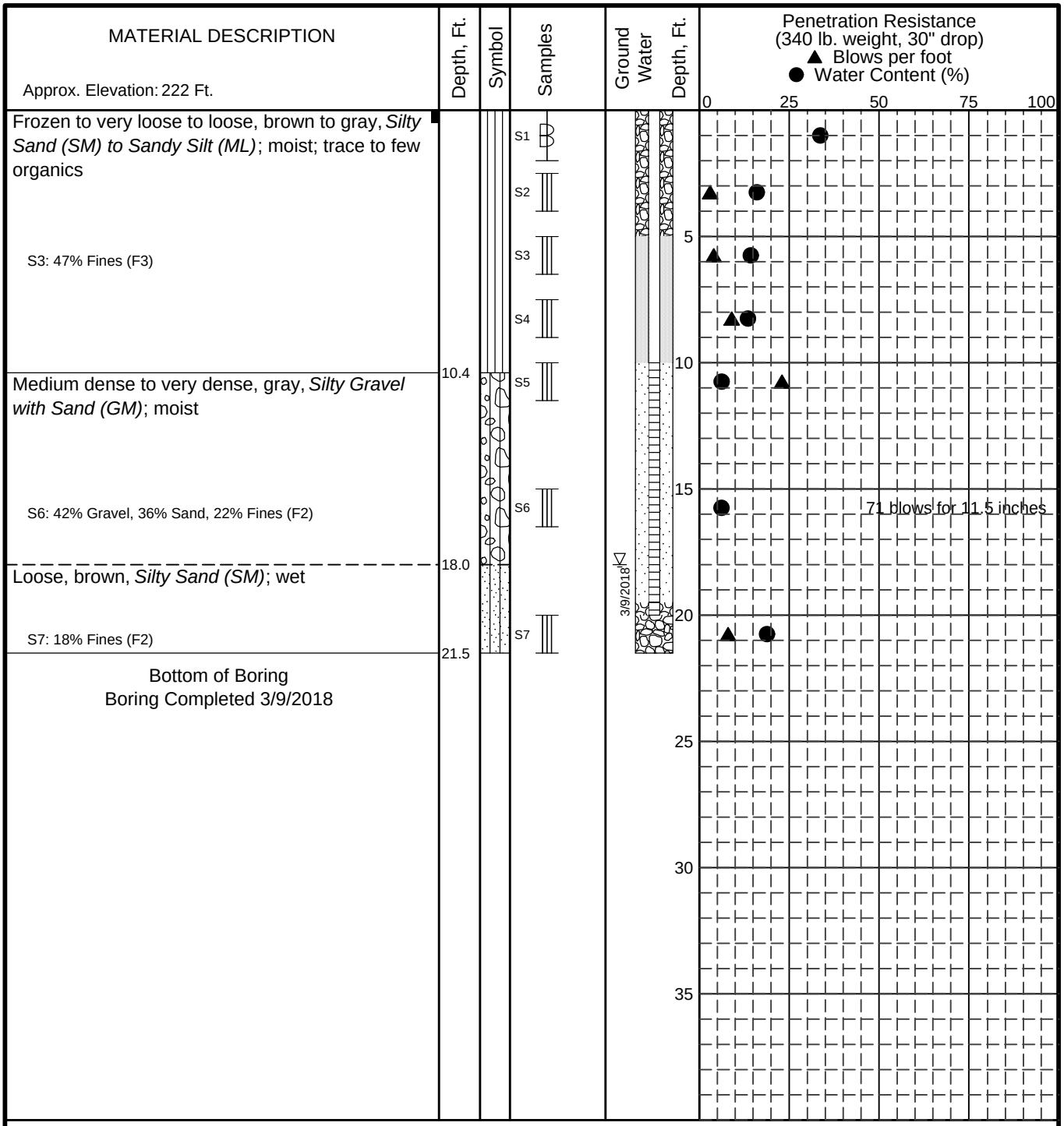
FIG. A-6

GEOTECHNICAL LOG GINT.GPJ S&W GEO1.GDT 6/4/18

REV 3 - Approved for Submittal



LEGEND

* Sample Not Recovered
Grab Sample
3" O.D. Split Spoon Sample
Frozen
Ground Water Level At Time Of Drilling
Blank Section, Cuttings Backfill
Slotted Section, Cuttings Backfill

● Water Content (%)
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.

Wastewater Treatment Plant Improvements
Additional Wells
Wasilla, Alaska

LOG OF BORING MW-15

June 2018 32-1-02452-003

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FIG. A-7

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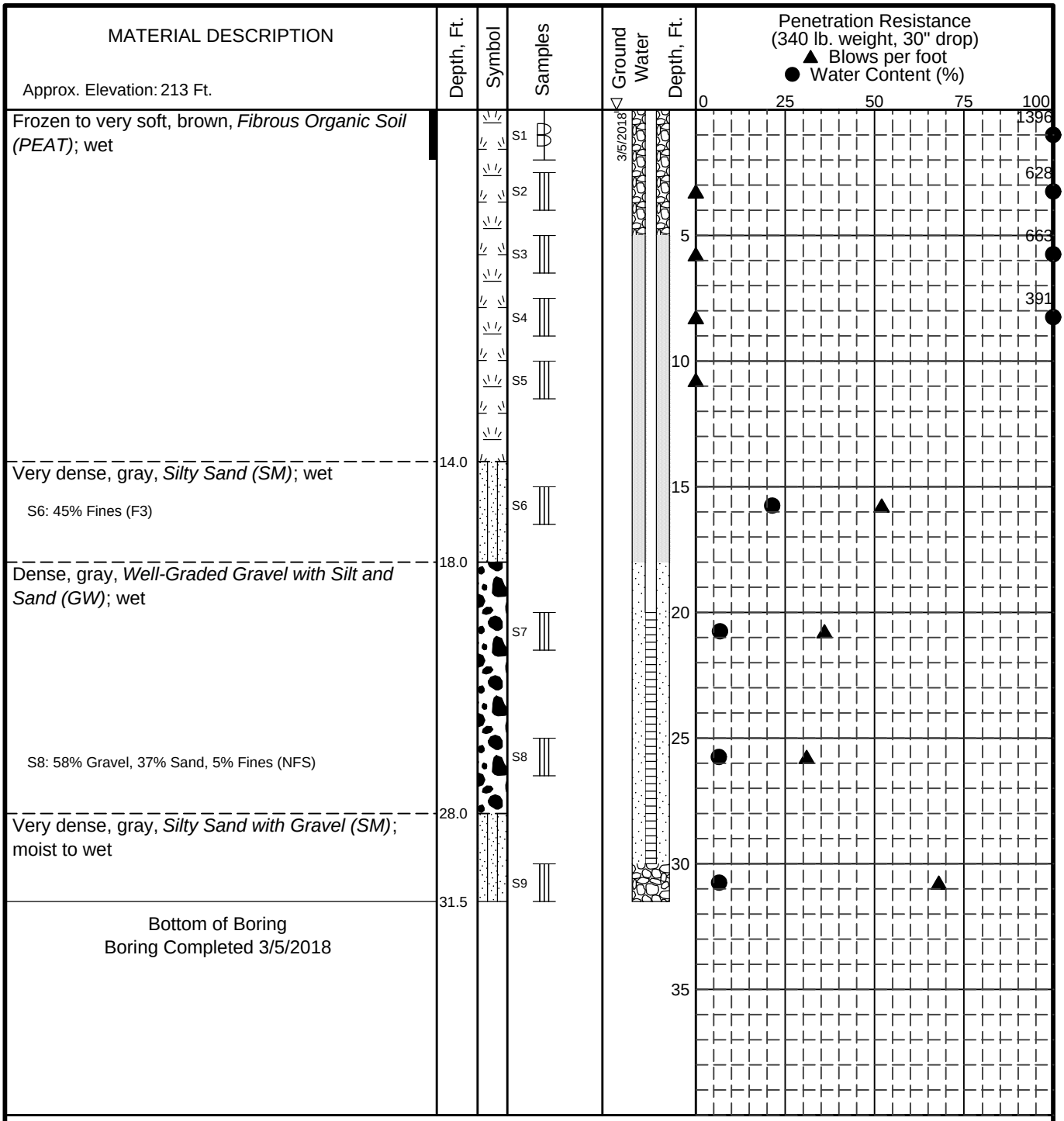
GEOTECHNICAL LOG GINT.GPJ S&W GEO1.GDT 6/4/18



LEGEND

- * Sample Not Recovered
- Grab Sample
- 3" O.D. Split Spoon Sample
- Frozen
- Ground Water Level At Time Of Drilling
- Blank Section, Cuttings Backfill
- Slotted Section, Cuttings Backfill
- Water Content (%)
- 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.

Wastewater Treatment Plant Improvements
Additional Wells
Wasilla, Alaska

LOG OF BORING MW-16

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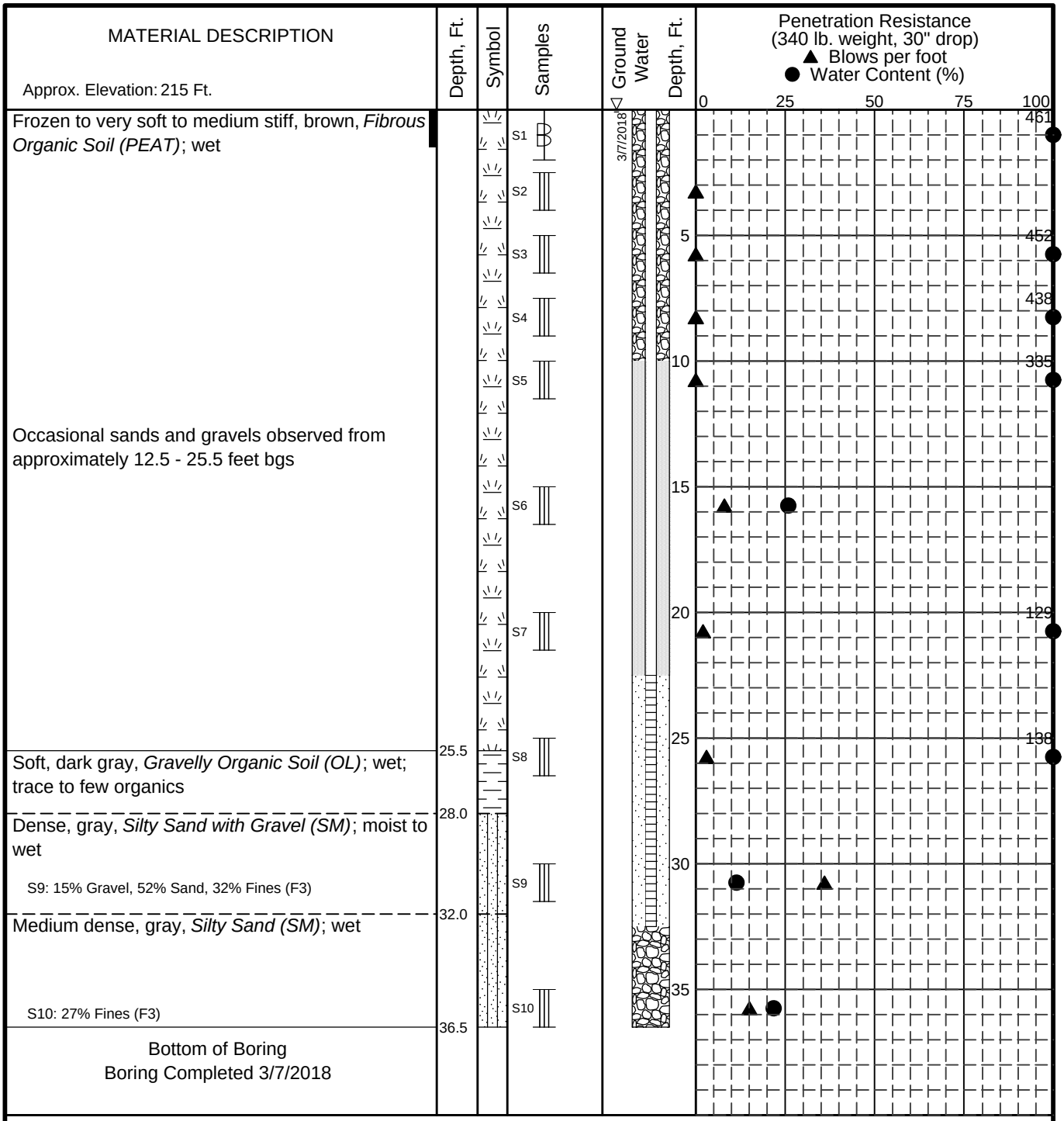
FIG. A-8

REV 3 - Approved for Submittal

GEOTECHNICAL LOG GINT.GPJ S&W GEO1.GDT 6/4/18



LEGEND

* Sample Not Recovered
Grab Sample
3" O.D. Split Spoon Sample
Frozen
Ground Water Level At Time Of Drilling
Blank Section, Cuttings Backfill
Slotted Section, Cuttings Backfill

Water Content (%)
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.

Wastewater Treatment Plant Improvements
Additional Wells
Wasilla, Alaska

LOG OF BORING MW-17

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FIG. A-9

GEOTECHNICAL LOG GINT.GPJ S&W GEO1.GDT 6/4/18

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MATERIAL DESCRIPTION Approx. Elevation: 305 Ft.	Depth, Ft.	Symbol	Samples	Ground Water	Depth, Ft.	Penetration Resistance (340 lb. weight, 30" drop) ▲ Blows per foot ● Water Content (%)
Frozen to very dense, brown, *Silty Sand with Gravel (SM) to Silty Gravel with Sand (GM)*; moist; few to little organics in upper 2 feet			S1		0	0 25 50 75 100
S2: 35% Gravel, 38% Sand, 28% Fines (F3)			S2		10	77 blows for 11 inches
			S3		20	63 blows for 6 inches
Very dense, brown, *Silty Sand (SM)*; moist	25.0		S4		30	50 blows for 5 inches
Very dense, brown, *Silty Sand with Gravel (SM)*; moist	35.0		S5 *		40	25 blows for 1 inch
Dense to very dense, gray, *Silt with Gravel to Silt (ML)*; moist	45.0				45	

CONTINUED NEXT PAGE

0 25 50 75 100

● Water Content (%)

Plastic Limit ⊢●⊣ Liquid Limit

Natural Water Content

LEGEND

- * Sample Not Recovered
- Grab Sample
- 3" O.D. Split Spoon Sample
- Frozen
- Ground Water Level At Time Of Drilling
- Blank Section, Cuttings Backfill
- Slotted Section, Cuttings Backfill

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.

Wastewater Treatment Plant Improvements
Additional Wells
Wasilla, Alaska

LOG OF BORING MW-20

June 2018 32-1-02452-003

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FIG. A-10
Sheet 1 of 3

REV 3 - Approved for Submittal

GEOTECHNICAL LOG GINT.GPJ S&W GEO1.GDT 6/4/18

MATERIAL DESCRIPTION Approx. Elevation: 305 Ft.	Depth, Ft.	Symbol	Samples	Ground Water	Depth, Ft.	Penetration Resistance (340 lb. weight, 30" drop) ▲ Blows per foot ● Water Content (%) 0 25 50 75 100
Dense to very dense, gray, *Silt with Gravel to Silt (ML)*; moist			S6		55	
S7: 82% Fines (F4)			S7		60	54 blows for 13 inches
			S8		65 70	
			S9		75 80	
Very dense, gray, *Silty Gravel with Sand (GM)*; moist	83.0					
Very dense, gray, *Silty Sand with Gravel (SM)*; moist	85.6		S10		85	85 blows for 12 inches
Medium dense to very dense, brown to gray, *Well-Graded Sand with Silt and Gravel (SW-SM)*; moist to wet	88.0		S11		90	50 blows for 2 inches
			S12		95	50 blows for 4 inches
CONTINUED NEXT PAGE						0 25 50 75 100

LEGEND

* Sample Not Recovered
Grab Sample
3" O.D. Split Spoon Sample
Frozen
Ground Water Level At Time Of Drilling
Blank Section, Cuttings Backfill
Slotted Section, Cuttings Backfill
● Water Content (%)
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.

Wastewater Treatment Plant Improvements
Additional Wells
Wasilla, Alaska

LOG OF BORING MW-20

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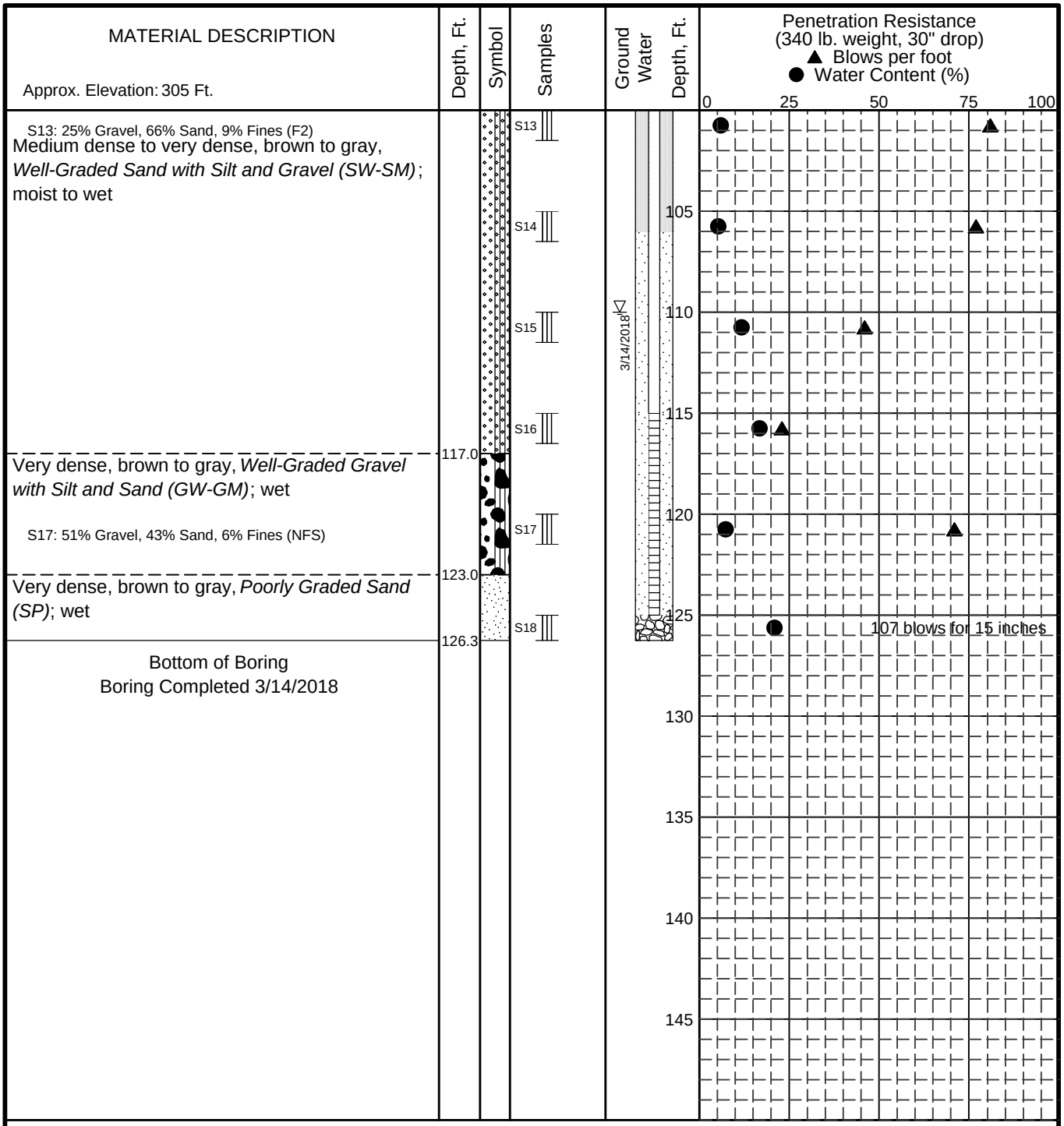
FIG. A-10
Sheet 2 of 3

REV 3 - Approved for Submittal

GEOTECHNICAL LOG GINT.GPJ S&W GEO1.GDT 6/4/18



LEGEND

* Sample Not Recovered
Grab Sample
3" O.D. Split Spoon Sample
Frozen
Ground Water Level At Time Of Drilling
Blank Section, Cuttings Backfill
Slotted Section, Cuttings Backfill

Water Content (%)
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.

Wastewater Treatment Plant Improvements
Additional Wells
Wasilla, Alaska

LOG OF BORING MW-20

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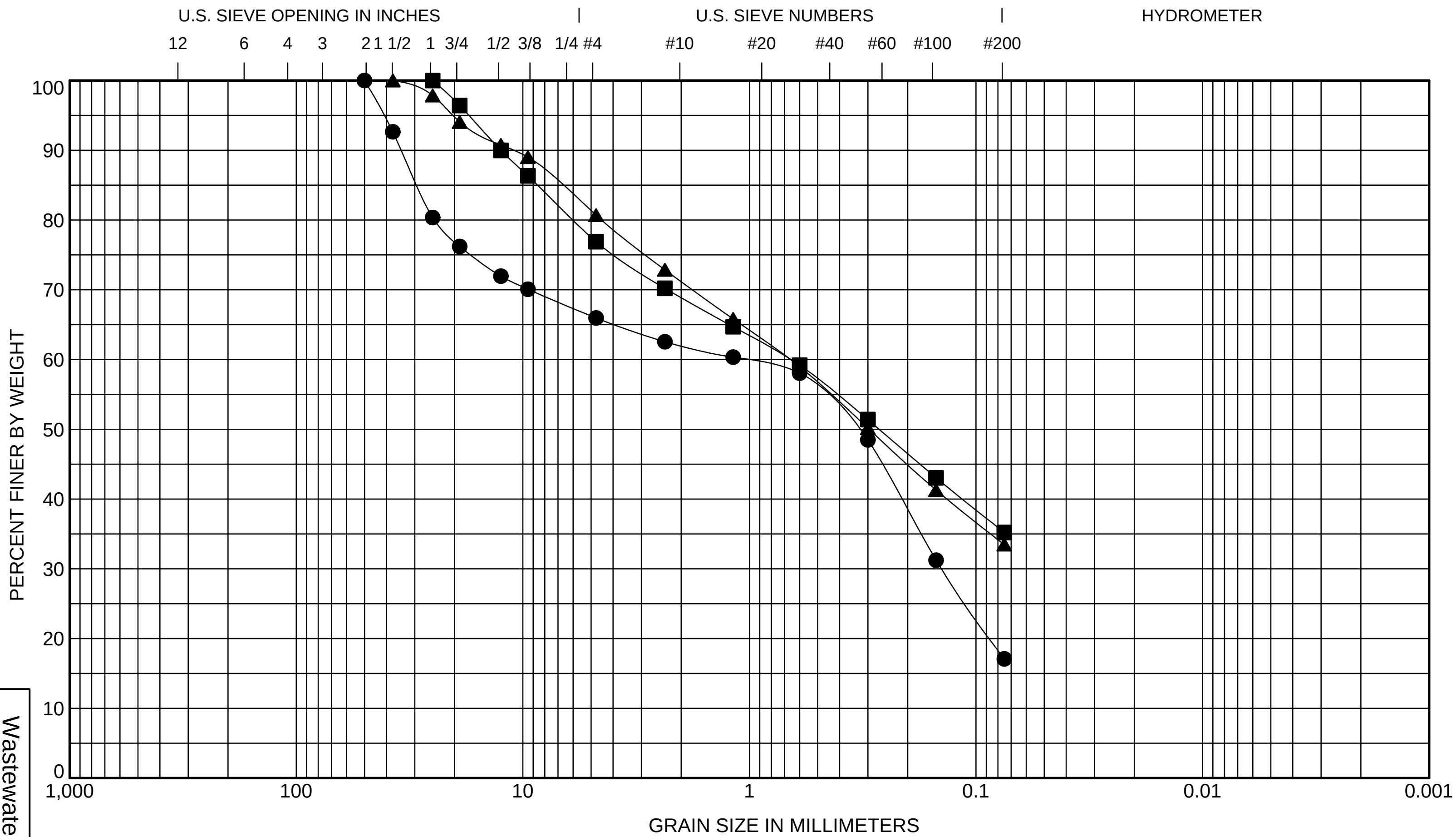
FIG. A-10
Sheet 3 of 3

REV 3 - Approved for Submittal

GEOTECHNICAL LOG GINT.GPJ S&W GEO1.GDT 6/4/18



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Sample		Depth, Ft	Classification	LL	PL	PI	Cc	Cu
●	**MW-2B S8**	**23.8 - 25.3**	**Silty Sand with Gravel (SM)**					
■	**MW-10 S3**	**5.0 - 6.5**	**Silty Sand with Gravel (SM)**					
▲	**MW-10 S7**	**20.0 - 21.5**	**Silty Sand with Gravel (SM)**					

Sample		Depth, Ft	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**MW-2B S8**	**23.8 - 25.3**	**50**	**1.07**	**0.14**		**34**	**49**	**17**	
■	**MW-10 S3**	**5.0 - 6.5**	**25**	**0.66**			**23**	**42**	**35**	
▲	**MW-10 S7**	**20.0 - 21.5**	**37.5**	**0.66**			**19**	**47**	**33**	

Wastewater Treatment Plant Improvements
Additional Wells
Wasilla, Alaska

GRAIN SIZE CLASSIFICATION

June 2018

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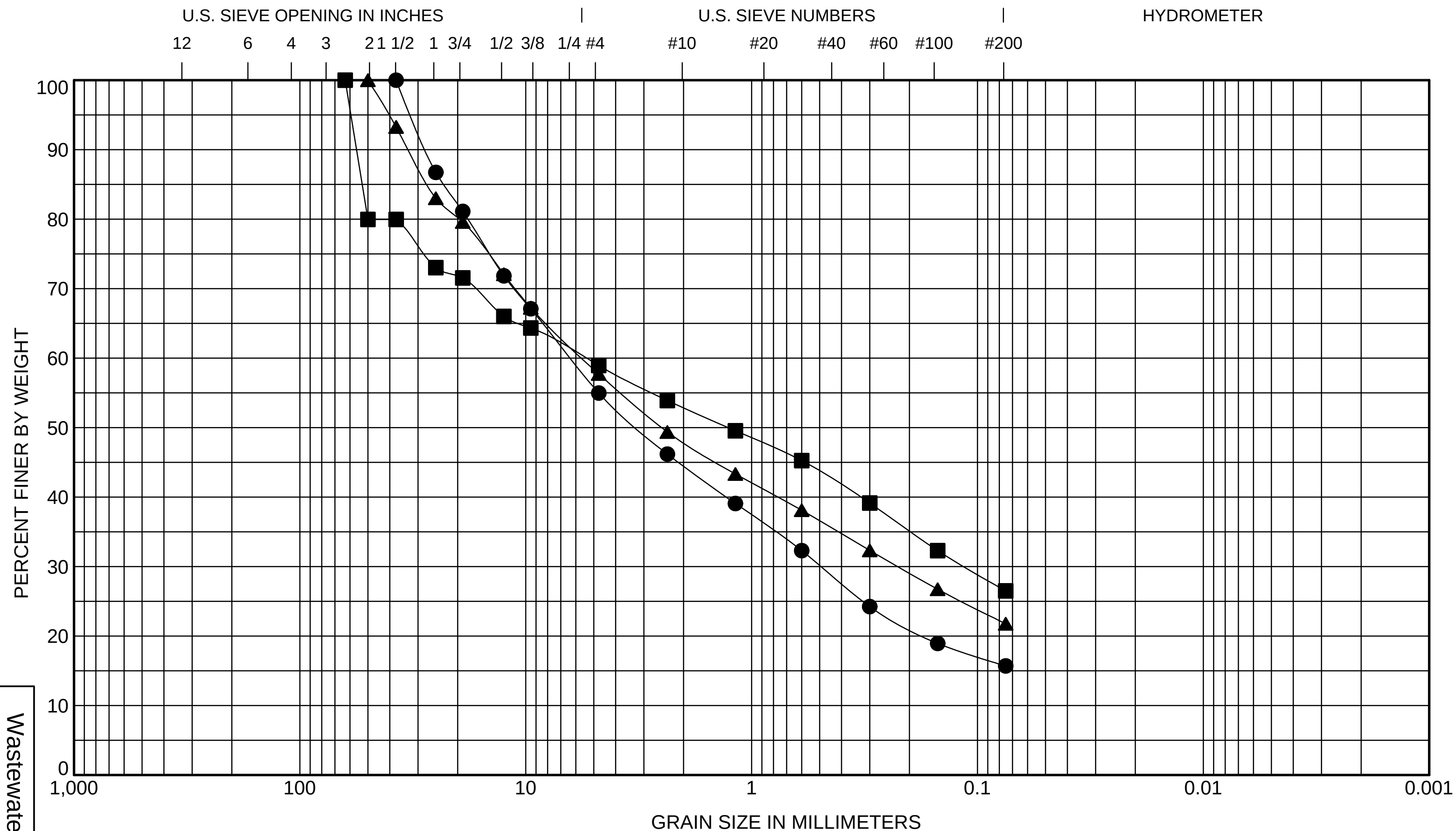
FIG. A-11
Sheet 1 of 4



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Sample		Depth, Ft	Classification	LL	PL	PI	Cc	Cu
●	**MW-12 S9**	**30.0 - 31.5**	**Silty Gravel with Sand (GM)**					
■	**MW-13 S1**	**25.0 - 26.5**	**Silty Gravel with Sand (GM)**					
▲	**MW-15 S6**	**15.0 - 16.5**	**Silty Gravel with Sand (GM)**					

Sample		Depth, Ft	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**MW-12 S9**	**30.0 - 31.5**	**37.5**	**6.33**	**0.49**		**45**	**39**	**16**	
■	**MW-13 S1**	**25.0 - 26.5**	**63**	**5.44**	**0.11**		**41**	**32**	**26**	
▲	**MW-15 S6**	**15.0 - 16.5**	**50**	**5.61**	**0.22**		**42**	**36**	**22**	

Wastewater Treatment Plant Improvements
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Wasilla, Alaska

GRAIN SIZE CLASSIFICATION

June 2018

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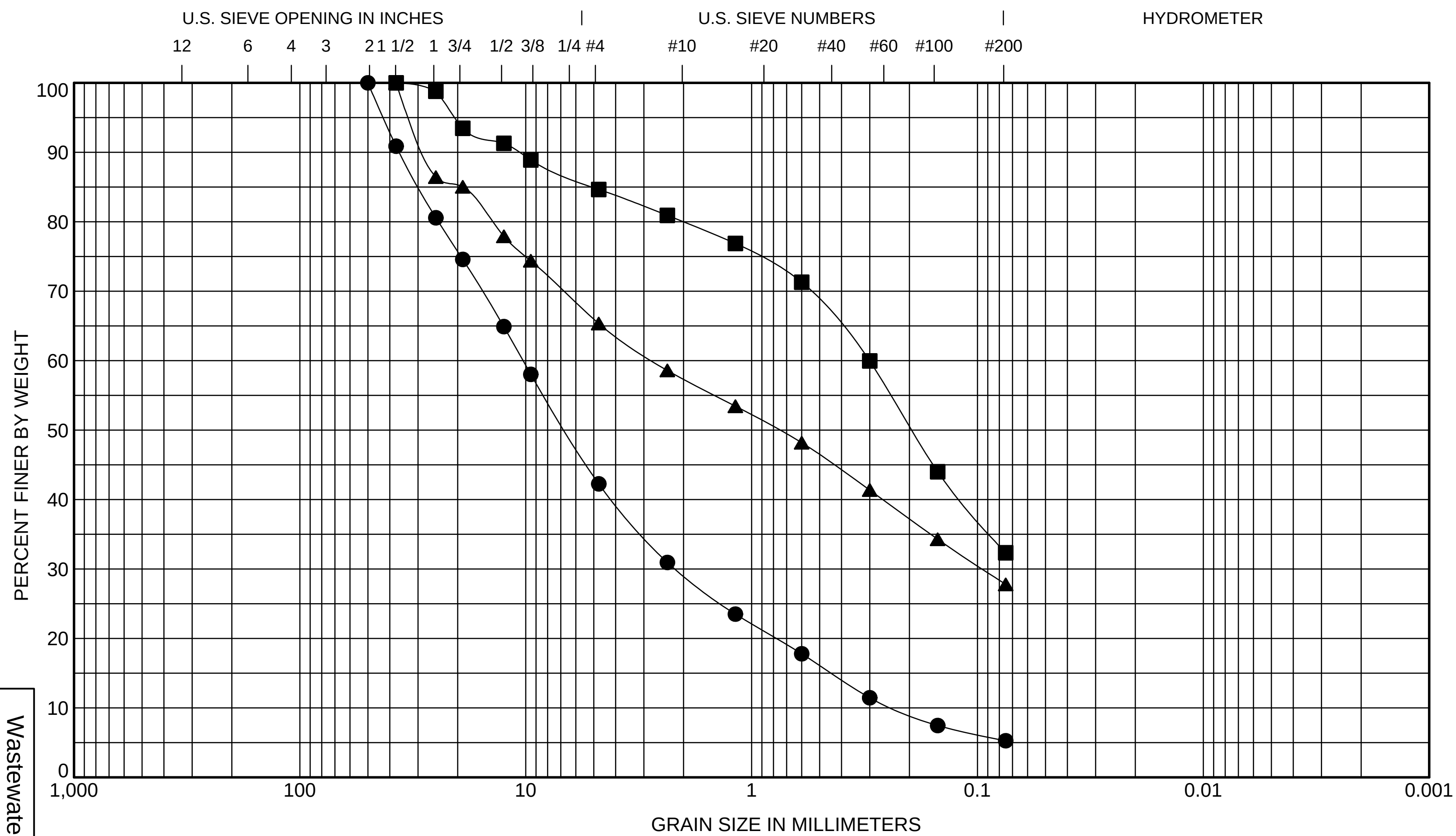
FIG. A-11
Sheet 2 of 4



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Sample		Depth, Ft	Classification	LL	PL	PI	Cc	Cu
●	MW-16 S8	25.0 - 26.5	**Well-Graded Gravel with Silt and Sand (GW)**				**2.0**	**44.1**
■	MW-17 S9	30.0 - 31.5	**Silty Sand with Gravel (SM)**					
▲	MW-20 S2	10.0 - 11.5	**Silty Sand with Gravel (SM)**					

Sample		Depth, Ft	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	MW-16 S8	25.0 - 26.5	**50**	**10.28**	**2.16**	**0.23**	**58**	**37**	**5**	
■	MW-17 S9	30.0 - 31.5	**37.5**	**0.3**			**15**	**52**	**32**	
▲	MW-20 S2	10.0 - 11.5	**37.5**	**2.73**	**0.1**		**35**	**38**	**28**	

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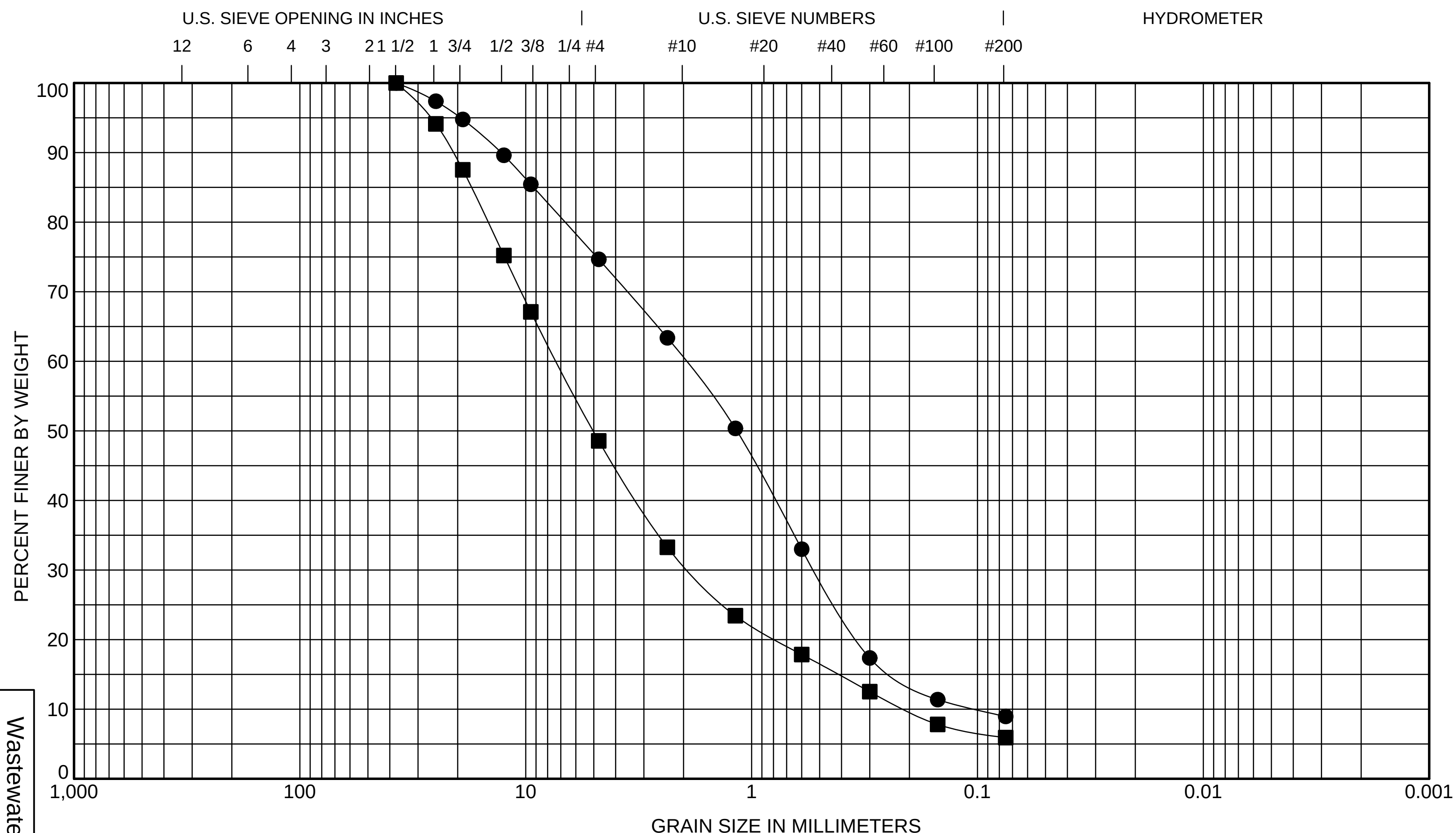
June 2018

32-1-02452-003

GRAIN SIZE CLASSIFICATION

Wastewater Treatment Plant Improvements
Additional Wells
Wasilla, Alaska

FIG. A-11
Sheet 3 of 4



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Sample	Depth, Ft	Classification	LL	PL	PI	Cc	Cu
●	**MW-20 S13**	**100.0 - 101.5**	**Well-Graded Sand with Silt and Gravel (SW-SM)**				**1.4**	**19.5**
■	**MW-20 S17**	**120.0 - 121.5**	**Well-Graded Gravel with Silt and Sand (GW-GM)**				**2.3**	**35.2**

	Sample	Depth, Ft	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**MW-20 S13**	**100.0 - 101.5**	**37.5**	**1.97**	**0.53**	**0.1**	**25**	**66**	**9**	
■	**MW-20 S17**	**120.0 - 121.5**	**37.5**	**7.29**	**1.87**	**0.21**	**51**	**43**	**6**	

Wastewater Treatment Plant Improvements
Additional Wells
Wasilla, Alaska

GRAIN SIZE CLASSIFICATION

June 2018

32-1-02452-003

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FIG. A-11
Sheet 4 of 4

APPENDIX B

JUNE 2016 REVISED GEOTECHNICAL DATA REPORT

by

Shannon & Wilson

Revised Geotechnical Data Report
Wastewater Treatment Plant Improvements
Wasilla, Alaska

June 2016

Submitted To:

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Anchorage, Alaska 99503
Phone: 907.276.4245

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5430 Fairbanks Street, Suite 3
Anchorage, Alaska 99518
Phone: (907)561-2120
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FIGURES

APPENDICES

REVISED GEOTECHNICAL DATA REPORT
WASTEWATER TREATMENT PLANT IMPROVEMENTS
WASILLA, ALASKA

1.0 INTRODUCTION

This report presents the results of subsurface explorations, field and laboratory testing, and geotechnical engineering studies by Shannon & Wilson, Inc. for the proposed improvements to the existing Wastewater Treatment Plant in Wasilla, Alaska. The purpose of this geotechnical study was to explore subsurface conditions and to allow for development of geotechnical engineering recommendations for the proposed new infiltration and treatment area. To accomplish this, a total of ten borings were drilled and infiltration testing was conducted in the wetland/bioswale treatment area and on top of the bluff to the southwest. Soil samples recovered from the borings were tested in our geotechnical laboratory and select soil and water samples were submitted to SGS for analytical testing. Presented in this report are descriptions of the site and project, subsurface exploration and laboratory test procedures, an interpretation of subsurface conditions, and conclusions and recommendations from our studies. Shannon & Wilson has provided support during prior phases of this project which were submitted in our May 2008 *Geotechnical Report, Wastewater Treatment Plant Percolation Cell, Wasilla, Alaska*. We have included a portion of the pertinent data from the 2008 report within this deliverable for ease of review.

Authorization to proceed with this work was received in the form of a Subconsultant Agreement, signed by Mr. Dean Syta, P.E. of Stantec on March 6, 2015. Our work was conducted in general accordance with our July 7, 2014 proposal with the exception that several of the proposed boring locations were inaccessible due to shallow water and soft ground conditions. Five of the planned borings were not able to be advanced. In addition, wet and thawed conditions caused the project scope to change and additional funds were authorized by Mr. Syta and the City of Wasilla (Purchase Order 20822) on April 24, 2015. An additional boring on the bluff to the southwest of the site was also added to our originally proposed scope. Results of engineering analyses and groundwater mounding will be presented under separate cover.

2.0 SITE AND PROJECT DESCRIPTION

The existing Wastewater Treatment Plant is located on Jude Drive in Wasilla, Alaska. The existing facility consists of several buildings, a four-cell aerated lagoon system, and nine percolation beds. The proposed improvements include an overland percolation and wetland/bioswale-type treatment area in a 70 acre parcel to the west of the existing facility.

Generally, the developed portion of the facility slopes down to the west and south with an approximately 90-foot tall bluff on the west side of the wetlands. The existing buildings and facilities are at an approximate elevation of 250 feet and directly west of the facility lies the existing sewage lagoons which are at an approximate elevation of 245 feet. The elevation drops to the west to approximately 208 feet in the wetland treatment area, which also slopes down to the south toward a stream and the proposed new point of compliance. The tall bluff is west of the wetland area and rises steeply up with an elevation increase of approximately 90 feet. A residential neighborhood is located atop the bluff and to the west of the project area. At the time of explorations, the project area was thick with vegetation including mature trees, brush, and grasses (with the exception of the existing developed wastewater facility buildings and lagoons). The low lying proposed wetland treatment area was hummocky, boggy, and standing water was observed in numerous locations.

We understand that there will be a distribution pipe that will transport effluent down slope to the wetland area in the summer only and that berms may be constructed within the wetland treatment area to allow ponding and prevent rapid loss of effluent to the stream (on the south end of the wetland). In addition to the explorations conducted for this field effort, which are included in Appendix A, we reviewed previous work by others and Shannon & Wilson, which is described below and provided in Appendix B.

3.0 PRIOR EXPLORATIONS

In 1983, the City of Wasilla contracted with CH2M to design a collection, treatment, and disposal system at the current facility location. A preliminary design report, based on geologic and hydrogeologic investigations of the site, was issued in February 1984 with final design of the facility completed in April 1984. During late 1985, CH2M contracted with RSE in Madison, Wisconsin to conduct an independent review of the drainfield design and estimated capacity.

The final design capacity for the new facility was estimated by CH2M (1986) to be 0.44 million gallons per day (mgd), while RSE (1986) estimated a capacity of 0.15 to 0.2 mgd during their review of the design. Notably, NTL Alaska, Inc. stated in their February 23, 2007, letter to Dean Syta that the water quality of the stream near the base of the slope indicates the system may be performing at capacity between about 0.3 and 0.35 mgd. NTL also observed that the drain field should have a probable treatment capacity between about 0.4 and 0.6 mgd as related to biological oxygen demand and total suspended solids removal by the wastewater lagoon system.

Additional subsurface investigation, laboratory analyses, and groundwater review of a portion of the WWTP site was conducted by Gilfilian Engineering (Gilfilian) in October 1986 to determine the suitability of the reserve area for installation of additional drainfield capacity. Gilfilian advanced 23 borings completed with monitoring wells across the site. We reviewed nine of the Gilfilian borings that were located west of the existing lagoons. In general, Gilfilian concluded that the subject portion of the site consists of free-draining outwash deposits overlying and interlayed with dense till deposits. These main depositional units overlay thick deposits of silty fine sand to sandy silt, which are largely impermeable and found to act as an upper confining layer to the artesian aquifer below. Boring logs and laboratory data that were reviewed are included in Appendix B and approximate boring locations are shown on the site plan in Figure 2.

In addition, Shannon & Wilson conducted explorations in 2007 west of the existing lagoons. Three borings completed with monitoring wells were advanced to supplement previous data. In general, the boring logs indicate that subsurface conditions generally consist of a surficial layer of silt overlying granular material and till. Boring logs and laboratory data from this exploration area included in Appendix B and approximate boring locations are shown on the site plan included as Figure 2. A summary of the previous Shannon & Wilson report indicates that the infiltration capacity of the existing drain fields was estimated at approximately 0.3 to 0.5 million gallons per day (mgd). The 2007 geotechnical and hydraulic design studies were conducted to support a proposed new 5-acre percolation cell west of the existing drain fields. The proposed percolation cell was intended to supplement a series of nine existing subsurface drain beds in an attempt to increase the current hydraulic capacity. Ignoring effluent loss to evaporation, the estimated added benefit of a new percolation cell could be limited to about 0.1 mgd. In addition, slope stability studies indicate that the bluffs to the south and west sides of the developed WWTP site are marginally stable and that increasing effluent discharge at the WWTP site (i.e., either by constructing a new percolation cell or increasing discharge to the existing drain beds) will likely lead to increased seepage on the slopes and reduced slope stability.

4.0 SUBSURFACE EXPLORATIONS

Subsurface explorations consisted of drilling and sampling ten soil borings, installing three monitoring wells, and conducting infiltration tests, which included double ring infiltrometer, falling head, and pilot infiltration test (PIT) methods. The original plan for the project area included a total of 13 proposed borings, however due to standing water and soft ground conditions, five borings were not able to be accessed. In addition, Boring B-14 (located atop the bluff along the west edge of the wetland) was added after the initial exploration phase. With the exception of Boring B-14, the borings were advanced in March, May, and June of 2015, the monitoring wells were developed and sampled in June 2015, and the infiltration testing was conducted in July 2015. Boring B-14 was advanced in February of 2016 and its observation wells were sampled in March of 2016. Stantec provided survey data for the observation wells on site in March 2016. The approximate locations of these explorations are identified on Figure 2. Summary logs of the borings are provided in Appendix A and infiltration results are presented Appendix C.

4.1 Drilling Explorations

Ten borings, designated Borings B-01 through B-04, B-06, B-08, B-09, B-11, B-13, and B-14, were advanced to depths ranging between 20.5 and 151 feet bgs. The boring locations were recorded using a handheld global positioning system (GPS) with an accuracy of ± 20 feet and were adjusted as appropriate where survey data was available. Elevations were estimated from topographic contours provided by the Matanuska Susitna Borough (MSB) interactive map website. The locations shown on Figure 2 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 and water samples, log subsurface conditions, observe installation of monitoring wells, and observe groundwater levels.

Drilling services for this project were provided by Denali Drilling, of Anchorage, Alaska, using track-mounted CME-850 and Mobile B-61 drill rigs. The borings were advanced with $4^1/_4$-inch inner diameter (ID) hollow stem auger. During drilling, soil samples were generally collected at 2.5-foot intervals to 10 feet bgs and at 5-foot intervals thereafter using Standard Penetration Test

(SPT) or Modified Penetration Test (MPT) methods. In general, MPT methods were employed when minimal recovery was observed with SPT methods. Boring B-14 was advanced with 3¼-inch ID hollow stem auger, 3½-inch and 3⅝-inch tricone bits and circulating bentonite based drilling fluid, and 3⅝-inch ODEX air hammer. To prevent caving of the borehole walls, 4-inch ID, threaded, flush-coupled casing was advanced along with the drilling. Samples were collected at 5-foot intervals to the bottom of the boring using MPT methods. 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 rods. In the MPT method, samples are recovered by driving a 3-inch outer diameter (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 rods. For each sample, the number of blows required to drive the sampler the final 12 inches of an 18-inch penetration into undisturbed soil is recorded. When the sampler did not penetrate the full 18 inches, we reported the total blow count and corresponding penetration in inches on the boring logs. Blow counts are shown graphically on the boring log figures 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.

Samples recovered during drilling were visually classified according to the classification system presented in Appendix A, Figure A-1. The field soil classifications were verified through laboratory analysis for selected samples. Frost classifications included on the logs in Appendix A and are followed by "0.02 Mil" or "P-200" to indicate whether frost classifications were based on hydrometer or sieve/P-200 data, respectively. The frost classification system is presented in Appendix A, Figure A-2. Summary logs of the borings are presented in Appendix A, Figures A-3 through A-12.

Three analytical soil samples were collected from Borings B-06, B-08, and B-09. Shannon & Wilson's field representative used clean stainless steel spoons and wore new nitrile gloves to transfer analytical soil samples into laboratory-supplied containers. The samples were transported to the laboratory in coolers with ice packs using chain-of-custody procedures.

Borings B-01 through B-04, B-11, and B-13 were completed by installing 1-inch, polyvinyl chloride (PVC) groundwater level observation wells with slotted tips to facilitate observation of groundwater levels. The annular space between the borehole walls and casings was backfilled

with auger cuttings produced during drilling activity. The installation details for each groundwater level observation well are shown on the boring logs. The PVC well casings were generally allowed to stick up out of the ground approximately 1 to 2 feet to aid in finding them in the future. Borings B-06, B-08, and B-09 were completed with Monitoring Wells MW6, MW8, and MW9 as described below in Section 4.2.

Boring B-14 was completed with two nested, 1-inch, PVC groundwater level observation wells with slotted tips. One of the PVC groundwater observation wells was placed at the bottom of the boring at approximately 149 feet bgs, and the other was placed at approximately 97 feet bgs. They were hand slotted from 144 to 149 feet bgs and 87 to 97 feet bgs, respectively. Sandpack was used as backfill around the slotted portions of the observation wells and a bentonite seal was also placed from approximately 131 to 137 feet bgs to prevent flow between the slotted portions of the observation wells. The remainder of the boring was backfilled with auger cuttings generated during drilling activities.

Two water samples were collected from Boring B-14 for Nitrate/Nitrite analysis. Shannon & Wilson's field representative used clean water bailers and wore nitrile gloves to collect and transfer the water samples into laboratory-supplied containers. The samples were transported to the laboratory in coolers with ice packs using chain-of-custody procedures.

4.2 Monitoring Wells

Groundwater characterization activities included well installation, development, and sampling. Monitoring Wells MW6, MW8, and MW9 were installed in Borings B-06, B-08, and B-09, respectively. The monitoring wells were constructed from 2-inch diameter schedule 40, polyvinyl chloride (PVC) pipe with threaded connections. The bottom 10 feet of the wells were constructed using 2-inch diameter, 0.010 slotted Schedule 40 PVC well screen. Silica sand was used to backfill around the well screen to approximately 2 feet above the screened section. Hydrated bentonite chips were used to backfill above the sand to the ground surface. The PVC was cut off above ground level. The monitoring well locations are the same as the boring locations and shown on the site plan in Figure 2.

The monitoring wells were developed at least 24 hours following installation using a surge block and a submersible pump with dedicated disposable tubing. Three to five minute periods of surging were alternated with periods of pumping. During well development, water quality

parameters including pH, temperature, turbidity, and conductivity were measured with a YSI 556 and a Hach turbidimeter at approximately 5 minute intervals.

Development was considered complete once the following stabilization criteria were met over three successive readings: pH was within 0.1 unit, temperature was within 3 percent (minimum 0.2 degree Celsius), conductivity was within three percent, and turbidity was within 10 percent or three consecutive readings were below 10 nephelometric turbidity units (NTU). Groundwater data, including final water quality parameter measurements during development, are summarized in Table D-1 in Appendix D.

Groundwater samples were collected from the developed monitoring wells directly following development. The wells were allowed to recharge to at least 80 percent of the pre-purge water volume, and the wells were not purged again prior to sampling. Samples were collected using a submersible pump and dedicated disposable tubing. Analytical samples were collected by transferring water directly from the pump tubing into the laboratory supplied containers. Groundwater test results are summarized in Table D-2 and provided in Appendix D.

Investigation derived waste (IDW) consisted of development water, purge water, and disposable sampling equipment. The development and purge water was discharged directly to the ground surface. The disposable sampling equipment was put into a dumpster.

4.3 Infiltration Testing

Infiltration testing at the site consisted of a PIT, a double ring infiltrometer test, and two falling head tests. The PIT test was conducted in an upland area west of the existing lagoons and east of the wetland/lowlying area. The double ring infiltrometer test was conducted adjacent to Boring B-06, and the falling head tests were conducted adjacent to Boring B-08 and the proposed location for B-12, which was not able to be advanced due to drill rig inaccessibility. The approximate locations of the infiltration tests are shown on the site plan in Figure 2. Procedures for testing and results of the infiltration testing are provided in Appendix C.

5.0 LABORATORY TESTING

Laboratory tests were performed on selected samples recovered from the borings to confirm field classifications and to estimate the index properties of the typical materials encountered in the

borings. The laboratory testing was formulated with emphasis on estimating the material gradation and in-situ water content.

Water content tests were performed in general accordance with ASTM International (ASTM) D2216. The results of the water content measurements are presented graphically on the boring logs in Appendix A.

Grain size classification (gradation) testing was performed to estimate the particle size distribution of selected samples from the borings. The gradation testing generally followed the procedures described in ASTM C136/117 and D422. The test results are presented in Appendix A as Figure A-13 (8 sheets), and summarized on the boring logs as percent gravel, percent sand, and percent fines. Percent fines on the boring logs are equal to the sum of the silt and clay fractions indicated by the percent passing the No. 200 sieve. Note that hydrometer testing indicates particle size only and visual classification under USCS designates the entire fraction of soil finer than the No. 200 sieve as silt. Plasticity characteristics (Atterberg Limits results) are required to differentiate between silt and clay soils under USCS.

In addition, we conducted tests on selected samples to estimate the amount of material passing the No. 200 sieve (P-200). The P-200 test provides an estimate of the fines (silt and clay) content. These tests were performed in general accordance with ASTM C117. The results of these tests are indicated as percent fines on the boring logs.

Atterberg Limits testing was conducted on select samples of cohesive/fine grained soil encountered to estimate plasticity characteristics. This test generally followed procedures described in ASTM D4318. The results of the tests are presented on the boring logs and in Appendix A, Figure A-14.

Three soil samples and three groundwater samples were collected from the 2015 explorations and analyzed for Resource Recovery and Conservation Act (RCRA) metals by Environmental Protection Agency (EPA) Method SW6020. In addition, the groundwater samples were analyzed for pH by EPA Method SM21 4500, total nitrate/nitrite by EPA Method SM21 4500. Two "grab" groundwater samples were collected from Boring B-14, one from the deep observation well and one from the shallow observation well, and tested for nitrate and nitrite levels by EPA Method 300.0.

The samples were submitted to SGS for analytical testing, using chain-of-custody procedures. The laboratory reports for the water samples are provided in Appendix D and the laboratory results for the soil samples are provided in Appendix E. The analytical groundwater and soil sample results are summarized in the Tables provided in Appendix D and E, respectively.

6.0 SUBSURFACE CONDITIONS

The subsurface conditions encountered at the site are depicted in detail on Shannon & Wilson's boring logs in Appendix A. In general, subsurface conditions encountered during this effort of explorations correlate well to the previous work (described above) by Gilfilian in 1986 and Shannon & Wilson in 2007. In general, our borings encountered decomposed organic soil (swamp material) overlying granular material interbedded with occasional thin silt layers. Borings B-01, B-02, B-03, B-06, B-08, B-11, and B-13 were drilled within the lowlying wetland area and encountered approximately 2.2 to 13 feet of very soft to soft brown decomposed organic soil. Blow counts were typically less than 5 blows per foot (bpf) while sampling within this layer and sample recovery was difficult. Borings B-04 and B-09 were advanced in upland area east of the wetland and encountered approximately 2 to 3 feet of silt with sand and occasional organics at the surface. Boring B-14 was advanced in the upland area west of the wetland and encountered approximately one foot of organic material at the surface. Below the surface silts and swamp material, thin (approximately 2 ½ to 6 feet thick) silt layers were found in Borings B-01, B-02, B-03, B-08, and B-13. Blow counts in the fine grained layers ranged from 5 to 25 bpf, with the average at approximately 12 bpf. Moisture content in the silt material ranged from 9 to 89 percent, with the average at approximately 42 percent moisture.

Granular material found within our borings consisted of sand and gravel with varying amounts of silt. We identified interfingered zones of alluvium/outwash and glacial till, which were distinct in their appearance, lower fines content, and higher blow counts. Granular material was generally medium dense to very dense with the exception of loose zones found between approximately 16 and 18 feet bgs in Boring B-01 and between approximately 13 and 18 feet bgs in Boring B-02. Blow counts within the granular material ranged from 3 to more than 50 blows bpf with the average at approximately 43 bpf, and moisture content ranged from 2 to 25 percent with the average at approximately 9 percent. Fines content within the granular soils ranged from 2 to 45 percent with the average at approximately 15 percent. Cobbles were noted in Borings B-04, B-08, B-09, B-11, and B-14 as evidenced by rough drill action and the presence of fractured

rock in samples. It should be noted that occasional cobbles and boulders may be present throughout the soils beneath the site.

Groundwater was encountered during drilling between 0 (at the surface) and 90 feet bgs. Static water levels in the lowlying borings have been measured between approximately 0 and 4 feet bgs and at approximately 15 feet bgs and 14 feet bgs in Borings B-04 and B-09, respectively. Boring B-14 had two water level measurements because of the nested observation wells. The deep well had a static water level of approximately 86 feet bgs and the shallow well had a static water level of approximately 90 feet bgs. In addition, Boring B-06 has exhibited water flowing out of the monitoring well installed during subsequent visits to the site. Static levels have been measured in June and July, 2015, January, 2016, and in March, 2016 and are presented in Tables 1 and 2. It should be noted that zones of perched water may be encountered on top of impermeable or low permeability soils during periods of high precipitation or rapid snow melt. Likewise these zones of perched water may also be present within cleaner pockets of soil that may be encountered during site work. Note that groundwater levels may fluctuate by several feet seasonally, or during periods of high precipitation or rapid snowmelt.

7.0 CLOSURE AND 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 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.

If, during construction, subsurface conditions different from those encountered in these are observed or appear to be present, Shannon & Wilson, Inc. should be advised at once so that these conditions can be reviewed where necessary. If there is a substantial lapse of time between the submittal of this report and the start of work at the site, or if conditions have changed due to natural causes or construction operations at or adjacent to the site, it is recommended that this report be reviewed to determine the applicability of the conclusions considering the changed conditions and time lapse.

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.

The scope of our geotechnical services did not include evaluating potential impacts to natural resources, including wetlands, endangered species, or environmentally critical areas.

Shannon & Wilson has prepared the attachments in Appendix F *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.

Katra Wedeking

Digitally signed by Katra Wedeking
Date: 2016.08.29 15:13:01 -08'00'

Katra Wedeking, CPG
Senior Geologist

Kyle Brennan, P.E.
Vice President

TABLE 1
GROUNDWATER LEVELS BEFORE SURVEY DATA

	Static Water Level Depth (feet bgs)							
Date	**Boring B-01**	**Boring B-02**	**Boring B-03**	**Boring B-04**	**Boring B-06**	**Boring B-08**	**Boring B-09**	**Boring B-11**
6/2/2015	0.0	4.0	0.7	15.1	-1.5	-1.0	14.4	4.7
6/23/2015	0.0	4.1	0.9	15.2	-1.5	0.0	13.9	4.2
7/24/2015	0.1	0.4	0.9	15.2	-0.9	0.2	13.9	3.9
1/8/2016	Frozen	Frozen	Frozen	15.1	Frozen	Frozen	14.0	4.2

Notes:

[1]bgs = Below Ground Surface

[2]Water flowing above the ground surface is shown with a negative value.

[3]Water level measurements on this table were taken without survey data.

TABLE 2
GROUNDWATER LEVELS AND ELEVATIONS

Static Water Levels			
Monitoring Well	**Date**	**Groundwater Elevation[3] (feet)**	**Water Level (feet bgs[1])**
20	3/7/2016	215.90	11.29
21	3/7/2016	215.59	22.74
22	3/7/2016	216.38	34.82
23	3/7/2016	216.34	33.63
26	3/7/2016	215.72	14.66
27	3/7/2016	215.75	26.15
28	3/7/2016	219.54	31.96
33	3/7/2016	216.03	16.03
34	3/7/2016	216.65	24.40
39	3/7/2016	216.46	26.47
B-01	3/7/2016	216.07[5]	Frozen
B-03	3/7/2016	216.12[5]	Frozen
B-04	3/7/2016	217.66	14.88
B-06	3/7/2016	215.89[5]	Frozen
B-08	3/7/2016	215.10[5]	Frozen
B-09	3/7/2016	215.25	13.55
B-11	3/7/2016	214.98	3.73
B-13	3/7/2016	210.84[5]	Frozen
B-14[4] Deep	3/7/2016	219.15	86.03
B-14[4] Shallow	3/7/2016	215.47	89.82
MW-17	3/7/2016	214.11	33.93
MW-18	3/7/2016	213.42	36.05
MW-19	3/7/2016	208.05	0.06
MW-20A Red	3/7/2016	211.52	-1.37[2]
MW-20A Yellow	3/7/2016	209.69[5]	Frozen
MW-21A High	3/7/2016	212.91	2.46
MW-21A Low	3/7/2016	212.74	2.61
TB-7	3/7/2016	221.14	20.43
TW-1	3/7/2016	228.32	13.00
TW-2	3/7/2016	229.14	19.69
TW-3	3/7/2016	217.18	33.55

Notes:

[1]bgs = Below Ground Surface

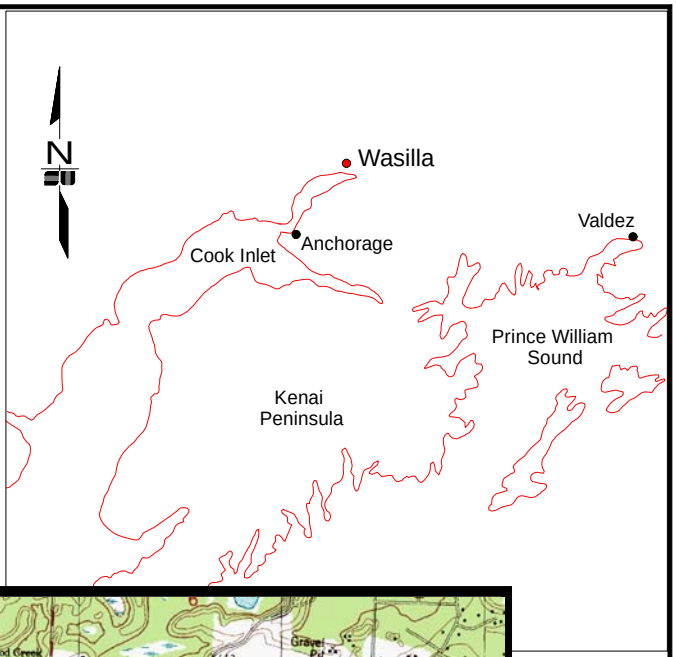
[2]Water flowing above the ground surface is shown with a negative value.

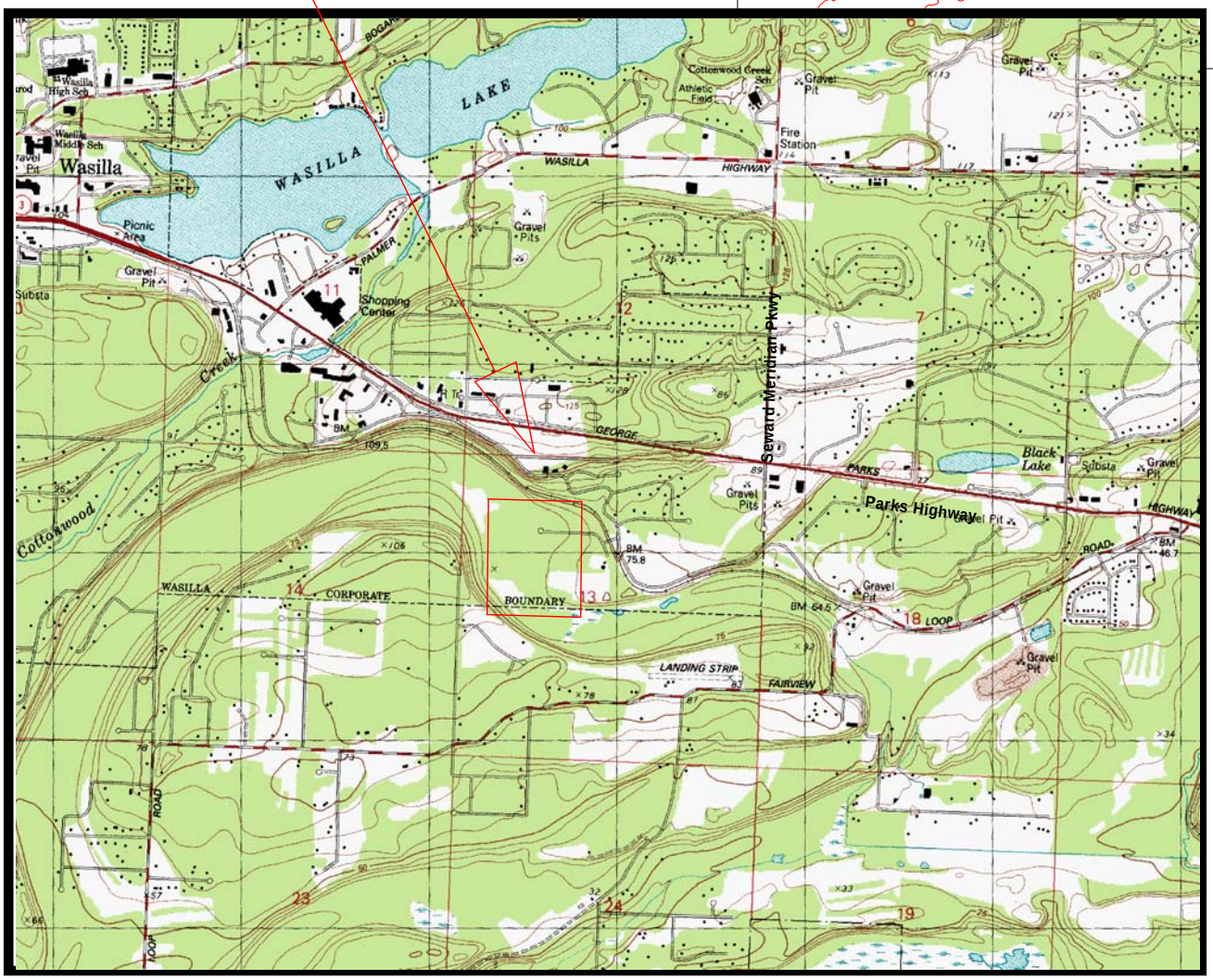
[3]Stantec survey data used in estimating groundwater elevations.

[4]Boring B-14 contains two nested piezometers for water level monitoring. The deep piezometer extends to approximately 149 feet bgs and the shallow piezometer extends to approximately 97 feet bgs. See boring log for well configuration details.

[5]Groundwater elevation assumed at approximate ground elevation due to frozen water conditions.

Approximate Project Location





Taken from Anchorage C-7 SE
U.S. Geological Survey Quadrangle

0 2500 5000 10000
APPROXIMATE SCALE IN FEET

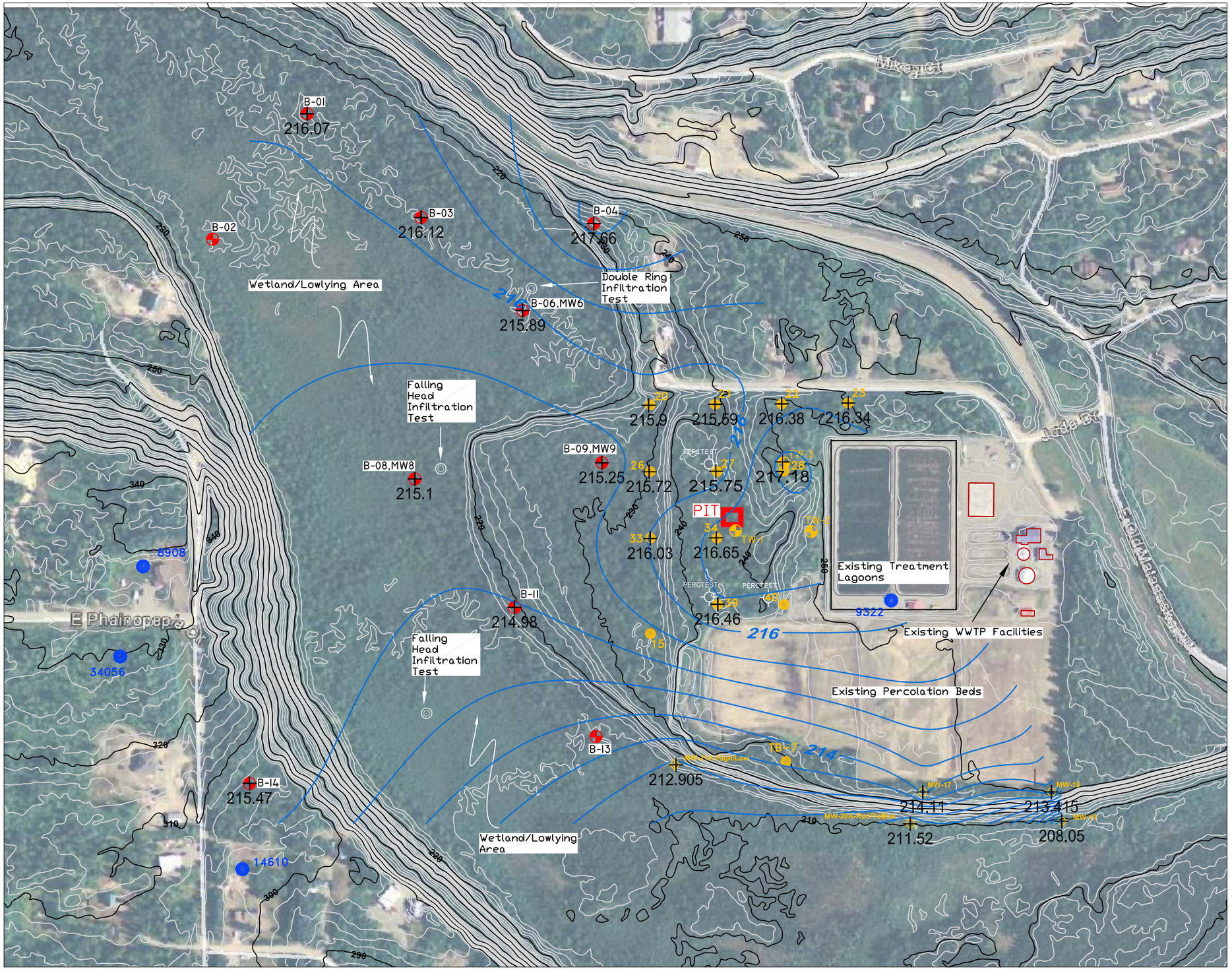
Wastewater Treatment Plant Improvements
Wasilla, Alaska

VICINITY MAP

June 2016 32-1-02452

SHANNON & WILSON, INC.
Geotechnical & Environmental Consultants

FIG. 1



LEGEND

- B-01 — Approximate location of Boring B-01 advanced by Shannon & Wilson, Inc., March/May 2015 and February 2016
- PIT — Approximate location of Pilot Infiltration Test conducted by Shannon & Wilson, Inc., July 2015
- TW-2 — Approximate location of Boring and Monitoring Well TW-2 advanced by Shannon & Wilson, Inc., August 2007
- PERCTEST — Approximate location of Percolation test conducted between 2.5 - 4 feet bgs with rates ranging from 0.07 to 1.4 min/in by Shannon & Wilson, Inc., August 2007
- 15 — Approximate location of Test Boring 15 by Gilfillian Engineering, Inc., May/October 1986
- 3908 — Approximate location of private well 3908
- 215.1 — Approximate Groundwater elevation used for contour generation
- Groundwater Contours, 0.5-foot Interval
- Topographic Contours, 2-foot Interval.

NOTES

1. Basemap imagery provided by Google Earth Pro, reproduced by permission granted by Google Earth™ Mapping Service.
2. Topographic contours from MatSu Borough GIS online database.

0 150 300 600
APPROXIMATE SCALE IN FEET

N

Wastewater Treatment Plant Improvements
Wasilla, Alaska

SITE PLAN

June 2016 32-1-02452

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. 2

APPENDIX A

BORING LOGS AND LABORATORY TEST RESULTS

FIGURES

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.

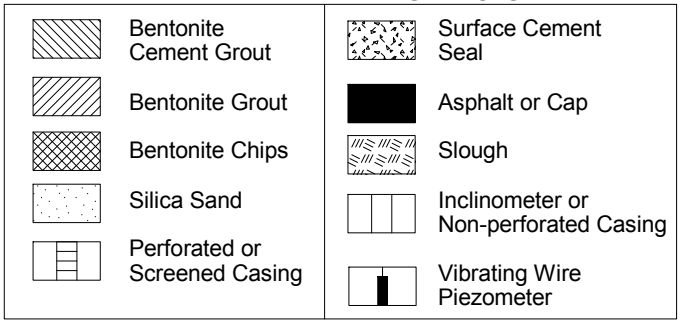
PARTICLE SIZE DEFINITIONS

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



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.

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Wastewater Treatment Plant Improvements
Wasilla, Alaska

SOIL DESCRIPTION AND LOG KEY

June 2016 32-1-02452

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. A-1
Sheet 1 of 3

2013_BORING_CLASS1_02452.GINT.GPJ SWNEW.GDT 6/7/16

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.

Wastewater Treatment Plant Improvements
Wasilla, Alaska

SOIL DESCRIPTION AND LOG KEY

June 2016 32-1-02452

SHANNON & WILSON, INC.
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FIG. A-1
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.

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Wastewater Treatment Plant Improvements
Wasilla, Alaska

SOIL DESCRIPTION AND LOG KEY

June 2016 32-1-02452

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FIG. A-1
Sheet 3 of 3

2013_BORING_CLASS3_02452.GINT.GPJ SWNEW.GDT 6/7/16

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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	Over 15	Over 19	ML, MH
	Very fine silty sands**			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

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

*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

Wastewater Treatment Plant Improvements
Wasilla, Alaska

FROST CLASSIFICATION LEGEND

June 2016 32-1-02452

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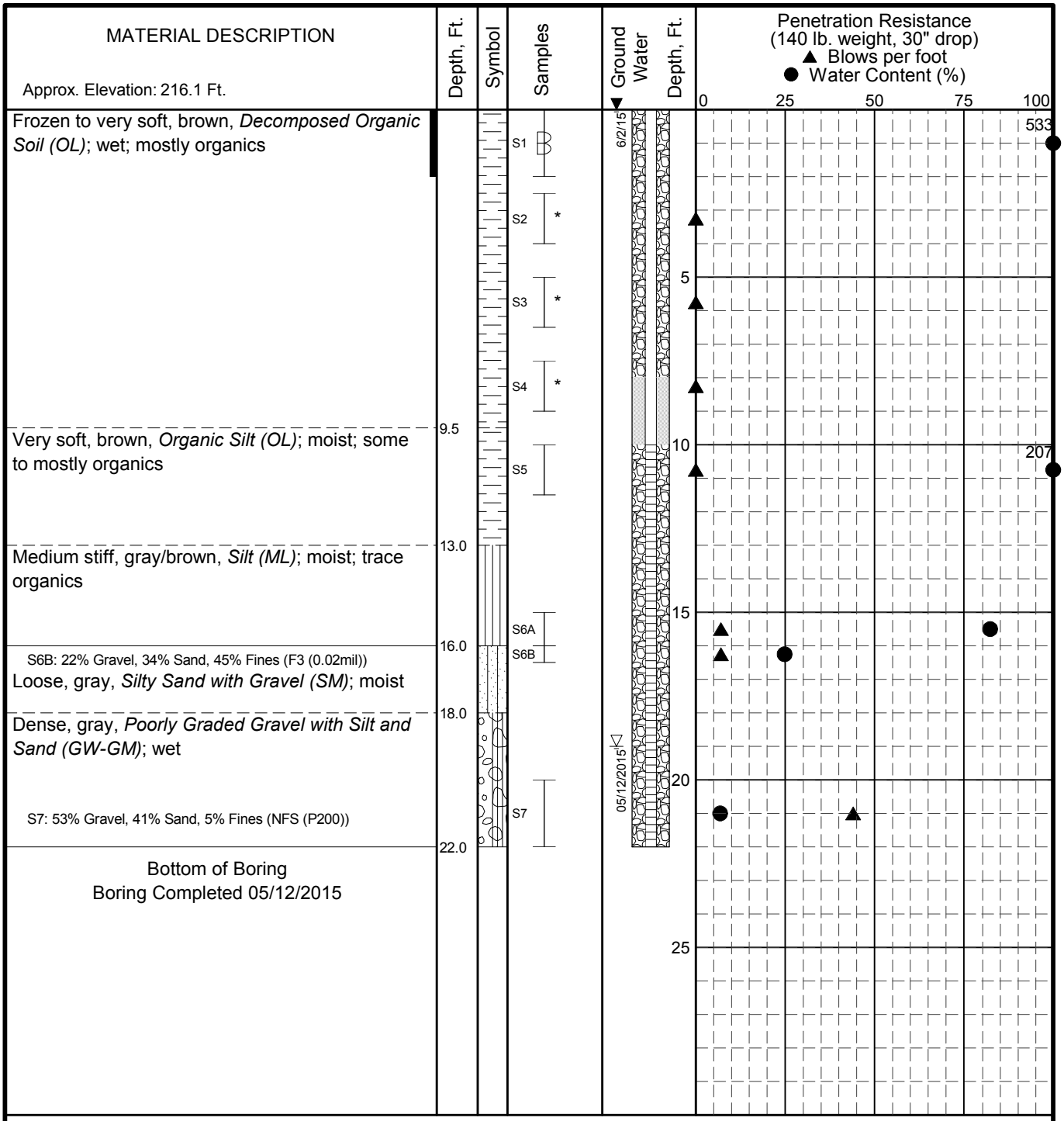
FIG. A-2



LEGEND

- * Sample Not Recovered
- Grab Sample
- 2" O.D. Split Spoon Sample
- 3" O.D. Split Spoon Sample
- Frozen
- Ground Water Level At Time Of Drilling
- Static Water Level
- Blank Section, Cuttings Backfill
- Blank Casing, Annular Seal
- Slotted Casing, Filter Sand
- Grouted Bottom Seal

● Water Content (%)
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.

Wastewater Treatment Plant Improvements
Wasilla, Alaska

LOG OF BORING B-01

June 2016 32-1-02452

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FIG. A-3

GEOTECHNICAL LOG 02452 GINT.GPJ S&W_GEO1.GDT 6/7/16

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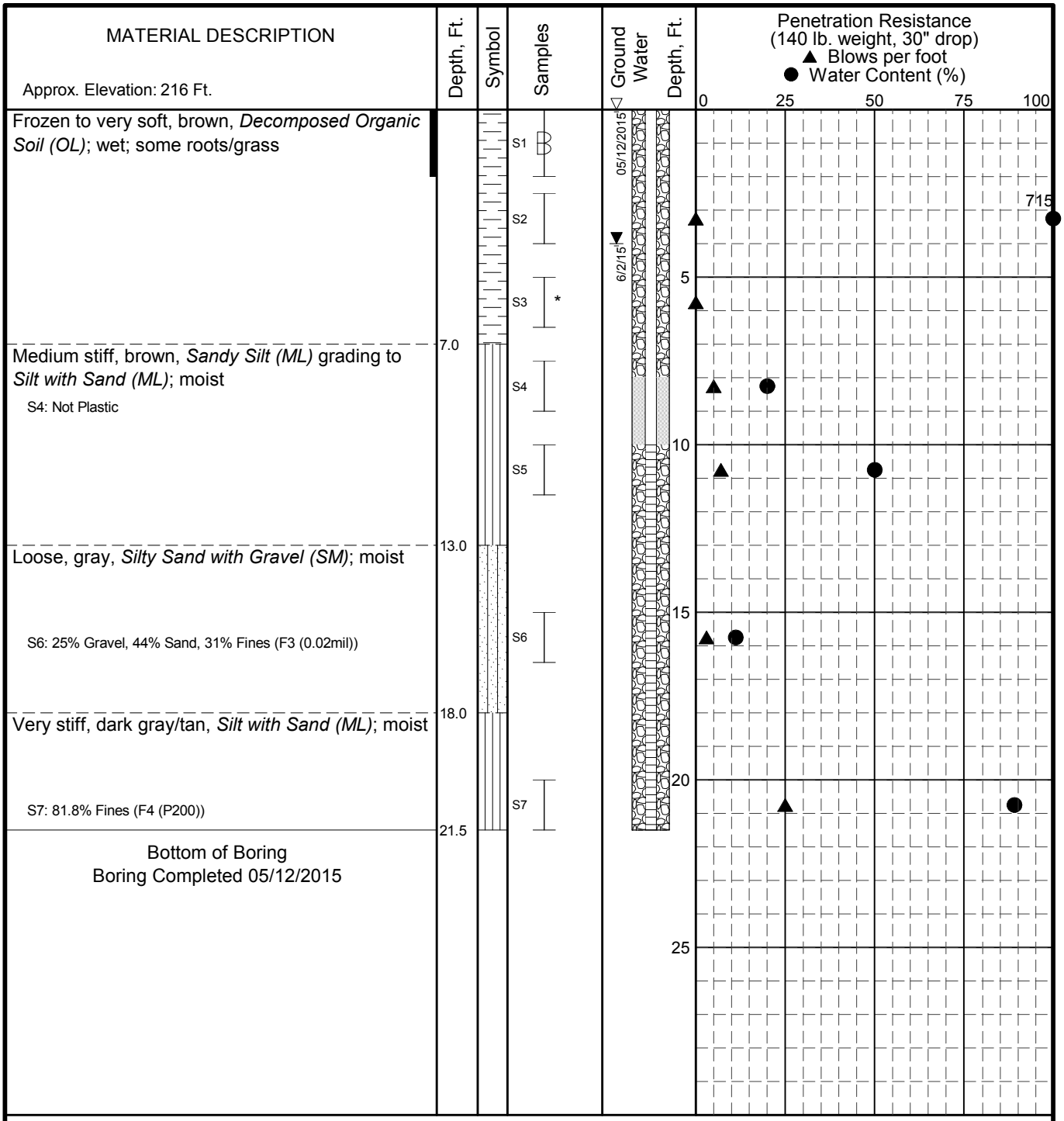

LEGEND

* Sample Not Recovered	Ground Water Level At Time Of Drilling
Grab Sample	Static Water Level
2" O.D. Split Spoon Sample	Blank Section, Cuttings Backfill
3" O.D. Split Spoon Sample	Blank Casing, Annular Seal
Frozen	Slotted Casing, Filter Sand
	Grouted Bottom Seal

● Water Content (%)
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.

Wastewater Treatment Plant Improvements
Wasilla, Alaska

LOG OF BORING B-02

June 2016 32-1-02452

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FIG. A-4

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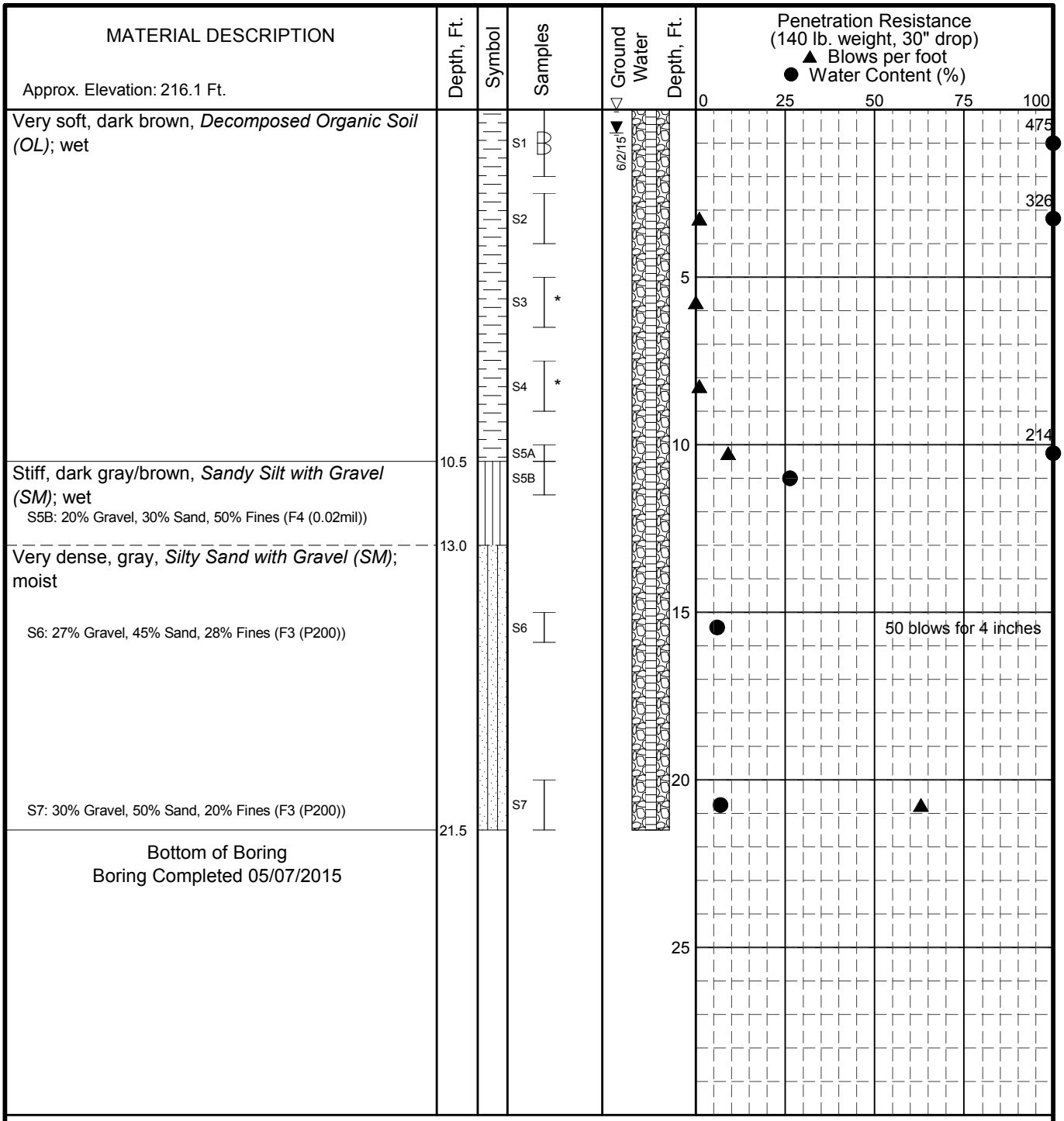

LEGEND

- * Sample Not Recovered
- Grab Sample
- 2" O.D. Split Spoon Sample
- 3" O.D. Split Spoon Sample
- Ground Water Level At Time Of Drilling
- Static Water Level
- Blank Section, Cuttings Backfill
- Blank Casing, Annular Seal
- Slotted Casing, Filter Sand
- Grouted Bottom Seal

● Water Content (%)
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.

Wastewater Treatment Plant Improvements
Wasilla, Alaska

LOG OF BORING B-03

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FIG. A-5

GEOTECHNICAL LOG 02452 GINT.GPJ S&W_GEO1.GDT 6/7/16

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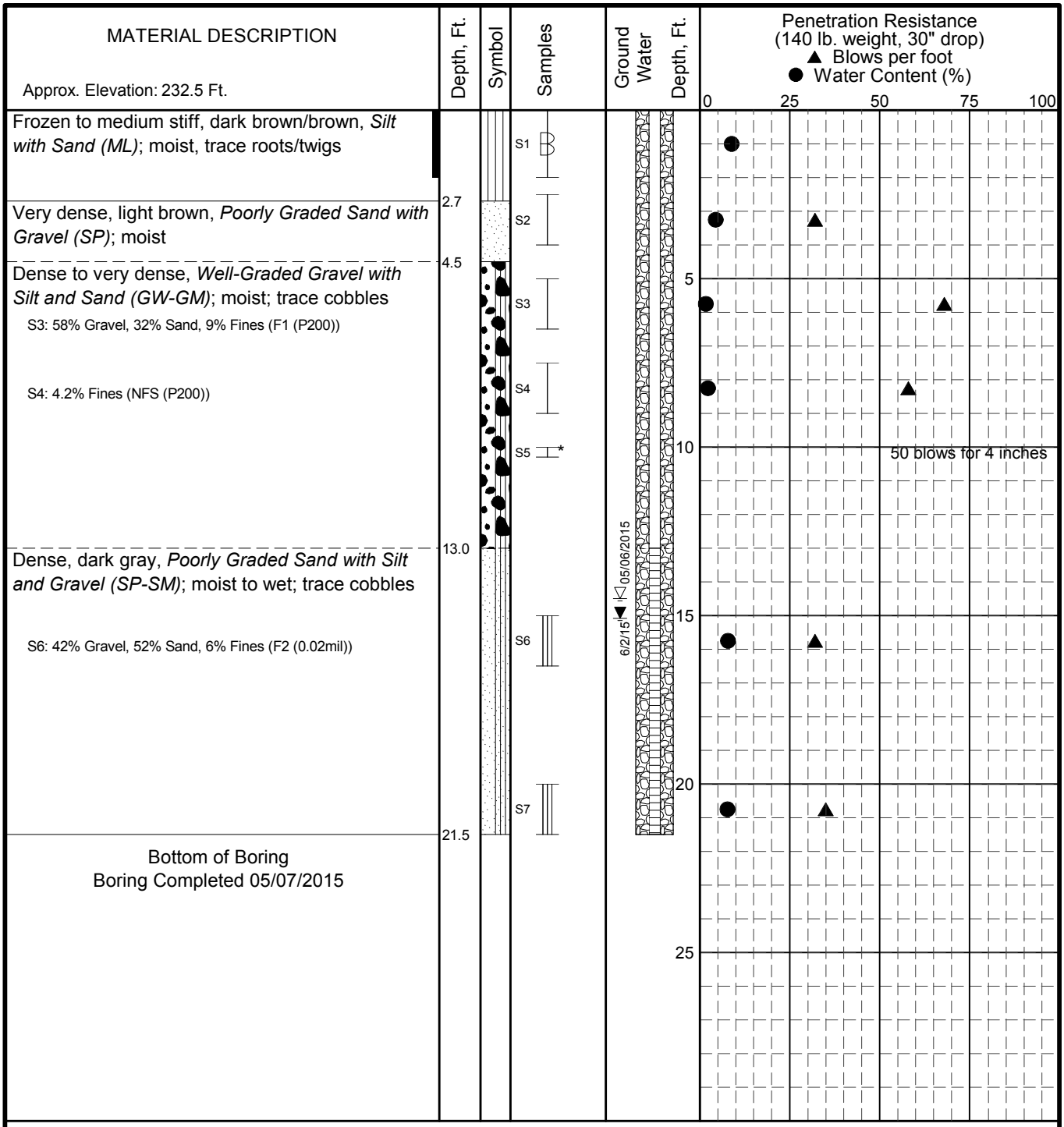

LEGEND

* Sample Not Recovered	Ground Water Level At Time Of Drilling
Grab Sample	Static Water Level
2" O.D. Split Spoon Sample	Blank Section, Cuttings Backfill
3" O.D. Split Spoon Sample	Blank Casing, Annular Seal
Frozen	Slotted Casing, Filter Sand
	Grouted Bottom Seal

● Water Content (%)
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.

Wastewater Treatment Plant Improvements
Wasilla, Alaska

LOG OF BORING B-04

June 2016 32-1-02452

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FIG. A-6

GEOTECHNICAL LOG 02452 GINT.GPJ S&W_GEO1.GDT 6/7/16

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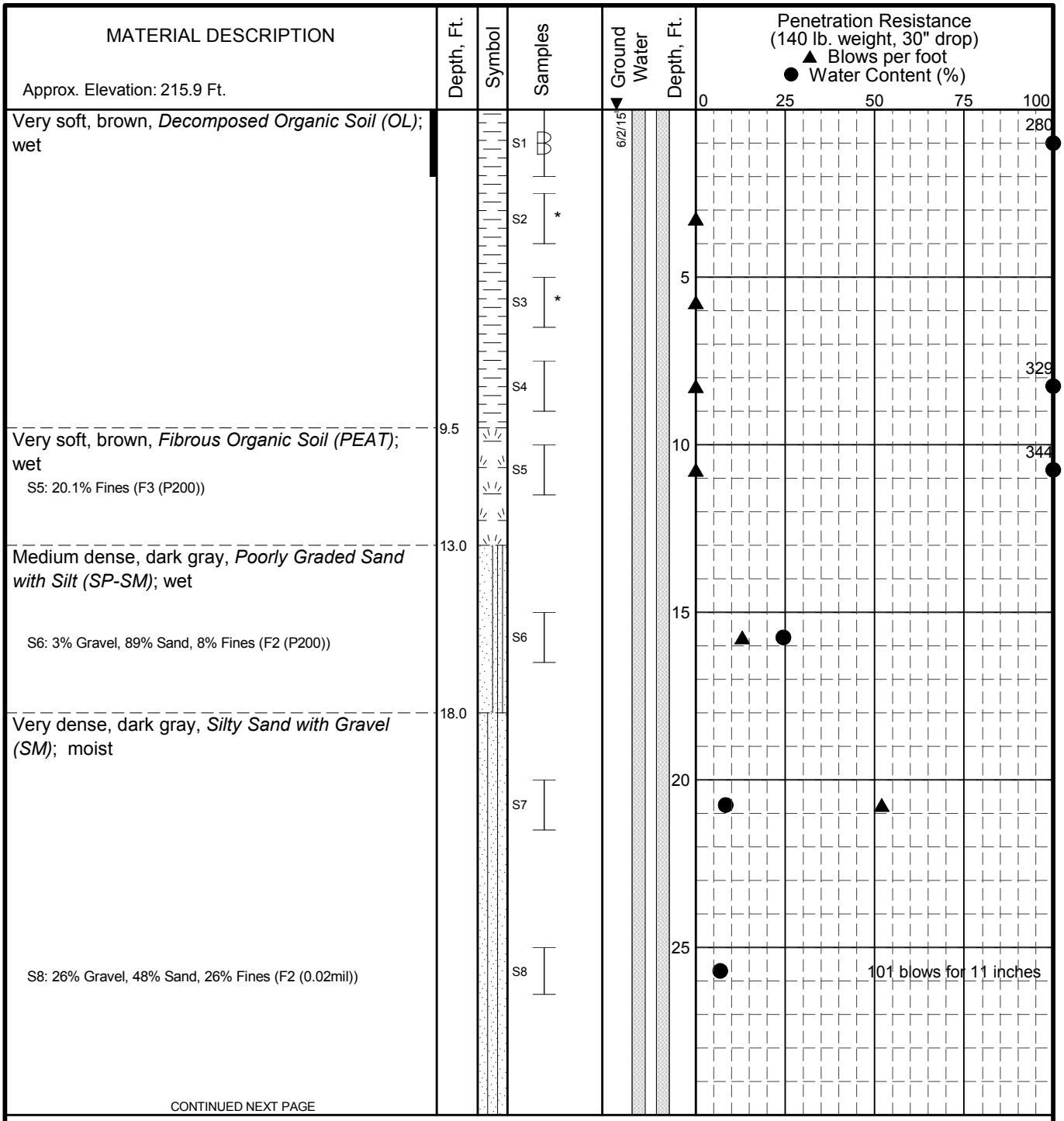

LEGEND

* Sample Not Recovered	Ground Water Level At Time Of Drilling
Grab Sample	Static Water Level
2" O.D. Split Spoon Sample	Blank Section, Cuttings Backfill
3" O.D. Split Spoon Sample	Blank Casing, Annular Seal
Frozen	Slotted Casing, Filter Sand
	Grouted Bottom Seal

● Water Content (%)
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.

Wastewater Treatment Plant Improvements
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LOG OF BORING B-06

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FIG. A-7
Sheet 1 of 2

GEOTECHNICAL LOG 02452 GINT.GPJ S&W_GEO1.GDT 6/7/16

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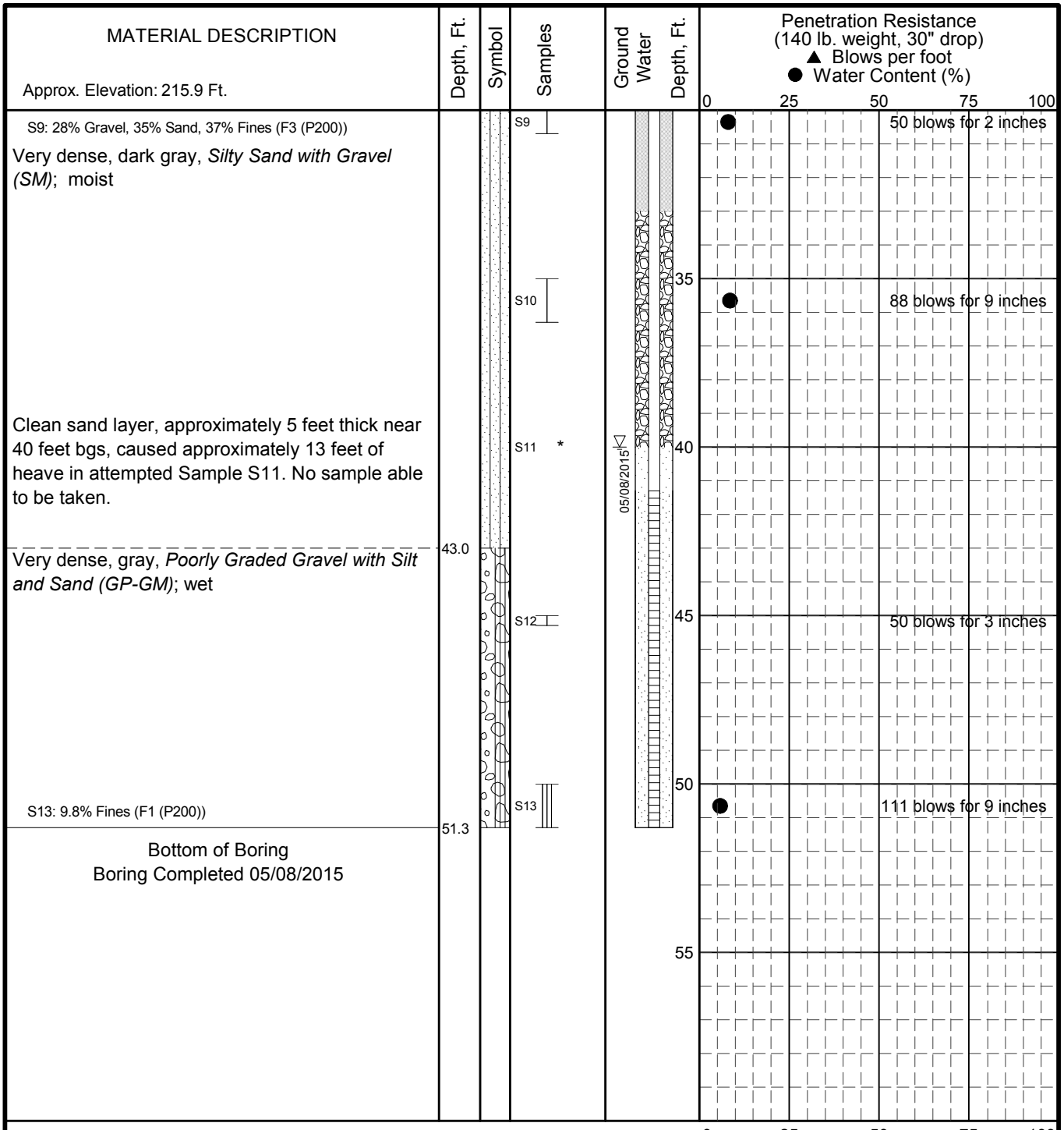

LEGEND

* Sample Not Recovered	Ground Water Level At Time Of Drilling
Grab Sample	Static Water Level
2" O.D. Split Spoon Sample	Blank Section, Cuttings Backfill
3" O.D. Split Spoon Sample	Blank Casing, Annular Seal
Frozen	Slotted Casing, Filter Sand
	Grouted Bottom Seal

● Water Content (%)
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.

Wastewater Treatment Plant Improvements
Wasilla, Alaska

LOG OF BORING B-06

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FIG. A-7
Sheet 2 of 2

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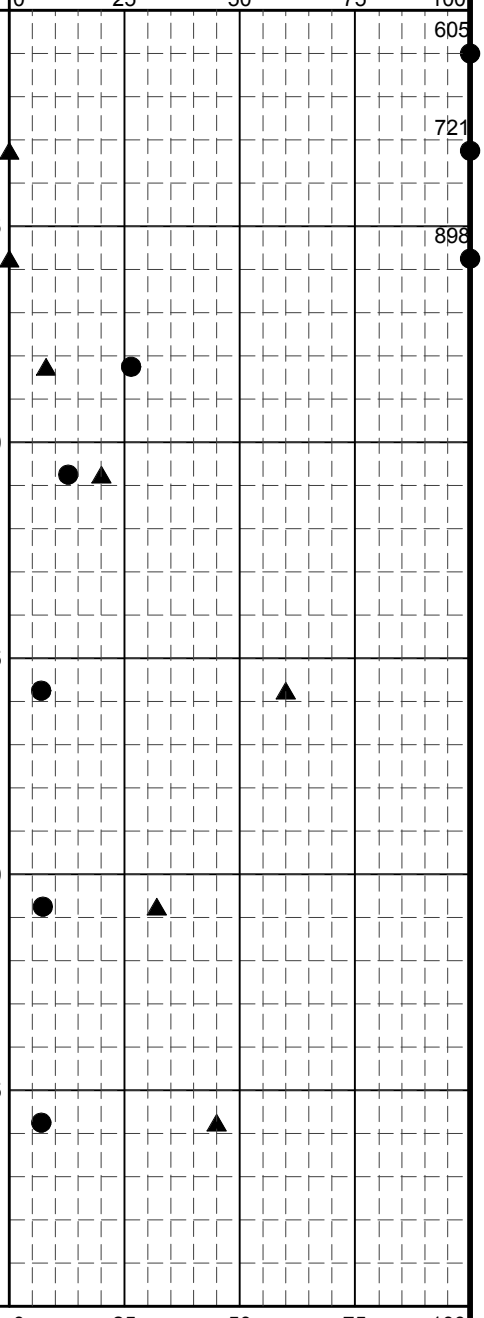
MATERIAL DESCRIPTION Approx. Elevation: 215.1 Ft.	Depth, Ft.	Symbol	Samples
Frozen to very soft, brown, *Decomposed Organic Soil (OL)*; wet			S1, S2, S3
Medium stiff, gray/brown, *Silt with Sand (ML)*; moist; trace organics S4: Not Plastic	7.0		S4
Medium dense, gray, *Poorly Graded Sand with Silt and Gravel (SP-SM)*; wet S5: 27% Gravel, 68% Sand, 5% Fines (NFS (P200))	9.5		S5
Very dense, gray, *Poorly Graded Gravel with Silt and Sand (GP-GM)*; wet; trace cobbles S6: 48% Gravel, 41% Sand, 11% Fines (F2 (0.02mil))	13.0		S6, S7
Dense to very dense, gray, *Poorly Graded Sand with Silt and Gravel (SP-SM)* grading to *Poorly Graded Sand with Gravel (SP)*; wet	23.0		S8

CONTINUED NEXT PAGE

Ground Water Depth, Ft.: 6/2/15 ▽ 05/11/2015

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



LEGEND

- * Sample Not Recovered
- Grab Sample
- 2" O.D. Split Spoon Sample
- 3" O.D. Split Spoon Sample
- Frozen
- ▽ Ground Water Level At Time Of Drilling
- ▼ Static Water Level
- Blank Section, Cuttings Backfill
- Blank Casing, Annular Seal
- Slotted Casing, Filter Sand
- Grouted Bottom Seal

● Water Content (%)
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.

Wastewater Treatment Plant Improvements
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LOG OF BORING B-08

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FIG. A-8
Sheet 1 of 2

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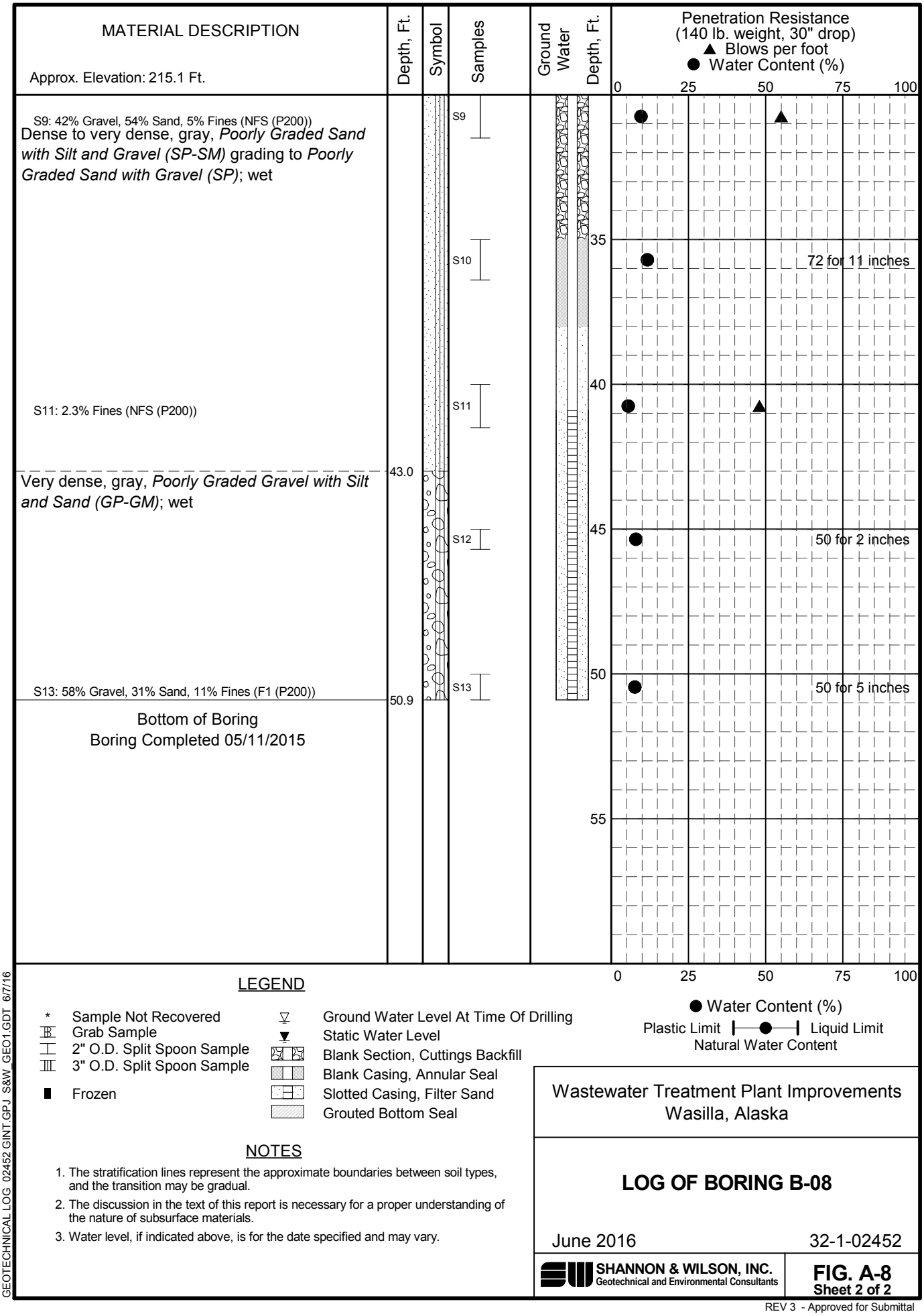
MATERIAL DESCRIPTION
Approx. Elevation: 215.1 Ft.
Depth, Ft.
Symbol
Samples
Ground Water
Depth, Ft.
Penetration Resistance
(140 lb. weight, 30" drop)
▲ Blows per foot
● Water Content (%)
0
25
50
75
100
S9: 42% Gravel, 54% Sand, 5% Fines (NFS (P200))
Dense to very dense, gray, Poorly Graded Sand with Silt and Gravel (SP-SM) grading to Poorly Graded Sand with Gravel (SP); wet
S9
S10
35
72 for 11 inches
S11: 2.3% Fines (NFS (P200))
S11
40
43.0
Very dense, gray, Poorly Graded Gravel with Silt and Sand (GP-GM); wet
S12
45
50 for 2 inches
S13: 58% Gravel, 31% Sand, 11% Fines (F1 (P200))
S13
50
50 for 5 inches
50.9
Bottom of Boring
Boring Completed 05/11/2015
55
LEGEND
* Sample Not Recovered
Grab Sample
2" O.D. Split Spoon Sample
3" O.D. Split Spoon Sample
Frozen
Ground Water Level At Time Of Drilling
Static Water Level
Blank Section, Cuttings Backfill
Blank Casing, Annular Seal
Slotted Casing, Filter Sand
Grouted Bottom Seal
● Water Content (%)
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.
Wastewater Treatment Plant Improvements
Wasilla, Alaska
LOG OF BORING B-08
June 2016
32-1-02452
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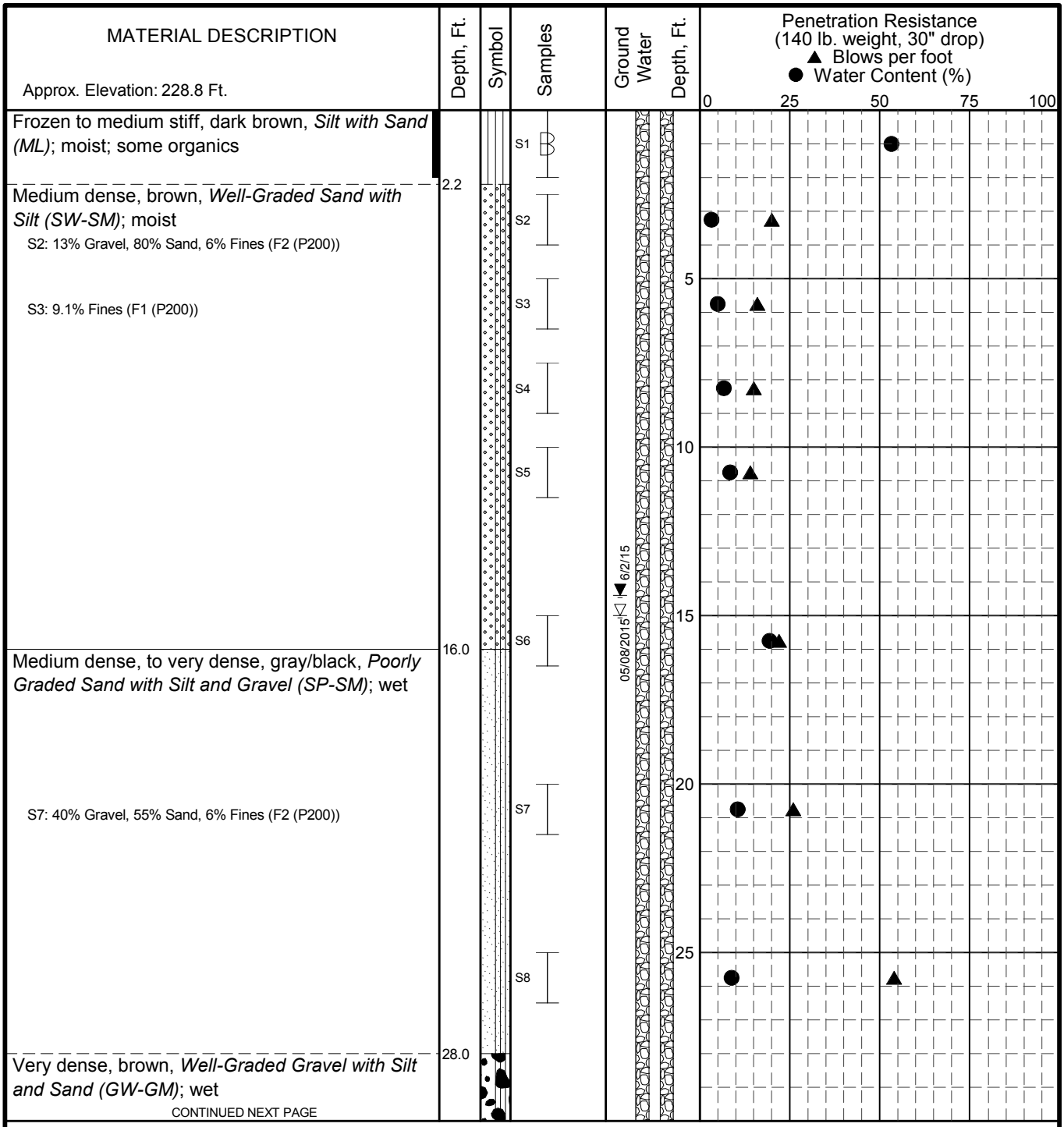
FIG. A-8
Sheet 2 of 2
GEOTECHNICAL LOG 02452 GINT.GPJ S&W_GEO1.GDT 6/7/16
REV 3 - Approved for Submittal



LEGEND

- * Sample Not Recovered
- Grab Sample
- 2" O.D. Split Spoon Sample
- 3" O.D. Split Spoon Sample
- Frozen
- Ground Water Level At Time Of Drilling
- Static Water Level
- Blank Section, Cuttings Backfill
- Blank Casing, Annular Seal
- Slotted Casing, Filter Sand
- Grouted Bottom Seal

● Water Content (%)
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.

Wastewater Treatment Plant Improvements
Wasilla, Alaska

LOG OF BORING B-09

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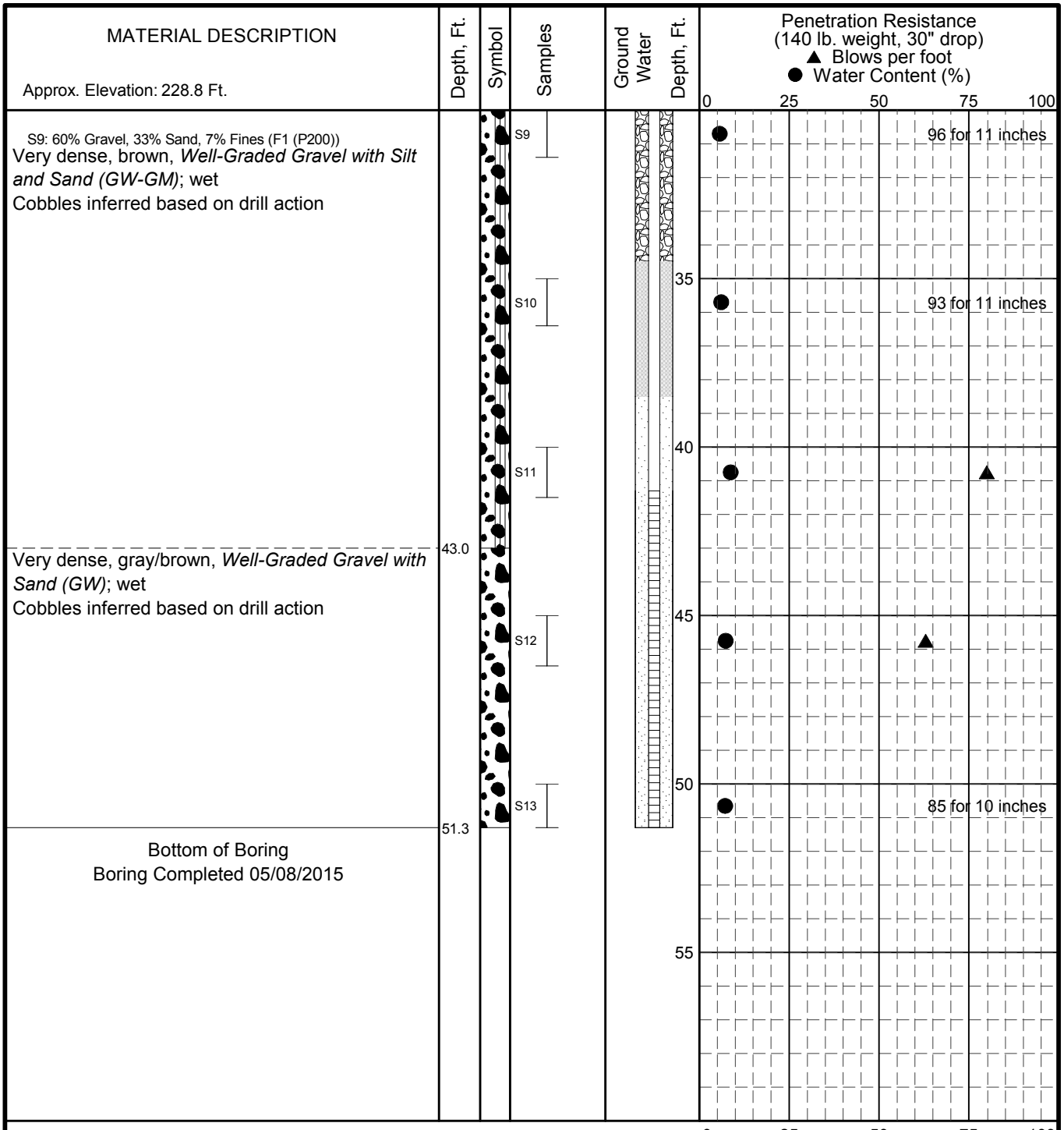
FIG. A-9
Sheet 1 of 2

REV 3 - Approved for Submittal

GEOTECHNICAL LOG 02452 GINT.GPJ S&W_GEO1.GDT 6/7/16



LEGEND

* Sample Not Recovered	Ground Water Level At Time Of Drilling
Grab Sample	Static Water Level
2" O.D. Split Spoon Sample	Blank Section, Cuttings Backfill
3" O.D. Split Spoon Sample	Blank Casing, Annular Seal
Frozen	Slotted Casing, Filter Sand
	Grouted Bottom Seal

● Water Content (%)
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.

Wastewater Treatment Plant Improvements
Wasilla, Alaska

LOG OF BORING B-09

June 2016 32-1-02452

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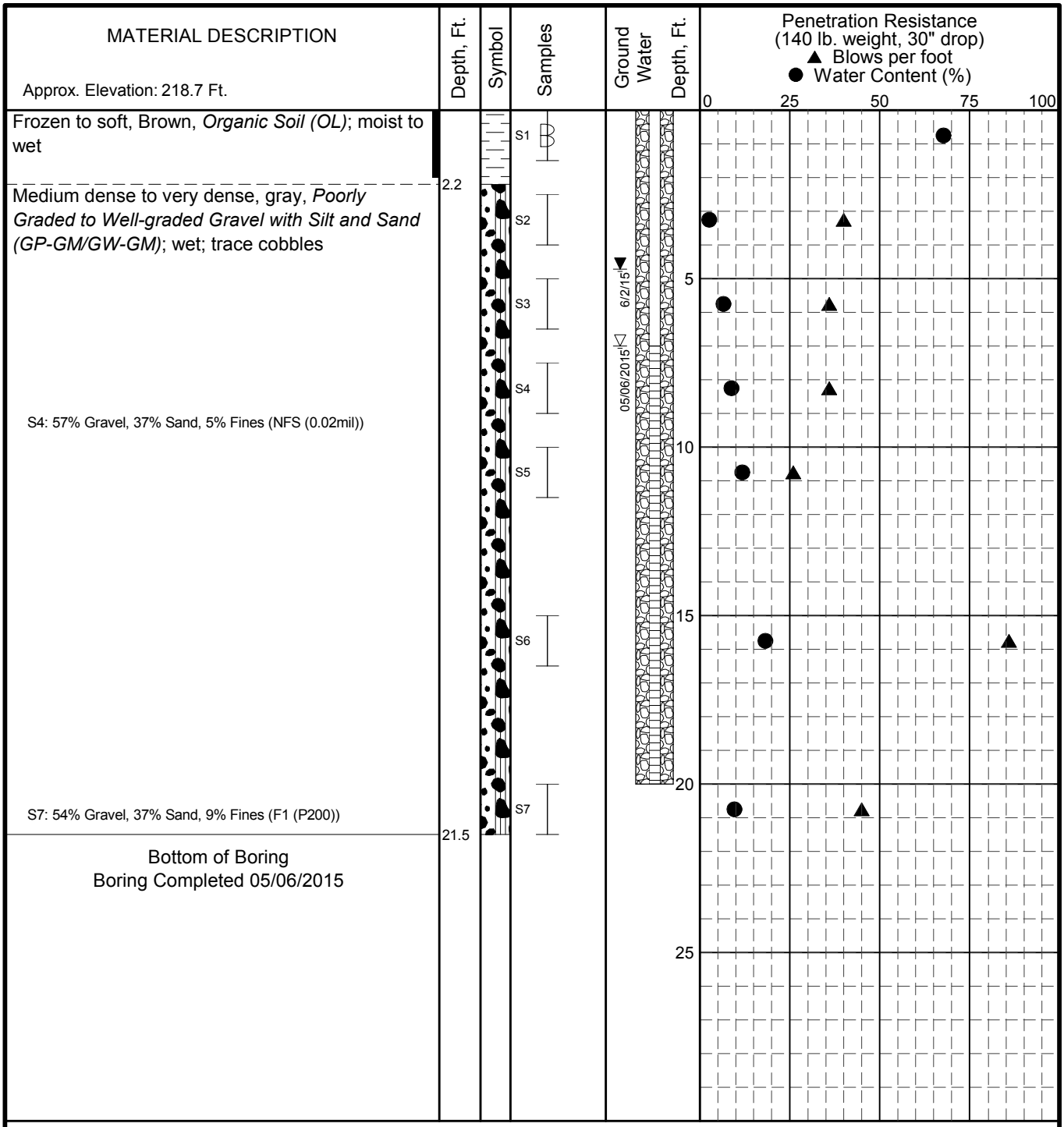
FIG. A-9
Sheet 2 of 2

GEOTECHNICAL LOG 02452 GINT.GPJ S&W_GEO1.GDT 6/7/16

REV 3 - Approved for Submittal



LEGEND

* Sample Not Recovered	Ground Water Level At Time Of Drilling
Grab Sample	Static Water Level
2" O.D. Split Spoon Sample	Blank Section, Cuttings Backfill
3" O.D. Split Spoon Sample	Blank Casing, Annular Seal
Frozen	Slotted Casing, Filter Sand
	Grouted Bottom Seal

● Water Content (%)
Plastic Limit — Liquid Limit
Natural Water Content

NOTES

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Wastewater Treatment Plant Improvements
Wasilla, Alaska

LOG OF BORING B-11

June 2016 32-1-02452

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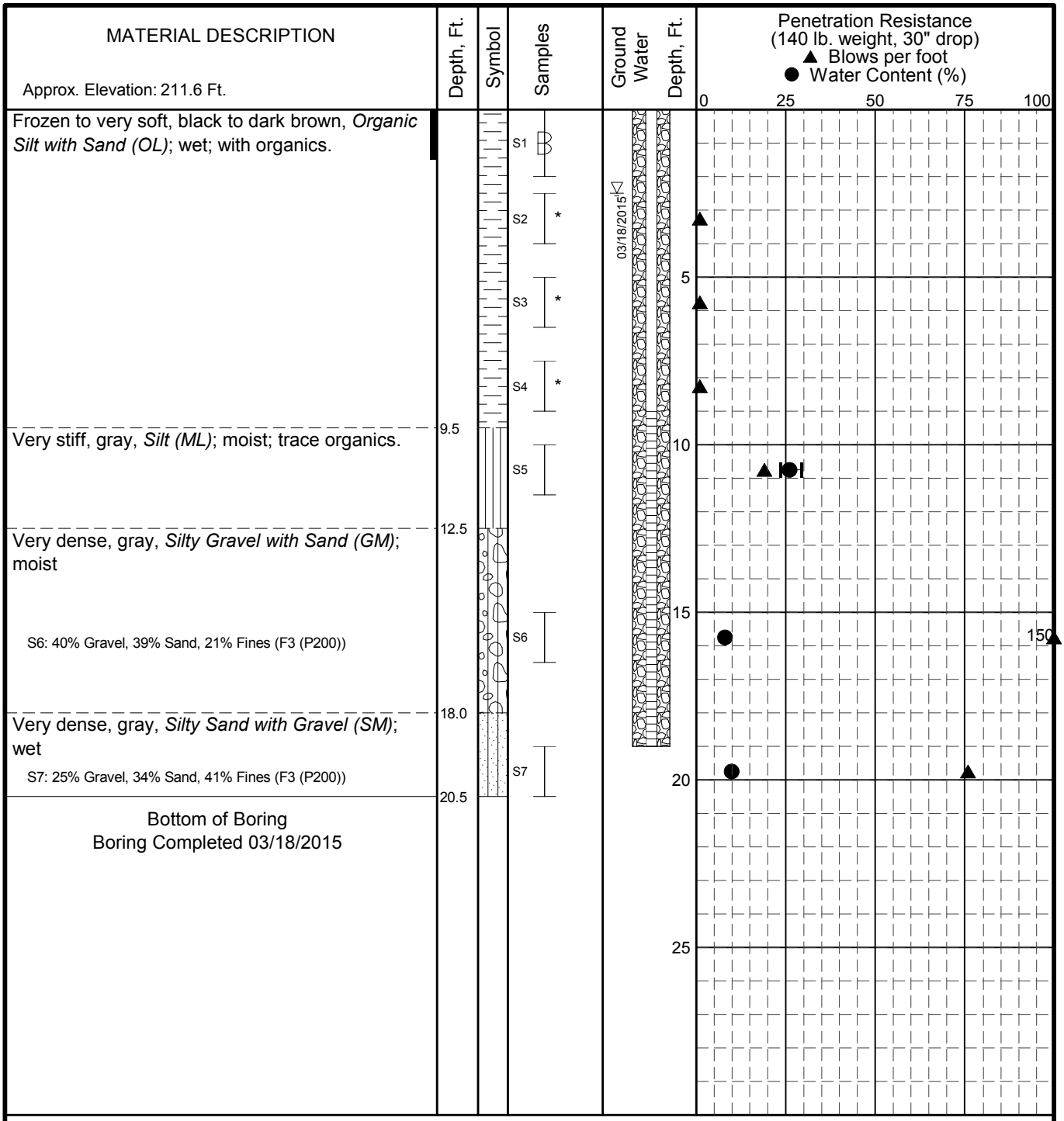
FIG. A-10

GEOTECHNICAL LOG 02452 GINT.GPJ S&W_GEO1.GDT 6/7/16

REV 3 - Approved for Submittal



LEGEND

- * Sample Not Recovered
- Grab Sample
- 2" O.D. Split Spoon Sample
- 3" O.D. Split Spoon Sample
- Frozen
- Ground Water Level At Time Of Drilling
- Blank Section, Cuttings Backfill
- Blank Casing, Annular Seal
- Slotted Casing, Filter Sand
- Grouted Bottom Seal

● Water Content (%)
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.
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Wastewater Treatment Plant Improvements
Wasilla, Alaska

LOG OF BORING B-13

June 2016 32-1-02452

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FIG. A-11

GEOTECHNICAL LOG 02452 GINT.GPJ S&W_GEO1.GDT 6/7/16

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MATERIAL DESCRIPTION Approx. Elevation: 305.1 Ft.	Depth, Ft.	Symbol	Samples	Ground Water	Depth, Ft.	Penetration Resistance (340 lb. weight, 30" drop) ▲ Blows per foot ● Water Content (%)
Organic Mat	1.0					
Dense to very dense, brown, *Silty Sand with Gravel (SM)*; moist; cobbles and possible boulders based on drill action			S1 S2 S3 S4 S5 S6 * S7 *		5 10 15 20 25 30 35	78 blows for 9 inches 83 blows for 9 inches 50 blows for 5 inches 15 blows for 0 inches 20 blows for 0 inches
Very dense, gray, *Silty Sand with Gravel (SM)*; moist	37.0		S8 S9 S10 S11 S12 S13 *		40 45 50 55 60 65	62 blows for 7 inches 25 blows for 2 inches 78 blows for 10 inches 128 blows for 17 inches 50 blows for 5 inches 50 blows for 3 inches
Very dense, gray, *Poorly Graded Gravel with Sand (GP)*; moist	68.0		S14 S15		70 75	65 blows for 4 inches 65 blows for 3 inches
	78.0					

CONTINUED NEXT PAGE

0 25 50 75 100

● Water Content (%)
Plastic Limit ⊢●⊣ Liquid Limit
Natural Water Content

LEGEND

* Sample Not Recovered
3" O.D. Split Spoon Sample
Ground Water Level At Time Of Drilling
Static Water Level
Blank Section, Cuttings Backfill
Blank Casing, Annular Seal
Slotted Casing, Filter Sand
Grouted Bottom Seal

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.

Wastewater Treatment Plant Improvements
Wasilla, Alaska

LOG OF BORING B-14

June 2016 32-1-02452

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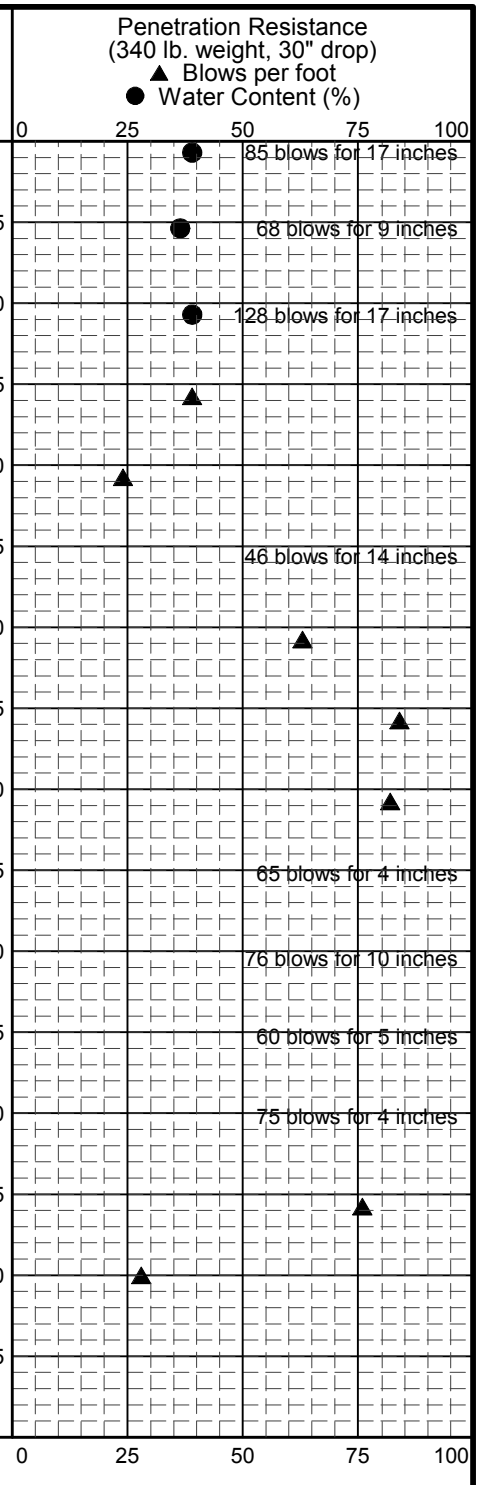
FIG. A-12
Sheet 1 of 2

DRAFT

REV 3 - Approved for Submittal

GEOTECHNICAL LOG 02452 GINT.GPJ S&W_GEO1.GDT 7/7/16

MATERIAL DESCRIPTION Approx. Elevation: 305.1 Ft.	Depth, Ft.	Symbol	Samples	Ground Water Depth, Ft.
Very dense, gray, *Poorly Graded Sand (SP)*; moist to wet	83.0		S16	
Very dense, gray, *Poorly Graded Gravel with Sand (GP)*; moist	88.0		S17	
Dense to very dense, gray, *Well-Graded Sand with Silt (SW-SM); wet* S19: 8% Gravel, 83% Sand, 9% Fines			S18 S19 S20 S21	02/19/2016 3/9/2016
Very dense, brown to gray, *Silty Sand (SM)*; moist to wet S23: 0% Gravel, 86% Sand, 14% Fines	108.0		S22 S23 S24	
Very dense, gray, *Silty Gravel with Sand (GM) to Silty Sand with Gravel (SM)*; moist to wet S25: 43% Gravel, 35% Sand, 21% Fines Sample S25 test results are a composite of Sample S25, S27, and S28	124.0		S25 S26 S27 S28	
Bottom of Boring Boring Completed 02/23/0216	151.0		S29 S30	



LEGEND

* Sample Not Recovered
3" O.D. Split Spoon Sample
Ground Water Level At Time Of Drilling
Static Water Level
Blank Section, Cuttings Backfill
Blank Casing, Annular Seal
Slotted Casing, Filter Sand
Grouted Bottom Seal

● Water Content (%)
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.

Wastewater Treatment Plant Improvements
Wasilla, Alaska

LOG OF BORING B-14

June 2016 32-1-02452

SHANNON & WILSON, INC.
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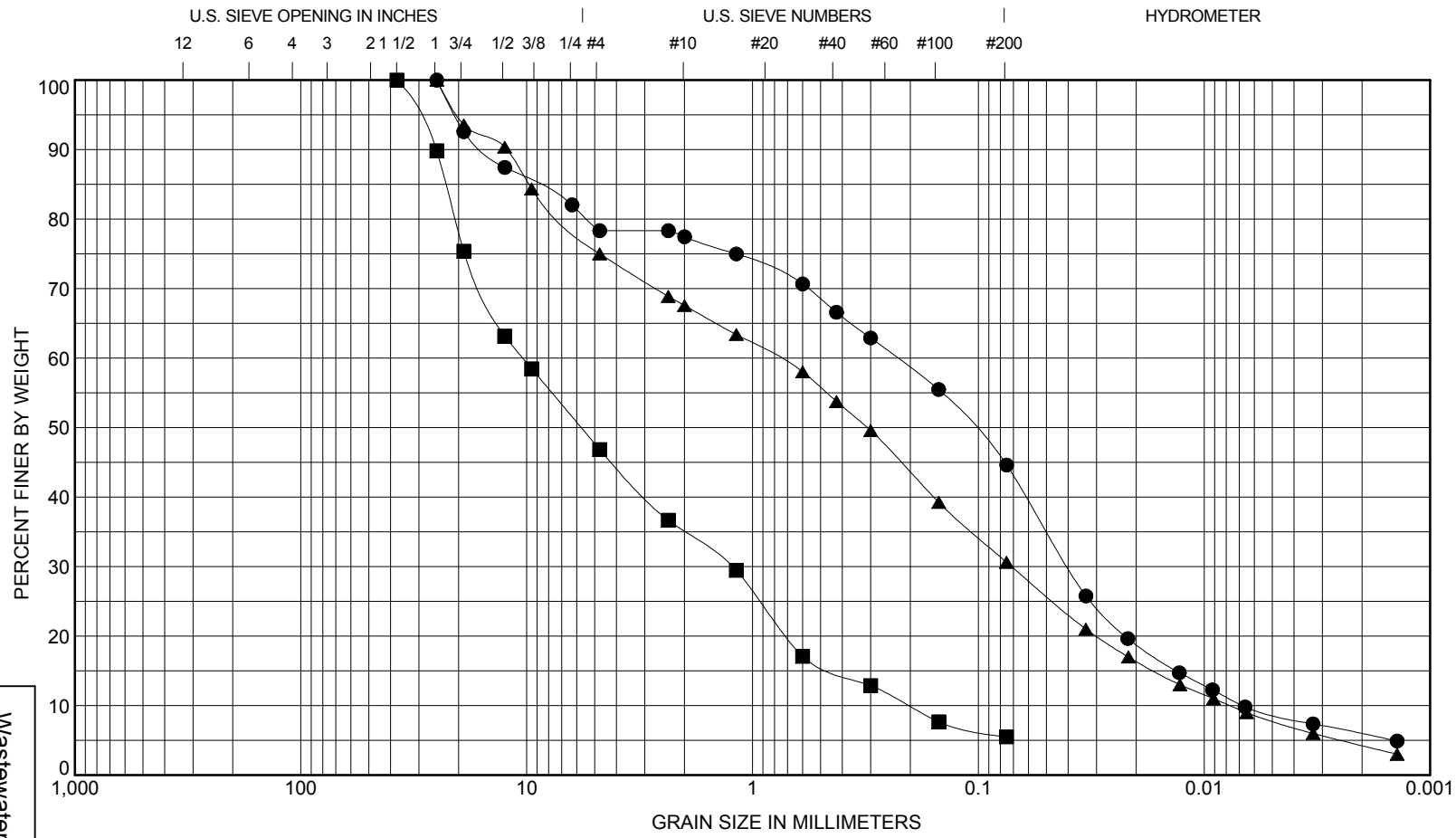
FIG. A-12
Sheet 2 of 2

DRAFT

REV 3 - Approved for Submittal

GEOTECHNICAL LOG 02452 GINT.GPJ S&W_GEO1.GDT 7/7/16



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Sample		Depth, Ft	Classification	LL	PL	PI	Cc	Cu
●	B-01 S6b	15.0 - 15.5	**Silty Sand with Gravel (SM)**				**1.0**	**33.8**
■	B-01 S7	20.0 - 21.5	**Poorly Graded Gravel with Silt and Sand (GP-GM)**				**0.7**	**50.7**
▲	B-02 S6	15.0 - 16.5	**Silty Sand with Gravel (SM)**				**0.9**	**100.0**

Sample		Depth, Ft	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	B-01 S6b	15.0 - 15.5	**25**	**0.23**	**0.04**	**0.01**	**22**	**34**	**45**	
■	B-01 S7	20.0 - 21.5	**37.5**	**10.39**	**1.24**	**0.2**	**53**	**41**	**5**	
▲	B-02 S6	15.0 - 16.5	**25**	**0.77**	**0.07**	**0.01**	**25**	**44**	**31**	

Wastewater Treatment Plant Improvements
Wasilla, Alaska

GRAIN SIZE CLASSIFICATION

June 2016

32-1-02452

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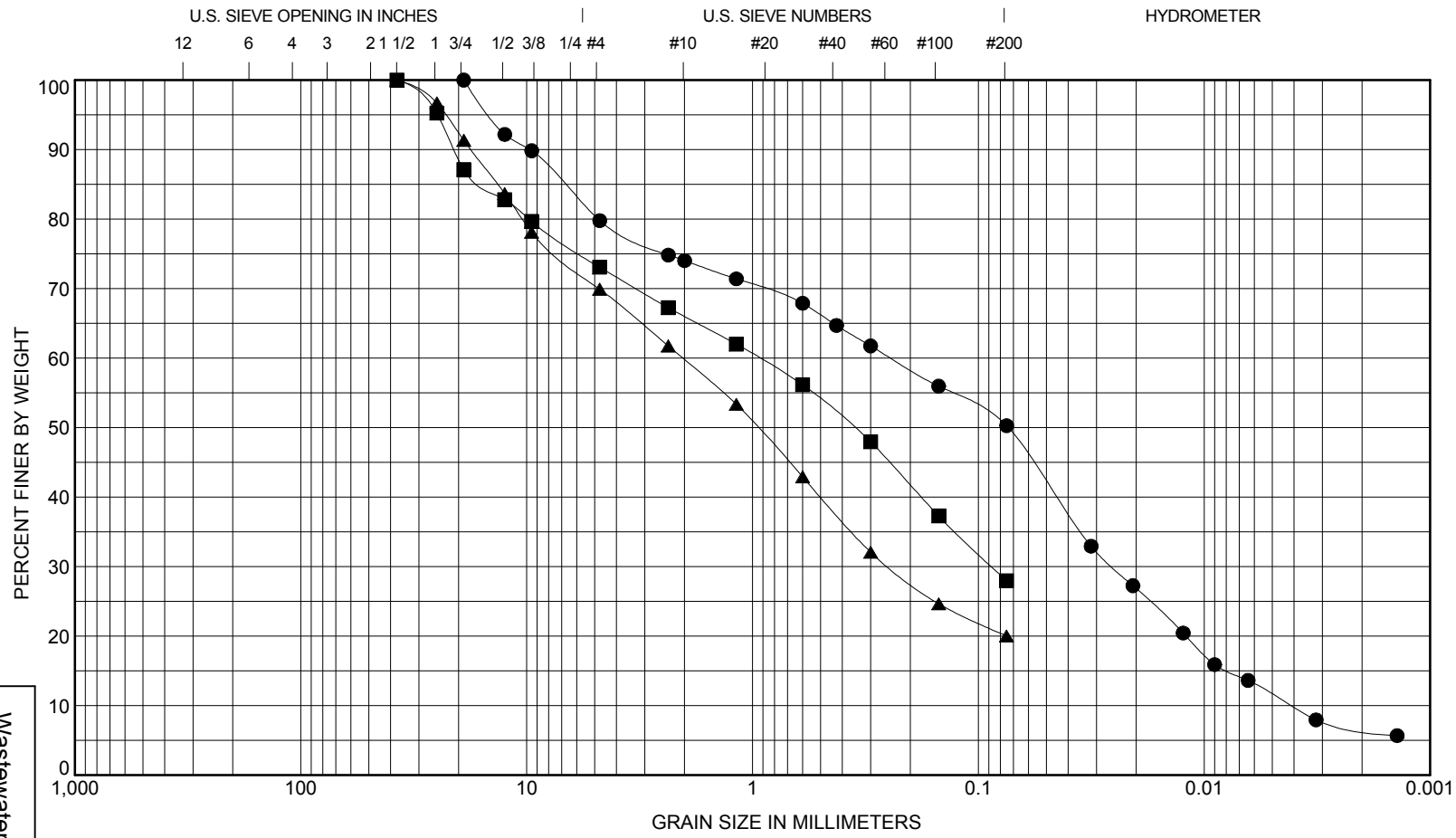
FIG. A-13
Sheet 1 of 9



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Sample	Depth, Ft	Classification	LL	PL	PI	Cc	Cu
●	B-03 S5B	10.0 - 11.5	**Sandy Silt with Gravel (ML)**				**0.6**	**59.2**
■	B-03 S6	15.0 - 16.5	**Silty Sand with Gravel (SM)**					
▲	B-03 S7	20.0 - 21.5	**Silty Sand with Gravel (SM)**					

	Sample	Depth, Ft	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	B-03 S5B	10.0 - 11.5	**19**	**0.24**	**0.03**	**0**	**20**	**30**	**50**	
■	B-03 S6	15.0 - 16.5	**37.5**	**0.94**	**0.09**		**27**	**45**	**28**	
▲	B-03 S7	20.0 - 21.5	**37.5**	**2.04**	**0.25**		**30**	**50**	**20**	

GRAIN SIZE CLASSIFICATION

Wastewater Treatment Plant Improvements
Wasilla, Alaska

June 2016

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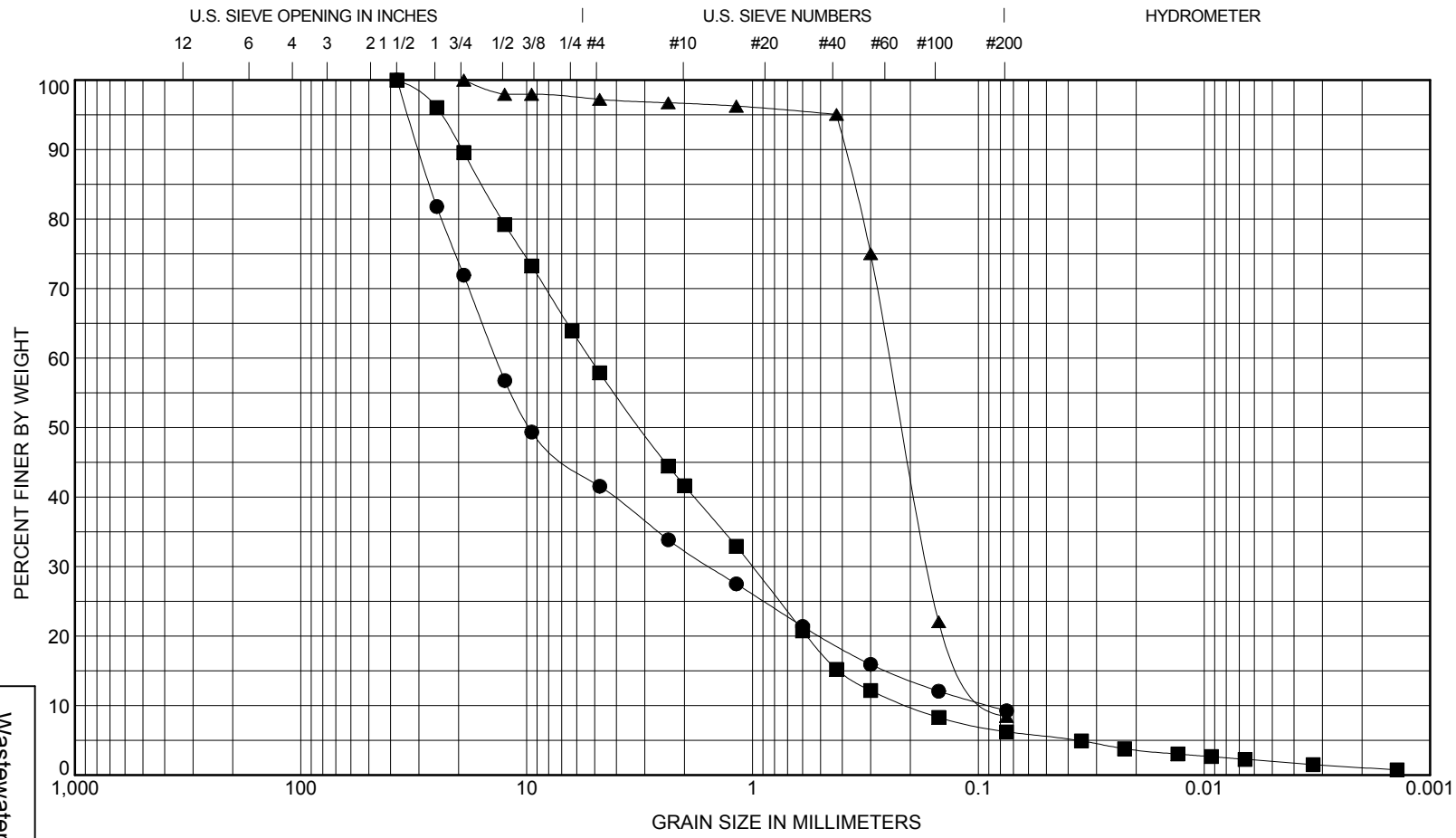
FIG. A-13
Sheet 2 of 9



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Sample		Depth, Ft	Classification	LL	PL	PI	Cc	Cu
●	B-04 S3	5.0 - 6.5	**Well-Graded Gravel with Silt and Sand (GW-GM)**				**1.9**	**151.5**
■	B-04 S6	15.0 - 16.5	**Poorly Graded Sand with Silt and Gravel (SP-SM)**				**0.9**	**25.7**
▲	B-06 S6	15.0 - 16.5	**Poorly Graded Sand with Silt (SP-SM)**				**1.4**	**3.0**

Sample		Depth, Ft	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	B-04 S3	5.0 - 6.5	**37.5**	**13.67**	**1.55**	**0.09**	**58**	**32**	**9**	
■	B-04 S6	15.0 - 16.5	**37.5**	**5.25**	**1**	**0.2**	**42**	**52**	**6**	
▲	B-06 S6	15.0 - 16.5	**19**	**0.25**	**0.17**	**0.08**	**3**	**89**	**8**	

GRAIN SIZE CLASSIFICATION

Wastewater Treatment Plant Improvements
Wasilla, Alaska

June 2016

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SHANNON & WILSON, INC.
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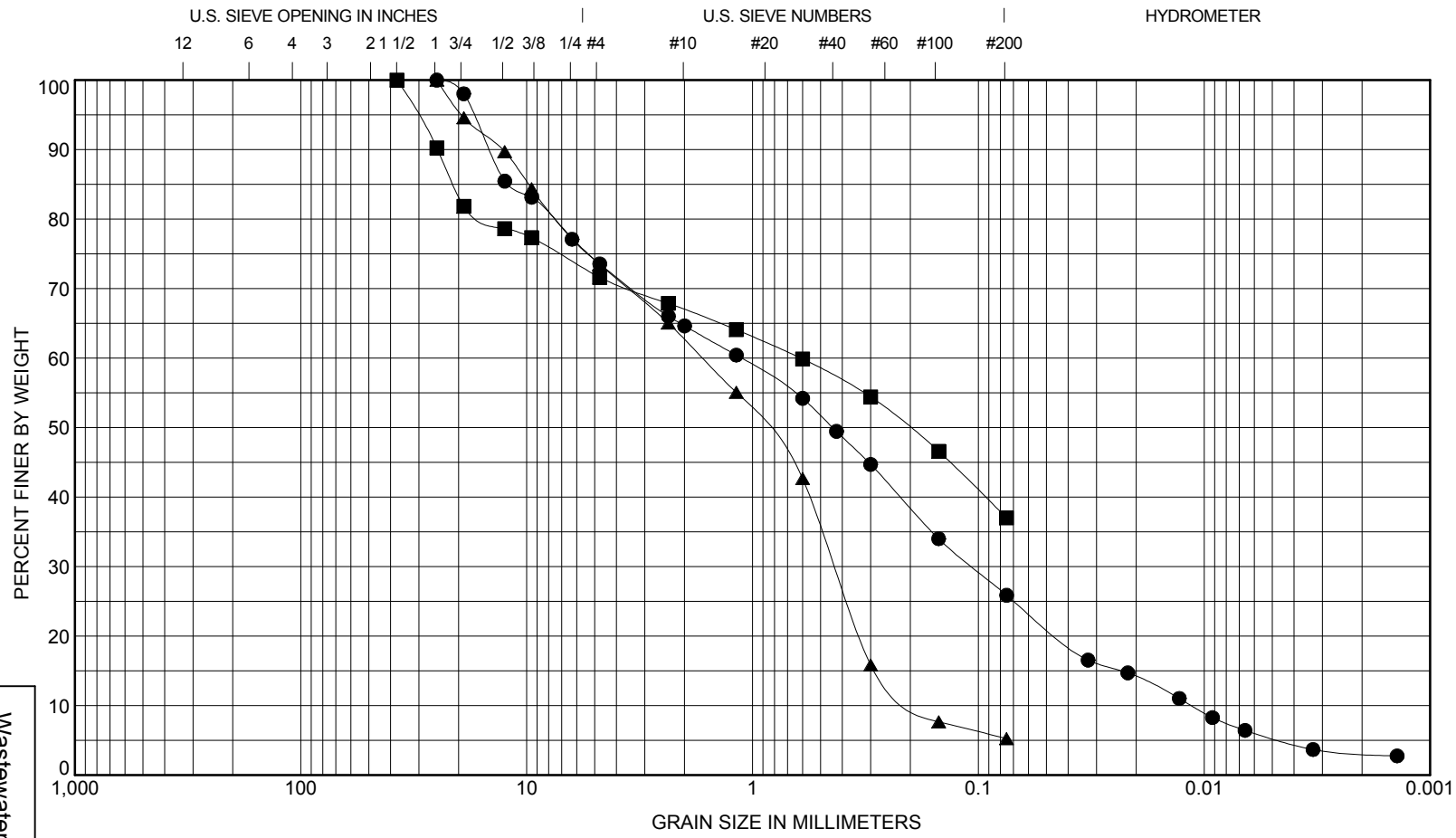
FIG. A-13
Sheet 3 of 9



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Sample		Depth, Ft	Classification	LL	PL	PI	Cc	Cu
●	B-06 S8	25.0 - 26.4	**Silty Sand with Gravel (SM)**				**0.9**	**99.1**
■	B-06 S9	30.0 - 31.5	**Silty Sand with Gravel (SM)**					
▲	B-08 S5	10.0 - 11.5	**Poorly Graded Sand with Silt and Gravel (SP-SM)**				**0.6**	**9.1**

Sample		Depth, Ft	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	B-06 S8	25.0 - 26.4	**25**	**1.13**	**0.11**	**0.01**	**26**	**48**	**26**	
■	B-06 S9	30.0 - 31.5	**37.5**	**0.61**			**28**	**35**	**37**	
▲	B-08 S5	10.0 - 11.5	**25**	**1.66**	**0.43**	**0.18**	**27**	**68**	**5**	

Wastewater Treatment Plant Improvements
Wasilla, Alaska

GRAIN SIZE CLASSIFICATION

June 2016

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SHANNON & WILSON, INC.
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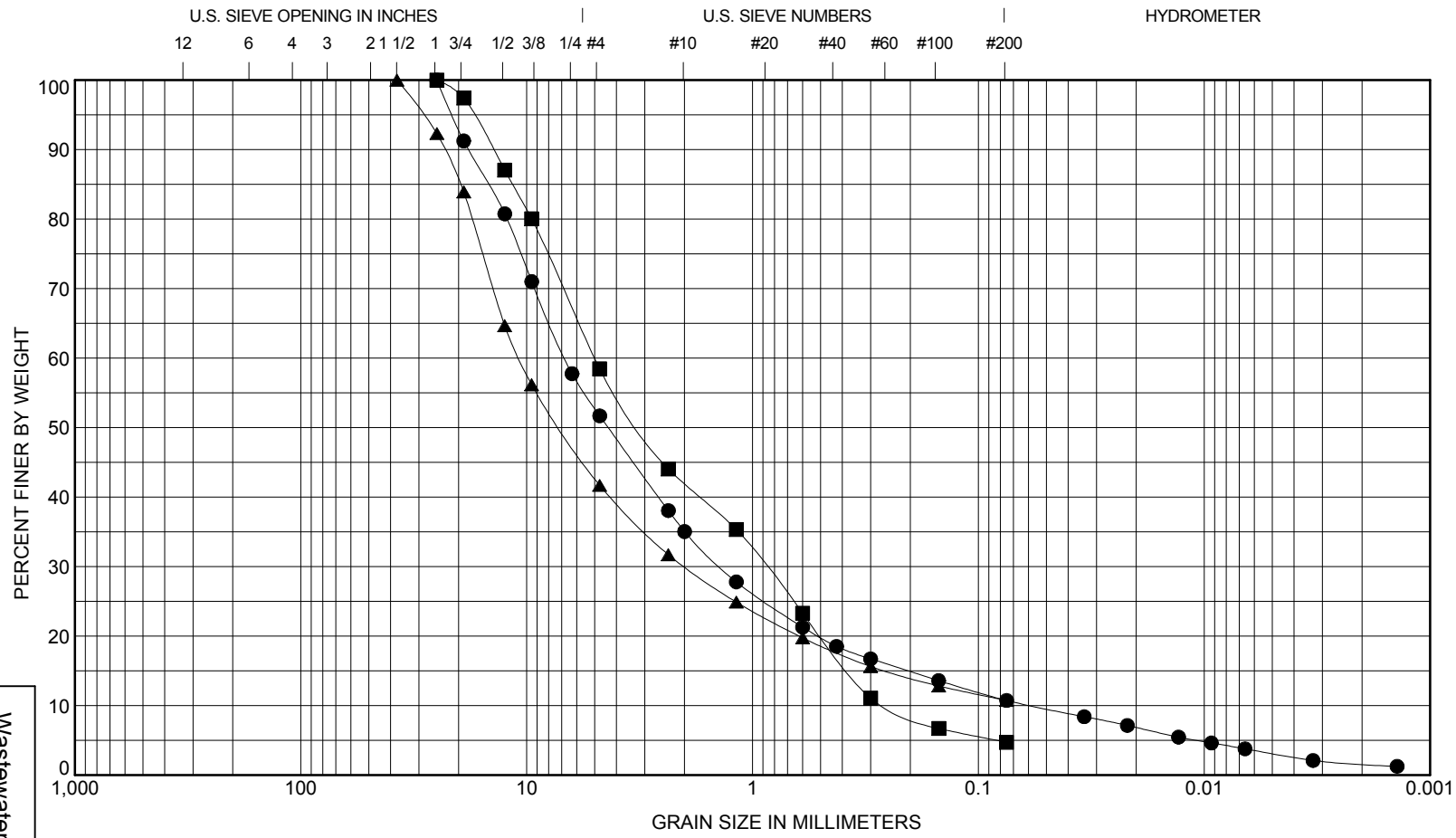
FIG. A-13
Sheet 4 of 9



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Sample		Depth, Ft	Classification	LL	PL	PI	Cc	Cu
●	B-08 S6	15.0 - 16.6	**Poorly Graded Gravel with Silt and Sand (GP-GM)**				**4.9**	**115.7**
■	B-08 S9	30.0 - 31.5	**Poorly Graded Sand with Silt and Gravel (SP-SM)**				**0.6**	**19.7**
▲	B-08 S13	50.0 - 51.5	**Poorly Graded Gravel with Silt and Sand (GP-GM)**				**6.3**	**184.8**

Sample		Depth, Ft	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	B-08 S6	15.0 - 16.6	**25**	**6.75**	**1.39**	**0.06**	**48**	**41**	**11**	
■	B-08 S9	30.0 - 31.5	**25**	**4.99**	**0.87**	**0.25**	**42**	**54**	**5**	
▲	B-08 S13	50.0 - 51.5	**37.5**	**10.75**	**1.98**		**58**	**31**	**11**	

GRAIN SIZE CLASSIFICATION

Wastewater Treatment Plant Improvements
Wasilla, Alaska

June 2016

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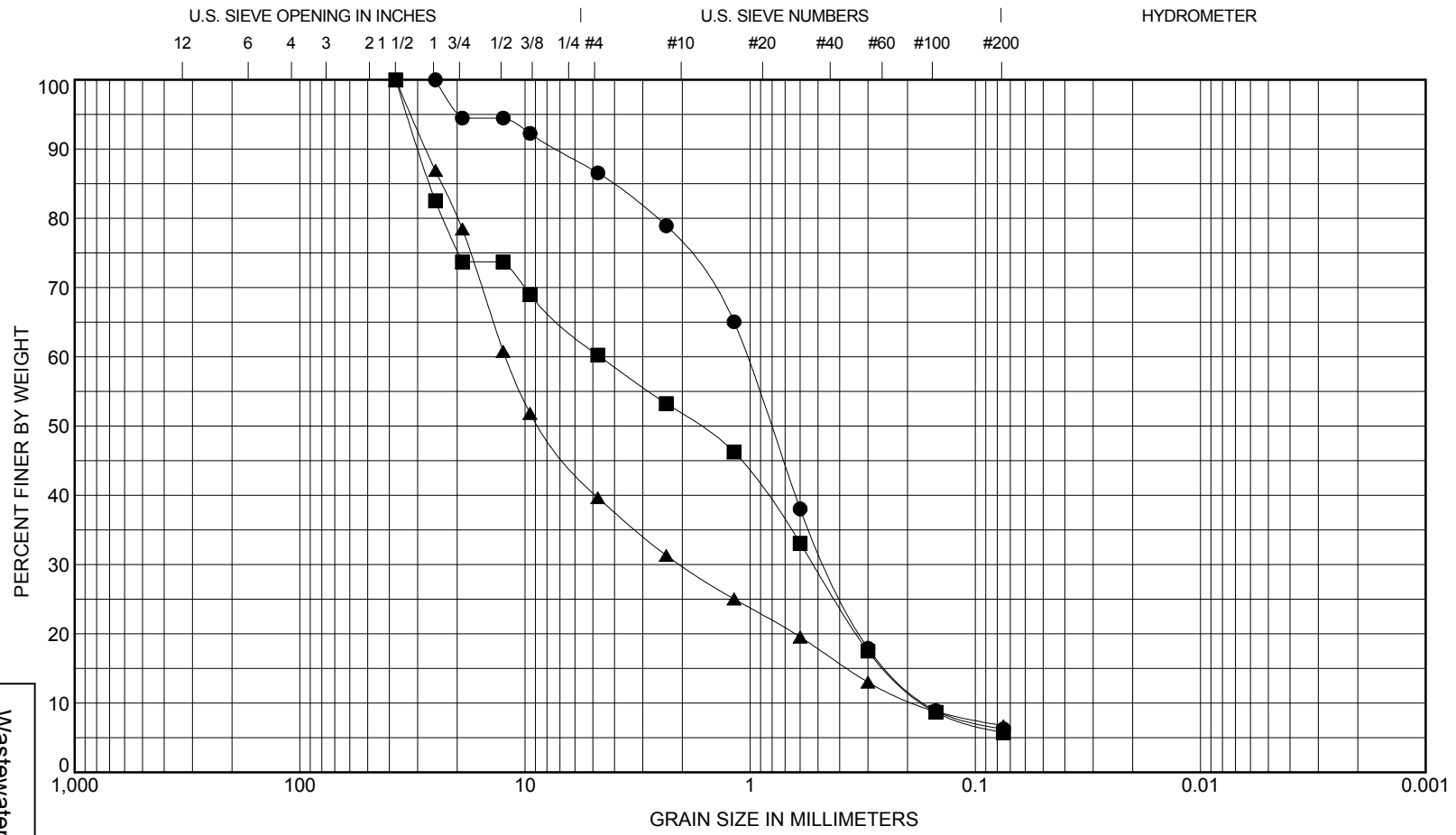
FIG. A-13
Sheet 5 of 9



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Sample		Depth, Ft	Classification	LL	PL	PI	Cc	Cu
●	B-09 S2	2.5 - 4.0	**Well-Graded Sand with Silt (SW-SM)**				**1.2**	**6.4**
■	B-09 S7	20.0 - 21.5	**Poorly Graded Sand with Silt and Gravel (SP-SM)**				**0.4**	**27.9**
▲	B-09 S9	30.0 - 31.5	**Well-Graded Gravel with Silt and Sand (GW-GM)**				**1.9**	**66.6**

Sample		Depth, Ft	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	B-09 S2	2.5 - 4.0	**25**	**1.04**	**0.45**	**0.16**	**13**	**80**	**6**	
■	B-09 S7	20.0 - 21.5	**37.5**	**4.64**	**0.52**	**0.17**	**40**	**55**	**6**	
▲	B-09 S9	30.0 - 31.5	**37.5**	**12.2**	**2.04**	**0.18**	**60**	**33**	**7**	

GRAIN SIZE CLASSIFICATION

Wastewater Treatment Plant Improvements
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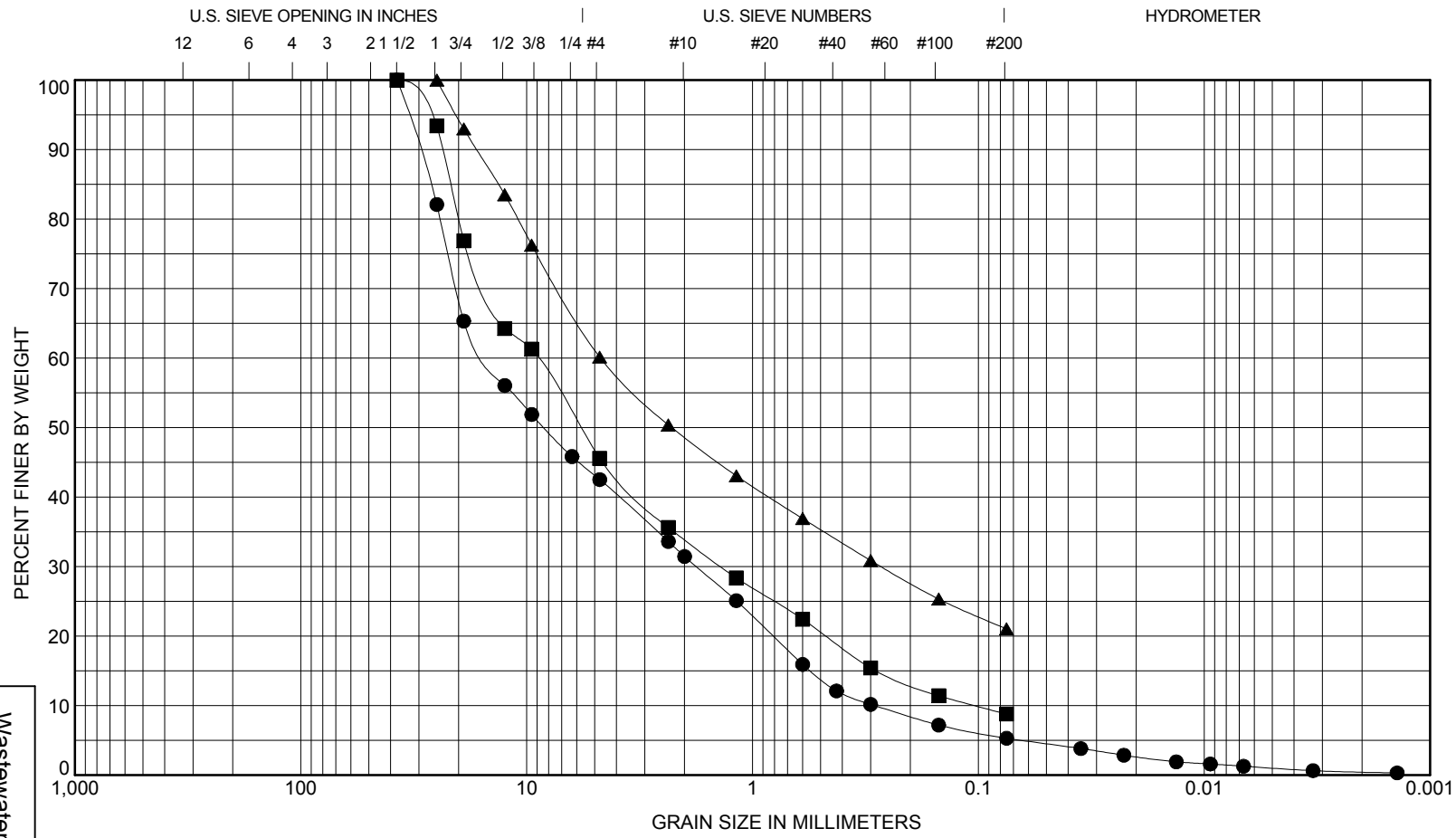
FIG. A-13
Sheet 6 of 9



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Sample		Depth, Ft	Classification	LL	PL	PI	Cc	Cu
●	B-11 S4	7.5 - 9.0	**Poorly Graded Gravel with Silt and Sand (GP-GM)**				**0.7**	**51.8**
■	B-11 S7	20.0 - 21.5	**Well-Graded Gravel with Silt and Sand (GW-GM)**				**2.0**	**86.8**
▲	B-13 S6	15.0 - 16.5	**Silty Gravel with Sand (GM)**					

Sample		Depth, Ft	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	B-11 S4	7.5 - 9.0	**37.5**	**14.94**	**1.77**	**0.29**	**57**	**37**	**5**	
■	B-11 S7	20.0 - 21.5	**37.5**	**8.98**	**1.38**	**0.1**	**54**	**37**	**9**	
▲	B-13 S6	15.0 - 16.5	**25**	**4.7**	**0.27**		**40**	**39**	**21**	

GRAIN SIZE CLASSIFICATION

Wastewater Treatment Plant Improvements
Wasilla, Alaska

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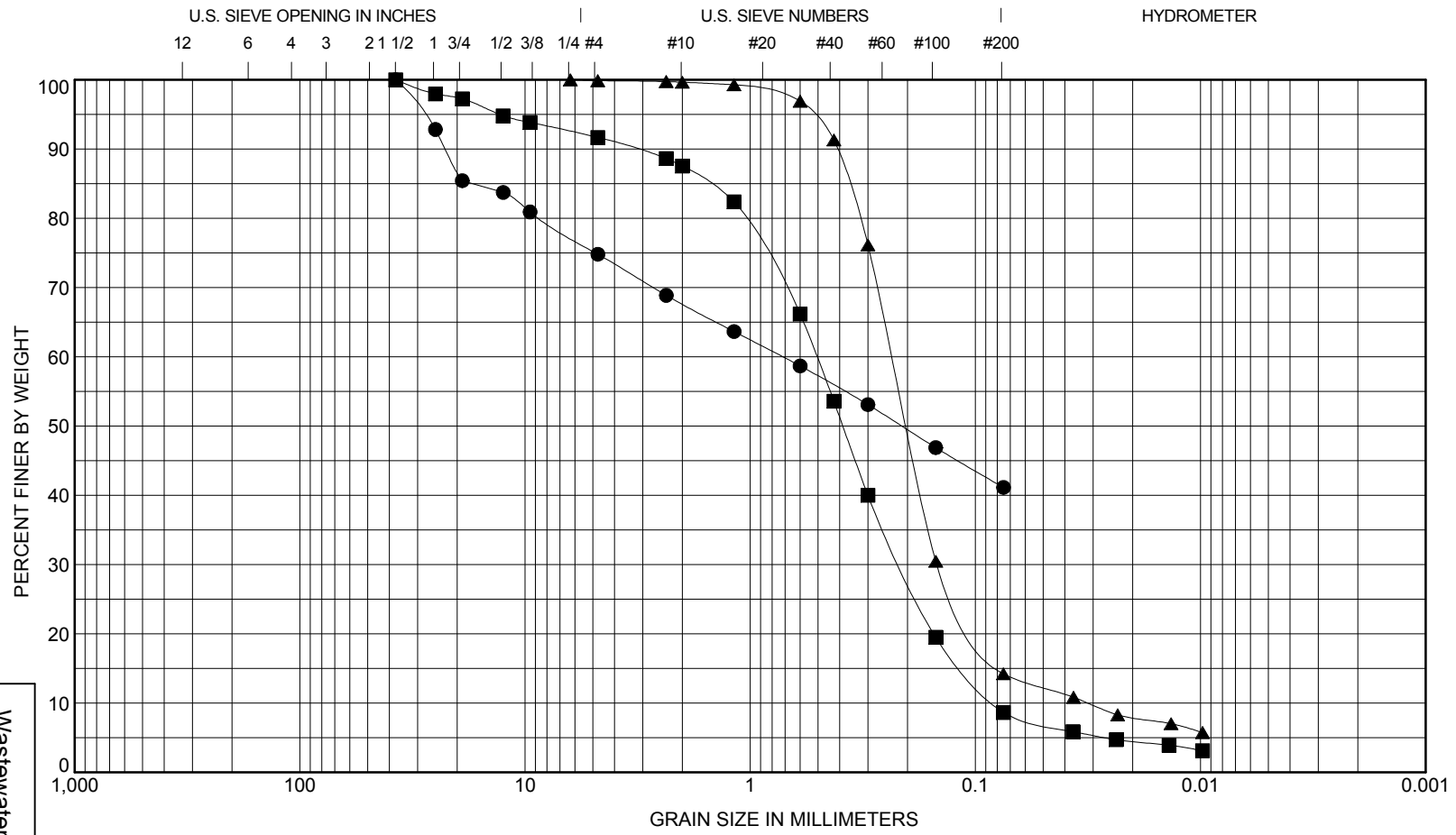
FIG. A-13
Sheet 7 of 9



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Sample		Depth, Ft	Classification	LL	PL	PI	Cc	Cu
●	B-13 S7	19.0 - 20.5	**Silty Sand with Gravel (SM)**					
■	B-14 S19	95.0 - 96.5	**Well-Graded Sand with Silt (SW-SM)**				1.1	6.2
▲	B-14 S23	115.0 - 116.5	**Silty Sand (SM)**				2.9	7.4

Sample		Depth, Ft	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	B-13 S7	19.0 - 20.5	37.5	0.72			25	34	41	
■	B-14 S19	95.0 - 96.5	37.5	0.51	0.21	0.08	8	83	9	
▲	B-14 S23	115.0 - 116.5	6.3	0.23	0.15	0.03	0	86	14	

GRAIN SIZE CLASSIFICATION

Wastewater Treatment Plant Improvements
Wasilla, Alaska

February 2016

32-1-02452

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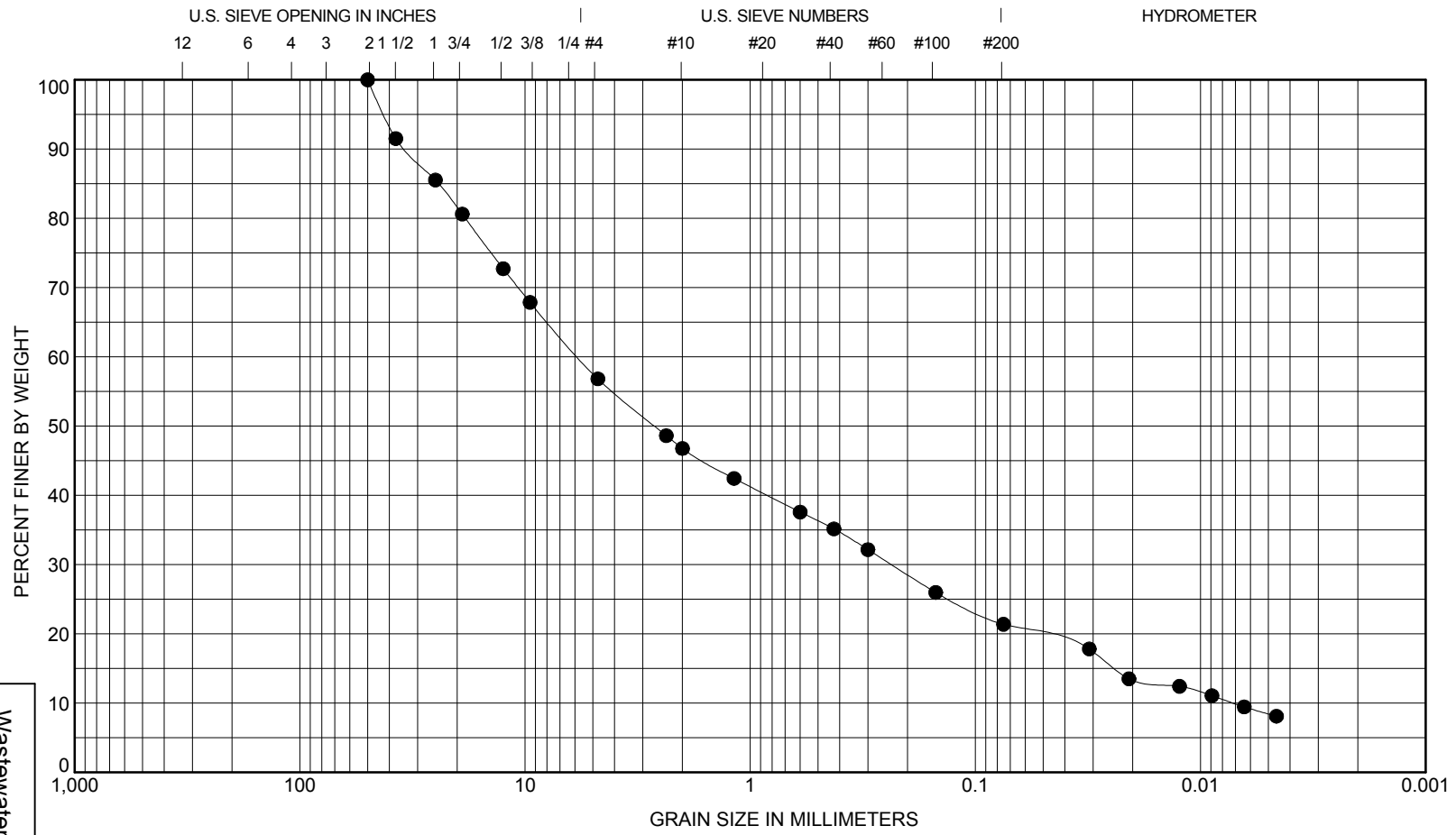
FIG. A-13
Sheet 8 of 9



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Sample	Depth, Ft	Classification	LL	PL	PI	Cc	Cu
●	**B-14 S25-28**	**125.0 - 140.0**	**Silty Gravel with Sand (GM)**				**1.3**	**810.2**

Sample	Depth, Ft	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**B-14 S25-28**	**125.0 - 140.0**	**50**	**5.8**	**0.24**	**0.01**	**43**	**35**	**21**

Wastewater Treatment Plant Improvements
Wasilla, Alaska

GRAIN SIZE CLASSIFICATION

February 2016

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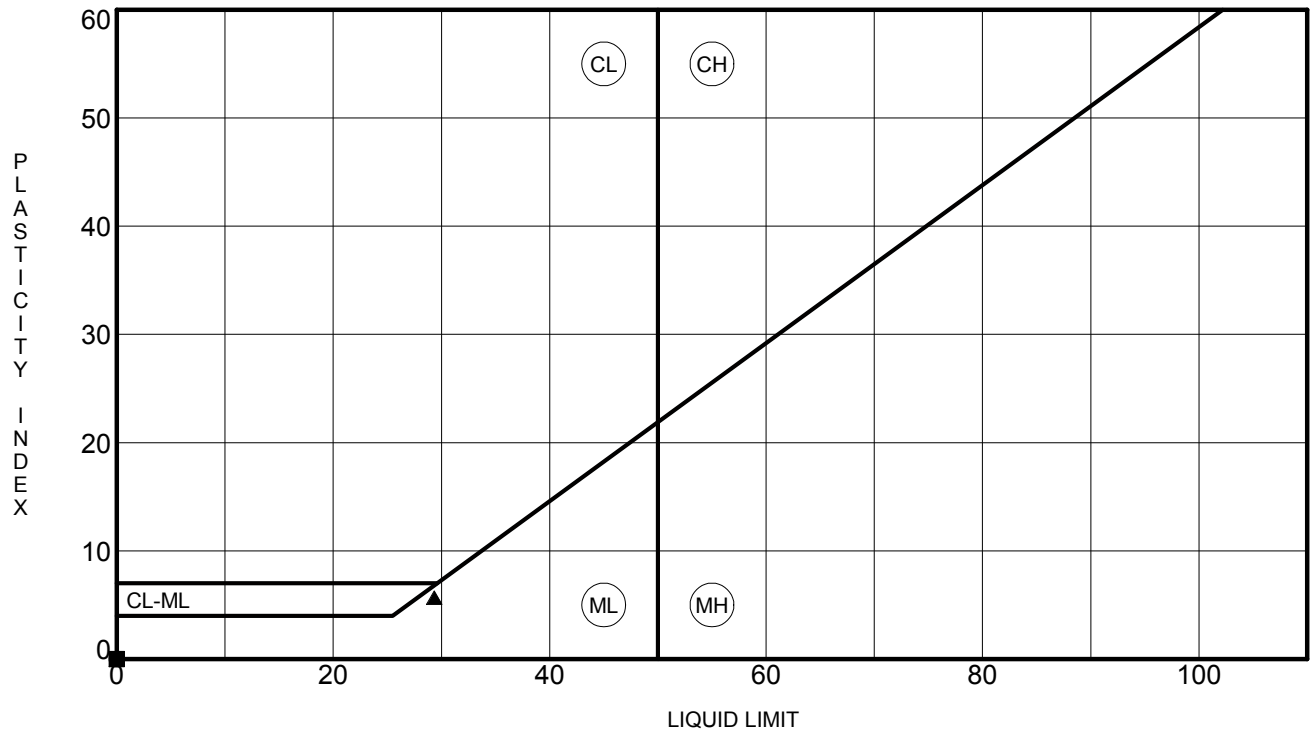
FIG. A-13
Sheet 9 of 9



Boring		Depth, Ft	LL	PL	PI	Fines	Classification
●	**B-02**	**7.5 - 9.0**	**NP**	**NP**	**NP**		**ML**
■	**B-08**	**7.5 - 9.0**	**NP**	**NP**	**NP**		**ML**
▲	**B-13**	**10.0 - 11.5**	**29**	**24**	**5**		**ML**

Wastewater Treatment Plant Improvements
Wasilla, Alaska

ATTERBERG LIMITS RESULTS

June 2016 32-1-02452

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FIG. A-14

APPENDIX B

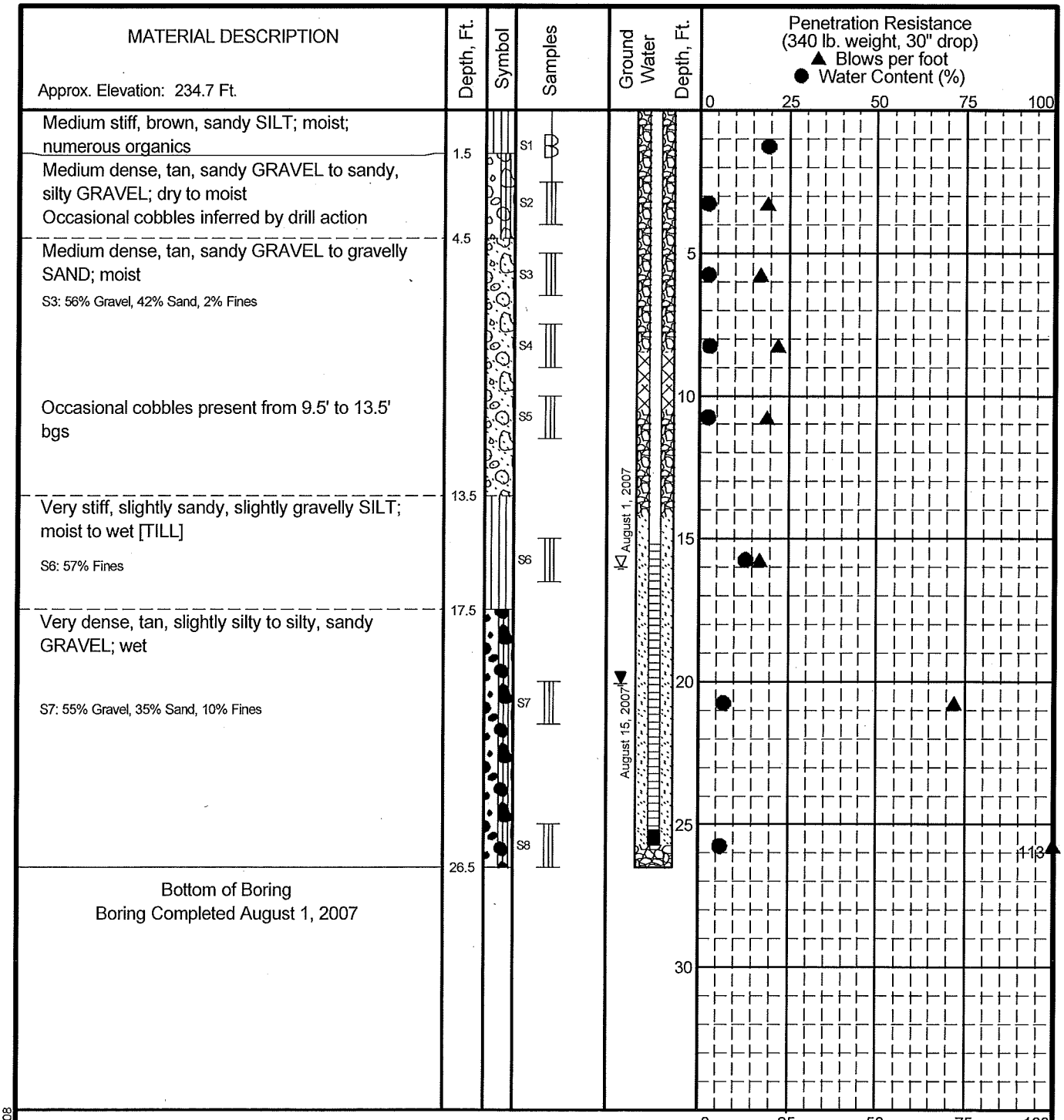
PRIOR EXPLORATIONS BY SHANNON & WILSON AND OTHERS

May 2008 Shannon & Wilson, Inc.

Log of Boring TW-1
Log of Boring TW-2
Log of Boring TW-3
Grainsize Classification (2 sheets)
Summary of Hydraulic Conductivity Test Results

1986 Gilfilian Engineering, Inc.

Test Boring No. 15 : Grain Size Analysis
Test Boring No. 20 : Grain Size Analysis
Test Boring No. 26 : Grain Size Analysis
Test Boring No. 27 : Grain Size Analysis
Test Boring No. 28 : Grain Size Analysis
Test Boring No. 33
Test Boring No. 34
Test Boring No. 39 : Grain Size Analysis
Test Boring No. 40 : Grain Size Analysis



LEGEND

* Sample Not Recovered
Grab Sample
3" O.D. Split Spoon Sample
Blank Section, Cuttings Backfill
Slotted Section, Cuttings Backfill
● Water Content (%)
Plastic Limit — Liquid Limit
Natural Water Content
Ground Water Level At Time Of Drilling
Static Water Level

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.

WWTP Percolation Cell
Wasilla, Alaska

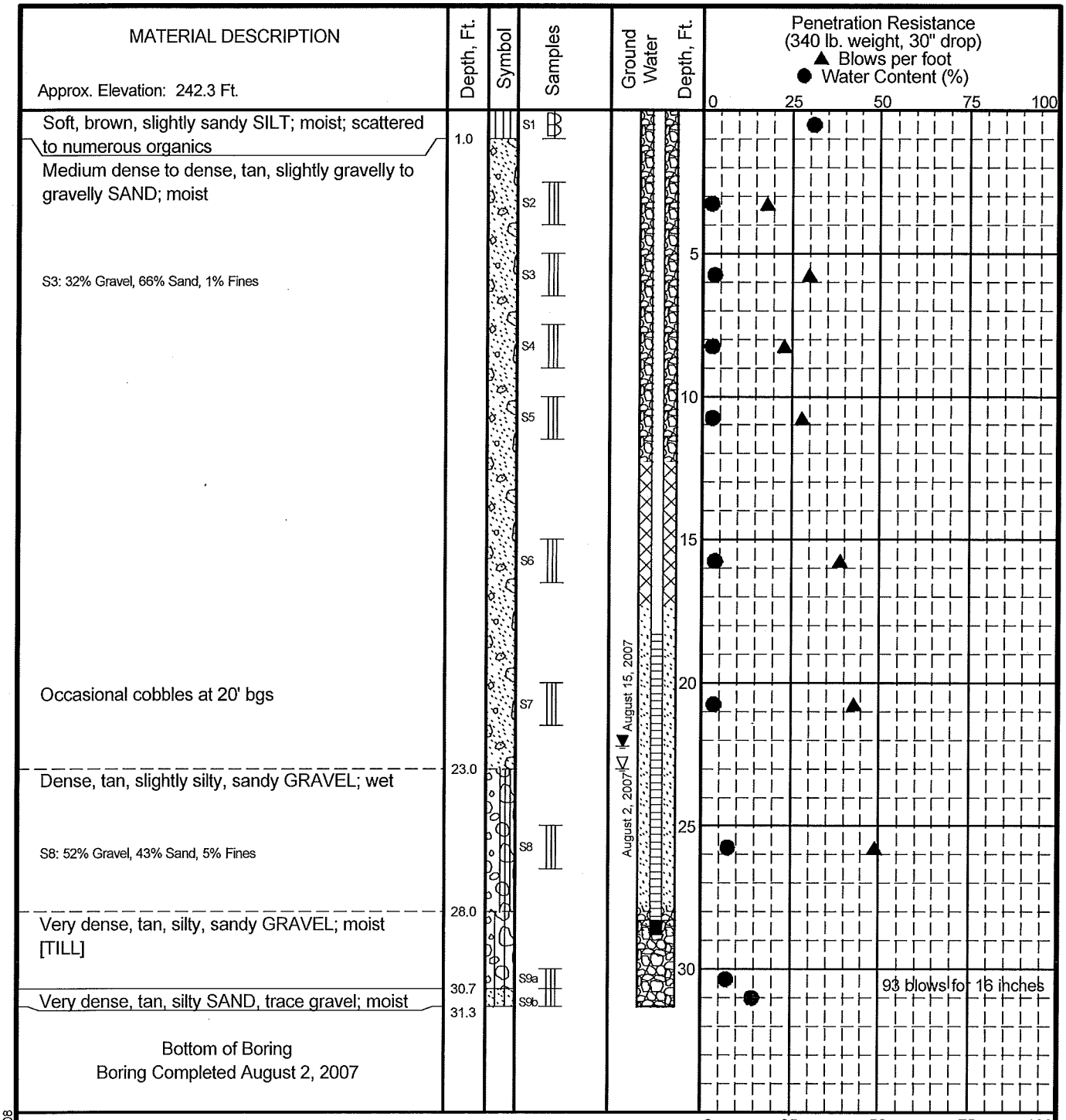
LOG OF BORING TW-1

May 2008 32-1-01883

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

Fig. 6

GEOTECHNICAL LOG 01883 LOGS.GPJ S&W GEO1.GDT 5/9/08



LEGEND

- * Sample Not Recovered
- Grab Sample
- 3" O.D. Split Spoon Sample
- Blank Section, Cuttings Backfill
- Slotted Section, Cuttings Backfill
- ● Water Content (%)
- Plastic Limit — Liquid Limit
- Natural Water Content
- ▽ Ground Water Level At Time Of Drilling
- ▼ Static Water Level

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.

WWTP Percolation Cell
Wasilla, Alaska

LOG OF BORING TW-2

May 2008 32-1-01883

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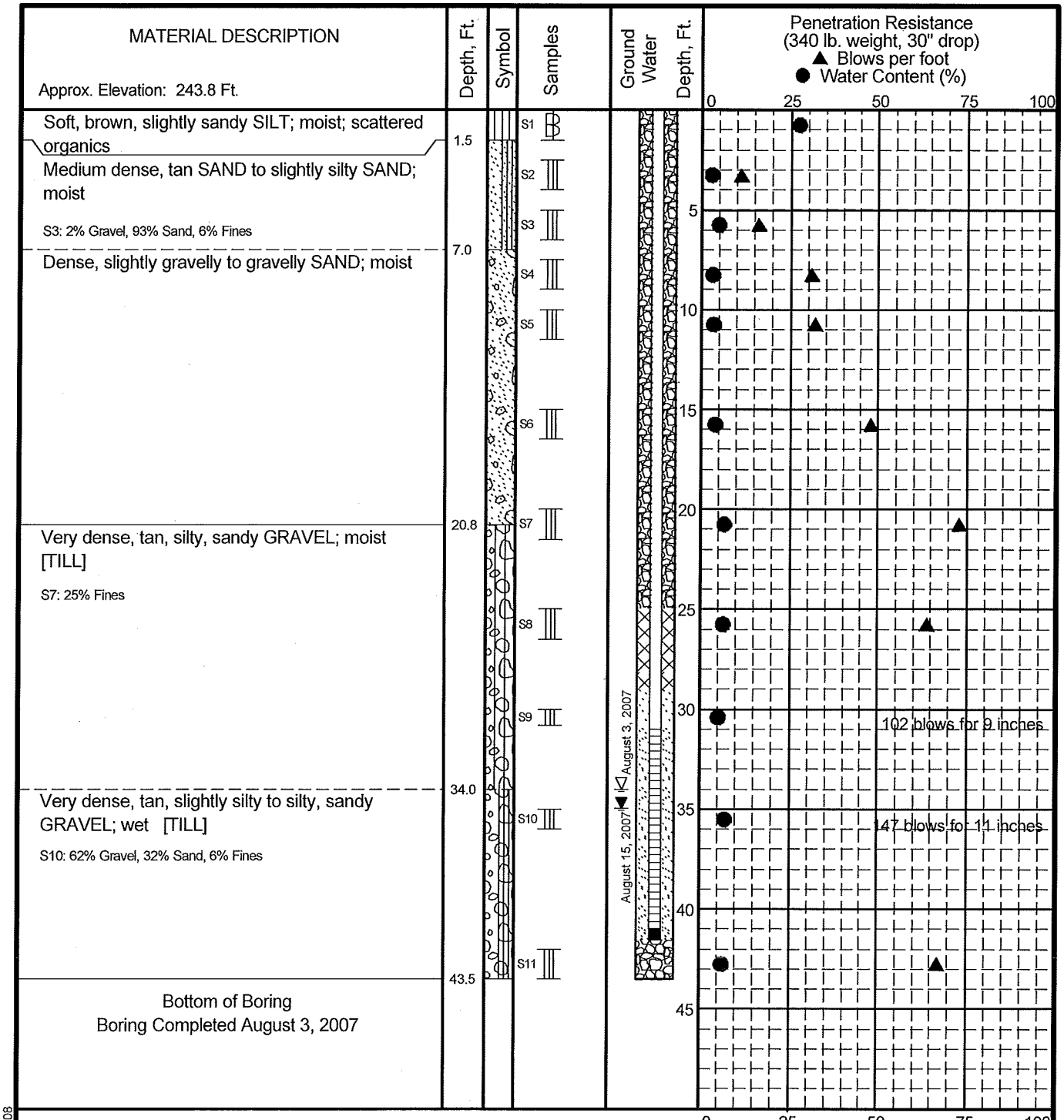
Fig. 7

GEOTECHNICAL LOG 01883 LOGS.GPJ S&W GEO1.GDT 5/9/08



LEGEND

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

Blank Section, Cuttings Backfill
Slotted Section, Cuttings Backfill

● Water Content (%)
Plastic Limit ⟷ Liquid Limit
Natural Water Content

Ground Water Level At Time Of Drilling
Static Water Level

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.

WWTP Percolation Cell
Wasilla, Alaska

LOG OF BORING TW-3

May 2008 32-1-01883

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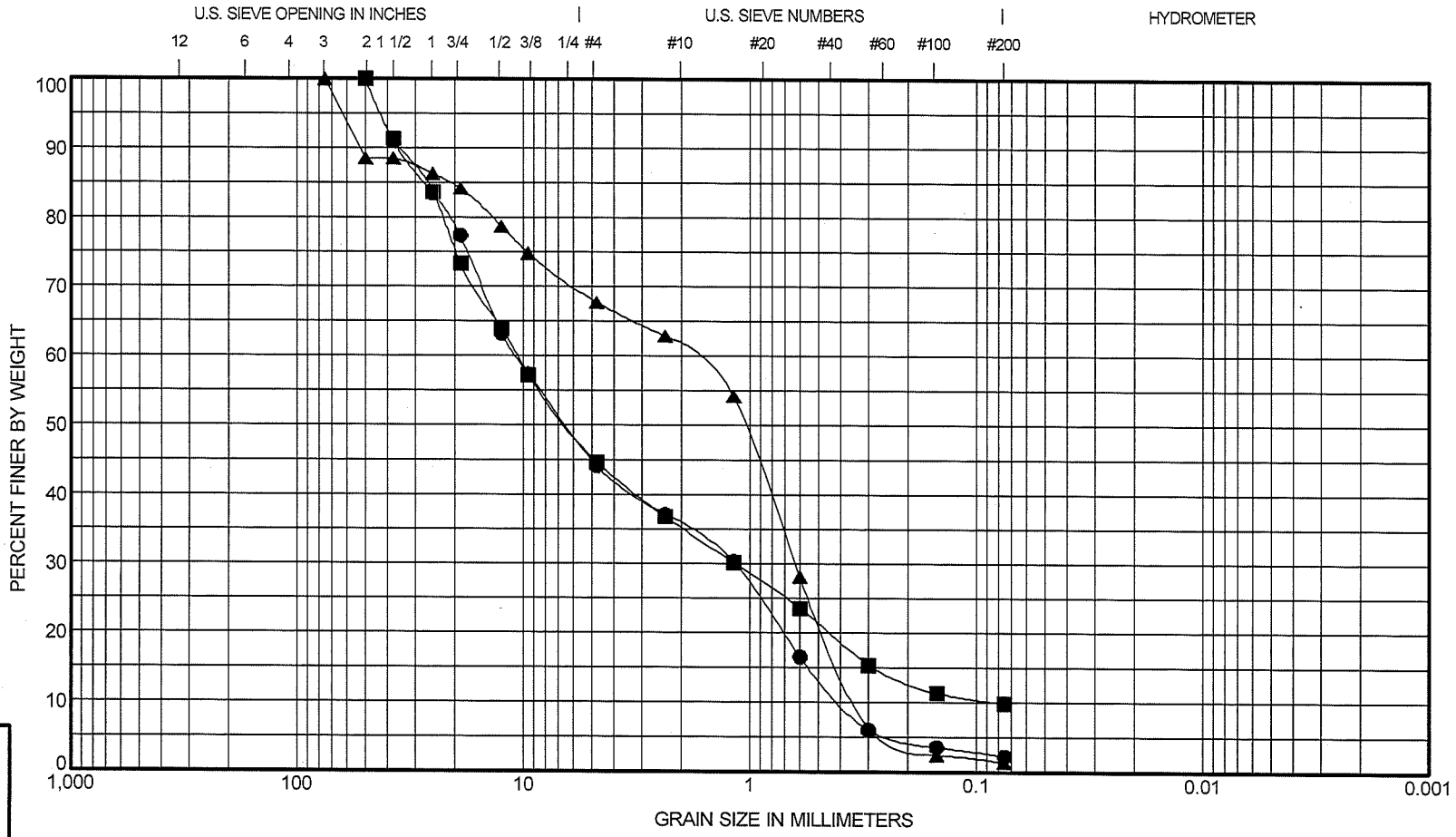
Fig. 8

GEOTECHNICAL LOG 01883 LOGS.GPJ S&W GEO1.GDT 5/9/08



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Sample	Depth, Ft	Classification	LL	PL	PI	Cc	Cu
●	TW-1 S3	5.0 - 6.5	**Sandy GRAVEL [GP]**				**0.3**	**27.7**
■	TW-1 S7	20.0 - 21.5	**Slightly silty, sandy GRAVEL [GW-GM]**				**1.6**	**134.0**
▲	TW-2 S3	5.0 - 6.5	**Gravelly SAND [SP]**				**0.6**	**5.6**

	Sample	Depth, Ft	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	TW-1 S3	5.0 - 6.5	**50**	**10.75**	**1.16**	**0.39**	**56**	**42**	**2**	
■	TW-1 S7	20.0 - 21.5	**50**	**10.61**	**1.15**	**0.08**	**55**	**35**	**10**	
▲	TW-2 S3	5.0 - 6.5	**75**	**1.87**	**0.63**	**0.34**	**32**	**66**	**1**	

WWTP Percolation Cell
Wasilla, Alaska

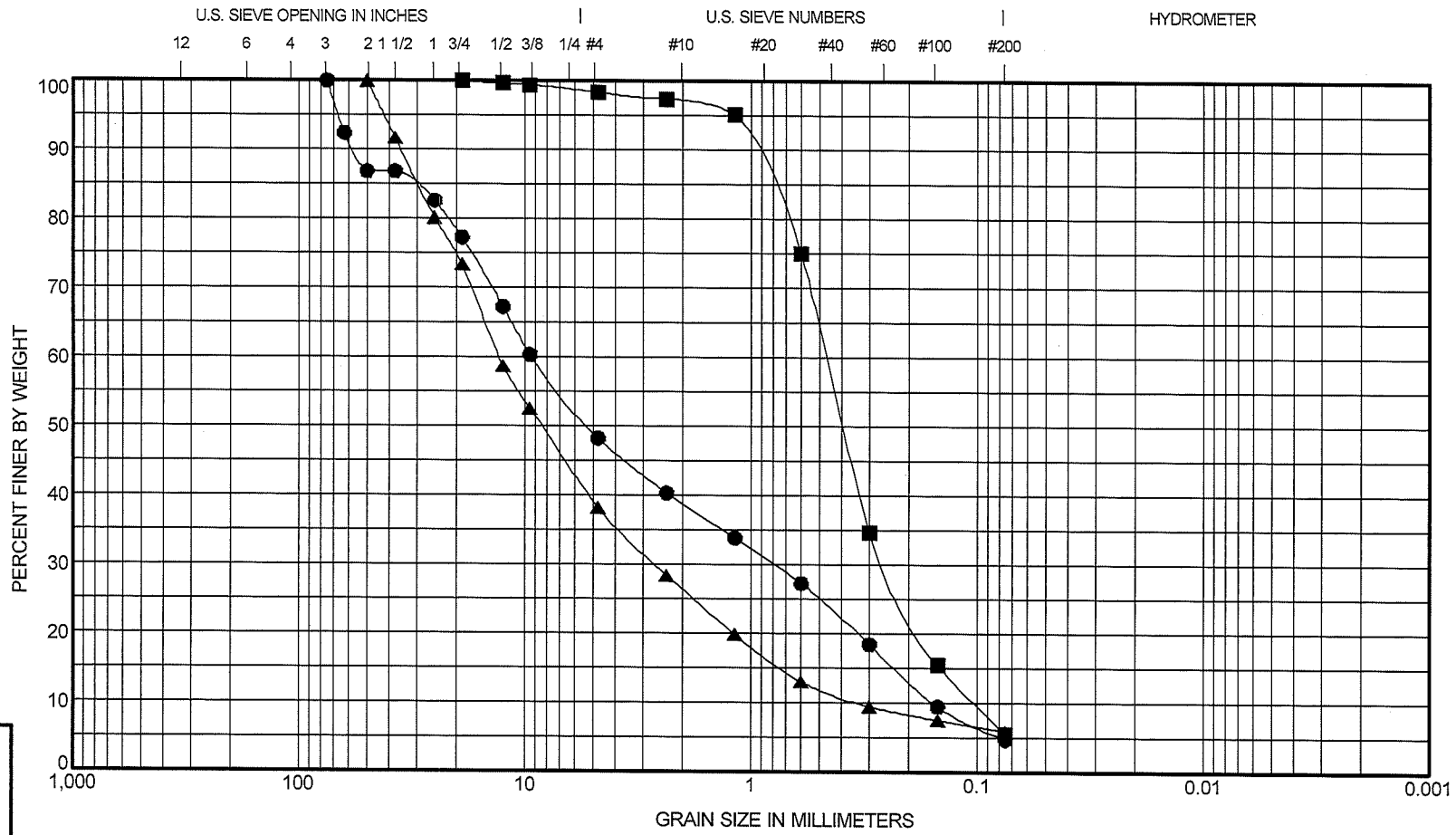
GRAIN SIZE CLASSIFICATION

May 2008

32-1-01883

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

Fig. 9
Sheet 1 of 2



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Sample	Depth, Ft	Classification	LL	PL	PI	Cc	Cu
●	TW-2 S8	25.0 - 26.5	**Slightly silty, sandy GRAVEL [GP-GM]**				**0.4**	**59.8**
■	TW-3 S3	5.0 - 6.5	**Slightly silty SAND [SP-SM]**				**1.4**	**4.5**
▲	TW-3 S10	35.0 - 36.5	**Slightly silty, sandy GRAVEL [GW-GM]**				**1.6**	**39.0**

	Sample	Depth, Ft	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	TW-2 S8	25.0 - 26.5	**75**	**9.3**	**0.79**	**0.16**	**52**	**43**	**5**	
■	TW-3 S3	5.0 - 6.5	**19**	**0.46**	**0.25**	**0.1**	**2**	**93**	**6**	
▲	TW-3 S10	35.0 - 36.5	**50**	**12.95**	**2.64**	**0.33**	**62**	**32**	**6**	

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GRAIN SIZE CLASSIFICATION

May 2008

32-1-01883

Fig. 9
Sheet 2 of 2

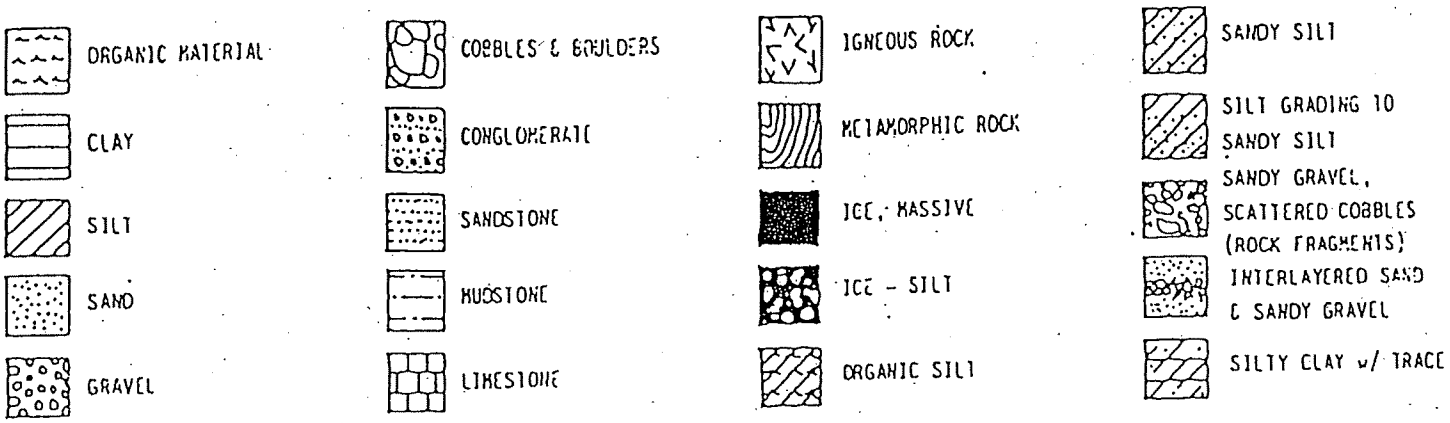
WWTP Percolation Cell
Wasilla, Alaska

SUMMARY OF HYDRAULIC CONDUCTIVITY TEST RESULTS MONITORING WELLS TW-1, TW-2, AND TW-3

Monitoring Well Designation	Date Tested	Saturated Screened Interval (feet bgs)	Soil Type Summary Description	Hydraulic Conductivity Range (cm/s)
TW-1	8/15/2007	20.0 to 25.3	slightly silty to silty, sandy gravel	**4×10^{-4} to 9×10^{-3}**
TW-2	8/15/2007	22.2 to 28.0	slightly silty, sandy gravel	**8×10^{-4} to 5×10^{-3}**
TW-3	8/15/2007	34.9 to 41.0	slightly silty to silty, sandy gravel	**6×10^{-4} to 8×10^{-3}**

Notes:
1. bgs = below ground surface; cm/s = centimeters per second
2. Hydraulic conductivity values were derived using the method of Bouwer and Rice (1976, 1989).

STANDARD SYMBOLS



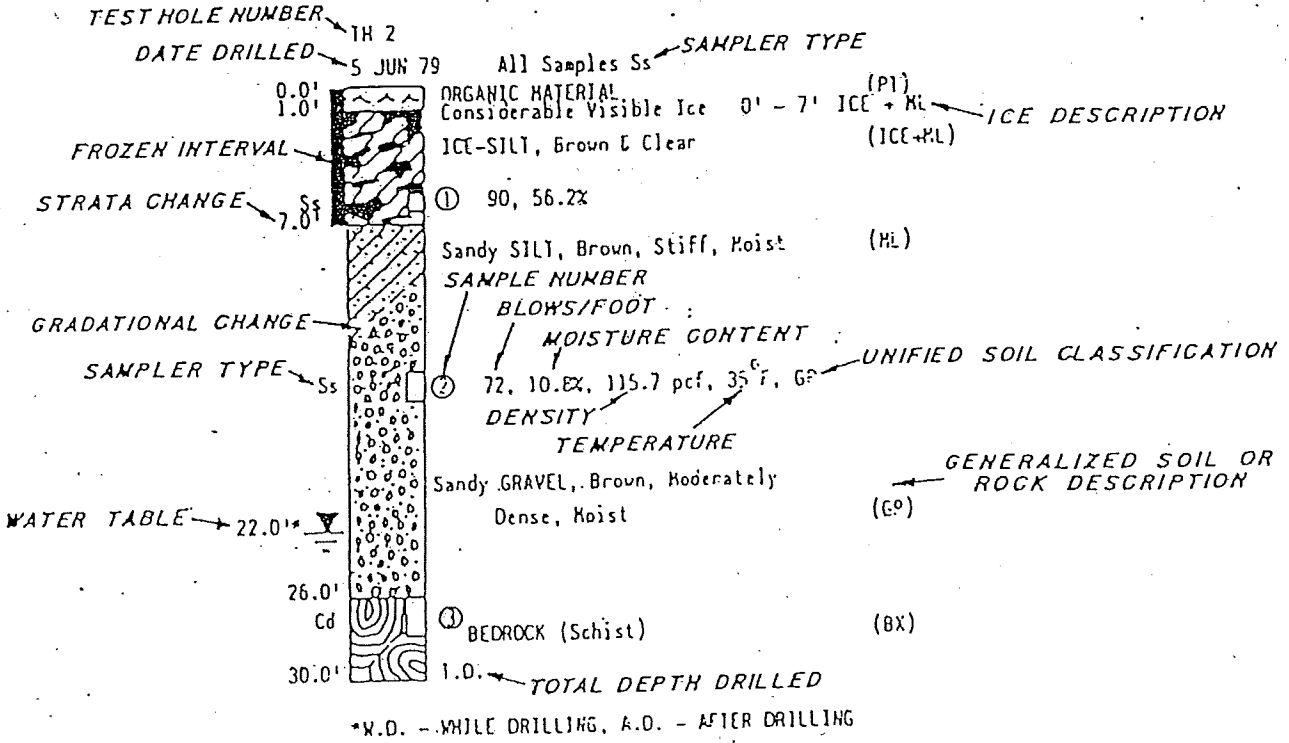
SAMPLER TYPE SYMBOLS

St . . . . . 1.4" SPLIT SPOON WITH 47 # HAMMER
Ss . . . . . 1.4" SPLIT SPOON WITH 140 # HAMMER
Sl . . . . . 2.5" SPLIT SPOON WITH 140 # HAMMER
Sh . . . . . 2.5" SPLIT SPOON WITH 340 # HAMMER
Sx . . . . . 2.0" SPLIT SPOON WITH 140 # HAMMER
Sz . . . . . 1.4" SPLIT SPOON WITH 340 # HAMMER
Sp . . . . . 2.5" SPLIT SPOON, PUSHED
Hs . . . . . 1.4" SPLIT SPOON DRIVEN WITH AIR HAMMER
Hl . . . . . 2.5" SPLIT SPOON DRIVEN WITH AIR HAMMER

Ts . . . . . SHELBY TUBE
Tx . . . . . MODIFIED SHELBY TUBE
Pb . . . . . PITCHER BARREL
Cs . . . . . CORE BARREL WITH SINGLE TUBE
Cd . . . . . CORE BARREL WITH DOUBLE TUBE
Bs . . . . . BULK SAMPLE
A. . . . . AUGER SAMPLE
G. . . . . GRAB SAMPLE

NOTE: SAMPLER TYPES ARE EITHER NOTED ABOVE THE BORING LOG OR ADJACENT TO IT AT THE RESPECTIVE SAMPLE DEPTH.

TYPICAL BORING LOG



*W.D. - WHILE DRILLING, A.D. - AFTER DRILLING

MAT-SU TEST LAB

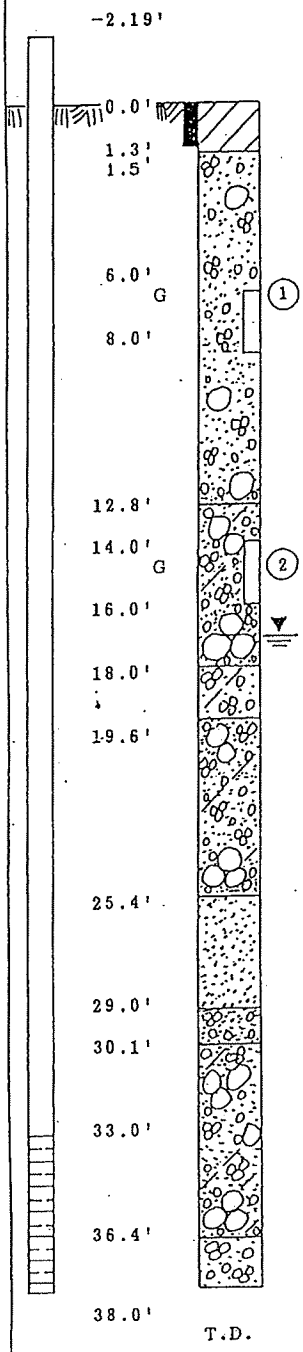
P.O. Box 871868, Wasilla, Alaska 99687

- (907) 376-3005 -

TEST HOLE LEGEND

Date N/A
Initials
Sheet 1 of 1

TEST BORING NO. 15



(Ground Surface Elevation 224.9)

SILT, Brown, Frozen (ML)
Frozen to 1.3'

Sandy GRAVEL w/ Occasional Cobbles, Brown, Moderately Dense, Dry (GW)

Sandy GRAVEL w/ Trace Silt, Numerous Cobbles, Brown, Dense, Dry to Moist (GW-GM) (2.57%)

Static Water Level at 17.1' on April 22, 1986

GRAVEL w/ Some Sand, Trace Silt, Brown, Moderately Dense, Saturated (GP)

Sandy GRAVEL w/ Trace Silt, Numerous Cobbles, Brown, Dense, Dry to Moist (GW-GM)

Fine to Medium SAND, Olive, Loose, Saturated (SP)
Produced 1-2 GPM

Sandy GRAVEL, Brown, Dense, Saturated (GW)

Sandy GRAVEL w/ Trace to Some Silt, Numerous Cobbles, Brown, Dense, Saturated (GM)

(Not Able to Develop. Low Permeability)

GRAVEL w/ Some Sand, Brown, Loose, Saturated (GP)

Produced 10 GPM

FIGURE II

Sheet 3 of 7

Gilfilian Engineering, Inc. P.O. Box 871868 Wasilla, Alaska 99687	TEST BORING AND MONITOR WELL LOG	Project No: WO86-02
		Scale: 1" = 4'
	WASILLA SEWAGE TREATMENT PLANT MONITOR WELLS	Drawn By: LJ
		Date Logged: 3-20-86

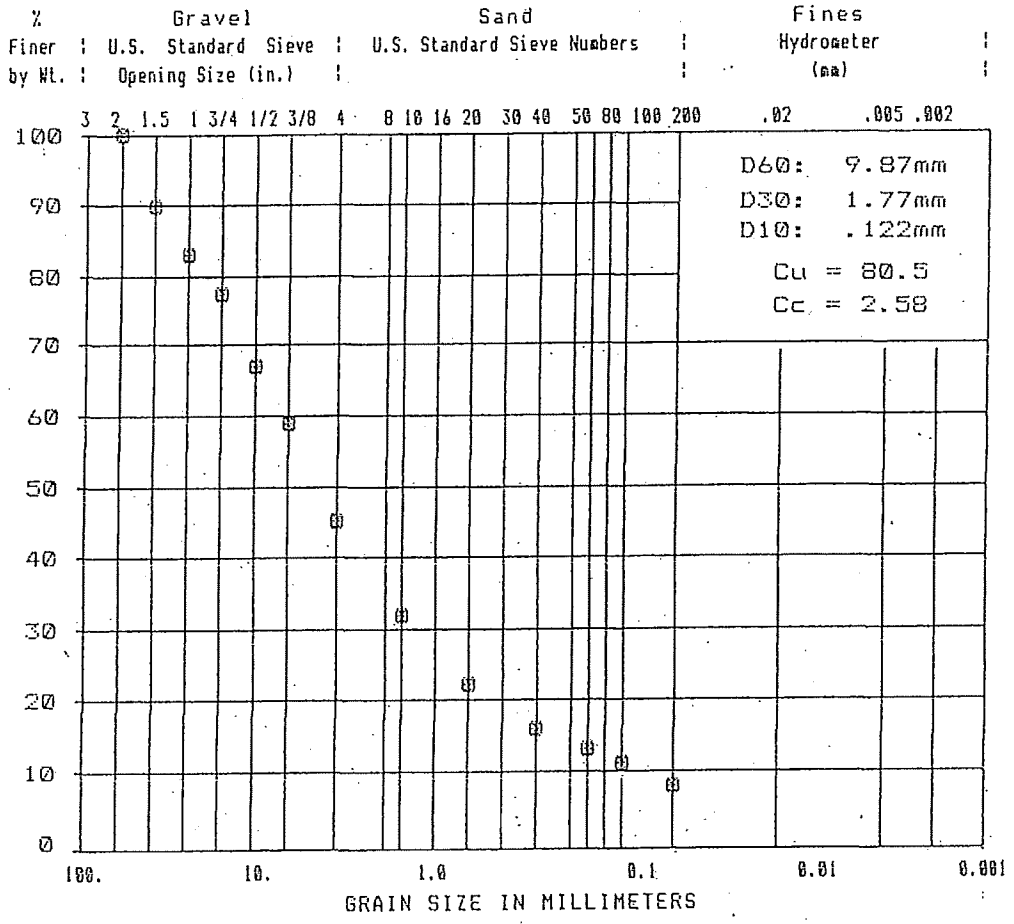
MAT-SU TEST LAB, INC.

Soils — Concrete — Water

Field and Laboratory Testing Services

P.O. Box 871868 • Wasilla, Alaska 99687 • (907) 376-3005

GRAIN SIZE ANALYSIS



Sieve Sizes	Percent Passing
2 in.	100
1.5 in.	90
1 in.	83
3/4 in.	77
1/2 in.	67
3/8 in.	59
#4	45
#10	32
#20	22
#40	16
#60	13
#100	11
#200	8.2

USC: GW-GM

Classification: Sandy Gravel w/ Trace Silt

As Received Moisture Content: 2.57%

Date: 2 April 1986 Project Number: 386016

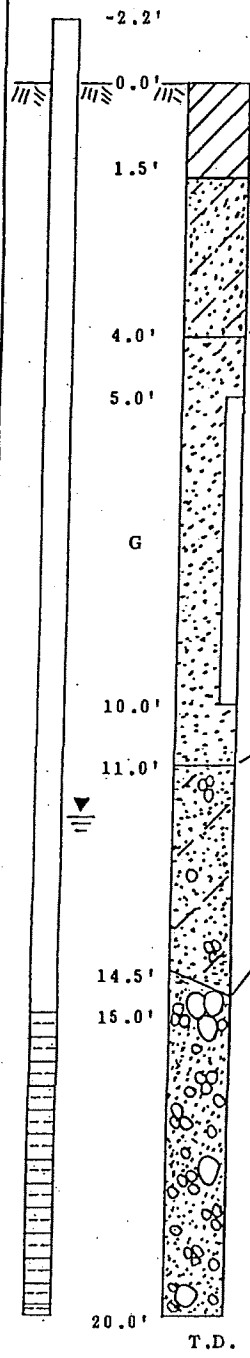
Project Name: Wasilla Sewerage Facility

Misc. Info.: Boring 15, Sample 2, 14-16'

Client Name: Gilfilian Engineering

Approved by: B. Queintasch

FIGURE III
Sheet 2 of 9



TEST BORING NO. 20

(Ground Surface Elevation 220.6)

SILT, Brown, Soft, Moist (ML)

Fine SAND w/Trace Silt, Brown, Moderately Dense, Dry (SM)

Fine SAND, Brown, Loose to Moderately Dense, Dry to Slightly Moist

(1) (SP-SM) 10.2 %

Gravelly SAND w/ Trace Silt, Moderately Dense, Brown, Moist to Saturated (GW-GM)

Static Water Level at 11.8' (208.8) 11/28/86

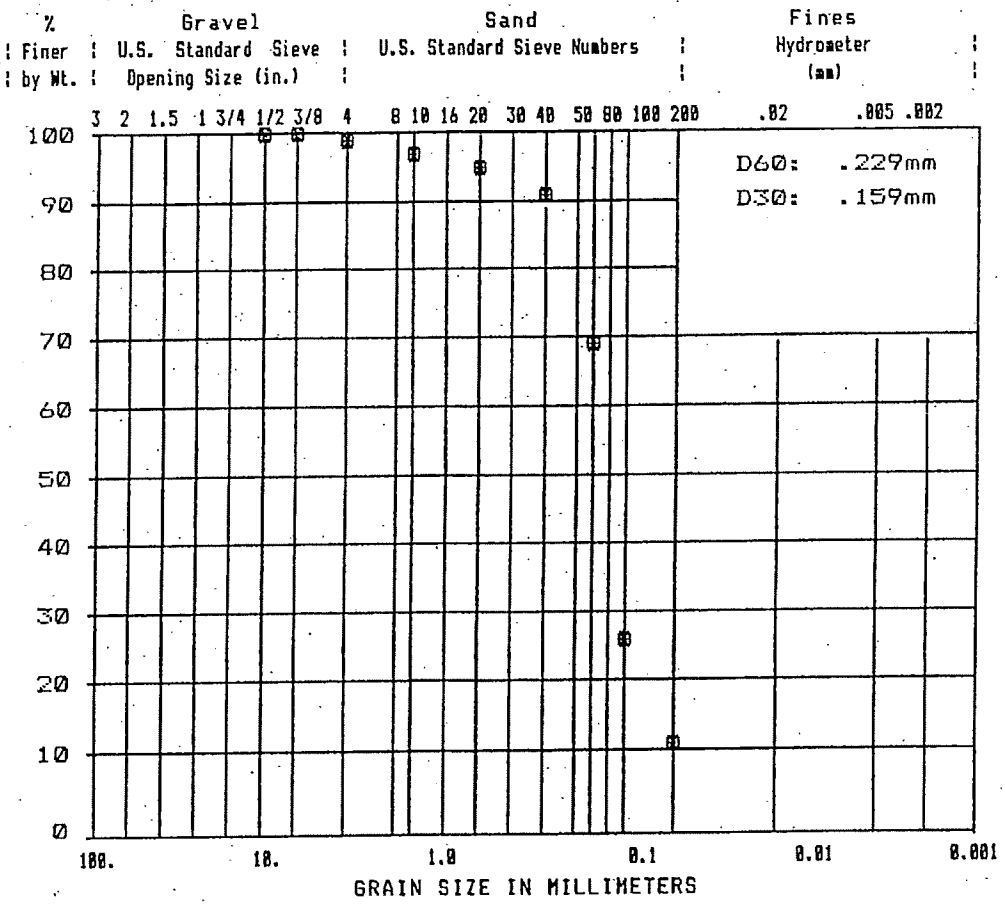
Sandy GRAVEL w/ Occasional Cobbles, Brown to Gray, Dense, Saturated (GW)

FIGURE 11

Sheet 1 of 23

Gilfilian Engineering, Inc. P.O. Box 871868 Wasilla, Alaska 99687	TEST BORING AND MONITOR WELL LOG	Project No: WO86-14
		Scale: 1"=2'
	WASILLA SEWERAGE FACILITY RESERVE AREA	Drawn By: CL
		Date Logged:10/13/86

GRAIN SIZE ANALYSIS



Sieve Sizes	Percent Passing
1/2 in.	100
3/8 in.	100
#4	99
#10	97
#20	95
#40	91
#60	69
#100	26
#200	11.3

Insufficient Data for a USC

Classification: Sand w/ Trace Silt

As Received Moisture Content: 10.2%

Date: October 27, 1986 Project Number: 386099

Project Name: WSFHI

Misc. Info.: TB #20, SA #1, at 5-10'

Client Name: Gilfilian Engineering, Inc. #86-14

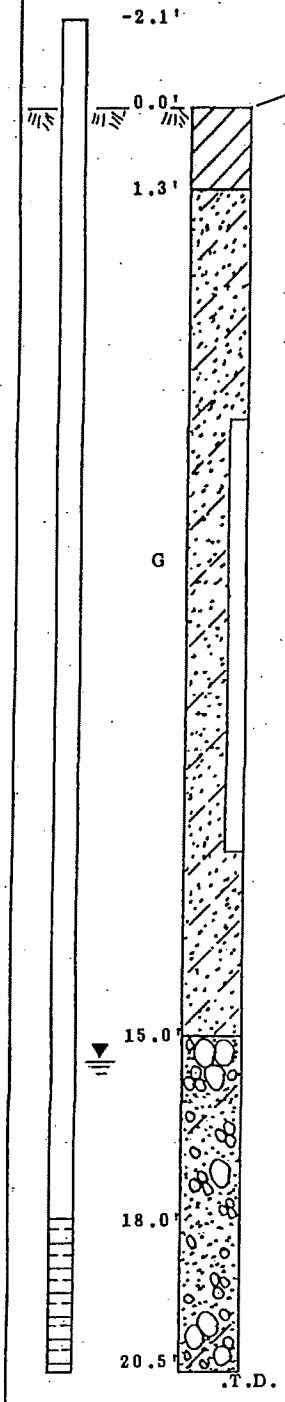
Approved by: B Gilfilian

FIGURE III

Sheet 1 of 18

Gilfilian Engineering, Inc.

P.O. Box 871868, Wasilla, Alaska 99687 (907) 376-3005



TEST BORING NO. 26

(Ground Surface Elevation 223.9)

SILT, Brown, Firm, Moist to Wet (ML)

(1) (SM)

Fine to Medium Silty SAND, Brown, Moderately Dense, Dry to Moist

Static Water Level at 15.4' (208.5) 11/28/86

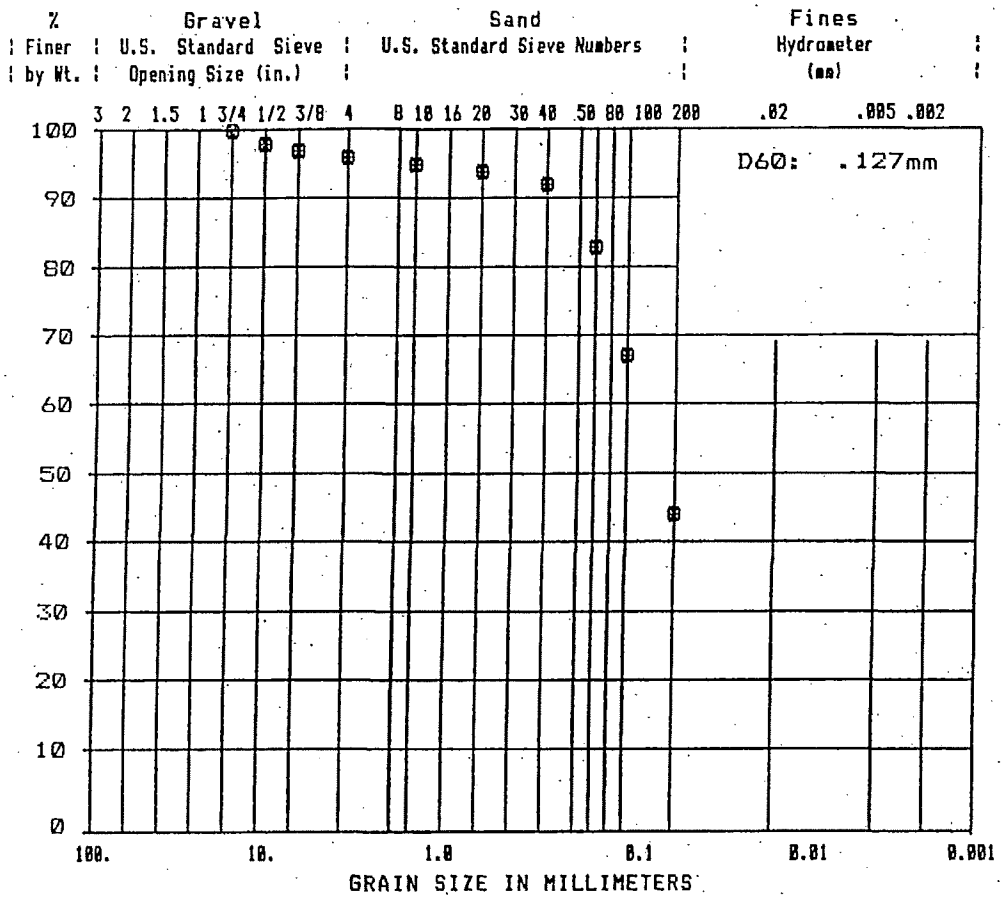
Sandy GRAVEL w/ Trace Silt, Numerous Cobbles, Brown, Dense, Saturated (GP-GM)
Pumped at 18 gpm at 20.0 ft.

FIGURE 11

Sheet 7 of 23

Gilfilian Engineering, Inc. P.O. Box 871868 Wasilla, Alaska 99687	TEST BORING AND MONITOR WELL LOG	Project No: WO86-14
		Scale: 1"= 2'
	WASILLA SEWERAGE FACILITY RESERVE AREA	Drawn By: CL
		Date Logged:10/13/86

GRAIN SIZE ANALYSIS



Sieve Sizes	Percent Passing
3/4 in.	100
1/2 in.	98
3/8 in.	97
#4	96
#10	95
#20	94
#40	92
#60	83
#100	67
#200	44.0

USC: SM

Classification: Silty Sand

Date: October 20, 1986 Project Number: 386099

Project Name: WSFHI

Misc. Info.: TB #26, SA #1, at 5-12'

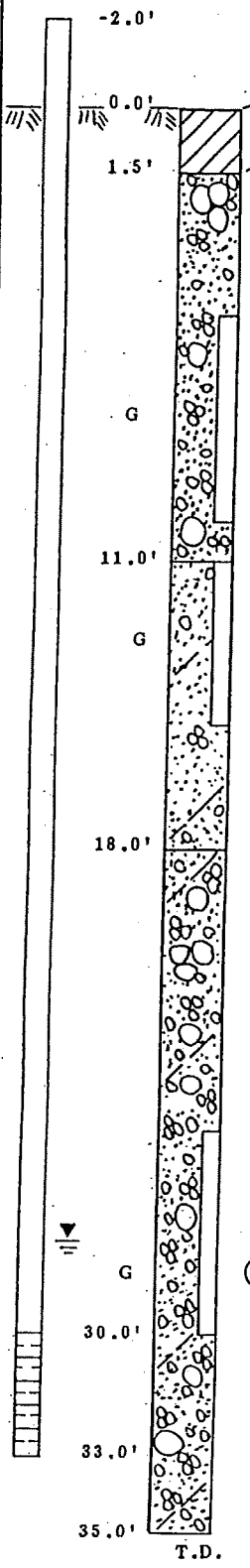
Client Name: Gilfilian Engineering, Inc. #86-14

Approved by: B. Gilfilian

FIGURE III

Gilfilian Engineering, Inc.

P.O. Box 871868, Wasilla, Alaska 99687 (907) 376-3005



TEST BORING NO. 27

(Ground Surface Elevation 235.8)

SILT, Brown, Soft, Moist (ML)

Sandy GRAVEL w/ Occasional Cobbles, Brown, Dense, Dry

3.29X10^{-2} cm/sec

① (GW)

② (SW-SM) 4.0%

Gravelly SAND w/ Trace Silt, Brown to Gray, Dense to Very Dense, Dry to Moist

Static Water Level at 27.2' (208.6) 11/28/86

③ (GW-GM) 4.0%

Sandy GRAVEL w/ Trace Silt, Numerous Cobbles, Gray to Brown, Dense, Slightly Moist to Saturated

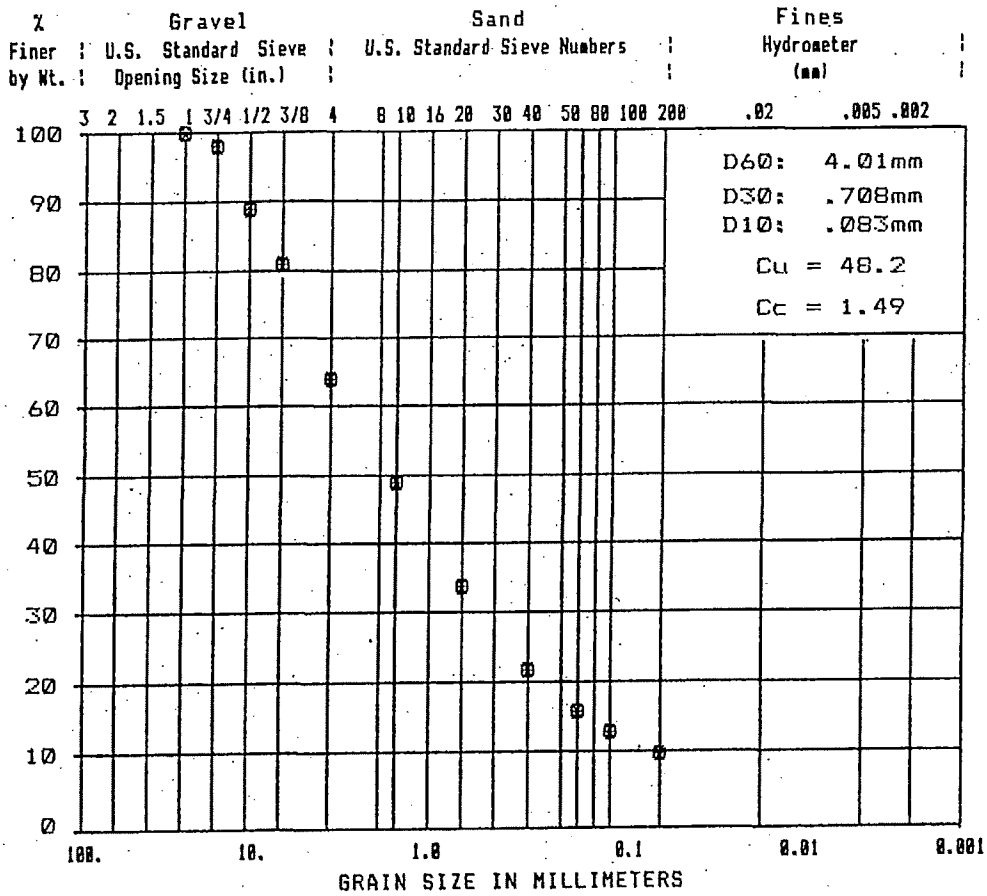
Noted Slow Seepage of Groundwater into Bore Hole Below 30.0 ft. While Drilling

FIGURE II

Sheet 8 of 23

Gilfilian Engineering, Inc. P.O. Box 871868 Wasilla, Alaska 99687	TEST BORING AND MONITOR WELL LOG	Project No: WO86-14
		Scale: 1"= 3'
	WASILLA SEWERAGE FACILITY RESERVE AREA	Drawn By: CL
		Date Logged: 10/15/86

GRAIN SIZE ANALYSIS



Sieve Sizes	Percent Passing
1 in.	100
3/4 in.	98
1/2 in.	89
3/8 in.	81
#4	64
#10	49
#20	34
#40	22
#60	16
#100	13
#200	9.6

USC: SW-SM

Classification: Gravelly Sand w/ Trace Silt

As Received Moisture Content: 4.04%

Date: October 22, 1986 Project Number: 386099

Project Name: WSFHI

Misc. Info.: TB #27, SA #2, at 11-15'

Client Name: Gilfilian Engineering, Inc. #86-14

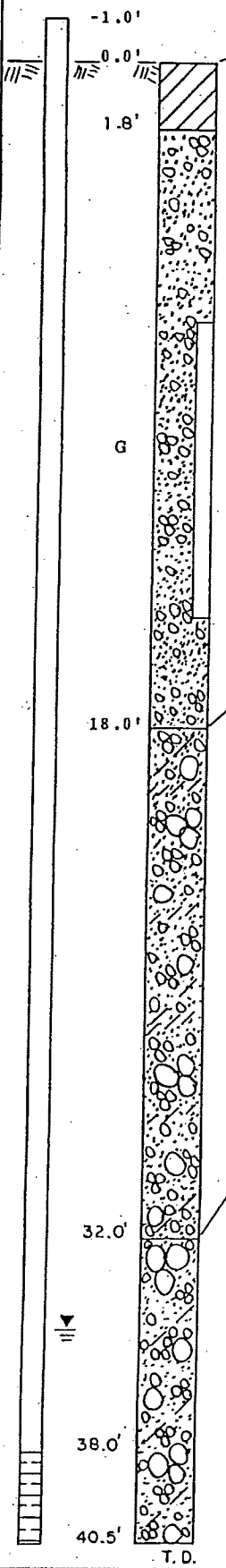
Approved by: BQueitsch

FIGURE III

Gilfilian Engineering, Inc.

P.O. Box 871868, Wasilla, Alaska 99687 (907) 376-3005

TEST BORING NO. 28



(Ground Surface Elevation 244.4)
SILT, Brown, Soft, Moist (ML)

(1) (GW) & (SP) 3.7%

Stratified Sandy GRAVEL and Gravelly SAND, Brown, Moderately Dense to Dense, Dry

Sandy GRAVEL w/ Numerous Cobbles, Trace Silt, Gray to Brown, Dense, Dry, Occasional Layers with Some Silt
(GP-GM)

Sandy GRAVEL w/ Numerous Cobbles, Occasional Trace Silt, Brown, Dense, Slightly Moist to Saturated
(GP)

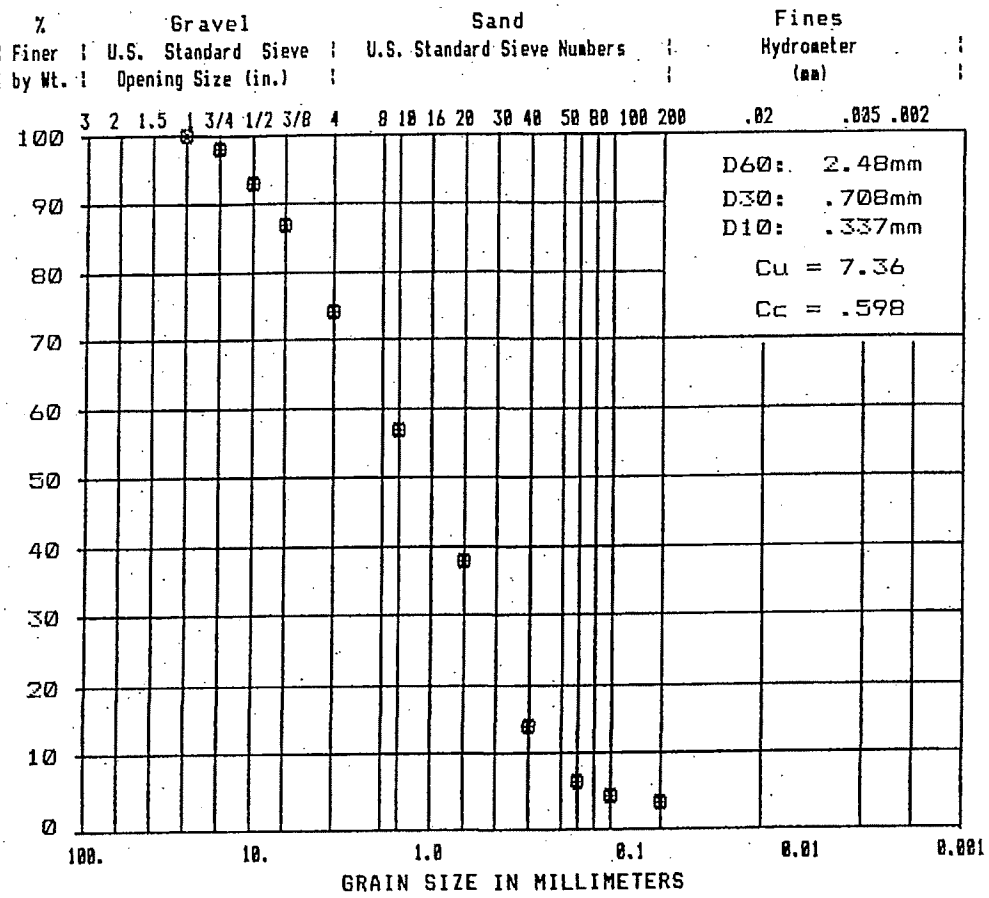
Static Water Level at 34.6' (209.8) 11/28/86

FIGURE II

Sheet 9 of 23

Gilfilian Engineering, Inc. P.O. Box 871868 Wasilla, Alaska 99687	TEST BORING AND MONITOR WELL LOG	Project No: WO86-14
		Scale: 1"= 3'
	WASILLA SEWERAGE FACILITY RESERVE AREA	Drawn By: CL
		Date Logged:10/16/86

GRAIN SIZE ANALYSIS



Sieve Sizes	Percent Passing
1 in.	100
3/4 in.	98
1/2 in.	93
3/8 in.	87
#4	74
#10	57
#20	38
#40	14
#60	6
#100	4
#200	2.5

USC: SP

Classification: Gravelly Sand

Frost Group: NFS

As Received Moisture Content: 3.70%

Date: October 22, 1986 Project Number: 386099

Project Name: WSFHI

Misc. Info.: TB #28, SA #1, at 5-15'

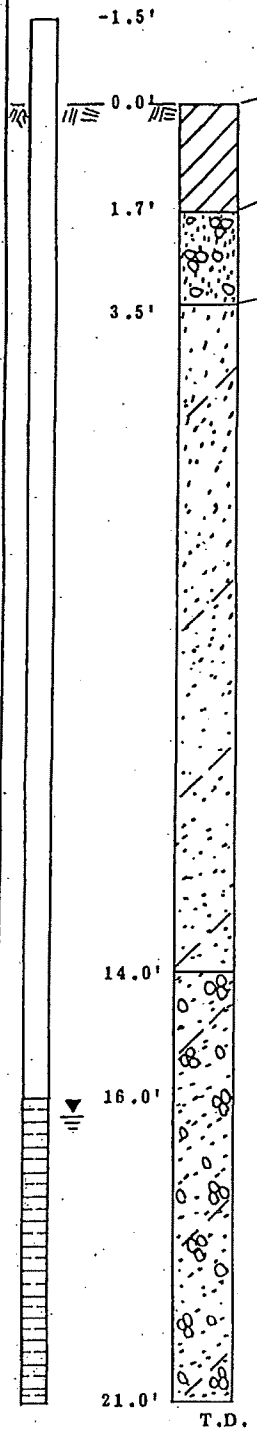
Client Name: Gilfilian Engineering, Inc. #86-14

Approved by: B Queitzsch

FIGURE III

Gilfilian Engineering, Inc.

P.O. Box 871868, Wasilla, Alaska 99687 (907) 376-3005



TEST BORING NO. 33

(Ground Surface Elevation 224.6)

SILT, Brown, Soft, Moist (ML)

Sandy GRAVEL, Brown, Dense, Dry (GW)

Fine to Medium SAND w/ Occasional Trace Silt, Brown to Olive, Moderately Dense, Dry to Slightly Moist (SP) & (SP-SM)

Static Water Level at 16.3' (208.3) 11/28/86

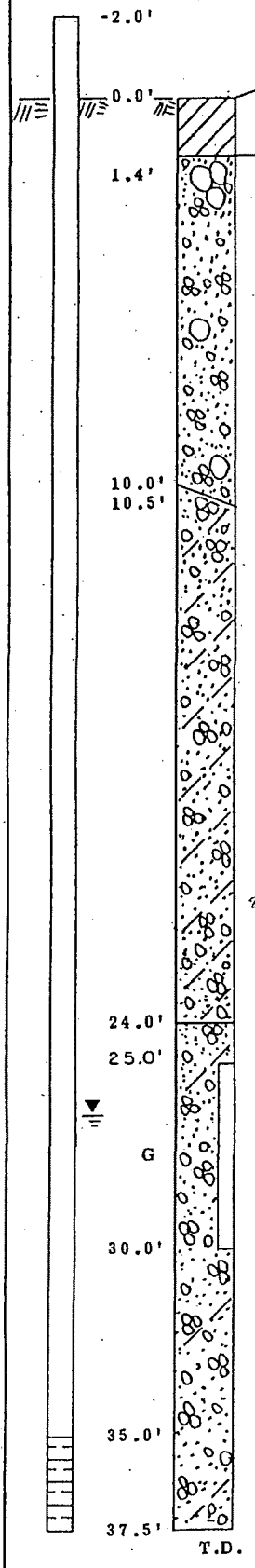
Sandy GRAVEL w/ Trace Silt, Brown, Dense, Dry to Saturated Below 16.3' (GP-GM)

Pumped 15 gpm at 20.8'

FIGURE 11

Sheet 14 of 23

Gilfilian Engineering, Inc. P.O. Box 871868 Wasilla, Alaska 99687	TEST BORING AND MONITOR WELL LOG	Project No: WO86-14
		Scale: 1"= 2'
	WASILLA SEWERAGE FACILITY RESERVE AREA	Drawn By: CL
		Date Logged:10/13/86



TEST BORING NO. 34

(Ground Surface Elevation 235.1)

SILT, Brown, Soft, Moist (ML)

Sandy GRAVEL w/ Occasional Cobbles, Brown, Dense, Dry (GW)

Silty Sandy GRAVEL, Gray, Dense, Dry to Slightly Moist (GM)

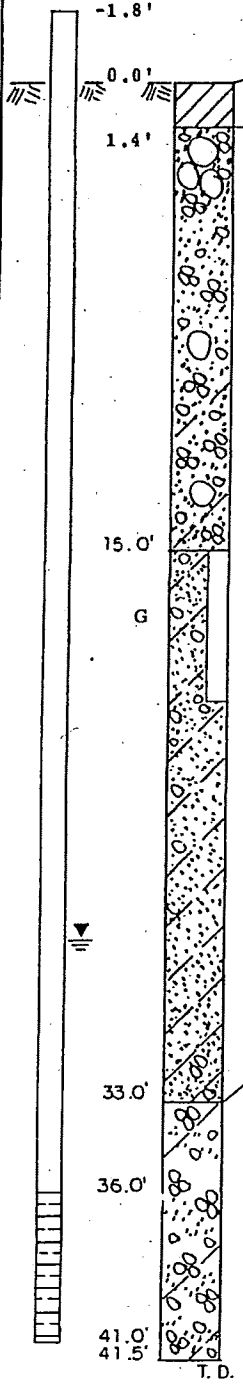
Static Water Level at 26.4' (208.7) 11/28/86

(1) (GW) Sandy GRAVEL and GRAVEL w/ Some Sand and Trace Silt, Brown, Dense, Saturated

FIGURE 11

Sheet 15 of 23

Gilfilian Engineering, Inc. P.O. Box 871868 Wasilla, Alaska 99687	TEST BORING AND MONITOR WELL LOG	Project No: WO86-14
		Scale: 1"= 3'
	WASILLA SEWERAGE FACILITY RESERVE AREA	Drawn By: CL
		Date Logged:10/15/86



TEST BORING NO. 39

(Ground Surface Elevation 235.9)

SILT, Brown, Firm, Moist (ML)

Sandy GRAVEL w/ Occasional Cobbles, Brown, Dense, Dry, Occasional Trace Silt Below 8.0' (GW)

(1) (SM)

Silty Gravelly SAND Gray, Dense, Dry to Slightly Moist

Static Water Level at 27.7' (208.2) 11/28/86

GRAVEL w/ Some Sand and Trace Silt, Brown, Dense, Wet to Saturated (GP-GM)

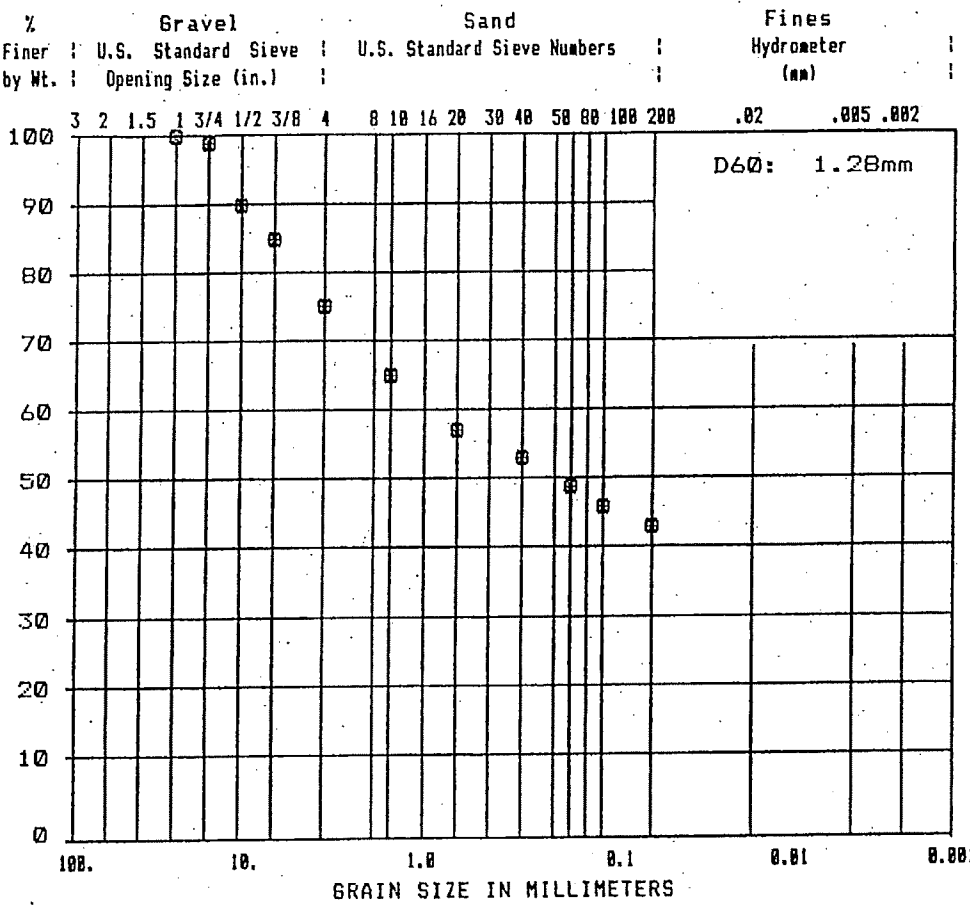
Pumped 2gpm at 40.0'

FIGURE 11

Sheet 20 of 23

Gilfilian Engineering, Inc. P.O. Box 871868 Wasilla, Alaska 99687	TEST BORING AND MONITOR WELL LOG	Project No: WO86-14
		Scale: 1"= 4'
	WASILLA SEWERAGE FACILITY RESERVE AREA	Drawn By: CL
		Date Logged:10/14/86

GRAIN SIZE ANALYSIS



Sieve Sizes	Percent Passing
1 in.	100
3/4 in.	99
1/2 in.	90
3/8 in.	85
#4	75
#10	65
#20	57
#40	53
#60	49
#100	46
#200	43.1

USC: SM

Classification: Silty Gravelly Sand

Date: October 20, 1986 Project Number: 386099

Project Name: WSFHI

Misc. Info.: TB #39, SA #1, at 15-20'

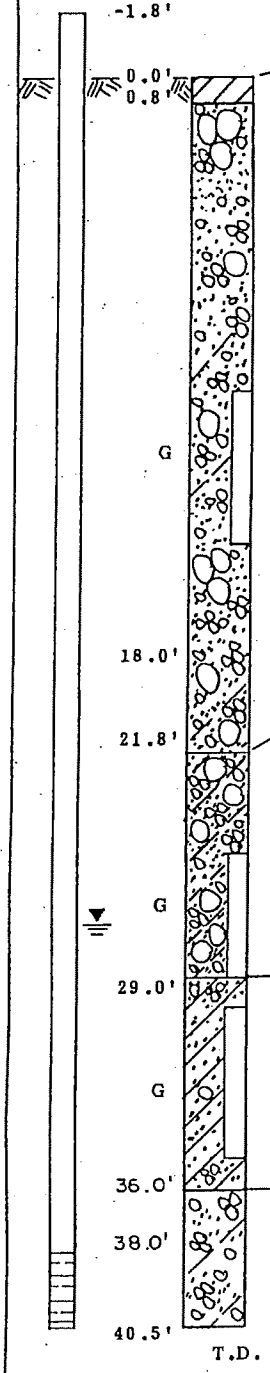
Client Name: Gilfilian Engineering, Inc. #86-14

Approved by: B Quintasch

FIGURE III

Gilfilian Engineering, Inc.

P.O. Box 871868, Wasilla, Alaska 99687 (907) 376-3005



TEST BORING NO. 40

(Ground Surface Elevation 238.3)

SILT, Brown, Firm, Moist (ML)

(1) (GW)

Sandy GRAVEL w/ Numerous Cobbles, Brown, Dense, Dry, Occasional Trace Silt Below 9.0'

GROUNDWATER ENCOUNTERED at 18.0' While Drilling
Pumped for 10 min. at 5 gpm

Silty Sandy GRAVEL w/ Numerous Cobbles, Brown, Dense, Slightly Moist to Wet

(2) (GM)
Static Water Level at 27.3' (211.0) 11/28/86

(3) (ML) 11.3 %
Sandy SILT w/ Some Gravel, Brown to Gray, Dense, Moist to Wet

GRAVEL w/ Trace to Some Sand and Silt, Brown, Dense, Saturated (GM) & (GP-GM)

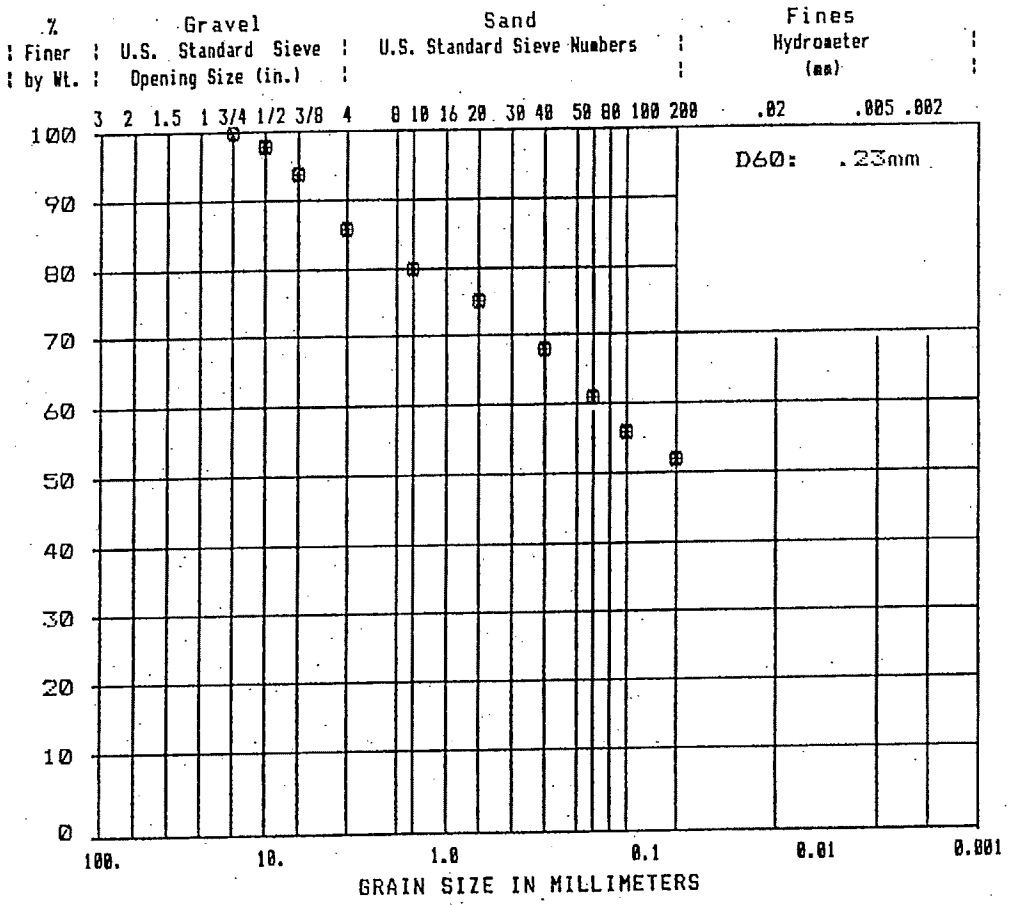
Produced Small Amount of Muddy Water at 40.0'

FIGURE 11

Sheet 21 of 23

Gilfilian Engineering, Inc. P.O. Box 871868 Wasilla, Alaska 99687	TEST BORING AND MONITOR WELL LOG	Project No: WO86-14
		Scale: 1"= 4'
	WASILLA SEWERAGE FACILITY RESERVE AREA	Drawn By: CL
		Date Logged:10/13/86

GRAIN SIZE ANALYSIS



Sieve Sizes	Percent Passing
3/4 in.	100
1/2 in.	98
3/8 in.	94
#4	86
#10	80
#20	75
#40	68
#60	61
#100	56
#200	51.5

USC: ML

Classification: Sandy Silt

Frost Group: F4

As Received Moisture Content: 11.3%

Date: October 22, 1986 Project Number: 386099

Project Name: WSFHI

Misc. Info.: TB #40, SA #3, at 30-35'

Client Name: Gilfilian Engineering, Inc. #86-14

Approved by: B Queitsch

FIGURE III

Gilfilian Engineering, Inc.

P.O. Box 871868, Wasilla, Alaska 99687 (907) 376-3005

APPENDIX C

INFILTRATION TESTING

Page

FIGURES

APPENDIX C

Infiltration testing at the site included a pilot infiltration test (PIT), a double ring infiltrometer test, and two falling head tests. The PIT test was conducted in an upland area west of the existing lagoons and east of the wetland/lowlying area where the borings were advanced for this portion of the project. The double ring infiltrometer test was conducted adjacent to Boring B-06, and the falling head tests were conducted adjacent to Boring B-08 and the proposed location for B-12, which was not able to be advanced due to drill rig inaccessibility. The approximate locations of the infiltration tests are shown on the site plan in Figure 2.

C.1 PILOT INFILTRATION TEST

The PIT was conducted at the site by an experienced member of our geotechnical staff on July 29, 2015. The PIT was conducted in general accordance with the small-scale method in the 2012 Ecology Stormwater Management Manual for Western Washington (Ecology 2012). We subcontracted with JTA Construction of Anchorage, Alaska to clear the test areas of trees, excavate the test pit used for the PIT, and coordinate water delivery to the test location. After the completion of the PIT, a bulk sample of the soil from the test pit bottom was collected for grain size analysis, the test pits were backfilled with materials removed during digging, and the native vegetation was placed back on the ground surface to the extent practical. The grainsize curve for the material sampled from the bottom of the test pit is included as Figure C-1.

The PIT procedure generally consisted of creating an excavation with bottom dimensions of approximately 5-foot by 5-foot at a depth of approximately 4 ½ feet bgs, adding water to the excavation, and adjusting the flow to maintain a constant water level (head) in the excavation. Water was supplied to the site with water trucks and pumped to the excavation using 1 ½ -inch diameter flexible hoses. Flow was controlled by adjusting the pump throttle. A measuring rod was placed in the excavation to allow manual measurements of the depth of water. Water was added to the excavation at varying rates of flow until a constant head was maintained for at least one hour under a relatively constant flow (until flow rates stabilized within 5 percent). During the PIT, water was maintained approximately 12 inches above the bottom of the excavation. The flow rate was recorded using an inline flow meter and checked with a 5-gallon bucket and stop watch.

Using the data from our PIT and limited laboratory testing, we calculated short term infiltration rates and hydraulic characteristics for the soil and groundwater conditions observed in our field explorations. The short term infiltration rate is determined by calculating the volume of water infiltrating across the bottom area of the excavation during the PIT. The Ecology Manual considers the rate of water infiltrating after the head and flow rate have stabilized within the excavation to be adequate for calculating the short term infiltration rate. *Volume III - Hydrologic Analysis and Flow Control BMPs, Table 3.3.1* of the Ecology Manual provides correction factors to apply to the short-term infiltration rates to obtain long-term or design infiltration rates. The correction factors include:

- CF_v, site variability and number of locations tested, ranges from 0.33 to 1.0.
- CF_t, test method, ranges from 0.4 to 0.75.
- CF_m, degree of influent control to prevent siltation and bio-buildup, 0.9 (assumes sediment is removed when the facility is infiltrating at 90 percent of its design capacity).

The *total correction factor* (CF_T) is determined by multiplying together the three *partial correction factors* described above.

We recommend the following ranges of correction factors be considered in developing the design infiltration rate for the facility:

- CF_v = 0.4 to 0.5 On the low end of the range based the subsurface variability at the site and the number of tests conducted.
- CF_t = 0.4 (for grain size, double ring, and falling head test methods) and 0.5 for small-scale PIT methods.
- CF_m = 0.9 Assumes a moderate level of influent control will be used to prevent siltation and bio-buildup and that siltation maintenance will be performed once the facility is infiltrating at 90 percent of its design capacity. This should be modified to reflect the anticipated actual maintenance frequency.

Grain size analyses were performed on the sample recovered from about 6 inches to 1 foot below the excavation bottom at the PIT location and represent the typical materials encountered in the unsaturated zone. The grain size results are presented in Figure C-1. Based on the grain size distribution curve we estimated short term infiltration rates of 3.1 inches per hour (in/hr). The infiltration rate from the grain size distribution curve is estimated based on a correlation between

the fraction of fines, 10 percent of the passing grain size (D_{10}), D_{60}, and D_{90} using Equation 1 from Section 3.3.6 of the 2012 Ecology Manual.

C.2 DOUBLE RING AND FALLING HEAD TESTS

Adjacent to Boring B-08, a double-ring infiltrometer (ASTM D3385) test was attempted. However, due to the fast draining nature of the soil and the inability to keep Mariotte Tubes filled with enough water to sustain a constant head, an improvised test was used. In this test, the two aluminum rings from the double-ring infiltrometer apparatus were seated into the ground approximately 6 inches, the annulus space was then filled with approximately 2 to 4 inches of water above the ground surface. Once the annulus space was filled, the inner-ring was filled with water to 6 inches above the ground surface. Once both rings were filled, the time taken for the inner-ring water level to drop from 6 inches to 2 inches above the ground surface was measured and the percolation rate value was recorded similar to a falling-head test.

At location B-12, due to standing water and other site conditions, a single 24-inch aluminum ring was seated approximately 6 inches into the ground, the ring was then filled to approximately 8 inches above the ground surface with water, and the time taken to drain from 8 inches to 2 inches was recorded.

At location B-06, a double-ring infiltrometer test was successfully performed according to ASTM D3385. For this test, two aluminum rings with 12 and 24 inch diameters were seated approximately six inches into the ground concentrically. The rings were then filled with water and held to a constant depth of approximately 6 inches above the ground surface using Mariotte tubes. The amount of water used to maintain a constant head within the inner aluminum tube was then recorded at 15, 30, and 60 minute intervals until the infiltration rate became constant. Infiltration rates are presented the in the table provided in the next section.

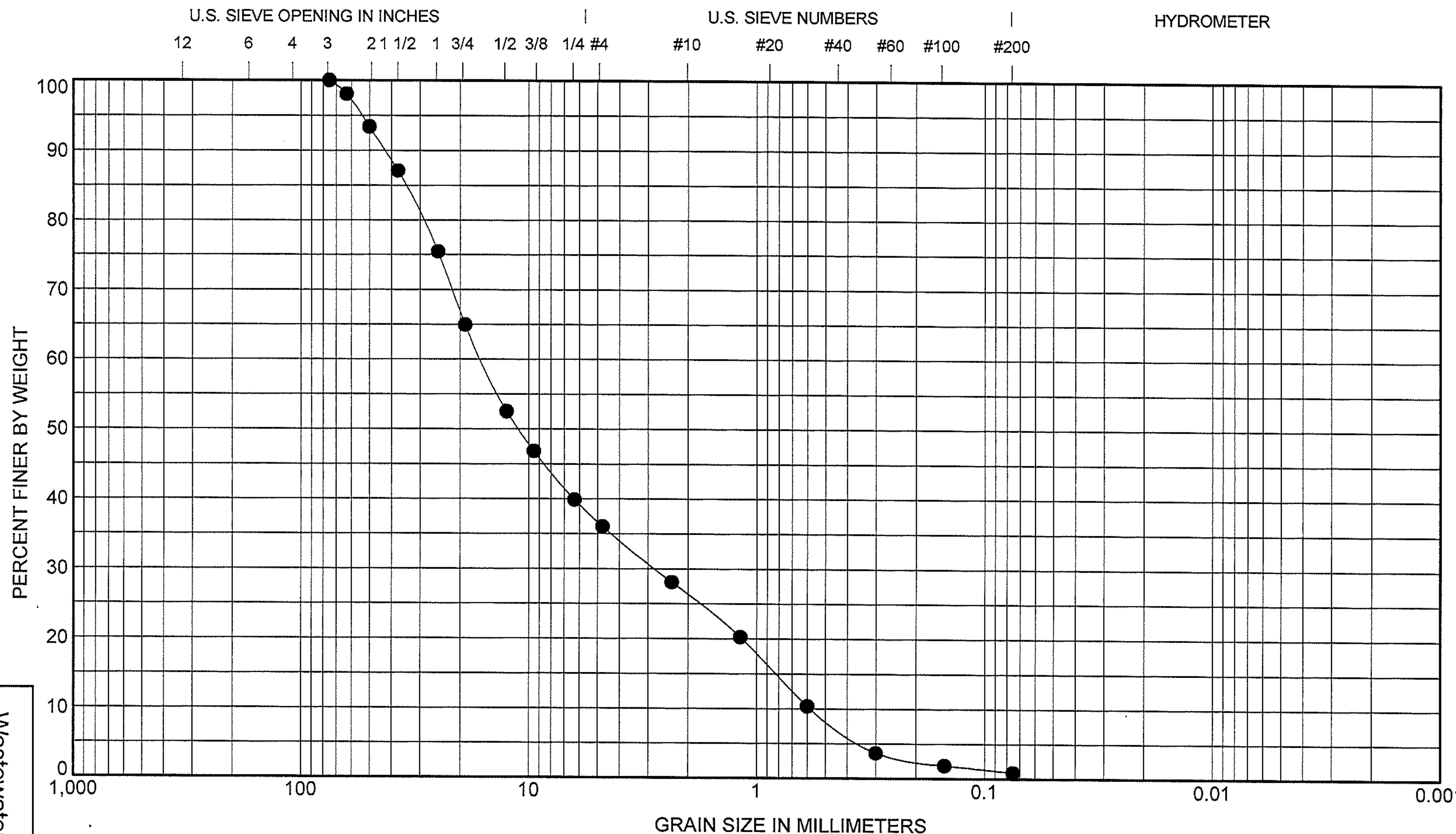
C.3 INFILTRATION RESULTS

The table below summarizes the field infiltration values, infiltration values from grain size results, and our suggested range of correction factors based on the Ecology Manual. We recommend that the engineer who designs the final infiltration structure determines appropriate correction factors for calculating the long term design infiltration rate.

Test Method	Water Level Above the Bottom of Test Pit During the Test (in)	Short Term Infiltration Rate[1] Constant Head (inches per hour)	Short Term Infiltration Rate[1] Falling Head (inches per hour)	Suggested Range for Total Correction Factor (CF_T)[2]
PIT (small – scale)	11	48	22	0.2 to 0.3
Grain Size (from PIT)	NA	-	3.1	0.1 to 0.2
Boring B-6 (double ring)	6	0.7	-	0.1 to 0.2
Boring B-8 (falling head)	6	-	14.4	0.1 to 0.2
Boring B-12 (falling head)	8	-	7.6	0.1 to 0.2

Notes: [1] Short Term Infiltration Rate refers to the infiltration rate measured during the test and does not represent the infiltration rate expected for a permanent infiltration structure. For the "grain size" test method, the table values refer to the "preliminary long term" infiltration rates. Infiltration rates for the falling head test period represent an average of multiple infiltration rates calculated over the falling head period.
[2]Suggested correction factors assume $CF_m = 0.9$ and should be varied depending on the anticipated performance and maintenance schedule. Furthermore, these correction factors do not account for the potential effects of groundwater mounding at the proposed facility.

Shannon & Wilson's water level observations in the piezometers installed as well as review of the previous data indicate that the groundwater table appears to be at approximate elevation 210 feet, and is seen on the surface in several places within the lowlying portion of the project area. The Ecology Manual suggests performing an analytical groundwater mounding analysis when the drainage area exceeds 1 acre and has less than 15 feet to seasonal high water (or other low permeability stratum). The infiltration rates and correction factors discussed in the preceding sections and summarized in the table above do not include allowances for groundwater mounding. We recommend that a detailed mounding analysis be performed using a program such as MODFLOW to refine our understanding of the effects of groundwater mounding within the project area. As a rule of thumb, the effects of groundwater mounding may reduce infiltration rates by at least an order of magnitude from corrected values. We understand that a mounding analysis is planned as a part of this project. Results will be provided under separate cover.



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Sample	Depth, Ft	Classification	LL	PL	PI	Cc	Cu
● PIT S1	4.5 - 5.0	**Poorly graded Gravel with Sand (GP)**				**0.8**	**27.8**

Sample	Depth, Ft	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● PIT S1	4.5 - 5.0	**75**	**16.09**	**2.79**	**0.58**	**64**	**35**	**1**	

Wastewater Treatment Plant Improvements
Wasilla, Alaska

GRAIN SIZE CLASSIFICATION

January 2016

32-1-02452

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. C-1

APPENDIX D

ANALYTICAL TEST RESULTS SUMMARY TABLES AND SGS RESULTS FOR GROUNDWATER TESTING

TABLE D-1
WELL DEVELOPMENT AND SAMPLING LOG

	Monitoring Well Number		
	MW6	**MW8**	**MW9**
Development Data			
Development Date	6/3/2015	6/3/2015	6/2/2015
Measured Depth to Water (ft bgs)*	-1.5	-1.0	15.8
Total Depth of Well (ft bgs)	45.24	40.51	49.20
Water Column in Well (ft)	46.74	41.51	33.40
Gallons per Foot	0.16	0.16	0.16
Water Column Volume (gallons)	7.5	6.64	5.34
Total Volume Pumped (gallons)	40	49	32.5
Development Method	Surge block/ Submersible pump	Surge block/ Submersible pump	Surge block/ Submersible pump
Water Level Measurement Data			
Date Water Level Measured	6/3/2015	6/3/2015	6/2/2015
Time Water Level Measured	12:35	10:05	10:55
Measured Depth to Water (ft bgs)*	-1.5	-1.0	15.8
Sampling Data			
Date Sampled	6/3/2015	6/3/2015	6/2/2015
Time Sampled	14:10	12:00	13:20
Measured Depth to Water (ft bgs)	-1.5	-1.0	15.8
Total Depth of Well (ft bgs)	45.24	40.51	49.20
Water Column in Well (ft)	46.74	41.51	33.40
Gallons per Foot	0.16	0.16	0.16
Water Column Volume (gallons)	7.5	6.64	5.34
Total Volume Pumped (gallons)	40	49	32.5
Sampling Method	Submersible pump	Submersible pump	Submersible pump
Diameter of Well Casing	2-inch	2-inch	2-inch
Water Quality Data			
Date Measured	6/3/2015	6/3/2015	6/2/2015
Temperature (°C)	5.5	3.42	4.89
pH (Standard Units)	8.34	8.45	205
Specific Conductivity (µS/cm)	115	108	6.68
ORP (mV)	-162.4	-152.6	-22.6
Turbidity (NTU)	8.48	460.7	107.5
Remarks	Artesian well	Water above ground surface in well	

Notes:

Water quality parameters were measured with a YSI 556 and a Hach turbidimeter

ft = Feet
bgs = below ground surface
°C = Degrees Celsius
µS/cm = Microsiemens per Centimeter
NTU = Nephelometric Turbidity Unit
mV = Millivolts
* = Negative depth value indicates water measured above ground surface

TABLE D-2
SUMMARY OF GROUNDWATER ANALYTICAL RESULTS

Parameter Tested	Method*	Drinking Water MCL/SDWR (mg/L)	Cleanup Level (mg/L)**	Sample ID Number^ and Water Depth in Feet bgs (See Figure 2 and Appendix A)				
				Monitoring Well			Observation Well	
				MW6 -1.5~	MW8 -1.0~	MW9 15.8	B-14 Shallow# 89.8	B-14 Deep## 86.0
pH - SU	SM21 4500	6.5 to 8.5	-	7.90	7.80	7.80	-	-
Total Nitrate/Nitrite - mg/L	SM21 4500	10	-	<0.0500	<0.0500	**0.937**	-	-
Nitrate - mg/L	EPA 300.0	10	-	-	-	-	**0.380**	**0.126**
Nitrite - mg/L	EPA 300.0	1	-	-	-	-	**0.0600 J**	<0.0500
Dissolved RCRA Metals								
Arsenic - mg/L	SW 6020	0.010	0.010	**0.0126**	**0.00866**	**0.00375 J**	-	-
Barium - mg/L	SW 6020	2.0	2.0	**0.0176**	**0.0159**	**0.0285**	-	-
Cadmium - mg/L	SW 6020	0.005	0.005	<0.00100	<0.00100	<0.00100	-	-
Chromium - mg/L	SW 6020	0.10	0.10	**0.00144 J**	**0.00123 J**	**0.00638**	-	-
Lead - mg/L	SW 6020	0.015	0.015	<0.000500	<0.000500	**0.00129**	-	-
Mercury - mg/L	SW 6020	0.002	0.002	<0.000100	<0.000100	<0.000100	-	-
Selenium - mg/L	SW 6020	0.05	0.05	<0.0100	<0.0100	<0.0100	-	-
Silver - mg/L	SW 6020	-	0.10	<0.00100	<0.00100	<0.00100	-	-

Notes:

*	= See Appendix D for compounds tested, methods, and laboratory reporting limits
**	= Groundwater cleanup levels are listed in Table C, 18 AAC 75.345 (January 2016)
^	= Sample ID number preceded by "02452-" on the chain of custody form
mg/L	= Milligrams per liter
<0.000500	= Analyte not detected; laboratory limit of detection of 0.000500 mg/L
0.0126	= Analyte detected
-	= Not applicable
~	= Groundwater is above ground surface in the well casing
J	= Estimated concentration less than the limit of quantitation. See the SGS laboratory report for more details.
MCL	= Maximum Contaminant Levels
SDWR	= Secondary Drinking Water Regulation
SU	= Standard units
RCRA	= Resource Recovery and Conservation Act
bgs	= Below ground surface
#	= 02452 WWTP.100 in SGS Results Report
##	= 02452 WWTP.150 in SGS Results Report

Laboratory Report of Analysis

To: Shannon & Wilson, Inc.
5430 Fairbanks St. Suite 3
Anchorage, AK 99518
(907)561-2120

Report Number: **1152555**

Client Project: **WWTP 02452-001**

Dear Katra Wedeking,

Enclosed are the results of the analytical services performed under the referenced project for the received samples and associated QC as applicable. The samples are certified to meet the requirements of the National Environmental Laboratory Accreditation Conference Standards. Copies of this report and supporting data will be retained in our files for a period of ten years in the event they are required for future reference. All results are intended to be used in their entirety and SGS is not responsible for use of less than the complete report. Any samples submitted to our laboratory will be retained for a maximum of fourteen (14) days from the date of this report unless other archiving requirements were included in the quote.

If there are any questions about the report or services performed during this project, please call Victoria at (907) 562-2343. We will be happy to answer any questions or concerns which you may have.

Thank you for using SGS North America Inc. for your analytical services. We look forward to working with you again on any additional analytical needs.

Sincerely,
SGS North America Inc.

Victoria Pennick Date
Project Manager
Victoria.Pennick@sgs.com

Print Date: 06/09/2015 3:08:50PM

Case Narrative

SGS Client: **Shannon & Wilson, Inc.**
SGS Project: **1152555**
Project Name/Site: **WWTP 02452-001**
Project Contact: **Katra Wedeking**

Refer to sample receipt form for information on sample condition.

*QC comments may be associated with the field samples found in this report. When applicable, comments will be applied to associated field samples.

SGS North America Inc.
200 West Potter Drive, Anchorage, AK 99518
t 907.562.2343 **f** 907.561.5301 www.us.sgs.com

Laboratory Qualifiers

Enclosed are the analytical results associated with the above work order. All results are intended to be used in their entirety and SGS is not responsible for use of less than the complete report. This document is issued by the Company under its General Conditions of Service accessible at <http://www.sgs.com/en/Terms-and-Conditions.aspx>. Attention is drawn to the limitation of liability, indenmification and jurisdiction issues defined therein.

Any holder of this document is advised that information contained hereon reflects the Company's findings at the time of its intervention only and within the limits of Client's instructions, if any. The Company's sole responsibility is to its Client and this document does not exonerate parties to a trasaction from exercising all their rights adn obligations under the transaction documents. Any unauthorized alteration, forgery or falsification of the contect or appearance of this documetn is unlawful and offenders may be prosecuted to the fullest extent of the law.

SGS maintains a formal Quality Assurance/Quality Control (QA/QC) program. A copy of our Quality Assurance Plan (QAP), which outlines this program, is available at your request. The laboratory certification numbers are AK00971 (DW Chemistry & Microbiology) & UST-005 (CS) for ADEC and 2944.01 for DOD ELAP/ISO17025 (RCRA methods: 1020B, 1311, 3010A, 3050B, 3520C, 3550C, 5030B, 5035A, 6020A, 7470A, 7471B, 8021B, 8082A, 8260B, 8270D, 8270D-SIM, 9040C, 9045D, 9056A, 9060A, AK101 and AK102/103). Except as specifically noted, all statements and data in this report are in conformance to the provisions set forth by the SGS QAP and, when applicable, other regulatory authorities.

The following descriptors or qualifiers may be found in your report:

*	The analyte has exceeded allowable regulatory or control limits.
!	Surrogate out of control limits.
B	Indicates the analyte is found in a blank associated with the sample.
CCV	Continuing Calibration Verification
CCCV	Closing Continuing Calibration Verification
CL	Control Limit
D	The analyte concentration is the result of a dilution.
DF	Dilution Factor
DL	Detection Limit (i.e., maximum method detection limit)
E	The analyte result is above the calibrated range.
F	Indicates value that is greater than or equal to the DL
GT	Greater Than
IB	Instrument Blank
ICV	Initial Calibration Verification
J	The quantitation is an estimation.
JL	The analyte was positively identified, but the quantitation is a low estimation.
LCS(D)	Laboratory Control Spike (Duplicate)
LOD	Limit of Detection (i.e., 1/2 of the LOQ)
LOQ	Limit of Quantitation (i.e., reporting or practical quantitation limit)
LT	Less Than
M	A matrix effect was present.
MB	Method Blank
MS(D)	Matrix Spike (Duplicate)
ND	Indicates the analyte is not detected.
Q	QC parameter out of acceptance range.
R	Rejected
RPD	Relative Percent Difference
U	Indicates the analyte was analyzed for but not detected.

Note: Sample summaries which include a result for "Total Solids" have already been adjusted for moisture content. All DRO/RRO analyses are integrated per SOP.

Sample Summary

Client Sample ID	Lab Sample ID	Collected	Received	Matrix
02452-MW9	1152555001	06/02/2015	06/03/2015	Water (Surface, Eff., Ground)
02452-MW8	1152555002	06/03/2015	06/03/2015	Water (Surface, Eff., Ground)
02452-MW6	1152555003	06/03/2015	06/03/2015	Water (Surface, Eff., Ground)

Method	Method Description
SW6020A	Dissolved RCRA Metals by ICP-MS
SM21 4500NO3-F	Nitrate/Nitrite Flow injection Pres.
SM21 4500-H B	pH Analysis

SGS North America Inc.
200 West Potter Drive, Anchorage, AK 99518
t 907.562.2343 f 907.561.5301 www.us.sgs.com

Detectable Results Summary

Client Sample ID: **02452-MW9**
Lab Sample ID: 1152555001

	Parameter	Result	Units
Dissolved Metals by ICP/MS	Arsenic	3.75J	ug/L
	Barium	28.5	ug/L
	Chromium	6.38	ug/L
	Lead	1.29	ug/L
Waters Department	pH	7.80	pH units
	Total Nitrate/Nitrite-N	0.937	mg/L

Client Sample ID: **02452-MW8**
Lab Sample ID: 1152555002

	Parameter	Result	Units
Dissolved Metals by ICP/MS	Arsenic	8.66	ug/L
	Barium	15.9	ug/L
	Chromium	1.23J	ug/L
Waters Department	pH	7.80	pH units

Client Sample ID: **02452-MW6**
Lab Sample ID: 1152555003

	Parameter	Result	Units
Dissolved Metals by ICP/MS	Arsenic	12.6	ug/L
	Barium	17.6	ug/L
	Chromium	1.44J	ug/L
Waters Department	pH	7.90	pH units

SGS North America Inc.
200 West Potter Drive, Anchorage, AK 99518
t 907.562.2343 **f** 907.561.5301 www.us.sgs.com

Results of **02452-MW9**

Client Sample ID: **02452-MW9**
Client Project ID: **WWTP 02452-001**
Lab Sample ID: 1152555001
Lab Project ID: 1152555

Collection Date: 06/02/15 13:20
Received Date: 06/03/15 16:08
Matrix: Water (Surface, Eff., Ground)
Solids (%):
Location:

Results by **Dissolved Metals by ICP/MS**

Parameter	Result	Qual	LOQ/CL	DL	Units	DF	Allowable Limits	Date Analyzed
Arsenic	3.75	J	5.00	1.50	ug/L	5		06/08/15 14:32
Barium	28.5		3.00	0.940	ug/L	5		06/08/15 14:32
Cadmium	1.00	U	2.00	0.620	ug/L	5		06/08/15 14:32
Chromium	6.38		4.00	1.20	ug/L	5		06/08/15 14:32
Lead	1.29		1.00	0.310	ug/L	5		06/08/15 14:32
Mercury	0.100	U	0.200	0.0620	ug/L	5		06/08/15 14:32
Selenium	10.0	U	20.0	6.20	ug/L	5		06/08/15 14:32
Silver	1.00	U	2.00	0.620	ug/L	5		06/08/15 14:32

Batch Information

Analytical Batch: MMS8948
Analytical Method: SW6020A
Analyst: EAB
Analytical Date/Time: 06/08/15 14:32
Container ID: 1152555001-A

Prep Batch: MXX28720
Prep Method: SW3010A
Prep Date/Time: 06/03/15 18:45
Prep Initial Wt./Vol.: 25 mL
Prep Extract Vol: 25 mL

Results of **02452-MW9**

Client Sample ID: **02452-MW9**
Client Project ID: **WWTP 02452-001**
Lab Sample ID: 1152555001
Lab Project ID: 1152555

Collection Date: 06/02/15 13:20
Received Date: 06/03/15 16:08
Matrix: Water (Surface, Eff., Ground)
Solids (%):
Location:

Results by **Waters Department**

Parameter	Result	Qual	LOQ/CL	DL	Units	DF	Allowable Limits	Date Analyzed
pH	7.80		0.100	0.100	pH units	1		06/05/15 17:09

Batch Information

Analytical Batch: WTI4224
Analytical Method: SM21 4500-H B
Analyst: KCT
Analytical Date/Time: 06/05/15 17:09
Container ID: 1152555001-C

Parameter	Result	Qual	LOQ/CL	DL	Units	DF	Allowable Limits	Date Analyzed
Total Nitrate/Nitrite-N	0.937		0.100	0.0310	mg/L	5		06/08/15 13:17

Batch Information

Analytical Batch: WFI2402
Analytical Method: SM21 4500NO3-F
Analyst: SLC
Analytical Date/Time: 06/08/15 13:17
Container ID: 1152555001-B

Print Date: 06/09/2015 3:08:55PM

J flagging is activated

Results of **02452-MW8**

Client Sample ID: **02452-MW8**
Client Project ID: **WWTP 02452-001**
Lab Sample ID: 1152555002
Lab Project ID: 1152555

Collection Date: 06/03/15 12:00
Received Date: 06/03/15 16:08
Matrix: Water (Surface, Eff., Ground)
Solids (%):
Location:

Results by **Dissolved Metals by ICP/MS**

Parameter	Result	Qual	LOQ/CL	DL	Units	DF	Allowable Limits	Date Analyzed
Arsenic	8.66		5.00	1.50	ug/L	5		06/08/15 14:35
Barium	15.9		3.00	0.940	ug/L	5		06/08/15 14:35
Cadmium	1.00	U	2.00	0.620	ug/L	5		06/08/15 14:35
Chromium	1.23	J	4.00	1.20	ug/L	5		06/08/15 14:35
Lead	0.500	U	1.00	0.310	ug/L	5		06/08/15 14:35
Mercury	0.100	U	0.200	0.0620	ug/L	5		06/08/15 14:35
Selenium	10.0	U	20.0	6.20	ug/L	5		06/08/15 14:35
Silver	1.00	U	2.00	0.620	ug/L	5		06/08/15 14:35

Batch Information

Analytical Batch: MMS8948
Analytical Method: SW6020A
Analyst: EAB
Analytical Date/Time: 06/08/15 14:35
Container ID: 1152555002-A

Prep Batch: MXX28720
Prep Method: SW3010A
Prep Date/Time: 06/03/15 18:45
Prep Initial Wt./Vol.: 25 mL
Prep Extract Vol: 25 mL

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Results of **02452-MW8**

Client Sample ID: **02452-MW8**
Client Project ID: **WWTP 02452-001**
Lab Sample ID: 1152555002
Lab Project ID: 1152555

Collection Date: 06/03/15 12:00
Received Date: 06/03/15 16:08
Matrix: Water (Surface, Eff., Ground)
Solids (%):
Location:

Results by **Waters Department**

Parameter	Result	Qual	LOQ/CL	DL	Units	DF	Allowable Limits	Date Analyzed
pH	7.80		0.100	0.100	pH units	1		06/05/15 17:14

Batch Information

Analytical Batch: WTI4224
Analytical Method: SM21 4500-H B
Analyst: KCT
Analytical Date/Time: 06/05/15 17:14
Container ID: 1152555002-C

Parameter	Result	Qual	LOQ/CL	DL	Units	DF	Allowable Limits	Date Analyzed
Total Nitrate/Nitrite-N	0.0500	U	0.100	0.0310	mg/L	5		06/08/15 13:26

Batch Information

Analytical Batch: WFI2402
Analytical Method: SM21 4500NO3-F
Analyst: SLC
Analytical Date/Time: 06/08/15 13:26
Container ID: 1152555002-B

Print Date: 06/09/2015 3:08:55PM

J flagging is activated

Results of **02452-MW6**

Client Sample ID: **02452-MW6**
Client Project ID: **WWTP 02452-001**
Lab Sample ID: 1152555003
Lab Project ID: 1152555

Collection Date: 06/03/15 14:10
Received Date: 06/03/15 16:08
Matrix: Water (Surface, Eff., Ground)
Solids (%):
Location:

Results by **Dissolved Metals by ICP/MS**

Parameter	Result	Qual	LOQ/CL	DL	Units	DF	Allowable Limits	Date Analyzed
Arsenic	12.6		5.00	1.50	ug/L	5		06/08/15 14:37
Barium	17.6		3.00	0.940	ug/L	5		06/08/15 14:37
Cadmium	1.00	U	2.00	0.620	ug/L	5		06/08/15 14:37
Chromium	1.44	J	4.00	1.20	ug/L	5		06/08/15 14:37
Lead	0.500	U	1.00	0.310	ug/L	5		06/08/15 14:37
Mercury	0.100	U	0.200	0.0620	ug/L	5		06/08/15 14:37
Selenium	10.0	U	20.0	6.20	ug/L	5		06/08/15 14:37
Silver	1.00	U	2.00	0.620	ug/L	5		06/08/15 14:37

Batch Information

Analytical Batch: MMS8948
Analytical Method: SW6020A
Analyst: EAB
Analytical Date/Time: 06/08/15 14:37
Container ID: 1152555003-A

Prep Batch: MXX28720
Prep Method: SW3010A
Prep Date/Time: 06/03/15 18:45
Prep Initial Wt./Vol.: 25 mL
Prep Extract Vol: 25 mL

Print Date: 06/09/2015 3:08:55PM

J flagging is activated

Results of **02452-MW6**

Client Sample ID: **02452-MW6**
Client Project ID: **WWTP 02452-001**
Lab Sample ID: 1152555003
Lab Project ID: 1152555

Collection Date: 06/03/15 14:10
Received Date: 06/03/15 16:08
Matrix: Water (Surface, Eff., Ground)
Solids (%):
Location:

Results by **Waters Department**

Parameter	Result	Qual	LOQ/CL	DL	Units	DF	Allowable Limits	Date Analyzed
pH	7.90		0.100	0.100	pH units	1		06/05/15 17:20

Batch Information

Analytical Batch: WTI4224
Analytical Method: SM21 4500-H B
Analyst: KCT
Analytical Date/Time: 06/05/15 17:20
Container ID: 1152555003-C

Parameter	Result	Qual	LOQ/CL	DL	Units	DF	Allowable Limits	Date Analyzed
Total Nitrate/Nitrite-N	0.0500	U	0.100	0.0310	mg/L	5		06/08/15 13:28

Batch Information

Analytical Batch: WFI2402
Analytical Method: SM21 4500NO3-F
Analyst: SLC
Analytical Date/Time: 06/08/15 13:28
Container ID: 1152555003-B

Print Date: 06/09/2015 3:08:55PM

J flagging is activated

Method Blank

Blank ID: MB for HBN 1710176 [MXX/28720]
Blank Lab ID: 1268507

Matrix: Water (Surface, Eff., Ground)

QC for Samples:
1152555001, 1152555002, 1152555003

Results by **SW6020A**

Parameter	Results	LOQ/CL	DL	Units
Arsenic	2.50U	5.00	1.50	ug/L
Barium	2.32J	3.00	0.940	ug/L
Cadmium	1.00U	2.00	0.620	ug/L
Chromium	2.00U	4.00	1.20	ug/L
Lead	0.500U	1.00	0.310	ug/L
Mercury	0.100U	0.200	0.0620	ug/L
Selenium	10.0U	20.0	6.20	ug/L
Silver	1.00U	2.00	0.620	ug/L

Batch Information

Analytical Batch: MMS8946
Analytical Method: SW6020A
Instrument: Perkin Elmer Sciex ICP-MS P3
Analyst: ACF
Analytical Date/Time: 6/7/2015 3:01:24PM

Prep Batch: MXX28720
Prep Method: SW3010A
Prep Date/Time: 6/3/2015 6:45:09PM
Prep Initial Wt./Vol.: 25 mL
Prep Extract Vol: 25 mL

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Blank Spike Summary

Blank Spike ID: LCS for HBN 1152555 [MXX28720]
Blank Spike Lab ID: 1268508
Date Analyzed: 06/07/2015 15:04

Matrix: Water (Surface, Eff., Ground)

QC for Samples: 1152555001, 1152555002, 1152555003

Results by **SW6020A**

Blank Spike (ug/L)

Parameter	Spike	Result	Rec (%)	CL
Arsenic	1000	1030	103	(80-120)
Barium	1000	1030	103	(80-120)
Cadmium	100	105	105	(80-120)
Chromium	400	409	102	(80-120)
Lead	1000	1110	111	(80-120)
Mercury	10	10.5	105	(80-120)
Selenium	1000	1040	104	(80-120)
Silver	100	105	105	(80-120)

Batch Information

Analytical Batch: **MMS8946**
Analytical Method: **SW6020A**
Instrument: **Perkin Elmer Sciex ICP-MS P3**
Analyst: **ACF**

Prep Batch: **MXX28720**
Prep Method: **SW3010A**
Prep Date/Time: **06/03/2015 18:45**
Spike Init Wt./Vol.: 1000 ug/L Extract Vol: 25 mL
Dupe Init Wt./Vol.: Extract Vol:

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Matrix Spike Summary

Original Sample ID: 1268511
MS Sample ID: 1268512 MS
MSD Sample ID: 1268513 MSD

Analysis Date: 06/07/2015 15:07
Analysis Date: 06/07/2015 15:09
Analysis Date: 06/07/2015 15:11
Matrix: Water (Surface, Eff., Ground)

QC for Samples: 1152555001, 1152555002, 1152555003

Results by **SW6020A**

		Matrix Spike (ug/L)			Spike Duplicate (ug/L)					
Parameter	Sample	Spike	Result	Rec (%)	Spike	Result	Rec (%)	CL	RPD (%)	RPD CL
Arsenic	2.58J	1000	1030	103	1000	1040	103	80-120	0.83	(< 15)
Barium	31.2	1000	1090	106	1000	1050	102	80-120	3.30	(< 15)
Cadmium	1.00U	100	108	108	100	105	105	80-120	2.75	(< 15)
Chromium	2.00U	400	404	101	400	403	101	80-120	0.35	(< 15)
Lead	0.500U	1000	1140	114	1000	1090	109	80-120	4.29	(< 15)
Mercury	0.100U	10.0	10.2	102	10.0	10.2	102	80-120	0.30	(< 15)
Selenium	10.0U	1000	1030	103	1000	1050	105	80-120	1.30	(< 15)
Silver	1.00U	100	107	107	100	104	104	80-120	3.04	(< 15)

Batch Information

Analytical Batch: MMS8946
Analytical Method: SW6020A
Instrument: Perkin Elmer Sciex ICP-MS P3
Analyst: ACF
Analytical Date/Time: 6/7/2015 3:09:28PM

Prep Batch: MXX28720
Prep Method: 3010 H20 Digest for Metals ICP-MS
Prep Date/Time: 6/3/2015 6:45:09PM
Prep Initial Wt./Vol.: 25.00mL
Prep Extract Vol: 25.00mL

Print Date: 06/09/2015 3:09:00PM

Method Blank

Blank ID: MB for HBN 1710588 (WFI/2402)
Blank Lab ID: 1269495

Matrix: Water (Surface, Eff., Ground)

QC for Samples:
1152555001, 1152555002, 1152555003

Results by **SM21 4500NO3-F**

Parameter	Results	LOQ/CL	DL	Units
Total Nitrate/Nitrite-N	0.0500U	0.100	0.0310	mg/L

Batch Information

Analytical Batch: WFI2402
Analytical Method: SM21 4500NO3-F
Instrument: Astoria segmented flow
Analyst: SLC
Analytical Date/Time: 6/8/2015 12:23:51PM

Print Date: 06/09/2015 3:09:01PM

Blank Spike Summary

Blank Spike ID: LCS for HBN 1152555 [WFI2402]
Blank Spike Lab ID: 1269469
Date Analyzed: 06/08/2015 12:22

Matrix: Water (Surface, Eff., Ground)

QC for Samples: 1152555001, 1152555002, 1152555003

Results by **SM21 4500NO3-F**

Blank Spike (mg/L)

Parameter	Spike	Result	Rec (%)	CL
Total Nitrate/Nitrite-N	0.4	0.412	103	(90-110)

Batch Information

Analytical Batch: **WFI2402**
Analytical Method: **SM21 4500NO3-F**
Instrument: **Astoria segmented flow**
Analyst: **SLC**

Prep Batch:
Prep Method:
Prep Date/Time:
Spike Init Wt./Vol.: 0.4 mg/L Extract Vol: 5 mL
Dupe Init Wt./Vol.: Extract Vol:

Print Date: 06/09/2015 3:09:03PM

Matrix Spike Summary

Original Sample ID: 1152520001
MS Sample ID: 1269462 MS
MSD Sample ID: 1269463 MSD

QC for Samples: 1152555001

Analysis Date: 06/08/2015 12:38
Analysis Date: 06/08/2015 12:40
Analysis Date: 06/08/2015 12:41
Matrix: Drinking Water

Results by **SM21 4500NO3-F**

		Matrix Spike (mg/L)			Spike Duplicate (mg/L)					
Parameter	Sample	Spike	Result	Rec (%)	Spike	Result	Rec (%)	CL	RPD (%)	RPD CL
Total Nitrate/Nitrite-N	3.32	5.00	7.88	91	5.00	8.30	100	90-110	5.10	(< 25)

Batch Information

Analytical Batch: WFI2402
Analytical Method: SM21 4500NO3-F
Instrument: Astoria segmented flow
Analyst: SLC
Analytical Date/Time: 6/8/2015 12:40:21PM

Prep Batch:
Prep Method:
Prep Date/Time:
Prep Initial Wt./Vol.: 5.00mL
Prep Extract Vol: 5.00mL

Print Date: 06/09/2015 3:09:04PM

Matrix Spike Summary

Original Sample ID: 1152555001
MS Sample ID: 1269464 MS
MSD Sample ID: 1269465 MSD

Analysis Date: 06/08/2015 13:17
Analysis Date: 06/08/2015 13:19
Analysis Date: 06/08/2015 13:20
Matrix: Water (Surface, Eff., Ground)

QC for Samples: 1152555001, 1152555002, 1152555003

Results by **SM21 4500NO3-F**

		Matrix Spike (mg/L)			Spike Duplicate (mg/L)					
Parameter	Sample	Spike	Result	Rec (%)	Spike	Result	Rec (%)	CL	RPD (%)	RPD CL
Total Nitrate/Nitrite-N	0.937	5.00	5.7	95	5.00	5.67	95	90-110	0.65	(< 25)

Batch Information

Analytical Batch: WFI2402
Analytical Method: SM21 4500NO3-F
Instrument: Astoria segmented flow
Analyst: SLC
Analytical Date/Time: 6/8/2015 1:19:21PM

Prep Batch:
Prep Method:
Prep Date/Time:
Prep Initial Wt./Vol.: 5.00mL
Prep Extract Vol: 5.00mL

Print Date: 06/09/2015 3:09:04PM

Matrix Spike Summary

Original Sample ID: 1152601001
MS Sample ID: 1269466 MS
MSD Sample ID: 1269467 MSD

Analysis Date: 06/08/2015 13:56
Analysis Date: 06/08/2015 13:58
Analysis Date: 06/08/2015 13:59
Matrix: Drinking Water

QC for Samples: 1152555002, 1152555003

Results by **SM21 4500NO3-F**

		Matrix Spike (mg/L)			Spike Duplicate (mg/L)					
Parameter	Sample	Spike	Result	Rec (%)	Spike	Result	Rec (%)	CL	RPD (%)	RPD CL
Total Nitrate/Nitrite-N	1.93	5.00	6.47	91	5.00	6.58	93	90-110	1.70	(< 25)

Batch Information

Analytical Batch: WFI2402
Analytical Method: SM21 4500NO3-F
Instrument: Astoria segmented flow
Analyst: SLC
Analytical Date/Time: 6/8/2015 1:58:21PM

Prep Batch:
Prep Method:
Prep Date/Time:
Prep Initial Wt./Vol.: 5.00mL
Prep Extract Vol: 5.00mL

Print Date: 06/09/2015 3:09:04PM

Duplicate Sample Summary

Original Sample ID: 1152597001
Duplicate Sample ID: 1268964
QC for Samples:
1152555001, 1152555002, 1152555003

Analysis Date: 06/05/2015 14:25
Matrix: Water (Surface, Eff., Ground)

Results by **SM21 4500-H B**

NAME	Original	Duplicate	Units	RPD (%)	RPD CL
pH	7.30	7.30	pH units	0.00	(< 5)

Batch Information

Analytical Batch: WTI4224
Analytical Method: SM21 4500-H B
Instrument: Titration
Analyst: KCT

Print Date: 06/09/2015 3:09:05PM

Duplicate Sample Summary

Original Sample ID: 1152597002
Duplicate Sample ID: 1268965
QC for Samples:
1152555001, 1152555002, 1152555003

Analysis Date: 06/05/2015 14:55
Matrix: Water (Surface, Eff., Ground)

Results by **SM21 4500-H B**

NAME	Original	Duplicate	Units	RPD (%)	RPD CL
pH	7.50	7.50	pH units	0.00	(< 5)

Batch Information

Analytical Batch: WTI4224
Analytical Method: SM21 4500-H B
Instrument: Titration
Analyst: KCT

Print Date: 06/09/2015 3:09:05PM

Blank Spike Summary

Blank Spike ID: LCS for HBN 1152555 [WTI4224]
Blank Spike Lab ID: 1268953
Date Analyzed: 06/05/2015 11:41

Matrix: Water (Surface, Eff., Ground)

QC for Samples: 1152555001, 1152555002, 1152555003

Results by **SM21 4500-H B**

Blank Spike (pH units)

Parameter	Spike	Result	Rec (%)	CL
pH	7	6.97	100	(99-101)

Batch Information

Analytical Batch: **WTI4224**
Analytical Method: **SM21 4500-H B**
Instrument: **Titration**
Analyst: **KCT**

Prep Batch:
Prep Method:
Prep Date/Time:
Spike Init Wt./Vol.: 7 pH units Extract Vol: 1 mL
Dupe Init Wt./Vol.: Extract Vol:

Print Date: 06/09/2015 3:09:07PM

1152555

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

CHAIN-OF-CUSTODY RECORD

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Page 1 of 1

Laboratory SGS
Attn: Tori

Analysis Parameters/Sample Container Description
(include preservative if used)

Sample Identity	Lab No.	Time	Date Sampled	Comp.	Grab	Dissolved Metals SW6020B	Nitrate/Nitrite SM4500NO3	TIC SM4500				Total Number of Containers	Remarks/Matrix
02452-MW9	1AC	1320	6/2/15		X	X	X	X				3	Groundwater
MW8	2AC	1200	6/3/15		X	X	X	X				3	↓
MW6	3AC	1410	6/3/15		X	X	X	X				3	↓

Project Information		Sample Receipt	
Project Number: 02452-001		Total Number of Containers	
Project Name: WWTP		COC Seals/Intact? Y/N/NA	
Contact: KVW		Received Good Cond./Cold	
Ongoing Project? Yes ☒ No ☐		Delivery Method:	
Sampler: JCT/TWC		(attach shipping bill, if any)	

Instructions

Requested Turnaround Time: Standard

Special Instructions:

open for Katra Wedeking

Relinquished By: 1.	Relinquished By: 2.	Relinquished By: 3.
Signature: TWC Time: 16:08	Signature: Time:	Signature: Time:
Printed Name: Date:	Printed Name: Date:	Printed Name: Date:
Company:	Company:	Company:

Received By: 1.	Received By: 2.	Received By: 3.
Signature: Time: 1608	Signature: Time:	Signature: Time:
Printed Name: Erik Johnson Date: 6/3/15	Printed Name: Date:	Printed Name: Date:
Company:	Company:	Company:

Distribution: White - w/shipment - returned to Shannon & Wilson w/ laboratory report
Yellow - w/shipment - for consignee files
Pink - Shannon & Wilson - Job File

F-19-91/UR

4.7°C - D3

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No. 30553

1152555

SAMPLE RECEIPT FORM

Review Criteria:	Yes	N/A	No	Comments/Action Taken:
Were **custody seals** intact? Note # & location, if applicable. COC accompanied samples?	☐ ☑	☑ ☐	☐ ☐	***Exemption permitted if sampler hand carries/delivers.***
Temperature blank compliant* (i.e., 0-6°C after CF)? *If >6°C, were samples collected <8 hours ago?* *If <0°C, were all sample containers ice free?* Cooler ID: [1] _____ @ 4.7 _____ w/ Therm.ID: D3 _____ Cooler ID: _____ @ _____ w/ Therm.ID: _____ Cooler ID: _____ @ _____ w/ Therm.ID: _____ Cooler ID: _____ @ _____ w/ Therm.ID: _____ Cooler ID: _____ @ _____ w/ Therm.ID: _____ If samples are received without a temperature blank, the "cooler temperature" will be documented in lieu of the temperature blank & "**COOLER TEMP**" will be noted to the right. In cases where neither a temp blank nor cooler temp can be obtained, note "ambient" or "chilled."	☑ ☑ ☐	☐ ☐ ☑	☐ ☐ ☐	***Exemption permitted if chilled & collected <8 hrs ago.*** ***Note: Identify containers received at non-compliant temperature. Use form FS-0029 if more space is needed.***
Delivery method (specify all that apply): ☑Client (hand carried) ☐USPS ☐Lynden ☐AK Air ☐Alert Courier ☐UPS ☐FedEx ☐RAVN ☐C&D Delivery ☐Carlile ☐Pen Air ☐Warp Speed ☐Other: _____ → *For WO# with airbills, was the WO# & airbill info recorded in the Front Counter eLog?*		☑	☐	
	Yes	N/A	No	
Were samples received within hold time? Do samples **match COC*** (i.e., sample IDs, dates/times collected)? Were analyses requested unambiguous?	☑ ☑ ☑	☐ ☐ ☐	☐ ☐ ☐	***Note: Refer to form F-083 "Sample Guide" for hold times.*** ***Note: If times differ <1hr, record details and login per COC.***
Were samples in **good condition** (no leaks/cracks/breakage)? Packing material used (specify all that apply): ☐Bubble Wrap ☐Separate plastic bags ☐Vermiculite ☐Other:	☑	☐	☐	
Were **proper containers** (type/mass/volume/preservative*) used? Were **Trip Blanks** (i.e., VOAs, LL-Hg) in cooler with samples? Were all VOA vials **free of headspace** (i.e., bubbles ≤6 mm)? Were all soil VOAs **field extracted** with MeOH+BFB?	☑ ☐ ☐ ☐	☐ ☑ ☑ ☑	☐ ☐ ☐ ☐	☐ ***Exemption permitted for metals (e.g., 200.8/6020A).***
For preserved waters (other than VOA vials, LL-Mercury or microbiological analyses), was **pH verified and compliant**? If pH was adjusted, were bottles flagged (i.e., stickers)?	☑ ☐	☐ ☑	☐ ☐	
For **special handling** (e.g., "MI" soils, foreign soils, lab filter for dissolved…, lab extract for volatiles, Ref Lab, limited volume), were bottles/paperwork flagged (e.g., sticker)?	☐	☑	☐	
For **RUSH/SHORT Hold Time**, were COC/Bottles flagged accordingly? Was Rush/Short HT email sent, if applicable?	☐	☑	☐	
For **SITE-SPECIFIC QC, e.g. BMS/BMSD/BDUP**, were containers / paperwork flagged accordingly?	☐	☑	☐	
For any question answered "No," has the PM been notified and the problem resolved (or paperwork put in their bin)?	☐	☑	☐	SRF Completed by: EDJ PM notified:
Was **PEER REVIEW** of ***sample numbering/labeling completed?***	☐	☑	☐	Peer Reviewed by:

Additional notes (if applicable):

Note to Client: *Any "no" answer above indicates non-compliance with standard procedures and may impact data quality.*

Sample Containers and Preservatives

Container Id	Preservative	Container Condition	Container Id	Preservative	Container Condition
1152555001-A	HNO3 to pH < 2	OK			
1152555001-B	H2SO4 to pH < 2	OK			
1152555001-C	No Preservative Required	OK			
1152555002-A	HNO3 to pH < 2	OK			
1152555002-B	H2SO4 to pH < 2	OK			
1152555002-C	No Preservative Required	OK			
1152555003-A	HNO3 to pH < 2	OK			
1152555003-B	H2SO4 to pH < 2	OK			
1152555003-C	No Preservative Required	OK			

Container Condition Glossary

Containers for bacteriological, low level mercury and VOA vials are not opened prior to analysis and will be assigned condition code OK unless evidence indicates than an inappropriate container was submitted.

OK - The container was received at an acceptable pH for the analysis requested.
PA - The container was received outside of the acceptable pH for the analysis requested. Preservative was added upon receipt and the container is now at the correct pH. See the Sample Receipt Form for details on the amount and lot # of the preservative added.
PH - The container was received outside of the acceptable pH for the analysis requested. Preservative was added upon receipt, but was insufficient to bring the container to the correct pH for the analysis requested. See the Sample Receipt Form for details on the amount and lot # of the preservative added.
BU - The container was received with headspace greater than 6mm.

Laboratory Report of Analysis

To: Shannon & Wilson, Inc.
5430 Fairbanks St. Suite 3
Anchorage, AK 99518
(907)561-2120

Report Number: **1161040**

Client Project: **32-1-02452 WWTP**

Dear Katra Wedeking,

Enclosed are the results of the analytical services performed under the referenced project for the received samples and associated QC as applicable. The samples are certified to meet the requirements of the National Environmental Laboratory Accreditation Conference Standards. Copies of this report and supporting data will be retained in our files for a period of ten years in the event they are required for future reference. All results are intended to be used in their entirety and SGS is not responsible for use of less than the complete report. Any samples submitted to our laboratory will be retained for a maximum of fourteen (14) days from the date of this report unless other archiving requirements were included in the quote.

If there are any questions about the report or services performed during this project, please call Victoria at (907) 562-2343. We will be happy to answer any questions or concerns which you may have.

Thank you for using SGS North America Inc. for your analytical services. We look forward to working with you again on any additional analytical needs.

Sincerely,
SGS North America Inc.

Victoria Pennick Date
Project Manager
Victoria.Pennick@sgs.com

Print Date: 03/10/2016 2:44:13PM

Case Narrative

SGS Client: **Shannon & Wilson, Inc.**
SGS Project: **1161040**
Project Name/Site: **32-1-02452 WWTP**
Project Contact: **Katra Wedeking**

Refer to sample receipt form for information on sample condition.

1160980002(1315338MS) (1315339) MS

300.0 - Anions - MS recovery for several analytes is outside QC criteria. Refer to LCS for accuracy requirements.

1160980002(1315338MSD) (1315340) MSD

300.0 - Anions - MSD recovery for several analytes is outside QC criteria. Refer to LCS for accuracy requirements.

*QC comments may be associated with the field samples found in this report. When applicable, comments will be applied to associated field samples.

SGS North America Inc.
200 West Potter Drive, Anchorage, AK 99518
t 907.562.2343 **f** 907.561.5301 www.us.sgs.com

Laboratory Qualifiers

Enclosed are the analytical results associated with the above work order. All results are intended to be used in their entirety and SGS is not responsible for use of less than the complete report. This document is issued by the Company under its General Conditions of Service accessible at <http://www.sgs.com/en/Terms-and-Conditions.aspx>. Attention is drawn to the limitation of liability, indenmification and jurisdiction issues defined therein.

Any holder of this document is advised that information contained hereon reflects the Company's findings at the time of its intervention only and within the limits of Client's instructions, if any. The Company's sole responsibility is to its Client and this document does not exonerate parties to a transaction from exercising all their rights and obligations under the transaction documents. Any unauthorized alteration, forgery or falsification of the context or appearance of this document is unlawful and offenders may be prosecuted to the fullest extent of the law.

SGS maintains a formal Quality Assurance/Quality Control (QA/QC) program. A copy of our Quality Assurance Plan (QAP), which outlines this program, is available at your request. The laboratory certification numbers are AK00971 (DW Chemistry & Microbiology) & UST-005 (CS) for ADEC and 2944.01 for DOD ELAP/ISO17025 (RCRA methods: 1020B, 1311, 3010A, 3050B, 3520C, 3550C, 5030B, 5035A, 6020A, 7470A, 7471B, 8021B, 8082A, 8260B, 8270D, 8270D-SIM, 9040C, 9045D, 9056A, 9060A, AK101 and AK102/103). Except as specifically noted, all statements and data in this report are in conformance to the provisions set forth by the SGS QAP and, when applicable, other regulatory authorities.

The following descriptors or qualifiers may be found in your report:

*	The analyte has exceeded allowable regulatory or control limits.
!	Surrogate out of control limits.
B	Indicates the analyte is found in a blank associated with the sample.
CCV/CVA/CVB	Continuing Calibration Verification
CCCV/CVC/CVCA/CVCB	Closing Continuing Calibration Verification
CL	Control Limit
D	The analyte concentration is the result of a dilution.
DF	Dilution Factor
DL	Detection Limit (i.e., maximum method detection limit)
E	The analyte result is above the calibrated range.
F	Indicates value that is greater than or equal to the DL
GT	Greater Than
IB	Instrument Blank
ICV	Initial Calibration Verification
J	The quantitation is an estimation.
JL	The analyte was positively identified, but the quantitation is a low estimation.
LCS(D)	Laboratory Control Spike (Duplicate)
LOD	Limit of Detection (i.e., 1/2 of the LOQ)
LOQ	Limit of Quantitation (i.e., reporting or practical quantitation limit)
LT	Less Than
M	A matrix effect was present.
MB	Method Blank
MS(D)	Matrix Spike (Duplicate)
ND	Indicates the analyte is not detected.
Q	QC parameter out of acceptance range.
R	Rejected
RPD	Relative Percent Difference
U	Indicates the analyte was analyzed for but not detected.

Note: Sample summaries which include a result for "Total Solids" have already been adjusted for moisture content. All DRO/RRO analyses are integrated per SOP.

SGS North America Inc. 200 West Potter Drive, Anchorage, AK 99518
t 907.562.2343 f 907.561.5301 www.us.sgs.com

Sample Summary

Client Sample ID	Lab Sample ID	Collected	Received	Matrix
02452 WWTP.100	1161040001	03/07/2016	03/08/2016	Water (Surface, Eff., Ground)
02452 WWTP.150	1161040002	03/07/2016	03/08/2016	Water (Surface, Eff., Ground)

Method	Method Description
EPA 300.0	Ion Chromatographic Analysis

SGS North America Inc.
200 West Potter Drive, Anchorage, AK 99518
t 907.562.2343 f 907.561.5301 www.us.sgs.com

Detectable Results Summary

Client Sample ID: **02452 WWTP.100**
Lab Sample ID: 1161040001
Waters Department

Parameter	Result	Units
Nitrate-N	0.380	mg/L
Nitrite-N	0.0600J	mg/L

Client Sample ID: **02452 WWTP.150**
Lab Sample ID: 1161040002
Waters Department

Parameter	Result	Units
Nitrate-N	0.126	mg/L

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200 West Potter Drive, Anchorage, AK 99518
t 907.562.2343 **f** 907.561.5301 www.us.sgs.com

Results of **02452 WWTP.100**

Client Sample ID: **02452 WWTP.100**
Client Project ID: **32-1-02452 WWTP**
Lab Sample ID: 1161040001
Lab Project ID: 1161040

Collection Date: 03/07/16 15:45
Received Date: 03/08/16 10:09
Matrix: Water (Surface, Eff., Ground)
Solids (%):
Location:

Results by **Waters Department**

Parameter	Result	Qual	LOQ/CL	DL	Units	DF	Allowable Limits	Date Analyzed
Nitrate-N	0.380		0.100	0.0310	mg/L	1		03/08/16 14:30
Nitrite-N	0.0600	J	0.100	0.0310	mg/L	1		03/08/16 14:30

Batch Information

Analytical Batch: WIC5521
Analytical Method: EPA 300.0
Analyst: KCT
Analytical Date/Time: 03/08/16 14:30
Container ID: 1161040001-A

Prep Batch: WXX11437
Prep Method: METHOD
Prep Date/Time: 03/08/16 11:38
Prep Initial Wt./Vol.: 10 mL
Prep Extract Vol: 10 mL

Print Date: 03/10/2016 2:44:21PM

J flagging is activated

Results of **02452 WWTP.150**

Client Sample ID: **02452 WWTP.150**
Client Project ID: **32-1-02452 WWTP**
Lab Sample ID: 1161040002
Lab Project ID: 1161040

Collection Date: 03/07/16 15:34
Received Date: 03/08/16 10:09
Matrix: Water (Surface, Eff., Ground)
Solids (%):
Location:

Results by **Waters Department**

Parameter	Result	Qual	LOQ/CL	DL	Units	DF	Allowable Limits	Date Analyzed
Nitrate-N	0.126		0.100	0.0310	mg/L	1		03/08/16 14:52
Nitrite-N	0.0500	U	0.100	0.0310	mg/L	1		03/08/16 14:52

Batch Information

Analytical Batch: WIC5521
Analytical Method: EPA 300.0
Analyst: KCT
Analytical Date/Time: 03/08/16 14:52
Container ID: 1161040002-A

Prep Batch: WXX11437
Prep Method: METHOD
Prep Date/Time: 03/08/16 11:38
Prep Initial Wt./Vol.: 10 mL
Prep Extract Vol: 10 mL

Print Date: 03/10/2016 2:44:21PM

J flagging is activated

Method Blank

Blank ID: MB for HBN 1730133 [WXX/11437]
Blank Lab ID: 1315289

Matrix: Water (Surface, Eff., Ground)

QC for Samples:
1161040001, 1161040002

Results by **EPA 300.0**

Parameter	Results	LOQ/CL	DL	Units
Nitrate-N	0.0500U	0.100	0.0310	mg/L
Nitrite-N	0.0500U	0.100	0.0310	mg/L
Total Nitrate/Nitrite-N	0.0500U	0.100	0.0310	mg/L

Batch Information

Analytical Batch: WIC5521
Analytical Method: EPA 300.0
Instrument: Metrohm 733 DX2
Analyst: KCT
Analytical Date/Time: 3/8/2016 1:45:44PM

Prep Batch: WXX11437
Prep Method: METHOD
Prep Date/Time: 3/8/2016 11:38:00AM
Prep Initial Wt./Vol.: 10 mL
Prep Extract Vol: 10 mL

Blank Spike Summary

Blank Spike ID: LCS for HBN 1161040 [WXX11437]
Blank Spike Lab ID: 1315290
Date Analyzed: 03/08/2016 14:08

Matrix: Water (Surface, Eff., Ground)

QC for Samples: 1161040001, 1161040002

Results by **EPA 300.0**

Blank Spike (mg/L)

Parameter	Spike	Result	Rec (%)	CL
Nitrate-N	10	10.6	106	(90-110)
Nitrite-N	10	10.5	105	(90-110)
Total Nitrate/Nitrite-N	20	21.1	105	(90-110)

Batch Information

Analytical Batch: **WIC5521**
Analytical Method: **EPA 300.0**
Instrument: **Metrohm 733 DX2**
Analyst: **KCT**

Prep Batch: **WXX11437**
Prep Method: **METHOD**
Prep Date/Time: **03/08/2016 11:38**
Spike Init Wt./Vol.: 10 mg/L Extract Vol: 10 mL
Dupe Init Wt./Vol.: Extract Vol:

SGS North America Inc.
200 West Potter Drive Anchorage, AK 95518
t 907.562.2343 **f** 907.561.5301 www.us.sgs.com

Matrix Spike Summary

Original Sample ID: 1315338
MS Sample ID: 1315339 MS
MSD Sample ID: 1315340 MSD

Analysis Date: 03/08/2016 15:37
Analysis Date: 03/08/2016 15:59
Analysis Date: 03/08/2016 16:21
Matrix: Water (Surface, Eff., Ground)

QC for Samples: 1161040001, 1161040002

Results by **EPA 300.0**

		Matrix Spike (mg/L)				Spike Duplicate (mg/L)						
Parameter	Sample	Spike	Result	Rec (%)		Spike	Result	Rec (%)		CL	RPD (%)	RPD CL
Nitrate-N	0.0500U	10.0	11.2	112	*	10.0	11.2	112	*	90-110	0.05	(< 15)
Nitrite-N	0.0500U	10.0	11.1	111	*	10.0	11.1	111	*	90-110	0.05	(< 15)
Total Nitrate/Nitrite-N	0.0500U	20.0	22.2	111	*	20.0	22.2	111	*	90-110	0.00	(< 15)

Batch Information

Analytical Batch: WIC5521
Analytical Method: EPA 300.0
Instrument: Metrohm 733 DX2
Analyst: KCT
Analytical Date/Time: 3/8/2016 3:59:42PM

Prep Batch: WXX11437
Prep Method: EPA 300.0 Extraction Waters/Liquids
Prep Date/Time: 3/8/2016 11:38:00AM
Prep Initial Wt./Vol.: 10.00mL
Prep Extract Vol: 10.00mL

Print Date: 03/10/2016 2:44:26PM

1161040

CHAIN-OF-CUSTODY RECORD

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

400 N. 34th Street, Suite 100
Seattle, WA 98103
(206) 632-8020

2043 Westport Center Drive
St. Louis, MO 63146-3564
(314) 699-9660

2705 Saint Andrews Loop, Suite A
Pasco, WA 99301-3378
(509) 946-6309

2355 Hill Road
Fairbanks, AK 99709
(907) 479-0600

5430 Fairbanks Street, Suite 3
Anchorage, AK 99518
(907) 561-2120

3990 Collins Way, Suite 100
Lake Oswego, OR 97035
(503) 223-6147

1321 Bannock Street, Suite 200
Denver, CO 80204
(303) 825-3800

Laboratory SGS Page 1 of 1
Attn: Tori Pennick

Analysis Parameters/Sample Container Description
(include preservative if used)

Sample Identity	Lab No.	Time	Date Sampled	Comp.	Grab	Nitrate SW 9056A	Nitrite SW 9056A					Total Number of Containers	Remarks/Matrix
02452 WWTP.100	1A	1545	3.7.16		X	✓	✓					1	Water
02452 WWTP.150	2A	1534	3.7.16		X	✓	✓					1	"

Project Information	Sample Receipt
Project Number: 32-1-02452	Total Number of Containers
Project Name: WWTP	COC Seals/Intact? Y/N/NA
Contact: Katra Wedeking	Received Good Cond./Cold
Ongoing Project? Yes ☐ No ☐	Delivery Method:
Sampler: Brenthon Leeper	(attach shipping bill, if any)

Instructions
Requested Turnaround Time: Standard
Special Instructions: Level II

Relinquished By: 1.	Relinquished By: 2.	Relinquished By: 3.
Signature: Time: 1009	Signature: Time:	Signature: Time:
Printed Name: Brenthon Leeper Date: 3/8/16	Printed Name: Date:	Printed Name: Date:
Company: Shannon & Wilson	Company:	Company:

Received By: 1	Received By: 2.	Received By: 3.
Signature: Time:	Signature: Time:	Signature: Time: 10:09
Printed Name: Date:	Printed Name: Date:	Printed Name: Cory Dunning Date: 3/8/16
Company:	Company:	Company: SGS

Distribution: White - w/shipment - returned to Shannon & Wilson w/ laboratory report
Yellow - w/shipment - for consignee files
Pink - Shannon & Wilson - Job File

F-19-91/UR

3.2 #012

No. 30642

1161040

SAMPLE RECEIPT FORM

Review Criteria:	Yes	N/A	No	Comments/Action Taken:
Were **custody seals** intact? Note # & location, if applicable. COC accompanied samples?	☑ ☑	☐ ☐	☐ ☐	***Exemption permitted if sampler hand carries/delivers.*** 1F
Temperature blank compliant* (i.e., 0-6°C after CF)? *If >6 °C, were samples collected <8 hours ago?* *If <0 °C, were all sample containers ice free?* Cooler ID: [1] _____ @ 3.2 _____ w/ Therm.ID: D12 _____ Cooler ID: _____ @ _____ w/ Therm.ID: _____ Cooler ID: _____ @ _____ w/ Therm.ID: _____ Cooler ID: _____ @ _____ w/ Therm.ID: _____ Cooler ID: _____ @ _____ w/ Therm.ID: _____ If samples are received without a temperature blank, the "cooler temperature" will be documented in lieu of the temperature blank & "**COOLER TEMP**" will be noted to the right. In cases where neither a temp blank nor cooler temp can be obtained, note "ambient" or "chilled."	☑ ☐ ☐	☐ ☑ ☑	☐ ☐ ☐	***Exemption permitted if chilled & collected <8 hrs ago.*** ***Note: Identify containers received at non-compliant temperature. Use form FS-0029 if more space is needed.***
Delivery method (specify all that apply): ☑Client (hand carried) ☐USPS ☐Lynden ☐AK Air ☐Alert Courier ☐UPS ☐FedEx ☐RAVN ☐C&D Delivery ☐Carlile ☐Pen Air ☐Warp Speed ☐Other: _____ → *For WO# with airbills, was the WO# & airbill info recorded in the Front Counter eLog?*	☐	☑	☐	
	Yes	N/A	No	
Were samples received within hold time? Do samples **match COC*** (i.e., sample IDs, dates/times collected)? Were analyses requested unambiguous?	☑ ☑ ☑	☐ ☐ ☐	☐ ☐ ☐	***Note: Refer to form F-083 "Sample Guide" for hold times.*** ***Note: If times differ <1hr, record details and login per COC.***
Were samples in **good condition** (no leaks/cracks/breakage)? Packing material used (specify all that apply): ☑Bubble Wrap ☐Separate plastic bags ☐Vermiculite ☐Other:	☑	☐	☐	
Were **proper containers** (type/mass/volume/preservative*) used? Were **Trip Blanks** (i.e., VOAs, LL-Hg) in cooler with samples? Were all VOA vials **free of headspace** (i.e., bubbles ≤6 mm)? Were all soil VOAs **field extracted** with MeOH+BFB?	☑ ☐ ☐ ☐	☐ ☑ ☑ ☑	☐ ☐ ☐ ☐	☐ ***Exemption permitted for metals (e.g., 200.8/6020A).***
For preserved waters (other than VOA vials, LL-Mercury or microbiological analyses), was **pH verified and compliant**? If pH was adjusted, were bottles flagged (i.e., stickers)?	☐ ☐	☑ ☑	☐ ☐	
For **special handling** (e.g., "MI" soils, foreign soils, lab filter for dissolved…, lab extract for volatiles, Ref Lab, limited volume), were bottles/paperwork flagged (e.g., sticker)?	☐	☑	☐	
For **RUSH/SHORT Hold Time**, were COC/Bottles flagged accordingly? Was Rush/Short HT email sent, if applicable?	☑	☐	☐	Nitrate+Nitrites
For **SITE-SPECIFIC QC, e.g. BMS/BMSD/BDUP**, were containers / paperwork flagged accordingly?	☐	☑	☐	
For any question answered "No," has the PM been notified and the problem resolved (or paperwork put in their bin)?	☐	☑	☐	SRF Completed by: K.W PM notified:
Was **PEER REVIEW** of ***sample numbering/labeling completed?***	☐	☑	☐	Peer Reviewed by:
Additional notes (if applicable):				

Note to Client: *Any "no" answer above indicates non-compliance with standard procedures and may impact data quality.*

Sample Containers and Preservatives

Container Id	Preservative	Container Condition	Container Id	Preservative	Container Condition
1161040001-A	No Preservative Required	OK			
1161040002-A	No Preservative Required	OK			

Container Condition Glossary

Containers for bacteriological, low level mercury and VOA vials are not opened prior to analysis and will be assigned condition code OK unless evidence indicates than an inappropriate container was submitted.

OK - The container was received at an acceptable pH for the analysis requested.
BU - The container was received with headspace greater than 6mm.
DM- The container was received damaged.
PA - The container was received outside of the acceptable pH for the analysis requested. Preservative was added upon receipt and the container is now at the correct pH. See the Sample Receipt Form for details on the amount and lot # of the preservative added.
PH - The container was received outside of the acceptable pH for the analysis requested. Preservative was added upon receipt, but was insufficient to bring the container to the correct pH for the analysis requested. See the Sample Receipt Form for details on the amount and lot # of the preservative added.

APPENDIX E

ANALYTICAL TEST RESULTS SUMMARY TABLE AND SGS RESULTS FOR SOIL TESTING

TABLE E-1
SUMMARY OF SOIL ANALYTICAL RESULTS

Parameter Tested	Method*	Cleanup Level (mg/kg)**	Sample ID Number^ and Soil Sample Depth in Feet bgs (See Figure 2 and Appendix A)		
			Soil Samples		
			B6S12	B8S4	B9S6
			45	7.5	16
RCRA Metals					
Arsenic - mg/kg	SW 6020	3.9	**2.70**	**8.09**	**2.26**
Barium - mg/kg	SW 6020	1,100	**29.0**	**147**	**53.5**
Cadmium - mg/kg	SW 6020	5	<0.0990	**0.0985 J**	<0.112
Chromium - mg/kg	SW 6020	25	**13.3**	**26.2 ¥**	**20.3**
Lead - mg/kg	SW 6020	400	**1.79**	**7.63**	**2.98**
Mercury - mg/kg	SW 6020	1.4	**0.0450**	**0.0565**	**0.0190 J**
Selenium - mg/kg	SW 6020	3.4	<0.495	**0.710 J**	**0.432 J**
Silver - mg/kg	SW 6020	11.2	<0.0990	<0.125	<0.112

Notes:

*	= See SGS Report included in this Appendix for compounds tested, methods, and laboratory reporting limits
**	= Soil cleanup level is the most stringent ADEC Method 2 standard listed in Table B1, 18 AAC 75 (June 2015), for the "under 40 inches (precipitation) zone"
^	= Sample ID number preceded by "02452-" on the chain of custody form
RCRA	= Resource Recovery and Conservation Act
mg/kg	= Milligram per kilogram
<0.112	= Analyte not detected; laboratory limit of detection of 0.112 mg/kg
2.70	= Analyte detected
26.2	= Reported concentration exceeds the ADEC cleanup level
J	= Estimated concentration less than the limit of quantitation. See the SGS laboratory report for more details.
ppm	= part per million
¥	= Analyte concentration is consistent with typical background concentrations in the Anchorage area.

Laboratory Report of Analysis

To: Shannon & Wilson, Inc.
5430 Fairbanks St. Suite 3
Anchorage, AK 99518
(907)561-2120

Report Number: **1152037**

Client Project: **32-1-02452 WWTF Wasilla**

Dear Katra Wedeking,

Enclosed are the results of the analytical services performed under the referenced project for the received samples and associated QC as applicable. The samples are certified to meet the requirements of the National Environmental Laboratory Accreditation Conference Standards. Copies of this report and supporting data will be retained in our files for a period of ten years in the event they are required for future reference. All results are intended to be used in their entirety and SGS is not responsible for use of less than the complete report. Any samples submitted to our laboratory will be retained for a maximum of fourteen (14) days from the date of this report unless other archiving requirements were included in the quote.

If there are any questions about the report or services performed during this project, please call Victoria at (907) 562-2343. We will be happy to answer any questions or concerns which you may have.

Thank you for using SGS North America Inc. for your analytical services. We look forward to working with you again on any additional analytical needs.

Sincerely,
SGS North America Inc.

Victoria Pennick Date
Project Manager
Victoria.Pennick@sgs.com

SGS North America Inc. 200 West Potter Drive, Anchorage, AK 99518
t 907.562.2343 f 907.561.5301 www.us.sgs.com

Case Narrative

SGS Client: **Shannon & Wilson, Inc.**
SGS Project: **1152037**
Project Name/Site: **32-1-02452 WWTF Wasilla**
Project Contact: **Katra Wedeking**

Refer to sample receipt form for information on sample condition.

1152205018(1266585MS) (1266586) MS

6020A - Metals - MS recoveries for barium (325%) and chromium (125%) do not meet QC criteria. Post digestion spike was successful.

1152205018(1266585MSD) (1266587) MSD

6020A - Metals - MSD recoveries for barium (380%) and chromium (128%) do not meet QC criteria. Post digestion spike was successful.

*QC comments may be associated with the field samples found in this report. When applicable, comments will be applied to associated field samples.

SGS North America Inc.
200 West Potter Drive, Anchorage, AK 99518
t 907.562.2343 **f** 907.561.5301 www.us.sgs.com

Laboratory Qualifiers

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Any holder of this document is advised that information contained hereon reflects the Company's findings at the time of its intervention only and within the limits of Client's instructions, if any. The Company's sole responsibility is to its Client and this document does not exonerate parties to a trasaction from exercising all their rights adn obligations under the transaction documents. Any unauthorized alteration, forgery or falsification of the contect or appearance of this documetn is unlawful and offenders may be prosecuted to the fullest extent of the law.

SGS maintains a formal Quality Assurance/Quality Control (QA/QC) program. A copy of our Quality Assurance Plan (QAP), which outlines this program, is available at your request. The laboratory certification numbers are AK00971 (DW Chemistry & Microbiology) & UST-005 (CS) for ADEC and 2944.01 for DOD ELAP/ISO17025 (RCRA methods: 1020B, 1311, 3010A, 3050B, 3520C, 3550C, 5030B, 5035A, 6020A, 7470A, 7471B, 8021B, 8082A, 8260B, 8270D, 8270D-SIM, 9040C, 9045D, 9056A, 9060A, AK101 and AK102/103). Except as specifically noted, all statements and data in this report are in conformance to the provisions set forth by the SGS QAP and, when applicable, other regulatory authorities.

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*	The analyte has exceeded allowable regulatory or control limits.
!	Surrogate out of control limits.
B	Indicates the analyte is found in a blank associated with the sample.
CCV	Continuing Calibration Verification
CL	Control Limit
D	The analyte concentration is the result of a dilution.
DF	Dilution Factor
DL	Detection Limit (i.e., maximum method detection limit)
E	The analyte result is above the calibrated range.
F	Indicates value that is greater than or equal to the DL
GT	Greater Than
IB	Instrument Blank
ICV	Initial Calibration Verification
J	The quantitation is an estimation.
JL	The analyte was positively identified, but the quantitation is a low estimation.
LCS(D)	Laboratory Control Spike (Duplicate)
LOD	Limit of Detection (i.e., 1/2 of the LOQ)
LOQ	Limit of Quantitation (i.e., reporting or practical quantitation limit)
LT	Less Than
M	A matrix effect was present.
MB	Method Blank
MS(D)	Matrix Spike (Duplicate)
ND	Indicates the analyte is not detected.
Q	QC parameter out of acceptance range.
R	Rejected
RPD	Relative Percent Difference
U	Indicates the analyte was analyzed for but not detected.

Note: Sample summaries which include a result for "Total Solids" have already been adjusted for moisture content. All DRO/RRO analyses are integrated per SOP.

SGS North America Inc. 200 West Potter Drive, Anchorage, AK 99518
t 907.562.2343 f 907.561.5301 www.us.sgs.com

Sample Summary

Client Sample ID	Lab Sample ID	Collected	Received	Matrix
02452-B6S12	1152037001	05/08/2015	05/13/2015	Soil/Solid (dry weight)
02452-B9S6	1152037002	05/08/2015	05/13/2015	Soil/Solid (dry weight)
02452-B8S4	1152037003	05/11/2015	05/13/2015	Soil/Solid (dry weight)

Method	Method Description
SW6020A	Metals by ICP-MS (S)
SM21 2540G	Percent Solids SM2540G

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Detectable Results Summary

Client Sample ID: **02452-B6S12**
Lab Sample ID: 1152037001
Metals by ICP/MS

Parameter	Result	Units
Arsenic	2.70	mg/Kg
Barium	29.0	mg/Kg
Chromium	13.3	mg/Kg
Lead	1.79	mg/Kg
Mercury	0.0450	mg/Kg

Client Sample ID: **02452-B9S6**
Lab Sample ID: 1152037002
Metals by ICP/MS

Parameter	Result	Units
Arsenic	2.26	mg/Kg
Barium	53.5	mg/Kg
Chromium	20.3	mg/Kg
Lead	2.98	mg/Kg
Mercury	0.0190J	mg/Kg
Selenium	0.432J	mg/Kg

Client Sample ID: **02452-B8S4**
Lab Sample ID: 1152037003
Metals by ICP/MS

Parameter	Result	Units
Arsenic	8.09	mg/Kg
Barium	147	mg/Kg
Cadmium	0.0985J	mg/Kg
Chromium	26.2	mg/Kg
Lead	7.63	mg/Kg
Mercury	0.0565	mg/Kg
Selenium	0.710J	mg/Kg

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t 907.562.2343 **f** 907.561.5301 www.us.sgs.com

Results of **02452-B6S12**

Client Sample ID: **02452-B6S12**
Client Project ID: **32-1-02452 WWTF Wasilla**
Lab Sample ID: 1152037001
Lab Project ID: 1152037

Collection Date: 05/08/15 12:55
Received Date: 05/13/15 11:48
Matrix: Soil/Solid (dry weight)
Solids (%):93.1
Location:

Results by **Metals by ICP/MS**

Parameter	Result	Qual	LOQ/CL	DL	Units	DF	Allowable Limits	Date Analyzed
Arsenic	2.70		0.990	0.307	mg/Kg	10		05/29/15 14:50
Barium	29.0		0.297	0.0930	mg/Kg	10		05/29/15 14:50
Cadmium	0.0990	U	0.198	0.0614	mg/Kg	10		05/29/15 14:50
Chromium	13.3		0.396	0.119	mg/Kg	10		05/29/15 14:50
Lead	1.79		0.198	0.0614	mg/Kg	10		05/29/15 14:50
Mercury	0.0450		0.0396	0.0119	mg/Kg	10		05/29/15 14:50
Selenium	0.495	U	0.990	0.307	mg/Kg	10		05/29/15 14:50
Silver	0.0990	U	0.198	0.0614	mg/Kg	10		05/29/15 14:50

Batch Information

Analytical Batch: MMS8933
Analytical Method: SW6020A
Analyst: ACF
Analytical Date/Time: 05/29/15 14:50
Container ID: 1152037001-A

Prep Batch: MXX28691
Prep Method: SW3050B
Prep Date/Time: 05/27/15 08:50
Prep Initial Wt./Vol.: 1.085 g
Prep Extract Vol: 50 mL

Results of **02452-B9S6**

Client Sample ID: **02452-B9S6**
Client Project ID: **32-1-02452 WWTF Wasilla**
Lab Sample ID: 1152037002
Lab Project ID: 1152037

Collection Date: 05/08/15 16:24
Received Date: 05/13/15 11:48
Matrix: Soil/Solid (dry weight)
Solids (%):82.3
Location:

Results by **Metals by ICP/MS**

Parameter	Result	Qual	LOQ/CL	DL	Units	DF	Allowable Limits	Date Analyzed
Arsenic	2.26		1.12	0.347	mg/Kg	10		05/29/15 14:53
Barium	53.5		0.336	0.105	mg/Kg	10		05/29/15 14:53
Cadmium	0.112	U	0.224	0.0694	mg/Kg	10		05/29/15 14:53
Chromium	20.3		0.448	0.134	mg/Kg	10		05/29/15 14:53
Lead	2.98		0.224	0.0694	mg/Kg	10		05/29/15 14:53
Mercury	0.0190	J	0.0448	0.0134	mg/Kg	10		05/29/15 14:53
Selenium	0.432	J	1.12	0.347	mg/Kg	10		05/29/15 14:53
Silver	0.112	U	0.224	0.0694	mg/Kg	10		05/29/15 14:53

Batch Information

Analytical Batch: MMS8933
Analytical Method: SW6020A
Analyst: ACF
Analytical Date/Time: 05/29/15 14:53
Container ID: 1152037002-A

Prep Batch: MXX28691
Prep Method: SW3050B
Prep Date/Time: 05/27/15 08:50
Prep Initial Wt./Vol.: 1.086 g
Prep Extract Vol: 50 mL

Results of **02452-B8S4**

Client Sample ID: **02452-B8S4**
Client Project ID: **32-1-02452 WWTF Wasilla**
Lab Sample ID: 1152037003
Lab Project ID: 1152037

Collection Date: 05/11/15 14:55
Received Date: 05/13/15 11:48
Matrix: Soil/Solid (dry weight)
Solids (%):79.0
Location:

Results by **Metals by ICP/MS**

Parameter	Result	Qual	LOQ/CL	DL	Units	DF	Allowable Limits	Date Analyzed
Arsenic	8.09		1.24	0.385	mg/Kg	10		05/29/15 14:55
Barium	147		0.373	0.117	mg/Kg	10		05/29/15 14:55
Cadmium	0.0985	J	0.249	0.0771	mg/Kg	10		05/29/15 14:55
Chromium	26.2		0.497	0.149	mg/Kg	10		05/29/15 14:55
Lead	7.63		0.249	0.0771	mg/Kg	10		05/29/15 14:55
Mercury	0.0565		0.0497	0.0149	mg/Kg	10		05/29/15 14:55
Selenium	0.710	J	1.24	0.385	mg/Kg	10		05/29/15 14:55
Silver	0.125	U	0.249	0.0771	mg/Kg	10		05/29/15 14:55

Batch Information

Analytical Batch: MMS8933
Analytical Method: SW6020A
Analyst: ACF
Analytical Date/Time: 05/29/15 14:55
Container ID: 1152037003-A

Prep Batch: MXX28691
Prep Method: SW3050B
Prep Date/Time: 05/27/15 08:50
Prep Initial Wt./Vol.: 1.018 g
Prep Extract Vol: 50 mL

Method Blank

Blank ID: MB for HBN 1709656 [MXX/28691]
Blank Lab ID: 1266583

Matrix: Soil/Solid (dry weight)

QC for Samples:
1152037001, 1152037002, 1152037003

Results by **SW6020A**

Parameter	Results	LOQ/CL	DL	Units
Arsenic	0.500U	1.00	0.310	mg/Kg
Barium	0.150U	0.300	0.0940	mg/Kg
Cadmium	0.100U	0.200	0.0620	mg/Kg
Chromium	0.200U	0.400	0.120	mg/Kg
Lead	0.100U	0.200	0.0620	mg/Kg
Mercury	0.0200U	0.0400	0.0120	mg/Kg
Selenium	0.500U	1.00	0.310	mg/Kg
Silver	0.100U	0.200	0.0620	mg/Kg

Batch Information

Analytical Batch: MMS8933
Analytical Method: SW6020A
Instrument: Perkin Elmer Sciex ICP-MS P3
Analyst: ACF
Analytical Date/Time: 5/29/2015 2:39:41PM

Prep Batch: MXX28691
Prep Method: SW3050B
Prep Date/Time: 5/27/2015 8:50:23AM
Prep Initial Wt./Vol.: 1 g
Prep Extract Vol: 50 mL

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Blank Spike Summary

Blank Spike ID: LCS for HBN 1152037 [MXX28691]
Blank Spike Lab ID: 1266584
Date Analyzed: 05/29/2015 14:42

Matrix: Soil/Solid (dry weight)

QC for Samples: 1152037001, 1152037002, 1152037003

Results by **SW6020A**

Blank Spike (mg/Kg)

Parameter	Spike	Result	Rec (%)	CL
Arsenic	50	50.0	100	(80-120)
Barium	50	50.2	100	(80-120)
Cadmium	5	5.11	102	(80-120)
Chromium	20	20.4	102	(80-120)
Lead	50	54.4	109	(80-120)
Mercury	0.5	0.516	103	(80-120)
Selenium	50	51.4	103	(80-120)
Silver	5	5.03	101	(80-120)

Batch Information

Analytical Batch: **MMS8933**
Analytical Method: **SW6020A**
Instrument: **Perkin Elmer Sciex ICP-MS P3**
Analyst: **ACF**

Prep Batch: **MXX28691**
Prep Method: **SW3050B**
Prep Date/Time: **05/27/2015 08:50**
Spike Init Wt./Vol.: 50 mg/Kg Extract Vol: 50 mL
Dupe Init Wt./Vol.: Extract Vol:

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Matrix Spike Summary

Original Sample ID: 1266585
MS Sample ID: 1266586 MS
MSD Sample ID: 1266587 MSD

Analysis Date: 05/29/2015 15:12
Analysis Date: 05/29/2015 15:17
Analysis Date: 05/29/2015 15:19
Matrix: Solid/Soil (Wet Weight)

QC for Samples: 1152037001, 1152037002, 1152037003

Results by **SW6020A**

		Matrix Spike (mg/Kg)				Spike Duplicate (mg/Kg)					
Parameter	Sample	Spike	Result	Rec (%)		Spike	Result	Rec (%)		CL	RPD (%)	RPD CL
Arsenic	2.81	46.7	51.9	105		47.5	54.8	109		80-120	5.42	(< 20)
Barium	60.8	46.7	213	325	*	47.5	241	380	*	80-120	12.50	(< 20)
Cadmium	0.0624J	4.67	4.87	103		4.75	5.02	104		80-120	3.12	(< 20)
Chromium	2.08	18.7	25.5	125	*	19.0	26.3	128	*	80-120	3.16	(< 20)
Lead	2.02	46.7	51.6	106		47.5	52.5	106		80-120	1.78	(< 20)
Mercury	0.0193U	0.467	.51	109		0.475	0.507	107		80-120	0.66	(< 20)
Selenium	0.483U	46.7	47.4	102		47.5	49.8	105		80-120	4.89	(< 20)
Silver	0.0965U	4.67	4.75	102		4.75	4.70	99		80-120	0.98	(< 20)

Batch Information

Analytical Batch: MMS8933
Analytical Method: SW6020A
Instrument: Perkin Elmer Sciex ICP-MS P3
Analyst: ACF
Analytical Date/Time: 5/29/2015 3:17:17PM

Prep Batch: MXX28691
Prep Method: Soils/Solids Digest for Metals by ICP-MS
Prep Date/Time: 5/27/2015 8:50:23AM
Prep Initial Wt./Vol.: 1.07g
Prep Extract Vol: 50.00mL

Print Date: 05/31/2015 8:15:23AM

Bench Spike Summary

Original Sample ID: 1266585
MS Sample ID: 1266588 BND
MSD Sample ID:

Analysis Date: 05/29/2015 15:12
Analysis Date: 05/29/2015 15:22
Analysis Date:
Matrix: Solid/Soil (Wet Weight)

QC for Samples: 1152037001, 1152037002, 1152037003

Results by **SW6020A**

		Matrix Spike (mg/Kg)			Spike Duplicate (mg/Kg)					
Parameter	Sample	Spike	Result	Rec (%)	Spike	Result	Rec (%)	CL	RPD (%)	RPD CL
Barium	60.8	242	318	106				80-120		
Chromium	2.08	121	133	108				80-120		

Batch Information

Analytical Batch: MMS8933
Analytical Method: SW6020A
Instrument: Perkin Elmer Sciex ICP-MS P3
Analyst: ACF
Analytical Date/Time: 5/29/2015 3:22:00PM

Prep Batch: MXX28691
Prep Method: Soils/Solids Digest for Metals by ICP-MS
Prep Date/Time: 5/27/2015 8:50:23AM
Prep Initial Wt./Vol.: 1.03g
Prep Extract Vol: 50.00mL

Print Date: 05/31/2015 8:15:23AM

Method Blank

Blank ID: MB for HBN 1709002 [SPT/9595]
Blank Lab ID: 1264927

Matrix: Soil/Solid (dry weight)

QC for Samples:
1152037001, 1152037002, 1152037003

Results by **SM21 2540G**

Parameter	Results	LOQ/CL	DL	Units
Total Solids	100			%

Batch Information

Analytical Batch: SPT9595
Analytical Method: SM21 2540G
Instrument:
Analyst: A.K
Analytical Date/Time: 5/18/2015 10:27:00PM

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Duplicate Sample Summary

Original Sample ID: 1152027001
Duplicate Sample ID: 1264928
QC for Samples:

Analysis Date: 05/18/2015 22:27
Matrix: Soil/Solid (dry weight)

Results by **SM21 2540G**

NAME	Original	Duplicate	Units	RPD (%)	RPD CL
Total Solids	93.9	92.9	%	1.10	(< 5)

Batch Information

Analytical Batch: SPT9595
Analytical Method: SM21 2540G
Instrument:
Analyst: A.K

Print Date: 05/31/2015 8:15:25AM

Duplicate Sample Summary

Original Sample ID: 1152027024
Duplicate Sample ID: 1264929
QC for Samples:
1152037001, 1152037002, 1152037003

Analysis Date: 05/18/2015 22:27
Matrix: Soil/Solid (dry weight)

Results by **SM21 2540G**

NAME	Original	Duplicate	Units	RPD (%)	RPD CL
Total Solids	95.0	93.8	%	1.20	(< 5)

Batch Information

Analytical Batch: SPT9595
Analytical Method: SM21 2540G
Instrument:
Analyst: A.K

Print Date: 05/31/2015 8:15:25AM

Duplicate Sample Summary

Original Sample ID: 1152077010
Duplicate Sample ID: 1264930
QC for Samples:
1152037001, 1152037002, 1152037003

Analysis Date: 05/18/2015 22:27
Matrix: Soil/Solid (dry weight)

Results by **SM21 2540G**

NAME	Original	Duplicate	Units	RPD (%)	RPD CL
Total Solids	85.1	84.8	%	0.27	(< 5)

Batch Information

Analytical Batch: SPT9595
Analytical Method: SM21 2540G
Instrument:
Analyst: A.K

Print Date: 05/31/2015 8:15:25AM

1152037

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

CHAIN-OF-CUSTODY RECORD

Page 1 of 1

Laboratory SGS

Attn: Tori

400 N. 34th Street, Suite 100
Seattle, WA 98103
(206) 632-8020

2043 Westport Center Drive
St. Louis, MO 63146-3564
(314) 699-9660

2705 Saint Andrews Loop, Suite A
Pasco, WA 99301-3378
(509) 946-6309

2355 Hill Road
Fairbanks, AK 99709
(907) 479-0600

5430 Fairbanks Street, Suite 3
Anchorage, AK 99518
(907) 561-2120

3990 Collins Way, Suite 100
Lake Oswego, OR 97035
(503) 223-6147

1321 Bannock Street, Suite 200
Denver, CO 80204
(303) 825-3800

Analysis Parameters/Sample Container Description
(include preservative if used)

Sample Identity	Lab No.	Time	Date Sampled	Comp.	Grab	RCRA Metals						Total Number of Containers	Remarks/Matrix
02452-B6512	(1) A	1255	5/8/15		X	X						1	So,l (45')
B956	(2) A	1624	5/8/15		X	X						1	(16')
B854	(3) A	1455	5/11/15		X	X						1	(7.5')

Project Information		Sample Receipt	
Project Number:	32-1-02452	Total Number of Containers	
Project Name:	WWTF Wasilla	COC Seals/Intact? Y/N/NA	
Contact:	kyw@shanwil.com	Received Good Cond./Cold	
Ongoing Project?	Yes ☐ No ☑	Delivery Method:	
Sampler:	KEW	(attach shipping bill, if any)	

Instructions
Requested Turnaround Time: Standard
Special Instructions:
open QT for Katya Wedeking vcp 5/14/15

Relinquished By: 1.	Relinquished By: 2.	Relinquished By: 3.
Signature: Time: 1147	Signature: Time:	Signature: Time:
Printed Name: Kyle Walker Date: 05/13	Printed Name: Date:	Printed Name: Date:
Company: Shannon & Wilson	Company:	Company:
Received By: 1.	**Received By: 2.**	**Received By: 3.**
Signature: Time:	Signature: Time:	Signature: Time: ~~1245~~ 1140
Printed Name: Date:	Printed Name: Date:	Printed Name: Kayla Wagenfehr Date: 5/13/15
Company:	Company:	Company: SGS

Distribution: White - w/shipment - returned to Shannon & Wilson w/ laboratory report
Yellow - w/shipment - for consignee files
Pink - Shannon & Wilson - Job File

F-19-91/UR

Temp. 2.7°/#203

No. 30531

1152037

SAMPLE RECEIPT FORM

Review Criteria:	Yes	N/A	No	Comments/Action Taken:
Were **custody seals** intact? Note # & location, if applicable. COC accompanied samples?	☐ ☑	☑ ☐	☐ ☐	***Exemption permitted if sampler hand carries/delivers.***
Temperature blank compliant* (i.e., 0-6°C after CF)? *If >6 °C, were samples collected <8 hours ago?* *If <0 °C, were all sample containers ice free?* Cooler ID: [1] _____ @ 2.7 _____ w/ Therm.ID: 203 _____ Cooler ID: _____ @ _____ w/ Therm.ID: _____ Cooler ID: _____ @ _____ w/ Therm.ID: _____ Cooler ID: _____ @ _____ w/ Therm.ID: _____ Cooler ID: _____ @ _____ w/ Therm.ID: _____ If samples are received without a temperature blank, the "cooler temperature" will be documented in lieu of the temperature blank & "**COOLER TEMP**" will be noted to the right. In cases where neither a temp blank nor cooler temp can be obtained, note "ambient" or "chilled."	☑ ☐ ☐	☐ ☐ ☐	☐ ☐ ☐	***Exemption permitted if chilled & collected <8 hrs ago.*** ***Note: Identify containers received at non-compliant temperature. Use form FS-0029 if more space is needed.***
Delivery method (specify all that apply): ☑Client (hand carried) ☐USPS ☐Lynden ☐AK Air ☐Alert Courier ☐UPS ☐FedEx ☐RAVN ☐C&D Delivery ☐Carlile ☐Pen Air ☐Warp Speed ☐Other: _____ → *For WO# with airbills, was the WO# & airbill info recorded in the Front Counter eLog?*		☑	☐	
	Yes	N/A	No	
Were samples received within hold time? Do samples **match COC*** (i.e., sample IDs, dates/times collected)? Were analyses requested unambiguous?	☑ ☑ ☑	☐ ☐ ☐	☐ ☐ ☐	***Note: Refer to form F-083 "Sample Guide" for hold times.*** ***Note: If times differ <1hr, record details and login per COC.***
Were samples in **good condition** (no leaks/cracks/breakage)? Packing material used (specify all that apply): ☐Bubble Wrap ☐Separate plastic bags ☐Vermiculite ☐Other:	☑	☐	☐	
Were **proper containers** (type/mass/volume/preservative*) used? Were **Trip Blanks** (i.e., VOAs, LL-Hg) in cooler with samples? Were all VOA vials **free of headspace** (i.e., bubbles ≤6 mm)? Were all soil VOAs **field extracted** with MeOH+BFB?	☑ ☐ ☐ ☐	☐ ☑ ☑ ☑	☐ ☐ ☐ ☐	☐ ***Exemption permitted for metals (e.g., 200.8/6020A).***
For preserved waters (other than VOA vials, LL-Mercury or microbiological analyses), was **pH verified and compliant**? If pH was adjusted, were bottles flagged (i.e., stickers)?	☐ ☐	☑ ☑	☐ ☐	
For **special handling** (e.g., "MI" soils, foreign soils, lab filter for dissolved…, lab extract for volatiles, Ref Lab, limited volume), were bottles/paperwork flagged (e.g., sticker)?	☐	☑	☐	
For **RUSH/SHORT Hold Time**, were COC/Bottles flagged accordingly? Was Rush/Short HT email sent, if applicable?	☐	☑	☐	
For **SITE-SPECIFIC QC, e.g. BMS/BMSD/BDUP**, were containers / paperwork flagged accordingly?	☐	☑	☐	
For any question answered "No," has the PM been notified and the problem resolved (or paperwork put in their bin)?	☐	☑	☐	SRF Completed by: VLP PM notified:
Was **PEER REVIEW** of ***sample numbering/labeling completed?***	☐	☐	☐	Peer Reviewed by:

Additional notes (if applicable):

Confirmed Open Qt for Katra W, per Katra 5/14/15

Note to Client: *Any "no" answer above indicates non-compliance with standard procedures and may impact data quality.*

Sample Containers and Preservatives

Container Id	Preservative	Container Condition	Container Id	Preservative	Container Condition
1152037001-A	No Preservative Required	OK			
1152037002-A	No Preservative Required	OK			
1152037003-A	No Preservative Required	OK			

Container Condition Glossary

Containers for bacteriological, low level mercury and VOA vials are not opened prior to analysis and will be assigned condition code OK unless evidence indicates than an inappropriate container was submitted.

OK - The container was received at an acceptable pH for the analysis requested.
PA - The container was received outside of the acceptable pH for the analysis requested. Preservative was added upon receipt and the container is now at the correct pH. See the Sample Receipt Form for details on the amount and lot # of the preservative added.
PH - The container was received outside of the acceptable pH for the analysis requested. Preservative was added upon receipt, but was insufficient to bring the container to the correct pH for the analysis requested. See the Sample Receipt Form for details on the amount and lot # of the preservative added.
BU - The container was received with headspace greater than 6mm.

APPENDIX F

IMPORTANT INFORMATION ABOUT YOUR GEOTECHNICAL/ENVIRONMENTAL REPORT

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

Attachment to 32-1-02452

Date: June 2016
To: Stantec
Re: Wastewater Treatment Plant Improvements, Wasilla, 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

3/2004

APPENDIX C

IMPORTANT INFORMATION ABOUT YOUR GEOTECHNICAL/ENVIRONMENTAL REPORT

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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.

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