

**Preliminary Geotechnical Engineering Report
Navigational Improvements Study
Head of Passage Canal
Whittier, Alaska**

August 2017

Submitted To:

The City of Whittier
P.O. Box 608
Whittier, Alaska
Phone: (907)472-2327

By:

Shannon & Wilson, Inc.
5430 Fairbanks Street, Suite 3
Anchorage, Alaska 99518
AECC 125

Phone: (907)561-2120
Fax: (206)695-6777
E-mail: klb@shanwil.com

32-1-02348-001

TABLE OF CONTENTS

	Page
1.0 INTRODUCTION.....	1
2.0 SITE DESCRIPTION	1
3.0 PROJECT DESCRIPTION.....	2
4.0 REGIONAL GEOLOGY AND SEISMICITY.....	3
4.1 Regional Geology.....	3
4.2 Seismicity	4
5.0 SUBSURFACE EXPLORATIONS.....	4
5.1 Onshore Explorations.....	5
5.2 Offshore Explorations	6
5.3 Soil Sampling	7
5.4 Field Screening and Environmental Soil Sampling	7
6.0 LABORATORY TESTING.....	7
6.1 Geotechnical Testing.....	8
6.2 Chemical Testing.....	8
7.0 SUBSURFACE CONDITIONS.....	9
7.1 USACE Alternative.....	9
7.1.1 Soil Conditions.....	9
7.1.2 Environmental Conditions	10
7.2 Shakespeare Creek Alternative	11
7.2.1 Soil Conditions.....	11
7.2.2 Environmental Conditions	12
7.3 Environmental Quality Control Samples	12
8.0 GEOLOGIC HAZARDS.....	13
8.1 Peak Ground Acceleration	14
8.2 Faulting.....	15
8.3 Tsunamis	16
8.4 Liquefaction	16
8.5 Lateral Spreading and Slope Stability	18
8.6 Flooding	19
9.0 PRELIMINARY ENGINEERING RECOMMENDATIONS.....	19
9.1 Dredging and Excavation	20
9.2 Rubble-mound Breakwater	21

9.2.1	Breakwater Design.....	22
9.2.2	Breakwater Stability Modeling.....	22
9.3	Boat Launch	24
9.4	Fills.....	24
9.5	Shallow Foundations.....	25
9.6	Pile Foundations.....	26
9.7	Settlements	27
9.8	Site Drainage.....	28
9.9	Environmental Considerations	28
9.10	Additional Considerations.....	29
10.0	CLOSURE/LIMITATIONS.....	29
11.0	REFERENCES.....	31

TABLES

1	Summary of Soil Sample Analytical Results
---	---

FIGURES

1	Vicinity Map
2	Site Plan
3	Generalized Geologic Map
4	Historical Seismicity
5	Subsurface Profile A-A'
6	Subsurface Profile B-B'
7	Subsurface Profile C-C'
8	Subsurface Profile D-D'
9	Generalized Slope Stability Analysis (2 Sheets)
10	Aggregate Gradation and Durability Requirements

APPENDICES

A	Boring Logs and Geotechnical Laboratory Testing
B	Results of Analytical Testing by SGS North America, Inc. of Anchorage, Alaska and ADEC Laboratory Data Review Checklists
C	Results of Liquefaction Analyses
D	Important Information About Your Geotechnical/Environmental Report

**PRELIMINARY GEOTECHNICAL ENGINEERING REPORT
NAVIGATIONAL IMPROVEMENTS STUDY
HEAD OF PASSAGE CANAL, WHITTIER, ALASKA**

1.0 INTRODUCTION

This report presents the results of subsurface explorations, laboratory testing, and preliminary geotechnical engineering studies conducted by Shannon & Wilson, Inc. for potential navigational improvements at the head of Passage Canal near Whittier, Alaska. At the time of this report, conceptual drawings indicate that the improvements generally consist of a new commercial boat launch small boat harbor and that two alternatives are being considered for the location of the facility. The purpose of this geotechnical study was to explore subsurface conditions and provide preliminary geotechnical engineering recommendations needed to support site selection, feasibility studies, and further the design efforts. To accomplish this, 19 soil borings were advanced at the two sites. Soil samples recovered from the borings were tested in our geotechnical laboratory and engineering studies were performed to support preliminary design. Analytical soil samples were also periodically collected during our explorations and selected samples were submitted to SGS North America, Inc. of Anchorage, Alaska (SGS) for limited chemical testing. Presented in this report are descriptions of the site and project, subsurface explorations and laboratory test procedures, an interpretation of subsurface conditions, and conclusions and preliminary recommendations from our engineering studies.

Our explorations were conducted for preliminary design purposes and were focused on collection of data for use in preliminary siting and feasibility studies and the data collected may not be sufficient for final design. We assume that the recommendations contained herein will only be used by the owner and their design team in conceptual level design, with the understanding that the recommendations will not be solely relied upon for final design and further studies may be needed.

Authorization to proceed with this work was received in the form of a signed proposal from Mr. Tom Bolen (former City Manager) of the City of Whittier, on September 15, 2013. Our work was conducted in general accordance with our proposal dated August 17, 2013. The scope of work was subsequently amended to include analytical testing and surveying.

2.0 SITE DESCRIPTION

The project area is located at the head of Passage Canal, less than one mile west of the City of Whittier, Alaska. According to the United States Geological Survey Seward D-5 63K

Quadrangle map, the project site is located in Sections 14, 15, and 23, Township 8 North, Range 4 East, Seward Meridian. Passage Canal is an approximately 11-mile long fjord situated along the western edge of the Prince William Sound. The fjord is characteristically steep-sided and deeply incised by glacial erosion. At the head of the canal, coalescing deltas created by streams emanating from Portage Pass, Shakespeare Glacier, and Learnard Glacier, form a more gently sloped area that is about 2.3 miles long by 2.3 miles wide. The northern portion of the delta area is overlain with moraine deposits from a more recent advance of the Learnard Glacier.

Historically, the delta area has been moderately developed with an airstrip and supporting facilities (a small building structure), a lumber company with a short rail spur, and more recently, a Department of Defense (DOD) tank farm. At present, development in the area consists of the Whittier access road (Camp Road) and tunnel, the railroad, airstrip, a telecommunications building, and a parking area. The DOD tank farm has been largely dismantled but some of its remnants remain. A vicinity map showing the general project area is presented in Figure 1.

3.0 PROJECT DESCRIPTION

We understand that the project is in the early conceptual phase and that two general areas are being considered for the proposed improvements. Conceptual sketches show that the proposed new development generally consists of an approximately 13 to 20-acre area which will be excavated/dredged for a new commercial, small boat harbor that will be largely enclosed behind a rubble-mound breakwater. The new facility may also contain a new boat launch, floats and slips, and other appurtenances. It is anticipated that new harbor would be dredged to a depth of about -19 feet Mean Lower Low Water (MLLW). A site plan showing the project area including proposed improvements, prominent site features, and our approximate boring locations is included as Figure 2.

The proposed United States Army Corps of Engineers (USACE) Alternative is situated along the waterfront east of the former DOD tank farm, north of the airstrip and south of the unnamed creek flowing from Learnard Glacier. The southwest corner of the USACE Alternative is located near the City of Whittier's existing parking area. Current concept sketches indicate that the new harbor area is approximately 1,400 feet long by 800 feet wide with its long axis oriented parallel to the shoreline. These dimensions include an entrance channel on the north end of the facility and a boat launch area at the southern end. The basin bottom is approximately 600 feet long by 600 feet wide. An approximately 1,300-foot long rubble-mound breakwater would be constructed to protect the harbor on the seaward side. At its conceptual location, the harbor area is largely situated between 0 and 40 feet MLLW, therefore it is anticipated that about half of the facility will be enclosed by slopes cut into the natural topography.

The proposed Shakespeare Creek Alternative is situated near the mouth of Shakespeare Creek, south of the airstrip and north of West Camp Road. Current concept sketches indicate that the new harbor area is irregularly shaped, (semi-rectangular in the southern half and arcuate in the northern half) and approximately 1,000 feet long by 800 feet wide, including a potential fill area along its southern edge. The entrance channel extends an additional 200 to 250 feet east at the southeast corner of the proposed facility. The basin bottom, at its greatest dimension, is approximately 700 feet long by 700 feet wide. The harbor area is largely situated between -2 and 14 feet MLLW, therefore it is anticipated that fills and rubble-mounds would generally be constructed on all sides of the facility. The seaward portion of the breakwater is approximately 1,000 to 1,200 feet long, including the entrance channel.

4.0 REGIONAL GEOLOGY AND SEISMICITY

The southern Alaska margin lies within the active tectonic belt that rims the northern Pacific Basin. This tectonic activity has resulted in rapid uplift, deposition and recycling of rocks along the plate margins and is responsible for creating one of the largest subduction-related accretionary complexes in the world (Plafker and others, 1994), the Southern Margin composite terrain. Sandwiched between the Wrangellia composite terrain to the north and the Aleutian megathrust fault system to the south, the Southern Margin composite terrain contains accreted blocks of the Chugach, Saint Elias, Ghost, Rocks, and Prince William terranes. Major lineaments in the area are likely controlled by fault zones and the erosional features associated with the tectonic environment and igneous and volcanic centers.

4.1 Regional Geology

The project area is more specifically located within the Kenai-Chugach Mountains physiographic province. The rock in the project area consists of intensely faulted and folded, and generally metamorphosed Cretaceous slates and graywackes of the Chugach terrane, which are locally overlain by unconsolidated Quaternary deposits (Barnes, 1943). The rocks are sparsely intruded by dikes or sills of quartz diorite and diorite containing intermittent zones of quartz veins and stringers. Barnes (1943) noted that small lenses of limestone and conglomerate are also present in the vicinity. Petrographic studies of similar rocks from the Chugach terrane indicate that the rocks are made up of lithic clasts that are predominantly of volcaniclastic origin (Plafker, 1994).

Massive ice sheets and extensive Pleistocene glaciation once buried the region and provided the processes by which Passage Canal was carved as ice flowed into Passage Canal from the southwest over Portage Pass and from the northeast from Learnard Glacier. According to Barnes (1943), a perched moraine on the valley walls west of Learnard Glacier provides evidence that the ice thickness was at least 3,500 feet above sea level at one time. Rounded topography and

slickensided rock faces on the surrounding peaks provide additional evidence of this glacial past. As recently as 1914 a debris-covered ice ridge, which had separated from the main lobe of Learnard Glacier, was located about midway down the moraine shown on the generalized geologic map included as Figure 3.

Unconsolidated soils were deposited as the glaciers retreated. Unconsolidated deposits in the project area typically consist of glacial moraine, glaciofluvial and alluvial silts, sands and gravels, and localized fills. Kachadoorian (1965) described the moraine deposits as “jumbled heaps and ridges of coarse angular blocks of slate and graywacke,” with local patches of sand and gravel. The approximate range of these deposits is shown on Figure 3.

4.2 Seismicity

The region is one of the most seismically active areas in the United States and historically subjected to large (greater than 6.0 Magnitude) earthquakes. Alaska experiences approximately 22,000 earthquakes of any given magnitude per year, which accounts for 52 percent of the earthquakes in the United States (AEIC no date). Figure 4 presents the locations of the major faults and earthquakes in the southern Alaska region.

The tectonics and seismicity of southern Alaska are the result of ongoing relative motion between two lithospheric plates; the Pacific Plate moves about 5 to 6 centimeters per year (cm/yr) northwestward relative to the North American Plate. The margin of convergence between the plates is the subduction zone and is marked on the surface by the Aleutian trench, about 150 miles southeast of Whittier. Active seismicity in southcentral Alaska occurs as both deep earthquakes associated with the subduction zone, as well as shallow earthquakes associated with long linear transform faults and smaller fault-cored fold structures (Figure 4). We searched the USGS earthquake database for events greater than magnitude (M) 5.0 within the past 50 years and a 125-mile radius. The search returned 69 results with 2 earthquakes greater than M6.0. Four results were returned when using the same search radius and M7.0 or greater, from 1901 to present. Further discussion of seismic conditions and their effect on design is included in Section 8.0.

5.0 SUBSURFACE EXPLORATIONS

Subsurface explorations for the project were advanced at the project sites between October 24 and November 8, 2013. Explorations consisted of advancing 13 onshore borings, designated Borings B-01, B-02, B-04, B-05(a and b), B-07, B-08, B-10, B-11, B-13, B-15, B-16, B-18 (a and b), and B-19 (a through c), and six offshore borings, designated Borings B-03, B-06, B-09, B-12, B-14, and B-17) to evaluate the subsurface conditions in the proposed development areas.

Borings B-01 through B-11 were advanced within the USACE Alternative and Borings B-12 through B-19 were advanced within the Shakespeare Creek Alternative. Drilling services for the project were provided by Denali Drilling of Anchorage, Alaska, under contract to the City of Whittier. Barge services were provided by Doshier Enterprises of Whittier, Alaska, under contract to Denali Drilling.

Prior to conducting explorations, Shannon and Wilson contacted the Call Locate Center to coordinate utility locates and clear the boring locations of potential conflicts with buried utilities. We have also coordinated with the USACE Regulatory Division to obtain permission to conduct the offshore drilling under a Nationwide #6 permit and with the Alaska Railroad Corporation (ARRC) for right of entry to ARRC-owned portions of the exploration area.

An experienced representative from our office was present continuously during the field work to locate the borings, observe drilling operations, recover soil and rock samples, log the subsurface conditions, and observe groundwater levels where appropriate. Actual boring locations were surveyed by Del Norte Surveying, LLC, under subcontract with Shannon & Wilson. The measurements were made using a Trimble R10 GNSS RTK system or Trimble S6 Robotic Total Station that are accurate within 0.1 foot. The locations of the borings are shown and tabulated on Figure 2. Logs of our borings are presented in Appendix A and subsurface profiles summarizing the soil conditions encountered during these explorations are summarized in Figures 5 through 8.

The soils encountered were observed and described in the field in general accordance with the classification system described by ASTM International (ASTM) D2487. Selected samples recovered during drilling were tested in our laboratory to refine our soil descriptions in general accordance with the Unified Soil Classification System (USCS) described in Appendix A, Figure A-1. Summary logs of the borings are presented in Appendix A, Figures A-2 through A-20.

An upland and bathymetric survey was conducted in the fall of 2008 by PND Engineers, Inc. (PND) as part of the Head of the Bay Parking Area and Vault Restroom project to establish topographic contours in the project area. The results of the survey were used by PND to prepare the topographic contours shown in Figure 2. The PND survey assumes an elevation datum of mean lower low water (MLLW). Unless otherwise stated, references to elevation in this report are stated in feet relative to this standard.

5.1 Onshore Explorations

It is noted that the term “onshore”, for the purpose of this discussion, refers to primarily to the drilling methodology rather than physical location or with reference to a specific elevation. In some cases, borings termed as onshore may have been advanced in the intertidal zone, but were

able to be drilled with terrestrial based drilling equipment at low tide. It should also be noted that Borings B-05, B-18, and B-19 experienced auger refusal during drilling, which required multiple attempts to achieve the desired depths. While the boring logs represent a composite of each attempt, the location of each attempt is shown separately on Figure 2 and represented by an “a”, “b”, or “c” designation following the boring number.

Onshore borings were advanced using a track mounted, CME-850x drill rig and 4 ¼-inch inner diameter (ID) hollow stem auger to depths of approximately 30.5 to 60.4 feet below the ground surface (bgs) or below mudline (bml). As the borings were advanced, a grab sample was collected from the auger cuttings in the upper 2 feet and penetration resistance samples were collected at 5-foot intervals thereafter. Additional samples were occasionally collected at intermediate intervals depending on drilling and sampling conditions, as determined by our representative. Soil and rock sampling was conducted using the procedures outlined in Section 5.3 below. The borings were backfilled with auger cuttings removed during drilling.

5.2 Offshore Explorations

The offshore borings were drilled using a track mounted, CME-850x drill rig (the same drill rig used to advance the onshore borings) parked on the deck of the “Oscar Mike”; an LCM8, mechanized landing craft. The drill was modified to advance solid casing and equipped with rotary wash drilling tools. These borings extended to depths ranging from approximately 32 to 85 feet bml. Water depths during drilling generally ranged from approximately 3 to 15 feet. Drilling was accomplished through an opening or “moon pool” on the landing craft’s loading ramp. The loading ramp also served as a work area for the drill crew. The landing craft was held in place during drilling using a three-point mooring system that consisted of a stern anchor and two lines tied to secure points onshore.

In general, the borings were initiated by setting 4-inch inside diameter (ID), threaded, conductor casing through the water and seating it into the soil at mudline. The borings were then advanced using rotary techniques and a 3-7/8-inch tricone bit. Seawater was flushed down the casing to return cuttings to the surface. The casing was advanced with the drilling to control caving of the borehole walls. As the borings were advanced, penetration resistance samples were generally collected at 5-foot intervals. Note, that sample intervals were varied to accommodate tidal fluctuations or other drilling and sampling conditions. Soil sampling was conducted using the procedures outlined in the following section. At the completion of drilling the casing was removed and the boreholes were allowed to backfill by natural caving of the borehole walls.

5.3 Soil Sampling

Samples were typically recovered using modified penetration test (MPT) or standard penetration test (SPT) or methods. In the MPT method, samples are recovered by driving a 3-inch OD split-spoon sampler into the bottom of the advancing hole with blows of a 340-pound hammer free falling 30 inches onto the drill rod. In the SPT method, samples are recovered by driving a 2-inch outer diameter (OD) split-spoon sampler into the bottom of the advancing hole with blows of a 140-pound hammer free falling 30 inches onto the drill rod. For both methods, the number of blows required to advance the sampler the final 12 inches of an 18-inch penetration or the middle 12 inches of a 24-inch penetration is termed the penetration resistance. 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.

5.4 Field Screening and Environmental Soil Sampling

Soil samples recovered during our explorations were “screened” for volatile organic vapors using an OVM 580B photoionization detector (PID) and an ADEC-approved headspace screening technique. The PID was calibrated before screening activities with 100 parts per million (ppm) isobutylene standard gas. Headspace screening was accomplished by placing soil into a re-sealable plastic bag using a stainless-steel spoon, warming the soil to a common temperature, and testing with the PID instrument within 60 minutes of sample collection. The headspace screening results are shown graphically on the boring logs and discussed in Sections 7.1 and 7.2.

Soil samples were collected from select borings for analytical laboratory analysis. Samples were generally collected from the unsaturated zone above the water table at upland locations and in the upper 5 to 10 feet of each boring at offshore locations. In general, analytical samples were collected from the middle portion of the recovered split-spoon sample. Our field representative used clean stainless steel spoons and new nitrile gloves to place the soil into laboratory-supplied containers in the order of volatility. Soil samples for volatile hydrocarbon analyses were field extracted using 25-milliliter (ml) aliquots of methanol in accordance with Alaska Method 101 (AK 101). Analytical results are summarized in Table 1 and included in Appendix B.

6.0 LABORATORY TESTING

Geotechnical and environmental laboratory tests were performed on selected samples recovered from the borings. The chemical testing was formulated with emphasis on testing for the presence of contaminants identified during previous work in the project area at the site as well as various other regulated substances. The geotechnical laboratory analyses were performed to support our

soil descriptions and to estimate the index properties of the typical materials encountered at the site. The geotechnical laboratory testing was formulated with emphasis on determining gradation properties, natural water content, and plasticity. This data, along with the estimated soil strength and density, aided in our preliminary engineering analyses.

6.1 Geotechnical Testing

Water content tests were performed on selected samples returned to our laboratory. Water content tests were performed in general accordance with ASTM D2216. The results of the water content measurements are presented graphically on the boring logs in Appendix A, Figures A-2 through A-20.

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 C117/C136 and ASTM D421/422. The test results are presented in Appendix A, Figure A-21 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 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.

Atterberg limits were evaluated on two samples of predominantly fine-grained materials recovered during drilling. The tests were performed in accordance with ASTM D4318. This analysis provides information on the plasticity characteristics of the silt or clay. The results of these tests are summarized on Appendix A, Figure A-22 and included on the boring logs.

6.2 Chemical Testing

Fourteen soil samples, including two duplicates, were submitted to SGS North America, Inc. (SGS) of Anchorage, Alaska for laboratory analysis on a standard 10 working-day turnaround time using chain-of-custody procedures. Each soil sample was analyzed by SGS for gasoline range organics (GRO) by Alaska Method (AK) 101, diesel range organics (DRO) by AK 102, residual range organics (RRO) by AK 103, aromatic volatile organics (BTEX) by Environmental Protection Agency (EPA) Method 8120B. Several samples were also analyzed for polynuclear aromatic hydrocarbons (PAHs) by EPA Method 8270D and Resource Conservation and Recovery Act (RCRA) metals by EPA Method 6020. Analytical soil results are summarized in Table 1. The SGS laboratory reports and Alaska Department of Environmental Conservation (ADEC) laboratory data review checklists are provided in Appendix B.

Under the sample numbering scheme used for this project, a typical analytical sample number is 2348- B01-S1 or 02348-B15S1 for soil boring samples. The “02348” indicates the Shannon & Wilson job number and the “B1S1” designations represent sample identification numbers. For brevity in the text of this report, the “02348” prefix is omitted.

7.0 SUBSURFACE CONDITIONS

The subsurface conditions described below are depicted graphically on the boring logs in Appendix A, Figures A-2 through A-20. In general, our borings encountered various soil conditions comprising glacial till or moraine deposits (consisting of varying amounts of gravel, sand, and silt), alluvium and glaciofluvial deposits (cleaner sand and gravel), reworked till and alluvium, and localized finer grained deposits (silty sand and sandy silt).

The results of field screening and analytical sampling conducted during our explorations are discussed below. Analytical sample results were compared to ADEC’s Method Two cleanup levels presented in the November 6, 2016, 18 Alaska Administrative Code (AAC) 75 regulations. The applicable soil criteria consist of the most stringent ADEC Method Two cleanup levels listed in Tables B1 and B2 of 18 AAC 75.341, for the “over 40-inch (precipitation) zone”. Cleanup levels for the soil samples collected for this project are provided in Table 1.

7.1 USACE Alternative

Borings B-01 through B-11 were advanced within the proposed USACE Alternative that is generally located north of the airstrip. Based on the current conceptual layout, this site is situated in variable terrain consisting of upland moraine topography along the northwestern 1/3 of the project limits and beach-head/deltaic environment in the eastern and southeastern 2/3 of the proposed area of development.

7.1.1 Soil Conditions

In general, our borings in this area encountered three main soil types consisting of glacial moraine deposits of sand and gravel, alluvial deposits of complexly interbedded sands and gravels, and reworked moraine and alluvial materials. A pocket of material interpreted as fill was also encountered in Boring B-07.

Borings B-05 and B-08 were advanced in the moraine area of the site (see Figure 4). The soils encountered by these borings consisted of gravel with silt and sand to silty gravel with sand. Based on the generally difficult drilling, rough drill action and surface observations, we estimate that a significant amount of cobbles and boulders are present. Penetration resistance values

ranged from 7 to greater than 60 blows per foot (bpf), with a marked increase below about 20 feet bgs in Boring B-05 and 32 feet bgs in Boring B-08. According to laboratory tests, the fines contents of samples tested ranged between 9 and 14 percent and moisture contents ranged from about 3 to 9 percent.

The remaining borings advanced within this alternative site generally encountered complexly interbedded sands and gravels with varying amounts of fines. Cobbles and boulders are likely present based on fractured particles in samples recovered and rough drilling action in many of the borings. In our opinion, these materials are interpreted as either alluvium, reworked alluvium, or reworked moraine. We believe the conditions encountered by Borings B-01, B-02, and B-07 are likely representative of reworked materials (likely related to the moraine deposits) on the basis of slightly higher fines contents and overall slightly higher relative density values when compared to the remaining borings at the site. Based on typical penetration resistance values ranging from 11 to greater than 50 bpf, the soils encountered would be considered medium dense to very dense. These values may exclude looser near surface (the upper 5 to 10 feet bml or bgs) soils, particularly at offshore locations. The loosest overall conditions were found in Boring B-06 where blow counts ranged from 7 to 17 bpf, with an average penetration resistance of 11 bpf. According to laboratory gradation tests, the fines contents of samples tested ranged between 3 and 14 percent.

Groundwater was encountered during drilling at depths ranging between 1.5 and 23 feet bgs (5 to 13 feet MLLW), excluding Borings B-03, B-06, and B-09, which were advanced from the landing craft. Borings B-04, B-05, B-08, and B-10 were advanced furthest from shore, toward the uplands, and are probably least affected by ocean levels. Groundwater levels estimated during drilling in those borings ranged from about 9 to 13 feet MLLW. Note that water levels may fluctuate by several feet seasonally and may vary during periods of high precipitation, rapid snow melt, or tidal influence.

7.1.2 Environmental Conditions

Soil samples from each boring were field screened for volatile organics using the PID. Screening results typically registered between 0 and 11 ppm. However, higher values of 64 and 230 ppm were observed in samples from Boring B-10 and B-07, respectively. In Boring B-07, strong hydrocarbon odors and sheen on the soil and sampling equipment were also noted below a depth of about 8 feet bgs. Moderate hydrocarbon odors were also detected in several samples collected from Boring B-10 between approximately 9 and 15 feet bgs.

Multiple analytical samples collected within the USACE Alternative contained detectable concentrations of GRO, RRO, BTEX, and PAHs, but less than the applicable ADEC clean up

levels. DRO concentrations were also measured in several analytical samples at concentrations less than the ADEC cleanup level of 230 milligrams/kilograms (mg/kg), with the exception of Sample B07-S3, which contained 4,530 mg/kg. All analytical samples analyzed for RCRA metals contained detectable concentrations of several metals, but less than the applicable ADEC cleanup levels, except for arsenic. However, the measured arsenic concentrations are generally consistent with typical background concentrations.

7.2 Shakespeare Creek Alternative

Borings B-12 through B-19 were advanced within the proposed Shakespeare Creek Alternative that is located within the intertidal area at the mouth of Shakespeare Creek. The topography is relatively gentle with less than about 20 feet of relief across the proposed basin area and a downward slope toward Passage Canal to the east.

7.2.1 Soil Conditions

In general, our borings in this area encountered complexly interbedded sands and gravels with varying amounts of silt. South and east of Boring B-15, near the center of the proposed facility, these deposits are underlain by silty sand and sandy silt and the wedge of coarser sand and gravel material above appears to thin out toward the southeast corner of the site. In our opinion, these materials are indicative of alluvium and that was likely deposited by multiple stream systems. Typically, we observed that the sediments were cleaner and somewhat coarser within the upper 3 to 5 feet of the ground surface. Strong organic odors, trace amounts of organic particles, and shell fragments were observed in the silty sands and sandy silts encountered by Boring B-17, particularly above elevation -30 feet MLLW. It is possible that a combination of topography, ocean and stream action has created an eddy which encourages deposition of the finer sediments, including organic particles. Bedrock was also encountered at about elevation -22.8 feet MLLW in B-16 near the southwest corner of the site. The rock consisted of moderately weathered, dark brown shale with occasional quartz veins. Rock strength is presumed to be relatively low based on the fact that we were able to drill and sample approximately 5.8 feet into the rock with soil sampling techniques.

Excluding the upper 5 to 10 feet which was typically looser, and based on penetration resistance values ranging from 5 to 50 bpf, the coarser, granular soils encountered would be considered medium dense to dense and the finer soils (silty sand and sandy silt) encountered would be considered loose to medium dense. The loosest conditions were found in Boring B-17 where blow counts ranged from 2 to 16 bpf, with the lowest blow counts generally recorded below about 30 feet bml (-33 feet MLLW).

According to our laboratory testing, fines contents in the coarser sands and gravels generally ranged between 6 and 12 percent and fines contents in the finer sands and silts ranged between 26 and 76 percent. Moisture contents in the coarser materials ranged from about 1 to 6 percent and 6 to 16 percent, in unsaturated and saturated samples, respectively. Moisture contents in the finer grained materials ranged between 17 and 35 percent. Atterberg limits were evaluated on two predominantly fine-grained samples recovered during drilling (Boring B-14 and B-17). The tests indicated that the materials were non-plastic and thus classified as silt.

Groundwater was encountered within several feet of the ground surface during drilling at each onshore location. The borings were generally advanced within the intertidal zone and the boring locations were regularly inundated by water during flood tides. Therefore, a discussion of groundwater, as it relates to our explorations and preliminary engineering is not appropriate for the purposes of this report.

7.2.2 Environmental Conditions

Soil samples from each boring were field screened for volatile organics using the PID. Screening results typically registered between 0 and 40 ppm. The highest values were registered in Boring B-17, where strong organic odors were detected in samples recovered during drilling between about 11 and 27 feet bml.

Samples B15S1 and B15S21 contained detectable levels of toluene and ethylbenzene, but at concentrations less than the applicable ADEC cleanup levels. B15S21 was collected as a duplicate to B15S1 for quality control purposes. All analytical samples analyzed for RCRA metals contained detectable concentrations of several metals, but at concentrations less than the applicable ADEC cleanup levels, except for arsenic. However, the measured arsenic concentrations are generally consistent with typical background concentrations.

7.3 Environmental Quality Control Samples

The project laboratory implements on-going quality assurance/quality control procedures to evaluate conformance to applicable ADEC data quality objectives (DQO). Internal laboratory controls to assess data quality for this project include surrogates, method blanks, matrix spike/matrix spike duplicates (MS/MSD), and laboratory control samples (LCS) to assess precision, accuracy, and matrix bias. If a DQO was not met, the project laboratory provides a report specific note identifying the problem in the Case Narrative section of their Laboratory Analysis Report. Analytical results were proved in three separate Laboratory Analysis Reports, identified as 1135553, 1135434, and 1135357 (See Appendix B).

External quality controls included trip blanks that accompanied the sample containers from the laboratory to the site during sampling activities and back again to SGS.

Shannon & Wilson reviewed the SGS data deliverables and no non-conformances that would adversely affect data usability were noted by the laboratory except for the following:

- In SGS report 135553, GRO was detected in the method blank. Analytical samples that contained concentrations of these parameters within five times the concentration reported in the method blank are considered non-detect at the reporting limit value and qualified with a “B” on Table 1.
- In SGS report 1135357, toluene was detected in the method blank. Analytical Sample B07-S3 contained an estimated concentration of toluene within five times the concentration reported in the method blank, therefore it is considered non-detect at the reporting limit value and qualified with a “B” on Table 1.

Along with SGS quality controls, Shannon & Wilson collected one duplicate soil sample for every 10 analytical soil samples collected. The relative percent differences calculated between the field primary/duplicate sample pairs were within the applicable ADEC DQOs.

8.0 GEOLOGIC HAZARDS

As discussed in Sections 4.1 and 4.2, the project site is located in a zone of active seismicity averaging about 22,000 recorded epicenters per year from both shallow crustal events and deep-seated subduction zone earthquakes. As such, the most significant geologic hazards at the site, in our opinion, are related to seismic activity and its effects. These effects include seismically induced ground failure (ie. surface rupture, faulting, lateral spreading, liquefaction, and landslides) and tsunamis. In addition to seismic-related hazards, the site is located in an area that may be affected by periodic flooding.

In 1964, Southcentral Alaska experienced the largest recorded earthquake in North America, the Great Alaskan Earthquake, with a Moment Magnitude of 9.2. The earthquake occurred in the northeast section of the Aleutian Megathrust which resulted in an estimated 100,000 square mile area of surface deformation (Plafker, 1969). According to available maps, Whittier is located within the area encompassed by the 1964 rupture zone.

It is our opinion that the project and its associated structures should be designed to mitigate the potential damages associated with geologic hazards. In some cases, the geologic hazards represent catastrophic events and it may not be feasible or even possible to design structures that

can withstand the effects of such events. However, we believe that if these contingencies are planned for, potential damages may be reduced and design features to minimize risk to human life can be incorporated into the project. A discussion of additional considerations with respect to geologic hazards (and specifically seismic evaluation of the site) as the project progresses is included in Section 9.10.

8.1 Peak Ground Acceleration

An assessment of the peak ground acceleration at the site often provides useful general information to the designers of the project. Values of peak ground acceleration may be estimated for the project site based upon regional seismicity studies performed by others or from a site-specific seismic analysis. As there is no singular over-arching design code related to seismic design of port structures, we used methods consistent with the American Society of Civil Engineers (ASCE) *Seismic Guidelines for Ports*, published in March 1998, for estimating the seismic acceleration values. Using the ASCE guidelines, two seismic events are considered: the operating earthquake and the contingency earthquake. According to the ASCE document, the operational and contingency shaking events have a 50 and 10 percent probability of exceedance, respectively, of occurring at the site in a 50-year time span. These probabilities relate to return periods of approximately 72 and 475 years for the operational and contingency events, respectively. We note these guidelines were applicable at the time of our draft report which was submitted in February 2014. Since then, these guidelines have been superseded by guidelines presented in the 2014 ASCE *Seismic Design of Piers and Wharves* (ASCE/COPRI 61-14), which uses design classifications of “low”, “moderate”, or “high” to determine seismic hazard and performance levels for use in design. Therefore, additional seismic design considerations may be required during final design. It is our opinion that the ground motions presented herein are appropriate for preliminary design considerations.

The 1998 ASCE design guidelines state that port structures should be designed such that if an operational event occurs, “operations are not interrupted and any damage that occurs will be repairable in a short period of time (possibly less than six months).” In addition, the ASCE document indicates that port structures should be designed to withstand the contingency event with damage that is “controlled, economically repairable, and not a threat to life and safety.”

Ground motions at the site, in the form of peak ground acceleration (PGA) and earthquake magnitude, were estimated from probabilistic seismic hazard analyses (PSHA) performed by the USGS (Frankel et al., 1996). The PSHA is a method for estimating ground motions that takes into account uncertainties and randomness in potential earthquake source, size, location, recurrence, and source-to-site attenuation. In maintaining consistency with the ASCE design

guidelines for ports, we conducted a PSHA for the operating and contingency events at the site. For reference purposes, we also conducted a PSHA for a more severe seismic event with a probability for exceedance of 2 percent in 50 years. This event is consistent with more conservative seismic designs for sensitive structures and buildings. We believe shaking of this magnitude represents, or is near to, the upper bound of shaking that could be experienced at the project site.

The results of the PSHA for the three seismic events considered in our analyses are presented in the table below. Values obtained from the PSHA estimate peak ground acceleration on rock (PGA_{rock}). Based on the expected average soil conditions at the site, the peak rock ground acceleration obtained was then modified by empirical amplification factors ranging between 0.9 and 1.5, as determined by AASHTO Table 3.10.3.2-1, corresponding to subsurface soil conditions to obtain a PGA_{soil} . Note that the acceleration values in the table below represent ground accelerations at discrete points and the seismic acceleration values used in the pseudostatic analyses described in this report are generally taken as $\frac{1}{2}$ of the values estimated by the PSHA.

Design Event	Probability of Exceedance	Return Period	PGA_{rock} (g)	PGA_{soil} (g)	Magnitude
Operating ¹	50% in 50 Years	108 years	0.23	0.30*/0.35**	6.3
Contingency	10% in 50 Years	475 years	0.41	0.45*/0.37**	6.8
Upper-Bound	2% in 50 Years	2,475 years	0.68	0.68*/0.61**	9.2

¹Values extrapolated from lower probability events

*Used in dynamic analyses where thick, medium dense to dense, granular soil conditions are present

** Used in dynamic analyses where thick, soft soil conditions are present, such as those encountered in Boring B-17

8.2 Faulting

In a review of existing geological data we found no known, active faults within 2 miles of the project site. Barnes (1943) indicated that no large faults of regional extent were recognized in the Portage Pass area, which includes the project site, but noted several small faults that were “obviously contemporaneous or older than the deep-seated deformation and metamorphism that defines the rock.” Additionally, our general observations of the site and borings did not indicate evidence of potential surface faulting in the vicinity of the project. Therefore, we have concluded that the potential hazard for surface faulting or ground rupture is low.

8.3 Tsunamis

Tsunamis are a phenomenon caused by seismic events located in or near submarine environments. The Aleutian Megathrust and its many splay faults are well-known and widely accepted sources of tsunamigenic earthquakes. Tsunamis may also be caused by submarine landslides that can be triggered by earthquakes or other sources. During or immediately after the 1964 event, three tsunami waves struck Passage Canal. According to Kachadoorian's (1965) post-1964 earthquake accounting, waves reached as high as 104 feet above mean sea level (MSL) along the northwest shore of Passage Canal. Near the Whittier town center, wave heights reportedly reached 25 to 50 feet above MSL. It was reported that wave heights at the head of Passage Canal ranged from 25 feet above MSL near the southern corner and 82 feet above MSL at the extreme northwest corner. It is generally accepted that at least two of the waves were likely caused by multiple submarine landslides in Passage Canal and that the tectonic tsunami probably struck the area within the first hour following the earthquake but went unnoticed. One of the largest submarine landslides occurred at the head of Passage Canal, near the airstrip. It is postulated that the initial wave, a seiche (oscillating wave), may have been caused by a 27-foot regional lateral displacement of the ground in Passage Canal. Based on this history, we believe there is risk for tsunamis at the project area and that development at this site be conducted in accordance with local codes and standards to protect personnel that will operate the new facility. The Alaska Tsunami Warning Center in Palmer, Alaska monitors tsunami activity and issues warnings to the City of Whittier. In 2011, the results of tsunami modeling and inundation mapping were published by The Alaska Division of Geological & Geophysical Surveys (DGGs) in *Tsunami Inundation Maps of Whittier and Western Passage Canal, Alaska*, Report of Investigations RI 2011-7 (RI 2011-7). The approximate observed maximum inundation line (taken from Kachadoorian, 1965) of the 1964 tsunami is shown on the site plan in Figure 2.

8.4 Liquefaction

Liquefaction of loose, saturated, cohesionless soils due to seismic loading has been studied over the past 35 years, resulting in methods based on both laboratory and field procedures to evaluate liquefaction potential. The most widely used methods are empirical, and based on correlations between Standard Penetration Test (SPT) resistance (N-value), peak ground acceleration (PGA), and earthquake magnitude.

We used three methods to conduct a preliminary evaluation of the liquefaction potential at the sites:

- Youd et al. (2001)

- Seed et al. (2003)
- Idriss and Boulanger (2004)

An important factor in evaluating liquefaction potential is the fines content (percent of soil by weight smaller than 0.075 millimeter [mm] or a No. 200 sieve) of the soil deposit. We performed grain size analyses and fines content tests to estimate the fines content of the typical subsurface soils encountered at the site. Where we did not perform laboratory tests, we visually estimated the fines content.

Liquefaction is generally associated with loose, saturated, cohesionless soils. The methods above are specifically intended for cohesionless soils, which are generally granular in nature. However some fine-grained soils exhibit cohesionless or “sand-like” behavior. Soft, cohesive soil layers may be subject to strength loss from ground shaking; however, if they exhibit cohesionless behavior, they could be considered “liquefiable.” Seed et al. (2003) and Boulanger and Idriss (2006) provide recommendations to evaluate whether a fine-grained soil is liquefiable. Their recommendations are based on experimental research and liquefaction field case studies.

We analyzed the liquefaction potential at Borings B-06, B-12, and B-17 using the ground motion parameters listed in the table in Section 8.1. In our analyses, liquefaction is considered as likely when the factor of safety (FS) against liquefaction is less than 1.0. The analyses associated with the operating level event show widespread triggering of liquefaction throughout Boring B-06 and below -30 feet MLLW in Boring B-17. In Boring B-12, liquefaction potential is more localized within discrete layers of the soil column. Of the 27 samples analyzed from Borings B-06 and B-17, approximately 21 of them may be susceptible to liquefaction under the operating level event in contrast to 3 of 11 samples analyzed, in Boring B-12. The analyses associated with the contingency and upper-bound events generally show widespread liquefaction of the soils in each of the borings analyzed. Of the 37 samples analyzed, only 2 samples had an FS greater than 1.0. Results of our analyses are plotted in Appendix C, Figures C-1 through C-3 as factor of safety (FS) against liquefaction versus depth.

In comparing the analyzed soil conditions to the conditions in the remaining borings, it appears that roughly 40 percent of the samples taken during our explorations may be susceptible to liquefaction during an operating level event, and roughly 60 to 65 percent of the samples may be susceptible to liquefaction during a contingency level event. The comparison also shows that the majority of potentially liquefiable soils are concentrated to about eight of the borings (roughly half). Of those eight borings, five were located in the Shakespeare Creek Alternative.

It should be noted that liquefaction analyses are generally based on SPT blow count correlations and our analyses are based on MPT blow counts. Efforts to correlate MPT and SPT blow counts (by others) have showed that correction factors ranging between 1.1 and 1.5 can be applied to convert MPT to SPT blow counts. These correlations are typically based on clean sands and cohesive, fine-grained soils. Based on the generally gravelly nature of the soils encountered by our borings, it is our opinion that applying a correction factor to the MPT results is not appropriate.

It should also be noted that theoretically, liquefaction could happen at any depth in the soil column, however, empirical evidence suggests that there is a lower bound (in terms of depth below ground surface) that liquefaction occurs regardless of soil conditions. It is thought that at these depths, there is enough overburden and confining pressures on the soil particles to counteract the rapid rise in pore pressure. Historically, the Alaska Department of Transportation has assumed that liquefaction does not occur deeper 60 feet below the ground surface. Other departments of transportation in the United States assume depths ranging between 60 and 120 feet below the ground surface.

8.5 Lateral Spreading and Slope Stability

Typically, lateral spreading occurs in concert with liquefaction and/or slope failures adjacent to a given site. Lateral spreading is a phenomenon that can occur in loose to dense, saturated sandy and/or gravelly soils beneath sloping ground surfaces and on level ground near slopes (i.e. free face) such as riverbanks or lakes. Lateral spreading results from the softening and weakening of liquefied soil; it differs from flow sliding in that it occurs in soils whose residual strength does not exceed the shear stresses required for static equilibrium. As a result, lateral spreading deformations generally occur during the period of earthquake ground shaking; the deformations develop in an incremental manner. Lateral spreading caused considerable, widespread damage to infrastructure in Central Alaska during the 2002 Denali Fault earthquake.

According to our liquefaction analyses and the subsurface information gathered during our explorations, it is evident that some of the soils within the project area could be prone to liquefaction if subjected to the operating and contingency seismic events. We believe that widespread areas of lateral spreading may occur in the project area, particularly in the near-shore marine environment. Widespread areas of lateral spreading of sloping shoreline or seafloor may occur. Soil displacement magnitudes will vary depending on the intensity and duration of shaking. Ground cracking, which may have been caused by lateral spreading, was observed in Whittier and at the Head of Passage Canal after the 1964 event. At the head of Passage Canal,

the observed cracks paralleled the shoreline and extended about 100 feet inland (Kachadoorian 1965).

The steeply sloped topography of Passage Canal also makes the area prone to terrestrial and submarine landslides and rockfalls. In our opinion, the proposed project is not located within an area likely to be subjected to debris avalanches from terrestrial landslides and the risks associated with such incidents are likely indirect and associated with landslide generated tsunami's. Historical evidence suggests that the project area is likely subject to greater risk by submarine landslides. As mentioned above, it is widely accepted that submarine landslides were the cause of two of the tsunami's that occurred in Whittier and the Passage Canal area after the 1964 earthquake. RI 2011-7 indicates that at least five submarine landslide events occurred as a result of the 1964 earthquake. Of those, the "airstrip" landslide occurred in the delta sediments at the head of Passage Canal and may have been one of the largest in terms of volume. It is likely that a similar event could recur under seismic loading. Other ground failures documented by Kachadoorian (1965) after the 1964 event in Whittier and the project area included regional subsidence of about 5.3 feet, an additional subsidence up to 2 to 3 feet due to compaction and densification of unconsolidated soils, displacement by lateral spreading and ground cracking.

8.6 Flooding

Shakespeare Creek and at least two other unnamed creeks are situated at the head of Passage Canal. The unnamed creek north of the USACE Alternative emanates from Learnard Glacier valley. Flow in the creeks is expected to be highly variable depending on temperature and precipitation. During extremely warm and rainy periods, water levels in the creeks may rise rapidly to flood stages. In the recent past, the unnamed creek emanating from Learnard Glacier reportedly overflowed its channel allowing floodwater to temporarily drain further to the south into the general vicinity of the USACE Alternative. Development at either site will need to consider the flooding potential of local drainages.

9.0 PRELIMINARY ENGINEERING RECOMMENDATIONS

Our engineering studies consist of preliminary evaluations of dredging and excavation, rubble-mound construction and stability, boat launch design, potential shallow foundations for building structures, and piles for potential pile supported structures. Other geotechnical considerations for site development include evaluating potential settlements, drainage, and structure fill and construction materials. The recommendations contained in the following sections are intended to be used by the owner for site selection and preliminary design and are therefore generalized and preliminary in nature. They are provided with the assumption that prospective design teams will be expected to review the available data from the site, make independent interpretations, and

conduct their own additional explorations (if warranted), engineering analyses and design studies. Recommendations and conclusions herein are based on our interpretation of the available data and our understanding of the project and preliminary design concepts at the time of this report. Our use of the available information should not be construed as a guarantee that there is sufficient subsurface information for final design of the proposed and future improvements. It is incumbent upon the owner and designers to review the available data and determine if additional data is needed to complete their design and obtain that data if needed.

9.1 Dredging and Excavation

A significant amount of dredging and/or excavation work will be required to construct the proposed new facility. Existing ground surface elevations range between about 0 and 45 feet MLLW at the conceptual location of the USACE Alternative and between -2 and 15 feet MLLW at the Shakespeare Creek Alternative. At the time of this report the bottom of the proposed facility is planned at -19 feet MLLW.

Our borings within the USACE Alternative encountered soil conditions consisting of loose to very dense sands and gravels containing various amounts of fines. In the moraine area (Figure 3), the ground surface is largely covered by cobbles and boulders with particle sizes that were estimated up to approximately 10 to 15 feet in diameter. Drill action, auger refusal (Boring B-05a), and drive fractured particles in many of the samples suggested that cobbles and boulders are present in the subsurface as well. In general, the densest conditions were encountered in borings advanced in the moraine area (Borings B-05 and B-08). The loosest conditions were encountered in Borings B-06 and B-09.

Our borings within the Shakespeare Creek Alternative encountered various soil conditions consisting of sand and gravel, silty sand and sandy silt, and bedrock. The presence of cobbles was also noted during drilling, as above, but the frequency and particle size appears to be less than in the USACE Area. It is noted that during drilling Boring B-19, the augers met refusal on a zone of cobbles and boulders twice (at separate locations) before they were able to be penetrated at a third location.

Dredging methods are generally dependent upon the nature of the materials being excavated and whether the material is to be reused as fill. Methods may consist of suction or clam shell dredging, or excavation using a dragline or large hoe. Based on our borings, we believe that the presence of cobbles, large boulders, and dense soils present a significant challenge for dredging and excavation operations at the USACE Alternative. At the Shakespeare Creek Alternative site, variable soil conditions may require several techniques to achieve a well-constructed project. In addition, bedrock was encountered in Boring B-16, near the southwest corner of the Shakespeare

Creek Alternative site. Although the rock was encountered below the anticipated depth of the proposed basin, it is possible that variations in the rock surface could exist that would impact dredging operations.

Submarine and above-water slopes will need to be constructed as part of the proposed improvements. With a few exceptions, the soils that will be dredged or excavated at either site typically consist of loose to dense, cohesionless, granular materials (sands and gravels) with fines contents less than 14 percent. Borings B-14, B-15, and B-17 encountered silty sands with fines contents between 26 and 42 percent, within the expected excavation zone. For planning purposes, submarine slopes in the cleaner sands and gravels should be developed no steeper than 4 horizontal (H) to 1 vertical (V). Submarine slopes in the silty sands, will likely need to be developed to 5H or 6H to 1V for long term stability. Slopes may be armored to improve stability and achieve somewhat steeper slopes. The amount of stability gained will depend factors such as slope angle, slope height, and the armor stone used. Above-water slopes, that will not be affected by wave action, can generally be developed no steeper than 2H or 3H to 1V. These slope estimates are based on our professional judgment and the conditions encountered by our borings and are intended for preliminary design purposes only. Further consideration to slope design will be needed prior to final design.

Regardless of the harbor configuration, it will be prudent to develop an excavation/dredging plan after the harbor design is complete, and before construction begins. The successful contractor typically prepares these plans which generally describe the methods and sequencing for excavation as well as any additional information for expected dewatering, groundwater control, and shoring as necessary. The excavation plan should also include the types and locations of shoring to be used and engineered plans for the shoring, if required. Dredging operations also require significant agency coordination and planning measures for material handling, screening, and disposal, the extent of which depends on the presence of contamination and whether the dredge spoils will be deposited offshore or in upland areas. Section 9.9 includes further discussion of environmental concerns related to the project.

9.2 Rubble-mound Breakwater

The boat harbor is expected to be protected from wave action by a rubble-mound breakwater. The design of a rubble-mound breakwater should consider the expected wave height, internal slope stability, and hydraulic properties that affect the transmittance of wave energy through the breakwater. We recommend retaining a firm with expertise in ocean engineering for final design of the breakwater.

9.2.1 Breakwater Design

Breakwaters are typically designed with a core consisting of sands and gravels, a filter layer of coarse gravel or cobbles, and external armoring consisting of riprap. For modeling purposes, we assumed properties of armor rock and core material, and estimated properties for the typical native sands and gravels based on our borings in the breakwater areas, which are presented in the table below. We also assumed the crest elevation of the breakwater to be 10 feet above Mean Higher High Water (MHHW) level, and a crest width of 10 feet.

Material	Angle of Internal Friction (degrees)	Effective Unit Weight (pcf)*
Riprap Above Waterline	40	135
Riprap Below Waterline	38	66**
Native Sands and Gravels	31	56**

The values in the above table are appropriate for static and pseudo-static loading conditions.

* pcf - pounds per cubic foot

** When calculating engineering properties of soils beneath the water table, effective unit weight of the soil is calculated as the saturated unit weight minus the weight of water (64.0 pcf for salt water).

For planning purposes, we assumed that armored portions of the breakwater above Mean Sea Level (MSL) be designed with slopes at 1.5 Horizontal (H) to 1 Vertical (V). Armored portions of the breakwater below MSL were assumed to have slopes at 2H to 1V, slopes constructed of native materials were assumed to have a maximum slope of 3H to 1V. These assumptions were made for preliminary evaluation only and will likely need to be adjusted to develop the final project design.

9.2.2 Breakwater Stability Modeling

Based on conceptual sketches provided by the City of Whittier, the breakwater will be constructed near the crest of the submarine delta at the head of Passage Canal. Based on historical landslides, particularly the landslides produced by the 1964 earthquake, we believe that global slope failure may occur in the event of a contingency level or upper-bound seismic event. Our stability modeling focused on localized slope failure based on an operating level seismic event.

To evaluate stability conditions, analyses were performed using the computer program Slope/W developed by GeoStudio. This is a two-dimensional, limit equilibrium slope stability program that is used to model a slope and estimate the factor of safety against rotational slope failure by the Morgenstern-Price method. The program performs limit equilibrium analysis based on a set of user defined points of entry and exit limits to find the critical slip surface for a circular failure

plane. We chose to model a circular failure surface based on the homogenous, generally frictional soil conditions encountered and historical evidence that past failures in the existing slope appear to be circular in nature. To evaluate the external stability of the proposed breakwater and submarine slope, we assumed the soil cross section shown on Figure 9. The cross section is based on an assumed dredged basin elevation of 19 feet below MLLW, and generalized topography based on studies performed by the DGGs in 2011. It is noted that the cross section is a representation of the general existing submarine slope condition and was not taken along a particular transect. As such, we believe the cross section is appropriate for use in these preliminary studies but will likely need to be refined as the design progresses. The assumed soil strength properties for the soil and breakwater units are presented in Section 8.2.1, and are also presented on Figure 9.

Two hypothetical locations for the breakwater (relative to the submarine slope at the head of Passage Canal) were considered, as well as the existing generalized slope (pre-development) condition. Factors of safety were calculated using the Morgenstern-Price method for static and dynamic (seismic) loading conditions, dynamic loading conditions were calculated using a pseudo-static analysis and acceleration coefficients consistent with an operating level event. Typically, slopes with factors of safety of at least 1.5 and 1.1 are considered stable for static and dynamic conditions, respectively.

In general, the analysis indicates that the presence of the breakwater has a minor effect on the dynamic stability of the overall submarine slope when the outer toe of the breakwater is situated near the crest of the submarine slope. However, it also indicates that the existing submarine slope is not stable under dynamic loading. Marginal dynamic slope stability can be achieved by moving the toe of the breakwater slope back 100 feet from the crest of the submarine slope. The setback will not prevent small surficial failures from occurring on the ocean side of the breakwater, but may prevent deeper failure of the slope and potential loss of the breakwater during an operating level seismic event. Note that the dynamic factor of safety for each scenario was near 1.00 and that slope failure is not well defined. A failure based on these factors of safety may consist of slight settlement or may indicate a complete, flow type failure. Displacements are not calculated in this type of analysis.

Deeper conditions may exist, such as bedrock, very dense soils, or very soft soils that can have a significant impact on slope performance. More exploratory work will be needed to better refine our understanding of the soil and submarine slope conditions within the study area. These explorations should consist of multiple geotechnical borings, advanced to sufficient depth, in order to evaluate a representative cross section of the portion of the slope above the suspected failure plain.

9.3 Boat Launch

A new boat launch is expected to be constructed as part of the project. The concept for the USACE Alternative indicates that the boat launch ramp will be approximately 300 feet long by 80 feet wide. We envision that the ramp will generally consist of a concrete pad that is constructed of poured-in-place or pre-cast concrete pads. Other appurtenances such as pile supported and/or floating temporary mooring structures may also be constructed at the boat launch. Geotechnical design of the launch ramp will largely need to consider the strength, frost susceptibility and drainage characteristics of the support soils. Based on our borings, the support soils are expected to consist of loose to medium dense, sands and gravels with typical frost classifications ranging from NFS to F1. Depending on the expected loading, we believe that these native subgrade materials should be capable of supporting the expected loads imparted by moderately loaded, slow moving vehicles and trailers.

For planning purposes, we recommend that the minimum structural section for the launch ramp consist of 6 inches of D-1 Base Course over 36 inches of Selected Material Type A. This section should extend seaward as far as practical for constructability purposes, or to MLLW, whichever achieves the lowest elevation. Concrete thickness should be designed by the structural engineer based on the load requirements. The structural section may also need to incorporate geotextile fabric and/or geogrid layers depending on the expected design usage and loading. Structural section requirements and materials should be verified before final design.

9.4 Fills

Structural and non-structural fills will be needed for various aspects of site development. Based on our borings, most of the materials dredged or excavated are expected to consist of sands and gravels with fines contents less than 14 percent. The sands and gravels should drain relatively rapidly after dredging or excavation and should generally be well suited for reuse as upland or embankment fills for site development. These materials generally appear to meet the gradation requirements for ADOT&PF Selected Materials Type B and C and can likely be used as structural fill. It should be noted that, depending on the dredging method, the gradation of these materials may vary significantly after dredging. The siltier materials, such as those encountered in Borings B-14, B-15, and B-17, will likely require significant moisture reduction efforts (stockpiling and draining) in order to place and compact effectively. In areas where fill slopes will be subjected to wave action or submersion, slopes should be protected by appropriately sized armor rock, placed soon after excavation or placement.

Classified structural fills will be needed in the boat launch structural section and beneath footings and slabs. Classified structural fill placed in these areas should be clean, granular soil to provide

drainage and frost protection. These soils should contain less than about six percent (by weight, based on the minus 3-inch portion) passing the No. 200 sieve. In general, ADOT&PF Selected Material Type A structural fill meets these requirements. Soil fills (ie. non riprap and filter layer materials) should be placed with moisture/density control for this project.

Riprap and armor rock fill will be needed for general slope stabilization in submerged environments and for construction of the rubble-mound. Some of this material may be able to be segregated from excavated on-site materials, especially from the moraine area. However, the quality and quantity of the rock that would be derived from that source is expected to be highly variable. We are not aware of an operational rock quarry in Whittier that would be capable of producing the expected volume of riprap and armor rock needed to construct the project. One option could be to develop a local quarry to source the rock needed for the project. However, development of a rock source specifically for the project may be impractical and it is likely that rock will need to be imported by rail from sources outside of Whittier, such as Birchwood or Seward. Rock for the project should conform to project specific gradation and durability requirements that are developed during preliminary design work. In general, rock for the project should be placed using methods that discourage segregation and does not damage any underlying engineered structure or treatments.

9.5 Shallow Foundations

New structures and other appurtenances may be constructed as part of the new facility. We envision these structures will be relatively lightly loaded buildings such as restrooms or offices that would typically be supported on conventional shallow foundations. Design of foundation elements must consider the bearing support capabilities, expected settlements, and the effects of seasonal frost action of the soil. In our opinion, the native, granular soils encountered by our borings are generally capable of supporting lightly loaded structures on shallow foundations. We anticipate that fills would be developed from on-site dredged or excavated granular materials. Depending on the method and quality of fill placement, these fills should also be capable of supporting lightly loaded structures on conventional shallow foundations. However, areas of loose fill may need to be healed by overexcavating the footings up to several feet below the bottom of the footings in order to provide a relatively stable platform to support the building loads and minimize settlements.

For preliminary design purposes, the minimum footing width should be assumed to be 16 inches for continuous strip footings and 24 inches for spread footings. We recommend assuming that perimeter footings in heated building be placed a minimum of 4 feet below the ground surface. For interior footings in heated areas, footings may be placed directly below the floor slab such

that embedment is 18 inches or more below the finished floor elevation. If portions buildings are to be unheated, the minimum burial depth for footings should be increased to 5 feet bgs for frost protection. We recommend assuming that footings bear directly on native, firm, unyielding mineral soils, or on ADOT&PF Selected Material Type A structural fill. Structural fills should conform to the gradation requirements shown in Figure 10 and should be compacted to at least 95 percent of its maximum dry density as determined by the Modified Proctor compaction procedure (ASTM D 1557).

9.6 Pile Foundations

Pile foundations will likely be needed for construction of trestles, slips, and other mooring supports. Our explorations were conducted to support feasibility studies, siting, and preliminary design of the basin and breakwater portions of the development. As such, our borings were not advanced deep enough to evaluate the subsurface soil conditions for development of pile load curves. Load support of pile foundations depends greatly on the in-place strength (cohesion, friction, and density) of the soils/rock and the depth of embedment of the piles in these soils or rock. Without specific explorations available to address these criteria, we can only assume generalized conditions and point out soil conditions that may affect the fundamental design of the proposed structures for these preliminary studies. Additionally, when determining pile design, consideration should be given to possible future development plans for the facility that may include increased dredging depths.

The most critical loading conditions for floating docks are typically from lateral load sources (wind, waves, mooring water craft, etc...). Other piles, such as those installed to support access trestles (to accommodate light traffic loads), will also need to withstand lateral loading from a variety of sources, but may require greater consideration of axial load sources. Lateral capacity in a driven, steel pile is derived from pile deflection and subsequent soil reaction to the stressed pile. Pile type, size and depth are selected to resist design loads without experiencing excessive deflection at and above the ground/sea floor and to penetrate past the point of fixity (the depth at which the pile does not undergo significant deflection). Based on our experiences on similar projects and assuming medium dense, granular soils, open-ended pipe piles will likely need to be embedded on the order of 20 to 60 feet below the bottom of the basin to develop sufficient lateral, axial, and uplift support for relatively lightly loaded, pile supported structures under static (non-seismic) conditions. Pile embedment will be dependent on the actual design loads.

Based on site history and our limited liquefaction analyses, it appears that there is significant potential for liquefaction of much of the soils beneath each potential site, as well as lateral spreading or failure of the adjacent submarine slope. During seismic activity, the soils could lose

a significant amount of strength and as a result, their support capabilities will change. In addition, lateral spreading could impart lateral forces on the piles. Piles installed for this project should be designed to accommodate the effects of liquefaction. We recommend that the performance criteria established under seismic conditions in ASCE Seismic Guidelines for Ports (1998) be maintained in the development of the final design of this project with designs meeting the performance criteria for the operating level, contingency level, and upper-bound events.

Further explorations will be needed to collect geotechnical data for pile design; however, based on the conditions encountered by our borings, issues may arise during driving that should be considered prior to construction. Our borings indicated that boulders and cobbles are likely present beneath the sites, particularly at the USACE Alternative. Bedrock may also be present in the southern portion of the Shakespeare Creek Alternative. Such materials may prevent full penetration of pipe piles and sheets, may cause piles to deviate from plumb, or may damage the piles during driving. As such, the piles may need to be fitted with hardened driving shoes to reduce the risk of damaging the piles. Piles that tip out on bedrock before achieving the design penetration may need to be socketed, anchored, or battered into the bedrock to gain uplift capacity.

9.7 Settlements

The magnitude of the settlements that will develop are dependent upon the applied loads, the density of the support materials, and the care with which fills are placed and compacted. In general, the support materials under the rubble-mounds are expected to be loose to medium dense sands and gravels. Given our preliminary assumptions regarding mound configuration, we estimate that total maximum static settlements will be about 12 inches or less with differential settlements being about 1/2 of the total settlements over about 200 feet. The greatest amount of settlement should occur during construction, essentially as fast as the loads are applied, such that long term differential settlements the rubble-mound will be relatively small. Rubble-mounds in the Shakespeare Creek Alternative may be developed on top of loose or soft soils and significantly more settlement, up to several feet can be expected. These estimates should be confirmed once a final site layout is determined. Design of individual buildings and piles is considered beyond the scope of this report and will be dependent on the nature of site development, location of the structures, and the settlement criteria developed by the designer; therefore settlement estimates for these items are not provided.

Densification of the granular soils above and below the water table may occur when subject to earthquake shaking, resulting in potential ground settlement at the site. We used the relationship by Tokimatsu and Seed (1987) and Pradel (1998), relating earthquake ground motion and

penetration resistance with volumetric strain, to estimate the magnitude of ground settlement that may occur at the site. The relationships estimate seismically induced settlements at the ground surface that range from several inches up to 2 to 3 feet during operating and contingency level seismic events, depending on the thickness and depth of liquefiable soils.

9.8 Site Drainage

Groundwater was generally encountered within the upper 1 to 4 feet of borings advanced within intertidal areas and between about 8 and 23 feet bgs (8.6 to 12.7 feet MLLW) in upland areas. Groundwater will likely be encountered while excavating cut slopes in the USACE Alternative and may be encountered in other excavations such as for utilities and other structures. Where water is expected to be encountered in cut slopes, additional drainage features such as springhead and/or trench drains may need to be incorporated into the design to minimize the effects of erosion or rilling. The design should also incorporate drainage provisions that will prevent surface water from flowing down cut slopes during periods of high rain or snow melting, during and after construction. Access road, parking areas, and other travelled ways should be sloped or crowned at a minimum 2 percent grade to encourage drainage of surface water off of the surface and into drainage ditches or other means of conveyance to remove the water off the site.

9.9 Environmental Considerations

Environmental field screening and limited sampling was conducted as part of this preliminary geotechnical study to evaluate potential soil contamination. DRO, at a concentration above ADEC Method Two cleanup levels, was detected in Boring B-07 within the USACE Alternative. The adjacent, former DOD tank farm is also a listed ADEC contaminated site due to known soil and groundwater contamination by various substances; however we understand that the respective contaminant plumes are not thought to extend into the proposed navigational project area. Nonetheless, it appears that contaminated soils may be encountered locally during construction, particularly at the USACE Alternative. Soil that is impacted with regulated compounds as a result of the site's use may be subject to state and/or federal regulations. Segregation and/or remedial action to remove contaminants from the proposed improvement areas may be required to comply with the Resource Conservation and Recovery Act (RCRA), and other state and federal regulations. We recommend contacting the ADEC to evaluate the impacts that potentially contaminated soils may have on site development. At a minimum, the work at the site will likely require agency coordination prior to soil-disturbing activities to ensure that site activities account for the known contamination and that an approved work plan is in place to handle hazardous materials that may be generated during construction of the project.

9.10 Additional Considerations

A significant exploration and laboratory testing effort was conducted to develop the preliminary geotechnical recommendations included in this report. Based on our preliminary evaluation, it appears that seismic conditions and overall stability of submarine slopes adjacent to the project will have a significant impact on the design of the project. Once a preferred location is selected, we recommend developing seismic performance criteria for the new harbor. The criteria will establish the level of acceptable damage to the facility given various seismic events. Once the performance criteria and site layout are established, the existing information can be reviewed and additional required information and/or analyses identified. Additional work that may be required could include deeper or more explorations to further evaluate slope stability and/or foundation properties of soils for pile foundations, or to explore dredging areas outside of the limits of this study. A site specific response spectrum may need to be developed for structural design and/or to facilitate more detailed liquefaction or slope stability analyses. Dynamic slope stability modeling may be required depending on the performance criteria established for the new harbor. We are prepared to assist you in developing the performance criteria and further evaluation that may be needed for this project as the design progresses.

10.0 CLOSURE/LIMITATIONS

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


If, during construction, subsurface conditions different from those encountered in these explorations are observed or appear to be present, Shannon & Wilson, Inc. should be advised at once so that these conditions can be reviewed and recommendations can be reconsidered 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 and recommendations 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. This information should be used in preliminary design and feasibility studies only and once a preferred site is selected, additional explorations should be conducted to characterize the subsurface conditions for final design. Shannon & Wilson has prepared the attachments in Appendix D *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.

SHANNON & WILSON, INC.


Ryan Collins, C.P.G.
Senior Geologist

RDC:KLB



Kyle Brennan, P.E.
Vice President

11.0 REFERENCES

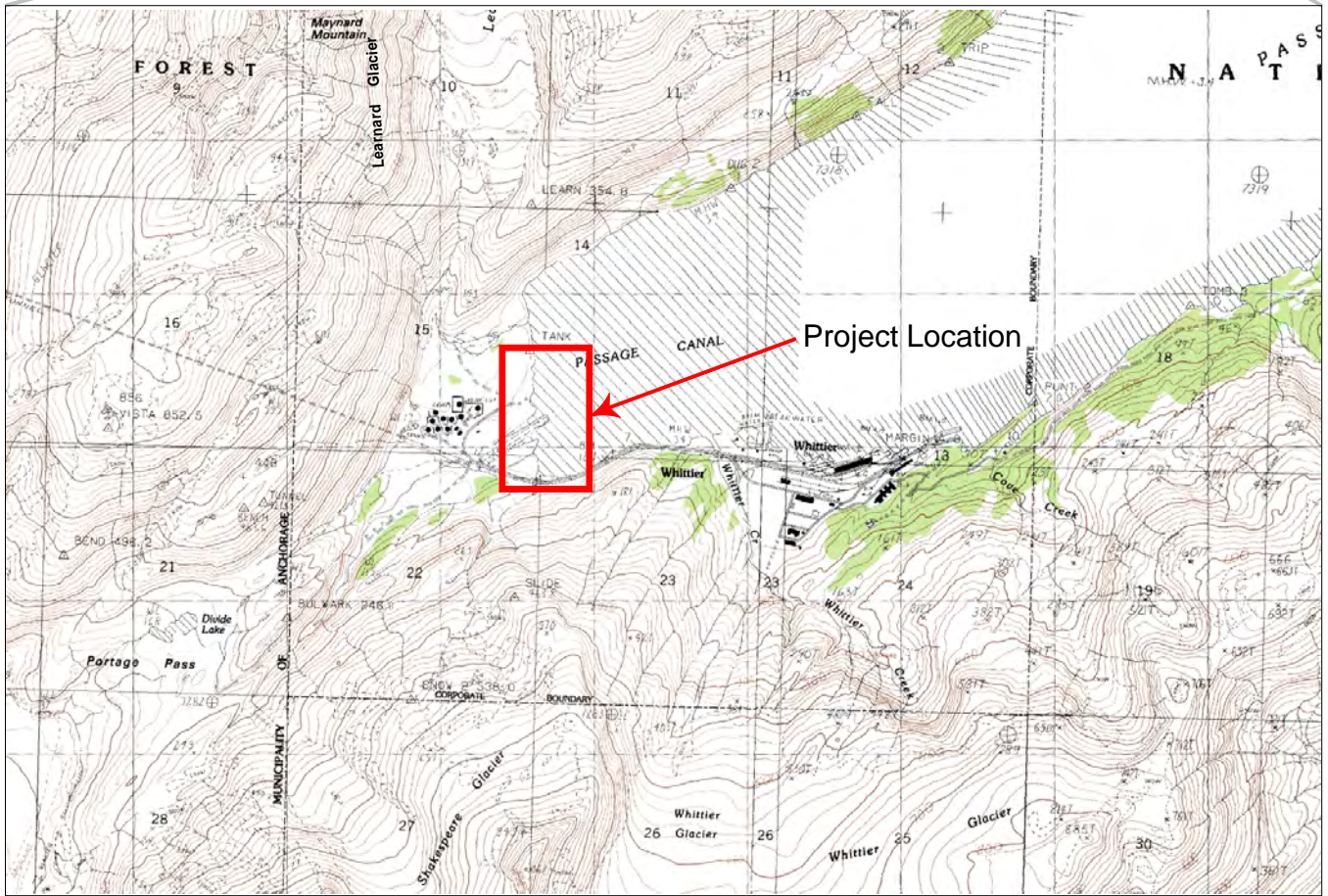
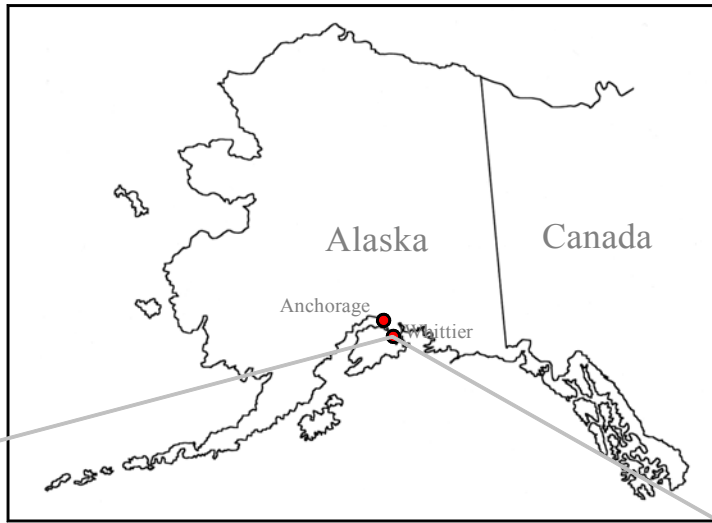
- Alaska Earthquake Information Center (AEIC). No Date. <http://www.aeic.alaska.edu>
- Barnes, F.E., 1943, Geology of the Portage Pass Area, Alaska. U.S. Geological Survey Bulletin 926-D. p 211-265.
- Boulanger, R. W. and Idriss, I. M., 2006, Liquefaction susceptibility criteria for silts and clays: Journal of Geotechnical and Geoenvironmental Engineering, v. 132, no. 11, p. 1413-1426.
- Cetin, K. O.; Seed, R. B.; Der Kiureghian, Armen; and others, 2004, Standard penetration test-based probabilistic and deterministic assessment of seismic soil liquefaction potential: Journal of Geotechnical and Geoenvironmental Engineering, v. 130, no. 12, p. 1314-1340.
- Idriss, I. M. and Boulanger, R. W., 2006, Semi-empirical procedures for evaluating liquefaction potential during earthquakes: Soil Dynamics and Earthquake Engineering, v. 26, no. 2-4, p. 115-130.
- Idriss, I. M. and Boulanger, R. W., 2007, Residual shear strength of liquefied soils, in Modernization and optimization of existing dams and reservoirs, 27th Annual USSD Conference, Philadelphia, Penn., 2007, Proceedings: Denver, Colo., U. S. Society on Dams, p. 621-634.
- Kachadoorian, R., 1965, Effects of the Earthquake of March 27, 1964 at Whittier, Alaska. U.S. Geological Survey Professional Paper 542-B.
- Nicolisky, D.J., Suleimani, E.N., Combellick, R.A., Hanson, R.A., 2011, Tsunami Inundation Maps of Whittier and Western Passage Canal, Alaska: Alaska Division of Geological and Geophysical Surveys Report of Investigations RI 2011-7.
- Olson, S. M. and Stark, T. D., 2002, Liquefied strength ratio from liquefaction flow failure case histories: Canadian Geotechnical Journal, v. 39, no. 3, p. 629-647.
- Olson, S. M. and Stark, T. D., 2003, Yield strength ratio and liquefaction analysis of slopes and embankments: Journal of Geotechnical and Geoenvironmental Engineering, v. 129, no. 8, p. 727-737.
- Plafker, G., Kachadoorian, R., Eckel, E.B., and Mayo, L.R., 1969, Effects of the Earthquake of March 27, 1964 on Various Communities. U.S. Geological Survey Professional Paper 542-G.
- Plafker, G., Nokleberg, W.J., Wilson, F.H., 1994, Geology of south-central Alaska, in Plafker, G., and Berg H.C., eds., The Geology of Alaska. Boulder, Colorado, Geological Society of America, the Geology of North America v. G-1, p. 311-388.
- Ports Committee of the Technical Council on Lifeline Earthquake Engineering, American Society of Civil Engineers, 1998, Seismic Guidelines for Ports. Reston, VA. American Society of Civil Engineers.

- Seed, R. B. and Harder, L. F., 1990, SPT-based analysis of cyclic pore pressure generation and undrained residual strength, in Duncan, J. M., ed., H. Bolton Seed, memorial symposium proceedings, May 1990: Vancouver, Canada, BiTech Publishers, Inc., v. 2, p. 351-376.
- Youd, T. L.; Idriss, I. M.; Andrus, R. D.; and others, 2001, Liquefaction resistance of soils: summary report from the 1996 NCEER and 1998 NCEER/NSF workshops on evaluation of liquefaction resistance of soils: Journal of Geotechnical and Geoenvironmental Engineering, v. 127, no. 10, p. 817-833.

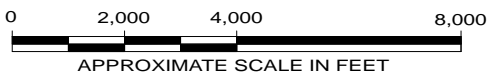
TABLE 1 - SUMMARY OF SOIL ANALYTICAL RESULTS

		Sample Source, ID Number [^] , and Collection Depth in Feet (See Appendix A, Figure 2, and Appendix B)																	
		Soil Borings														Trip Blanks			
Parameter Tested	Method*	Cleanup Level (mg/kg)**	Boring B-01 B01-S1 0-2	Boring B-02 B02-S7 25-26.5	Boring B-04 B04-S2 5-6.5	Boring B-05 B05S3 13.5-15.5	Boring B-06 B06-S2 6.1-7.6	Boring B-07 B07-S3 10-11.5	Boring B-07 B07-S7 30-31.5	Boring B-07 B07-S21~ 30-31.5	Boring B-10 B10-S4 9-10.5	Boring B-11 B11-S1 0.5-1.0	Boring B-14 B14-S1 0-2	Boring B-15 B15S1 0.5-1.0	Boring B-15 B15S21~ 0.5-1.0	Boring B-17 B17-S4 15.5-17.0	TB 10/29/13 -	TB 11/4/2013 -	TB 11/9/2013 -
PID Headspace Reading - ppm	580B PID	-	0.0	0.6	0.3	10	1.5	231	5.3	5.3	64	0.3	3.4	4.5	4.5	19	-	-	-
Percent Solids	SM20 2540G	-	92.4	92.6	94.1	93.1	87.3	90.3	90.7	88.8	87.5	91.8	83.9	91.3	88.9	79.4	100	100	100
Gasoline Range Organics (GRO) - mg/kg	AK 101	260	<1.43	<1.15	<1.06	<2.13 B	<1.45	16.1 J+	0.744 J	0.739 J	0.897 J	<1.11	<1.56	<2.08 B	<2.44 B	<1.98	<1.48	<1.54	1.58 J
Diesel Range Organics (DRO) - mg/kg	AK 102	230	<13.3	<13.3	19.5 J	<10.6	<14.2	4.530	8.74 J	10.4 J	66.9	7.54 J	<13.7	<10.8	<11.1	<15.3	-	-	-
Residual Range Organics (RRO) - mg/kg	AK 103	9,700	<13.3	<13.3	58.3	<10.6	<14.2	<136	<13.6	<13.8	<14.0	25.3	<13.7	<10.8	<11.1	<15.3	-	-	-
Aromatic Volatile Organics (BTEX)																			
Benzene - mg/kg	EPA 8021B	0.022	<0.00762	<0.00614	<0.00566	<0.00530	<0.00772	<0.00704	<0.00640	<0.00622	<0.00686	<0.00594	<0.00830	<0.00520	<0.00610	<0.0106	<0.00788	<0.00820	<0.00620
Toluene - mg/kg	EPA 8021B	6.7	<0.0149	<0.0120	<0.0110	<0.0107	<0.0150	<0.0220 B	<0.0125	<0.0121	<0.0134	<0.0116	<0.0162	0.190	0.190	<0.0206	<0.0154	0.0113 J	0.00866 J
Ethylbenzene - mg/kg	EPA 8021B	0.13	<0.0149	<0.0120	<0.0110	<0.0107	<0.0150	0.0302	<0.0125	<0.0121	<0.0134	<0.0116	<0.0162	0.00750 J	<0.0122	<0.0206	<0.0154	<0.0160	<0.0124
Xylenes (total) - mg/kg	EPA 8021B	1.5	<0.0435	<0.0350	<0.0322	<0.0320	<0.0440	0.241	<0.0365	<0.0355	0.00793 J	<0.0338	<0.0472	<0.0652 B	<0.0366	<0.0599	<0.0450	<0.0468	0.00965 J
Polynuclear Aromatic Hydrocarbons (PAHs)																			
1-Methylnaphthalene - mg/kg	EPA 8270D SIM	0.41	-	-	-	<0.00264	<0.00336	<0.0664 J-	-	-	0.00936	-	<0.00358	<0.00271	<0.00277	<0.00378	-	-	-
2-Methylnaphthalene - mg/kg	EPA 8270D SIM	1.3	-	-	-	<0.00264	<0.00336	<0.0664 J-	-	-	0.0169	-	<0.00358	<0.00271	<0.00277	<0.00378	-	-	-
Benzo(a)Anthracene - mg/kg	EPA 8270D SIM	0.28	-	-	-	<0.00264	<0.00336	0.0115	-	-	<0.00342	-	<0.00358	<0.00271	<0.00277	<0.00378	-	-	-
Benzo[a]pyrene - mg/kg	EPA 8270D SIM	0.17	-	-	-	<0.00267	<0.00336	0.00556	-	-	<0.00342	-	<0.00358	<0.00271	<0.00275	<0.00378	-	-	-
Benzo[g,h,i]perylene - mg/kg	EPA 8270D SIM	1,900	-	-	-	<0.00264	<0.00336	0.00249	-	-	<0.00342	-	<0.00358	<0.00271	<0.00277	<0.00378	-	-	-
Chrysene - mg/kg	EPA 8270D SIM	82	-	-	-	<0.00264	<0.00336	0.0135	-	-	<0.00342	-	<0.00358	<0.00271	<0.00277	<0.00378	-	-	-
Phenanthrene - mg/kg	EPA 8270D SIM	39	-	-	-	<0.00264	<0.00336	<0.0664 J-	-	-	0.00600	-	<0.00358	<0.00271	<0.00277	<0.00378	-	-	-
All other PAHs	EPA 8270D SIM	Various	-	-	-	ND	ND	ND	-	-	ND	-	ND	ND	ND	ND	-	-	-
RCRA Metals																			
Arsenic - mg/kg	SW 6020	0.20	-	-	-	20.4	10.6	-	12.6	-	20.5	-	10.1	9.12	8.52	7.68	-	-	-
Barium - mg/kg	SW 6020	2,100	-	-	-	40.4	24.7	-	39.9	-	37.7	-	30.1	23.0	23.3	32.4	-	-	-
Cadmium - mg/kg	SW 6020	9.1	-	-	-	0.133 J	<0.118	-	0.0646 J	-	0.0781 J	-	<0.137	<0.110	<0.108	<0.145	-	-	-
Chromium - mg/kg	SW 6020	100,000	-	-	-	48.7	42.0	-	56.7	-	49.3	-	40.8	33.2	32.6	47.2	-	-	-
Lead - mg/kg	SW 6020	400	-	-	-	14.8	8.97	-	12.1	-	11.4	-	10.0	9.79	11.1	6.82	-	-	-
Mercury - mg/kg	SW 6020	0.36	-	-	-	0.0513	0.0324 J	-	0.0473	-	0.0587	-	0.0213 J	0.0245 J	0.0251 J	0.0242 J	-	-	-
Selenium - mg/L	SW 6020	6.9	-	-	-	<0.248	<0.286	-	<0.310	-	<0.312	-	<0.332	<0.274	<0.270	<0.350	-	-	-
Silver - mg/kg	SW 6020	11	-	-	-	0.0651 J	0.0754 J	-	0.0696 J	-	0.0541 J	-	0.0440 J	0.0438 J	0.0472 J	<0.0726	-	-	-

KEY	DESCRIPTION
*	See Appendix B for compounds tested, methods, and laboratory reporting limits
**	Soil cleanup level is the most stringent standard listed in Table B1 or B2, 18 AAC 75 (November 2016), for the "over 40 inches (precipitation) zone"
^	Sample ID No. preceded by "2348" on the chain of custody form
<1.43	Analyte not detected; laboratory reporting limit of 1.43 mg/kg
20.4	= Analyte concentration exceeds applicable cleanup criterion
ppm	Parts per million
ND	Non-detect
RCRA	Resource Conservation and Recovery Act
-	Not applicable or sample not tested for this analyte
mg/kg	Milligrams per kilogram
B	Analyte concentration potentially affected by method and/or trip blank contamination. See the Laboratory Data Review Checklists for more details.
J	Result is an estimate less than the laboratory limit of quantitation
J+	Result is an estimated value that may be considered biased high due to surrogate recoveries. See the Laboratory Data Review Checklists for more details.
J-	Result is an estimated value that may be considered biased low due to surrogate recoveries. See the Laboratory Data Review Checklists for more details.
~	Duplicate of preceding sample



Map adapted from All Topo Maps, USGS Seward D-5 SW and D-5 SE 25K Quadrangle



Navigational Improvements Study
Head of Passage Canal, Whittier, Alaska

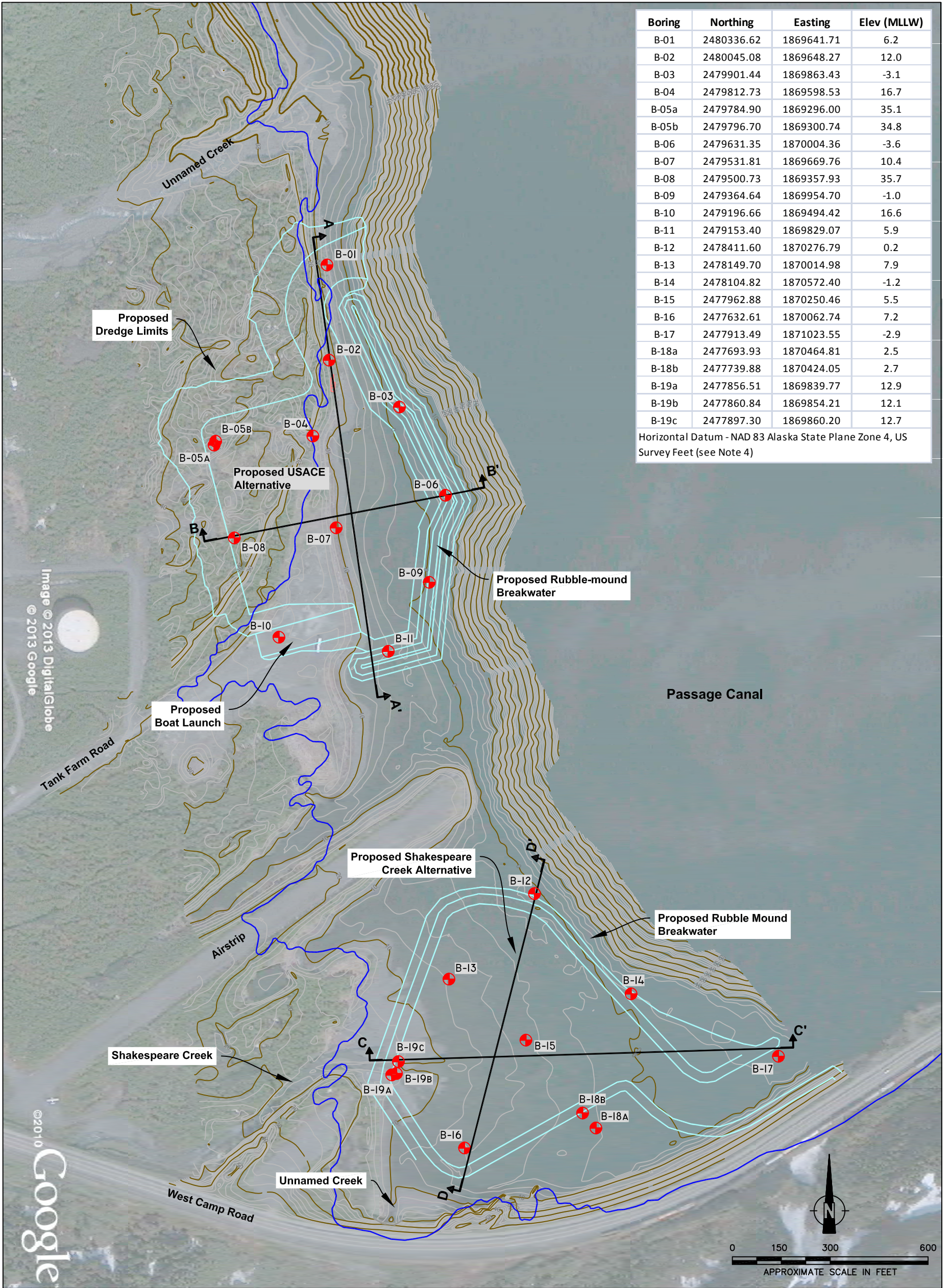
VICINITY MAP

August 2017

32-1-02348-001

SW SHANNON & WILSON, INC.
Geotechnical & Environmental Consultants

FIG. 1



LEGEND

- B-01 Approximate Location of Boring B-01, Advanced by Shannon & Wilson, October/November 2013
- A-A' Generalized Subsurface Profile A-A' (See Figures 5 through 8)
- Topographic Contours (Feet MLLW). 2-foot Interval.
- Approximate Extents of Observed Maximum Inundation from 1964 tsunami (digitized from Plate 1, Kachadoorian 1965)

NOTES

1. Proposed alternative outlines were adapted from conceptual sketches provided by the City of Whittier and USACE.
2. Topography/bathymetry based on 2008 survey by PND Engineers, Inc for the *Head of Passage Canal Parking Lot and Vault Restroom* project. Provided by City of Whittier.
3. Basemap imagery provided by Google Earth Pro, reproduced by permission granted by Google Earth™ Mapping Service.
4. Boring locations were surveyed by Del Norte Surveying, Inc. October/November 2013.

Navigational Improvements Study
Head of Passage Canal, Whittier, Alaska

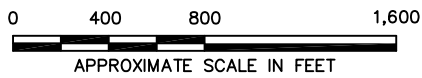
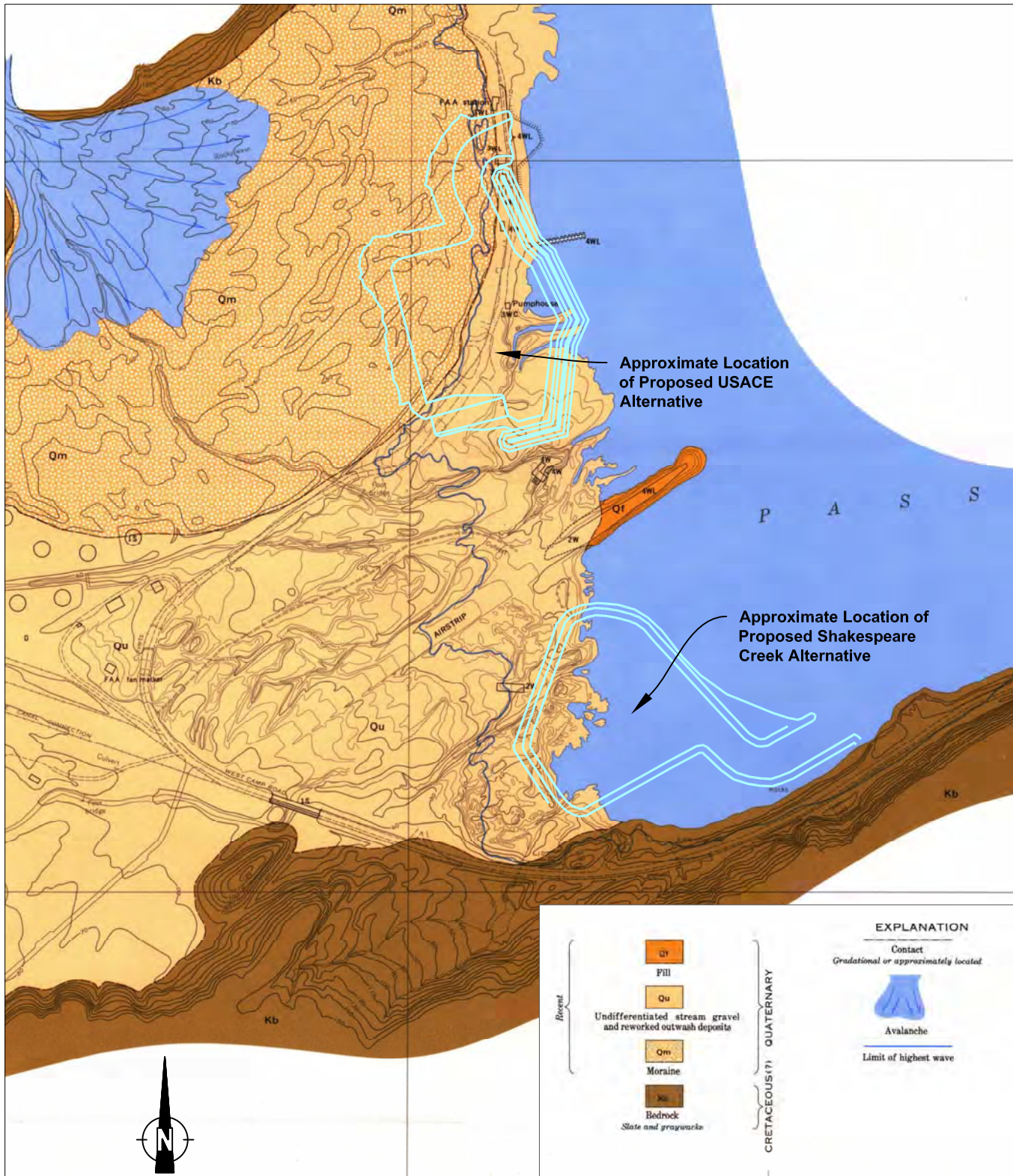
SITE PLAN

August 2017

32-1-02348-001

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. 2



NOTES

1. Map adapted from Plate 1, Effects of the Earthquake of March, 27, 1964 at Whittier, Alaska, Kachadoorian, R., 1965

Navigational Improvements Study
Head of Passage Canal, Whittier, Alaska

GENERALIZED GEOLOGIC MAP

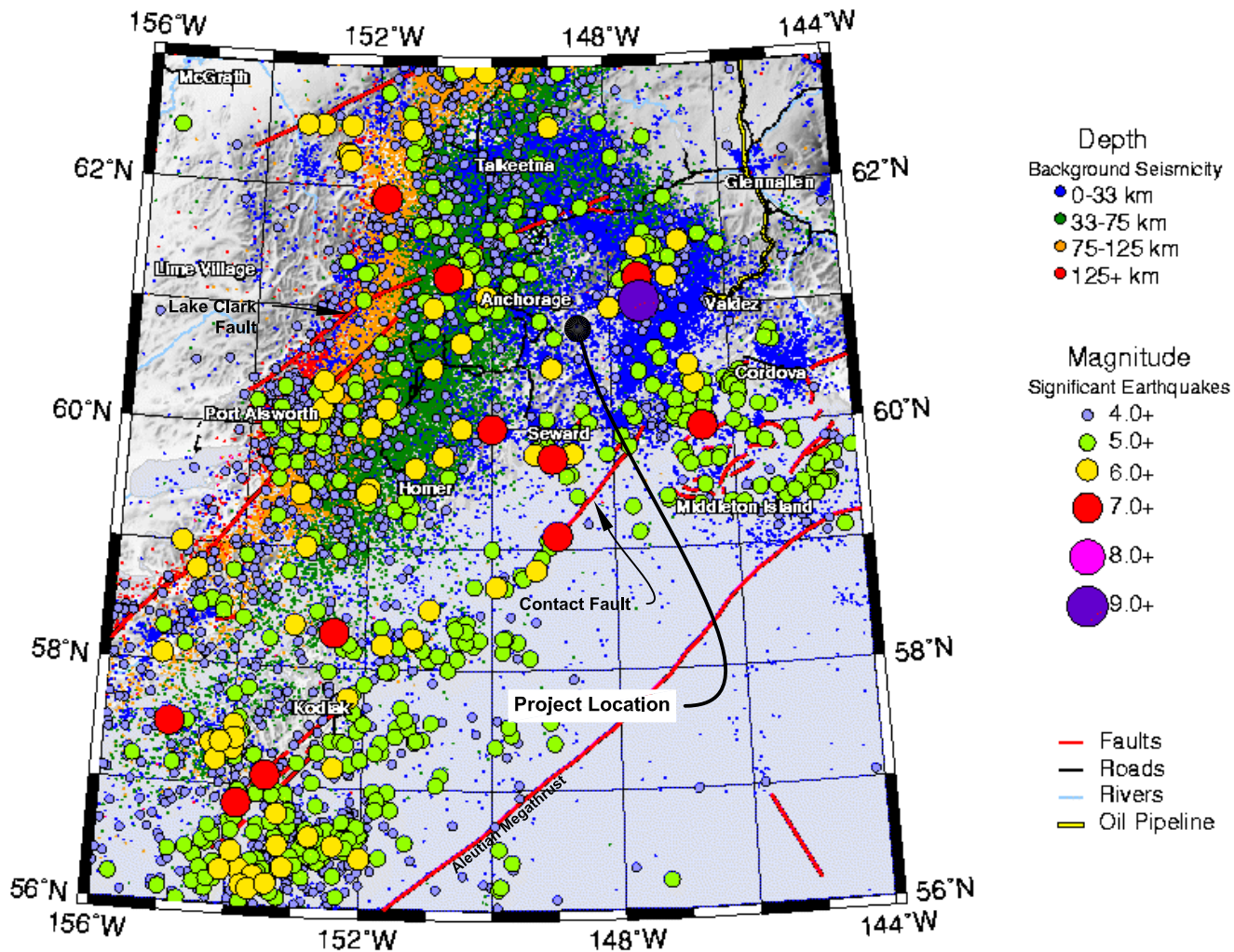
August 2017

32-1-02348-001

South Central Alaska Seismicity

1899 to December 2004

(Adapted from Alaska Earthquake Information Center)



Navigational Improvements Study
Head of Passage Canal, Whittier, Alaska

HISTORICAL SEISMICITY

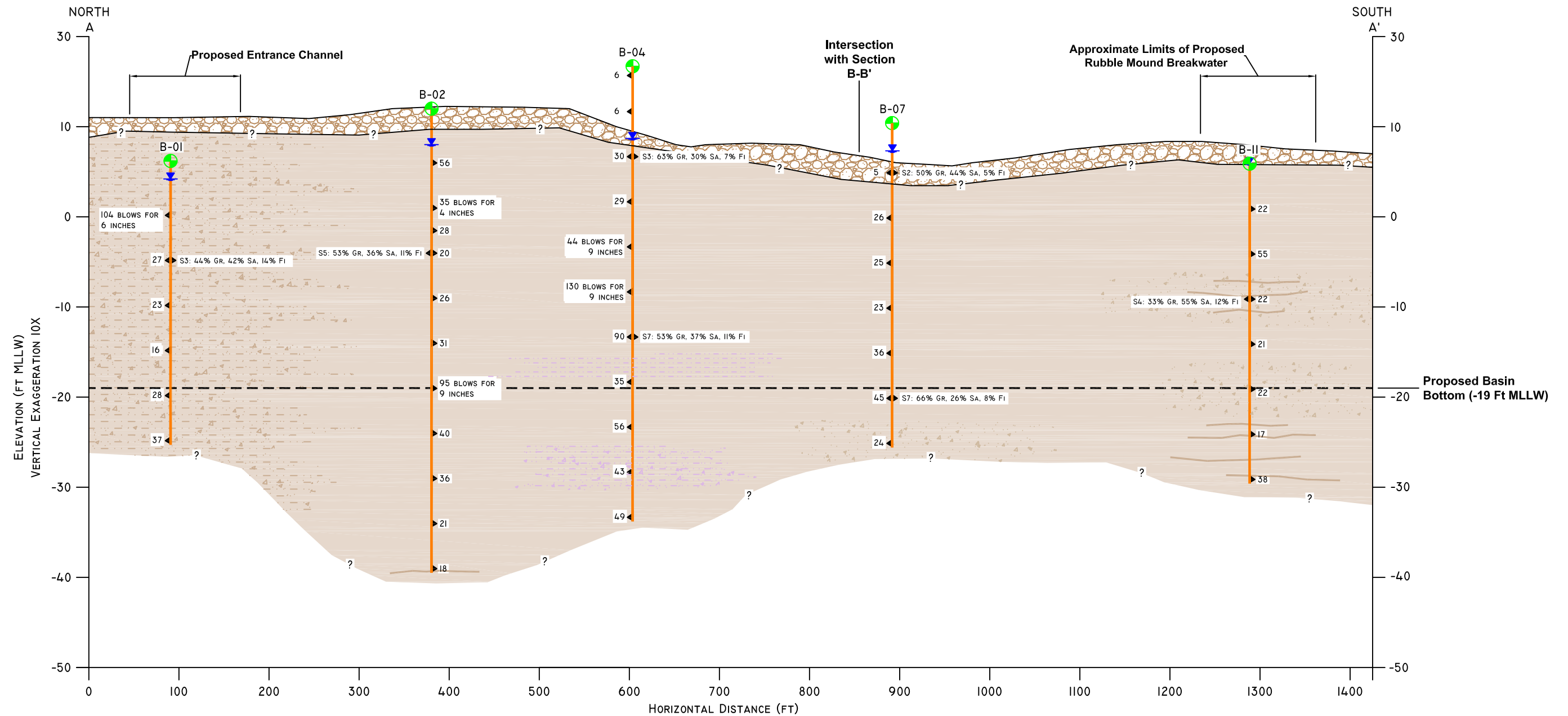
August 2017

32-1-02348-001



SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. 4

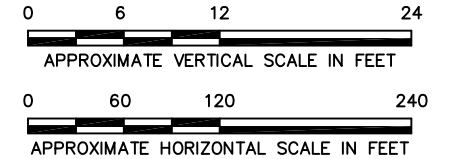


LEGEND

- B-01 Approximate Location of Boring B-01, Advanced by Shannon & Wilson, October/November 2013.
- S3: 44% GR, 42% SA, 14% FI Sample S3 laboratory testing results indicating 44 percent gravel, 42 percent sand, and 14 percent fines (silt and clay) by weight.
- 23 SPT Values (blows per foot at approximate sample depth, SH indicates sampling by Shelby Tube).
- Approximate water level as estimated during drilling.
- GRAVEL Surface soils typically containing variable amounts of Sand and < 5% Silt
- GRAVEL Soils containing variable amounts of Sand and > 12% Fines
- GRAVEL Soils containing variable amounts of Sand and < 12% Fines
- SAND Soils containing variable amounts of Gravel and <12% Fines
- SAND Soils containing variable amounts of Gravel and >12% Fines
- SILTY SAND Soils containing >12% Silt and < 12% Gravel
- Indicates interbedded texture as inferred by observations of recovered samples. Lines do not depict thickness or length of layers.

NOTES

1. Profile taken along the A - A' line as shown on the Site Plan, Figure 2.
2. Stratigraphy interpreted from observations made during drilling (see Appendix A for graphical logs).
3. Soil contacts on profile between boring locations are interpreted from our understanding of local conditions and should be considered approximate.
4. Borings shown above may not lie exactly on profile line shown on Figure 2. Subsurface conditions in some areas may be projected from borings near the profile line.
5. Proposed site configuration adapted from conceptual drawings provided by the City of Whittier.
6. Ground surface profile based topographic contours provided by PND Engineers (from Fall 2008 survey for *Head of Passage Canal Parking Lot and Vault Restroom*).



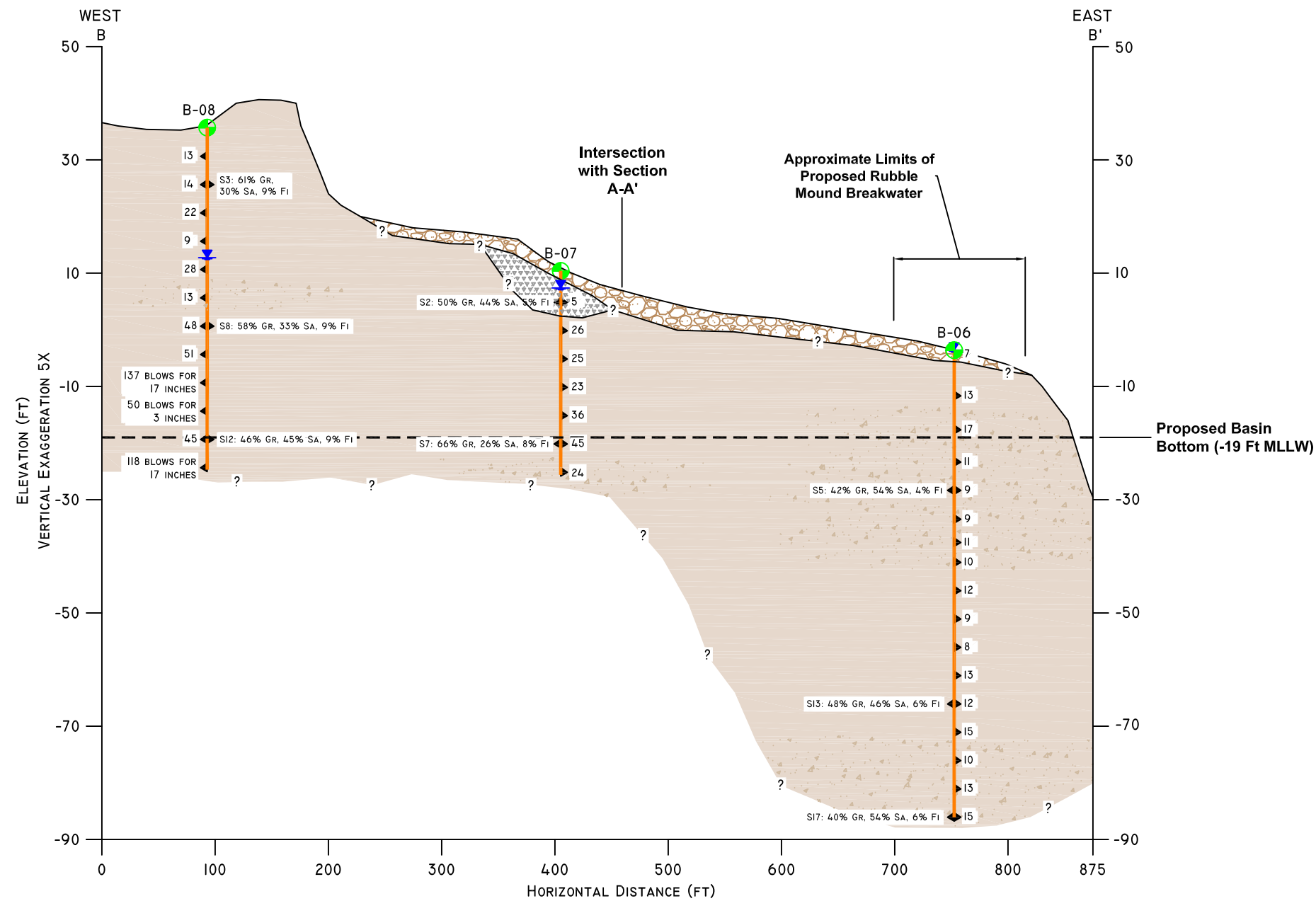
Navigational Improvements Study
Head of Passage Canal, Whittier, Alaska

SUBSURFACE PROFILE A-A'

August 2017 32-1-02348-001

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. 5

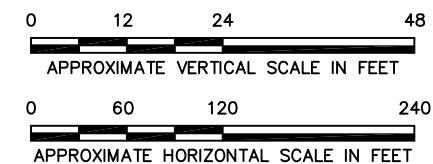


LEGEND

- B-08 Approximate Location of Boring B-08, Advanced by Shannon & Wilson, October/November 2013.
- S3: 61% GR, 30% SA, 9% FI Sample S3 laboratory testing results indicating 61 percent gravel, 30 percent sand, and 9 percent fines (silt and clay) by weight.
- 24 MPT/SPT Values (blows per foot at approximate sample depth).
- Approximate water level as estimated during drilling.
- GRAVEL Surface soils typically containing variable amounts of Sand and < 5% Fines
- GRAVEL Soils containing variable amounts of Sand and < 12% Fines
- SAND Soils containing variable amounts of Gravel and < 12% Fines
- FILL Gravelly soils containing variable amounts of Sand, Fines, and Organics.

NOTES

1. Profile taken along the B - B' line as shown on the Site Plan, Figure 2.
2. Stratigraphy interpreted from observations made during drilling (see Appendix A for graphical logs).
3. Soil contacts on profile between boring locations are interpreted from our understanding of local conditions and should be considered approximate.
4. Borings shown above may not lie exactly on profile line shown on Figure 2. Subsurface conditions in some areas may be projected from borings near the profile line.
5. Proposed site configuration adapted from conceptual drawings provided by the City of Whittier.
6. Ground surface profile based topographic contours provided by PND Engineers (from Fall 2008 survey for Head of Passage Canal Parking Lot and Vault Restroom).



Navigational Improvements Study
Head of Passage Canal, Whittier, Alaska

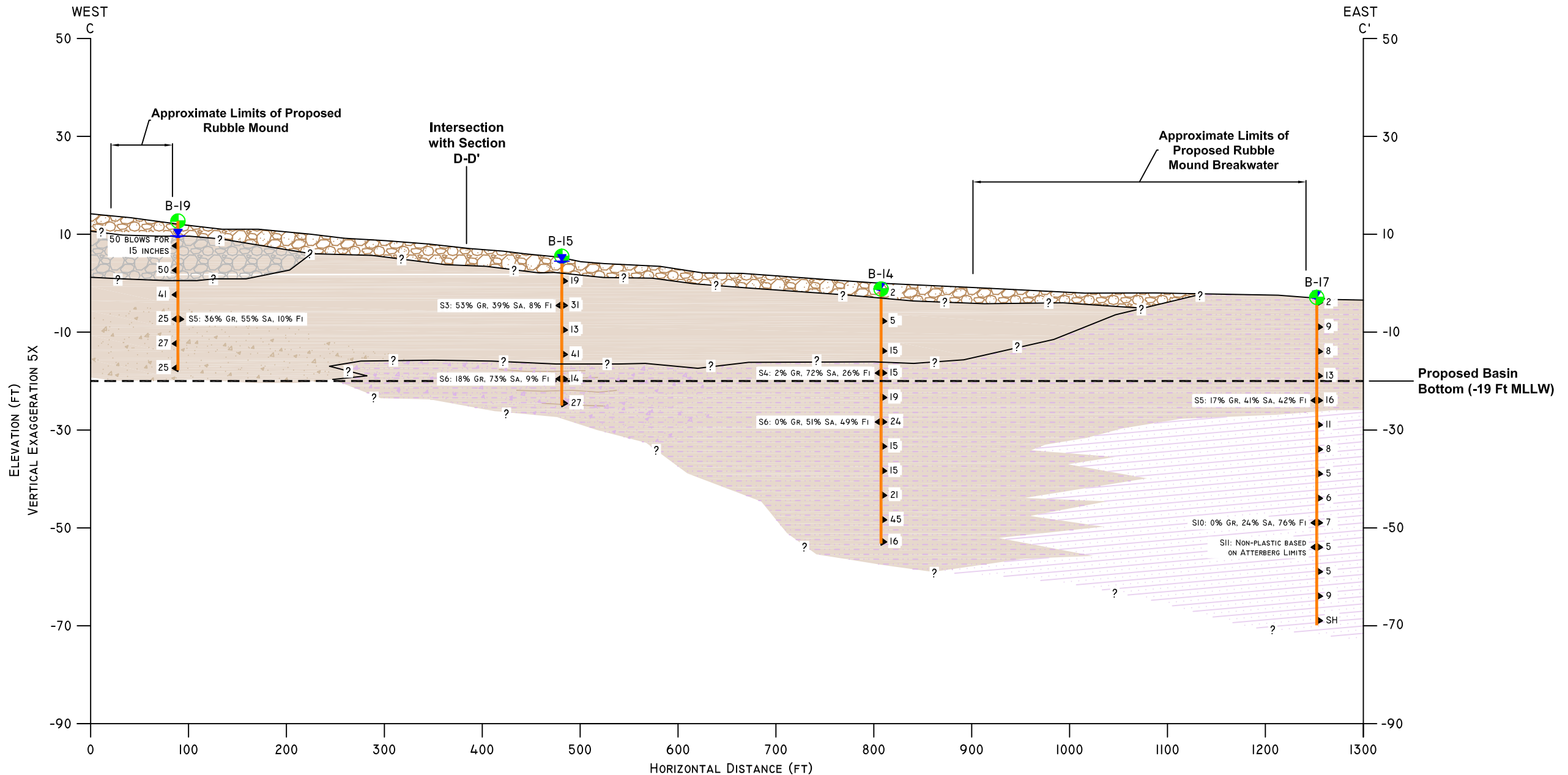
SUBSURFACE PROFILE B-B'

August 2017

32-1-02348-001



FIG. 6

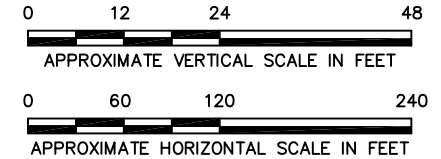


LEGEND

- B-19 Approximate Location of Boring B-19, Advanced by Shannon & Wilson, October/November 2013.
- S3: 53% GR, 39% SA, 8% FI Sample S3 laboratory testing results indicating 53 percent gravel, 39 percent sand, and 8 percent fines (silt and clay) by weight.
- ▶ 24 MPT/SPT Values (blows per foot at approximate sample depth, SH indicates sampling by Shelby Tube).
- Approximate water level as estimated during drilling.
- GRAVEL Surface soils typically containing variable amounts of Sand and < 5% Fines
- MOSTLY COBBLES AND BOULDERS
- GRAVEL Soils containing variable amounts of Sand and < 12% Fines
- SAND Soils containing variable amounts of Gravel and <12% Fines
- SAND Soils containing variable amounts of Gravel and >12% Fines
- SILTY SAND Soils containing >12% Fines and < 12% Gravel
- SILT Soils containing various amounts of Sand

NOTES

1. Profile taken along the C - C' line as shown on the Site Plan, Figure 2.
2. Stratigraphy interpreted from observations made during drilling (see Appendix A for graphical logs).
3. Soil contacts on profile between boring locations are interpreted from our understanding of local conditions and should be considered approximate.
4. Borings shown above may not lie exactly on profile line as shown on Figure 2. Subsurface conditions in some areas may be projected from borings near the profile line.
5. Proposed site configuration adapted from conceptual drawings provided by the City of Whittier.
6. Ground surface profile based topographic contours provided by PND Engineers (from Fall 2008 survey for *Head of Passage Canal Parking Lot and Vault Restroom*).



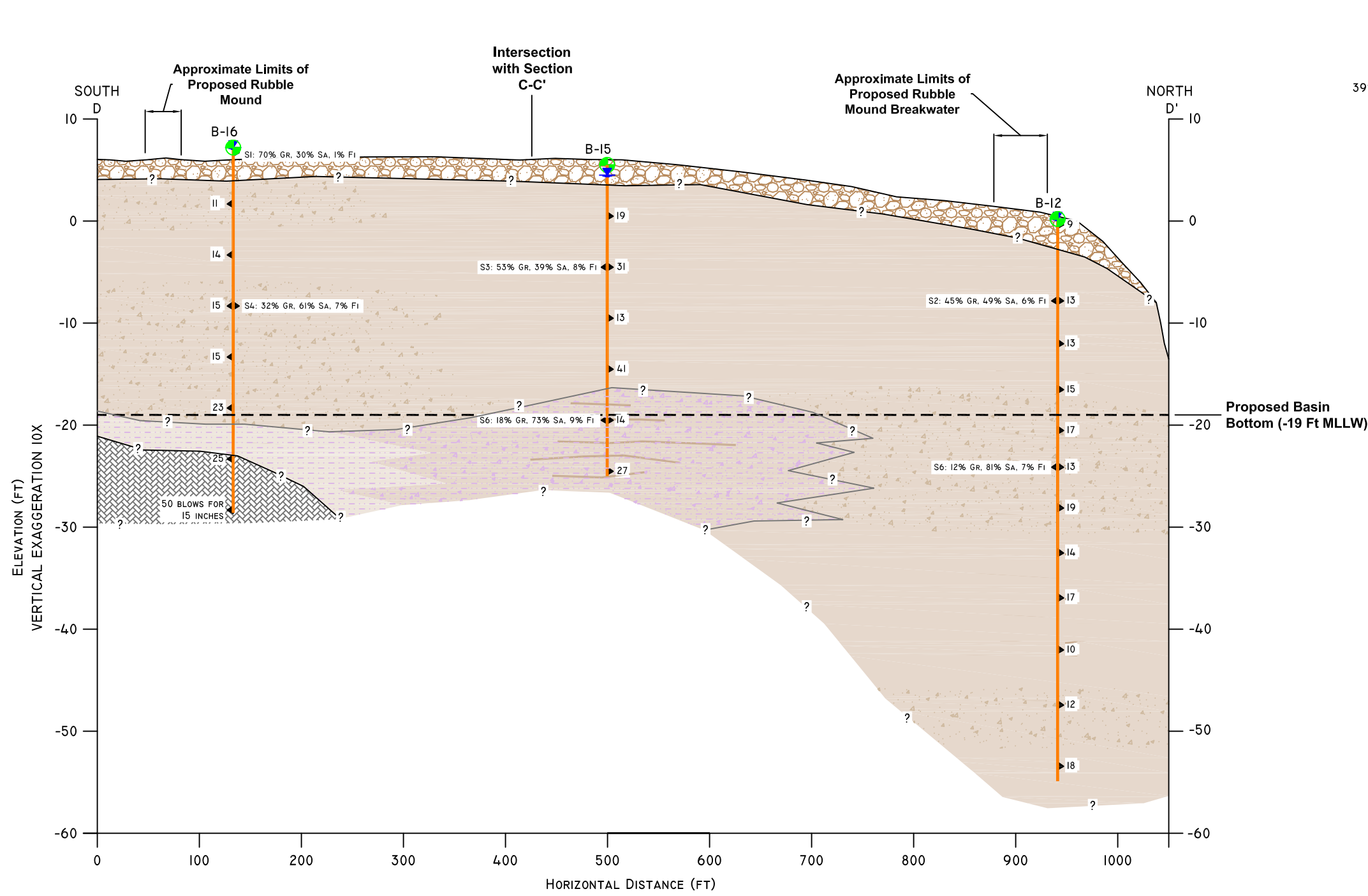
Navigational Improvements Study
Head of Passage Canal, Whittier, Alaska

SUBSURFACE PROFILE C-C'

August 2017 32-1-02348-001

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

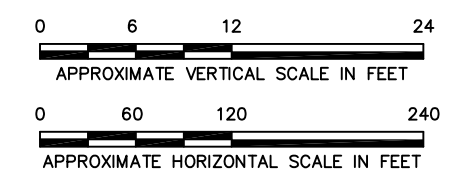
FIG. 7



LEGEND

- B-16 Approximate Location of Boring B-16, Advanced by Shannon & Wilson, October/November 2013.
- S3: 53% GR, 39% SA, 8% FI Sample S3 laboratory testing results indicating 53 percent gravel, 39 percent sand, and 8 percent fines (silt and clay) by weight.
- 24 MPT/SPT Values (blows per foot at approximate sample depth).
- Approximate water level as estimated during drilling.
- GRAVEL Surface soils typically containing variable amounts of Sand and < 5% Fines
- GRAVEL Soils containing variable amounts of Sand and < 12% Fines
- SAND Soils containing variable amounts of Gravel and <12% Fines
- SAND Soils containing variable amounts of Gravel and >12% Fines
- SILTY SAND Soils containing >12% Fines and < 12% Gravel
- BEDROCK Highly weathered Slate

- ### NOTES
- Profile taken along the D - D' line as shown on the Site Plan, Figure 2.
 - Stratigraphy interpreted from observations made during drilling (see Appendix A for graphical logs).
 - Soil contacts on profile between boring locations are interpreted from our understanding of local conditions and should be considered approximate.
 - Borings shown above may not lie exactly on profile line shown on Figure 2. Subsurface conditions in some areas may be projected from borings near the profile line.
 - Proposed site configuration adapted from conceptual drawings provided by the City of Whittier.
 - Ground surface profile based topographic contours provided by PND Engineers (from Fall 2008 survey for Head of Passage Canal Parking Lot and Vault Restroom).



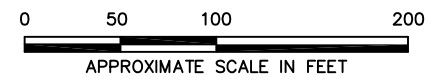
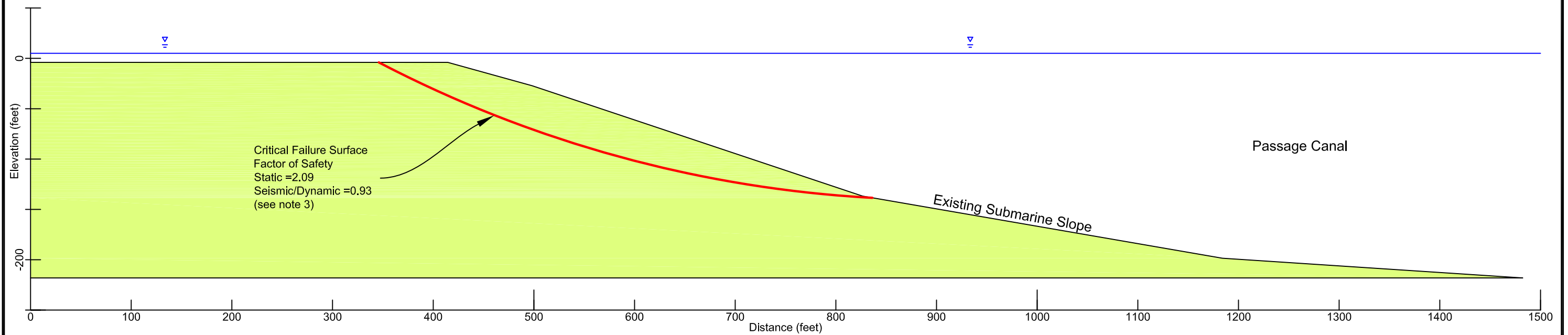
Navigation Improvements Study
Head of Passage Canal, Whittier, Alaska

SUBSURFACE PROFILE D-D'

August 2017 32-1-02348-001

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. 8



LEGEND

- Breakwater Above Waterline: Friction Angle = 40°, Unit Weight = 135 pcf
- Breakwater Below Waterline: Friction Angle = 38°, Unit Weight = 130 pcf
- Native Sands and Gravels: Friction Angle = 31°, Unit Weight = 120 pcf
- Piezometric Surface: 5 feet above MLLW

NOTES

1. Elevations are relative to Mean Lower Low Water level (MLLW)
2. Water level modeled at 5 feet above MLLW
3. Pseudo-static seismic event based on operating level event as discussed in Section 8.1 of the report text. Modeled horizontal acceleration = 0.15g
4. Bathymetry based on *Tsunami Inundation Maps of Whittier and Western Passage Canal, Alaska* report by the Alaska Division of Geological & Geophysical Surveys (RI 2011-7).

Navigational Improvements Study
Whittier, Alaska

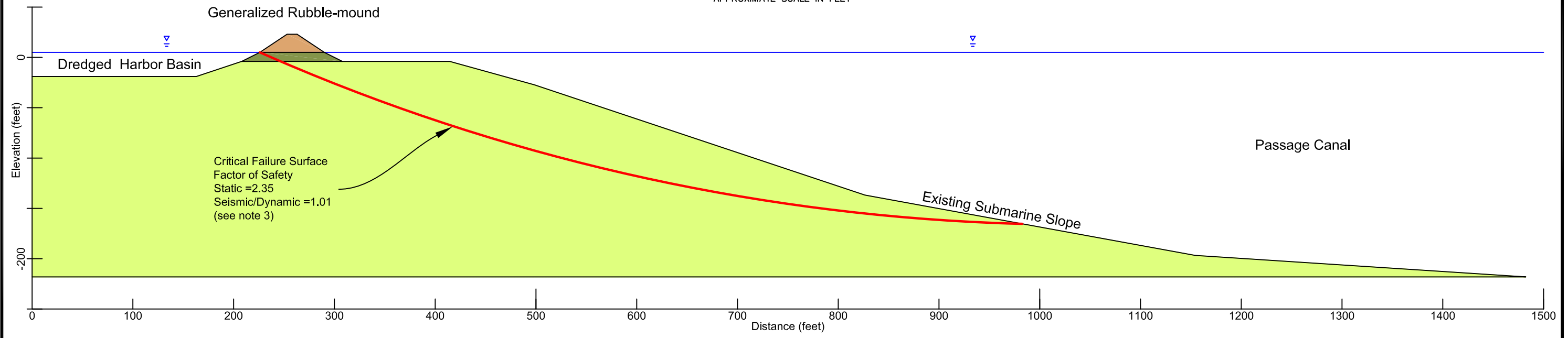
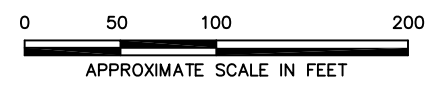
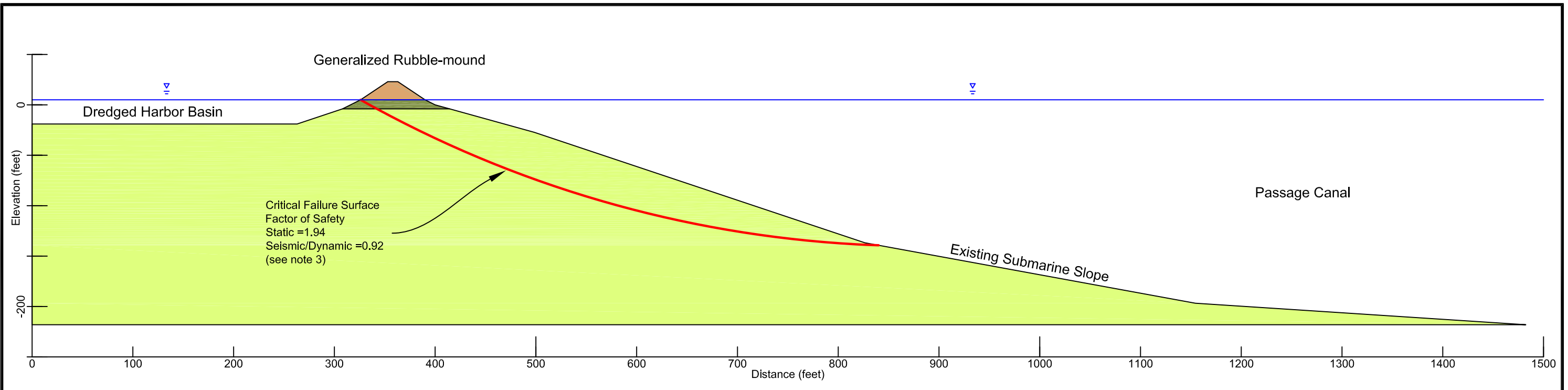
**GENERALIZED SLOPE
STABILITY ANALYSIS**

August 2017

32-1-02348-001



FIG. 9
Sheet 1 of 2



LEGEND

- Breakwater Above Waterline: Friction Angle = 40°, Unit Weight = 135 pcf
- Breakwater Below Waterline: Friction Angle = 38°, Unit Weight = 130 pcf
- Native Sands and Gravels: Friction Angle = 31°, Unit Weight = 120 pcf
- Piezometric Surface: 5 feet above MLLW

NOTES

1. Elevations are relative to Mean Lower Low Water level (MLLW)
2. Water level modeled at 5 feet above MLLW
3. Pseudo-static seismic event based on operating level event as discussed in Section 8.1 of the report text. Modeled horizontal acceleration = 0.15g
4. Assumed generalized rubble-mound breakwater modeled as described in Section 9.2.
5. Bathymetry based on *Tsunami Inundation Maps of Whittier and Western Passage Canal, Alaska* report by The Alaska Division of Geological & Geophysical Surveys (RI 2011-7). Boat harbor basin depth assumed to be -19 ft MLLW.

Navigational Improvements Study
Head of Passage Canal Whittier, Alaska

**GENERALIZED SLOPE
STABILITY ANALYSIS**

August 2017 32-1-02348-001

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. 9
Sheet 2 of 2

GRADATION AND DURABILITY REQUIREMENTS

After: Alaska Department of Transportation
Standard Specifications for Highway Construction

D-1 Base Course

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

Selected Material Type A

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

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

Selected Material Type B

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

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

Selected Material Type C

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

Coarse Aggregate Durability

Retained on #4 Sieve

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

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

Navigational Improvements Study
Head of Passage Canal, Whittier, Alaska

AGGREGATE GRADATION AND DURABILITY REQUIREMENTS

August 2017

32-1-02348-001

APPENDIX A

**BORING LOGS AND GEOTECHNICAL
LABORATORY TESTING**

FIGURES

A-1	Soil Description and Log Key
A-2 through A-20	Log of Borings B-01 through B-19
A-21	Grain Size Classification
A-22	Atterberg Limits Results

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 Clay³	Sand or Gravel⁴
Modifying (Secondary) Precedes major constituent	30% or more coarse-grained: Sandy or Gravelly⁴	More than 12% fine-grained: Silty or Clayey³
Minor Follows major constituent	15% to 30% coarse-grained: with Sand or with Gravel⁴ 30% or more total coarse-grained and lesser coarse-grained constituent is 15% or more: with Sand or with Gravel⁵	5% to 12% fine-grained: with Silt or with Clay³ 15% or more of a second coarse-grained constituent: with Sand or with Gravel⁵

¹All percentages are by weight of total specimen passing a 3-inch sieve.
²The order of terms is: *Modifying Major with Minor*.
³Determined based on behavior.
⁴Determined based on which constituent comprises a larger percentage.
⁵Whichever 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 Medium Coarse	#200 to #40 (0.075 to 0.4 mm; 0.003 to 0.02 in.) #40 to #10 (0.4 to 2 mm; 0.02 to 0.08 in.) #10 to #4 (2 to 4.75 mm; 0.08 to 0.187 in.)
GRAVEL Fine Coarse	#4 to 3/4 in. (4.75 to 19 mm; 0.187 to 0.75 in.) 3/4 to 3 in. (19 to 76 mm)
COBBLES	3 to 12 in. (76 to 305 mm)
BOULDERS	> 12 in. (305 mm)

RELATIVE DENSITY / CONSISTENCY

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

WELL AND BACKFILL SYMBOLS

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

PERCENTAGES TERMS^{1,2}

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

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

²Reprinted, 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.
















Navigational Improvements Study
Head of Passage Canal, Whittier, Alaska

SOIL DESCRIPTION AND LOG KEY

August 2017

32-1-02348-001

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
	Silts and Clays (liquid limit 50 or more)	Inorganic	OL 	Organic Silt or Clay; Organic Silt or Clay with Sand or Gravel; Sandy or Gravelly Organic Silt or Clay
			MH 	Elastic Silt; Elastic Silt with Sand or Gravel; Sandy or Gravelly Elastic Silt
		Organic	CH 	Fat Clay; Fat Clay with Sand or Gravel; Sandy or Gravelly Fat Clay
			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.

Navigational Improvements Study
 Head of Passage Canal, Whittier, Alaska

**SOIL DESCRIPTION
 AND LOG KEY**

August 2017

32-1-02348-001

 SHANNON & WILSON, INC.
 Geotechnical and Environmental Consultants

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 TERMS¹

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

PLASTICITY²

DESCRIPTION	VISUAL-MANUAL CRITERIA	APPROX. PLASTICITY 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 takes 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 TERMS¹

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.

¹Reprinted, 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.

²Adapted, 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.

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 TERMS¹

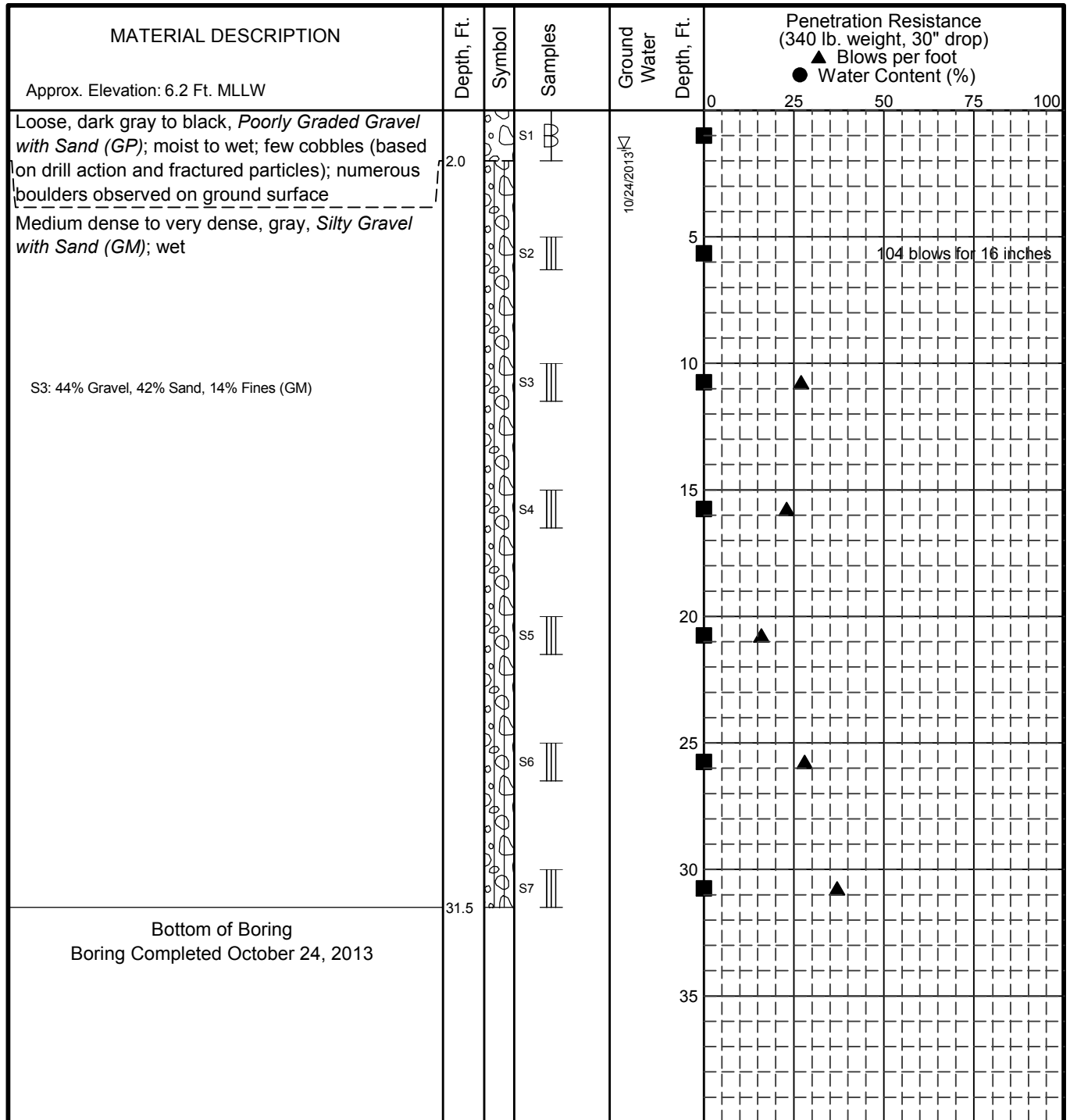
Interbedded	Alternating layers of varying material or color with layers at least 1/4-inch thick; singular: bed.
Laminated	Alternating layers of varying material or color with layers less than 1/4-inch thick; singular: lamination.
Fissured	Breaks along definite planes or fractures with little resistance.
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.

Navigational Improvements Study
Head of Passage Canal, Whittier, Alaska

SOIL DESCRIPTION AND LOG KEY

August 2017

32-1-02348-001



LEGEND

- * Sample Not Recovered
- Grab Sample
- 3" O.D. Split Spoon Sample
- Ground Water Level At Time Of Drilling
- PID Reading (ppm)
- Plastic Limit
- Liquid Limit
- Natural Water Content

NOTES

- The stratification lines represent the approximate boundaries between soil types, and the transition may be gradual.
- The discussion in the text of this report is necessary for a proper understanding of the nature of subsurface materials.
- Water level, if indicated above, is for the date specified and may vary.
- PP (Pocket Penetrometer) tests estimate Unconfined Compressive Strength of Cohesive Soils. TV (Torvane) tests estimate the Undrained Shear Strength of Cohesive Soils. All measurements in tons per square foot.

Navigational Improvements Study
Head of Passage Canal, Whittier, Alaska

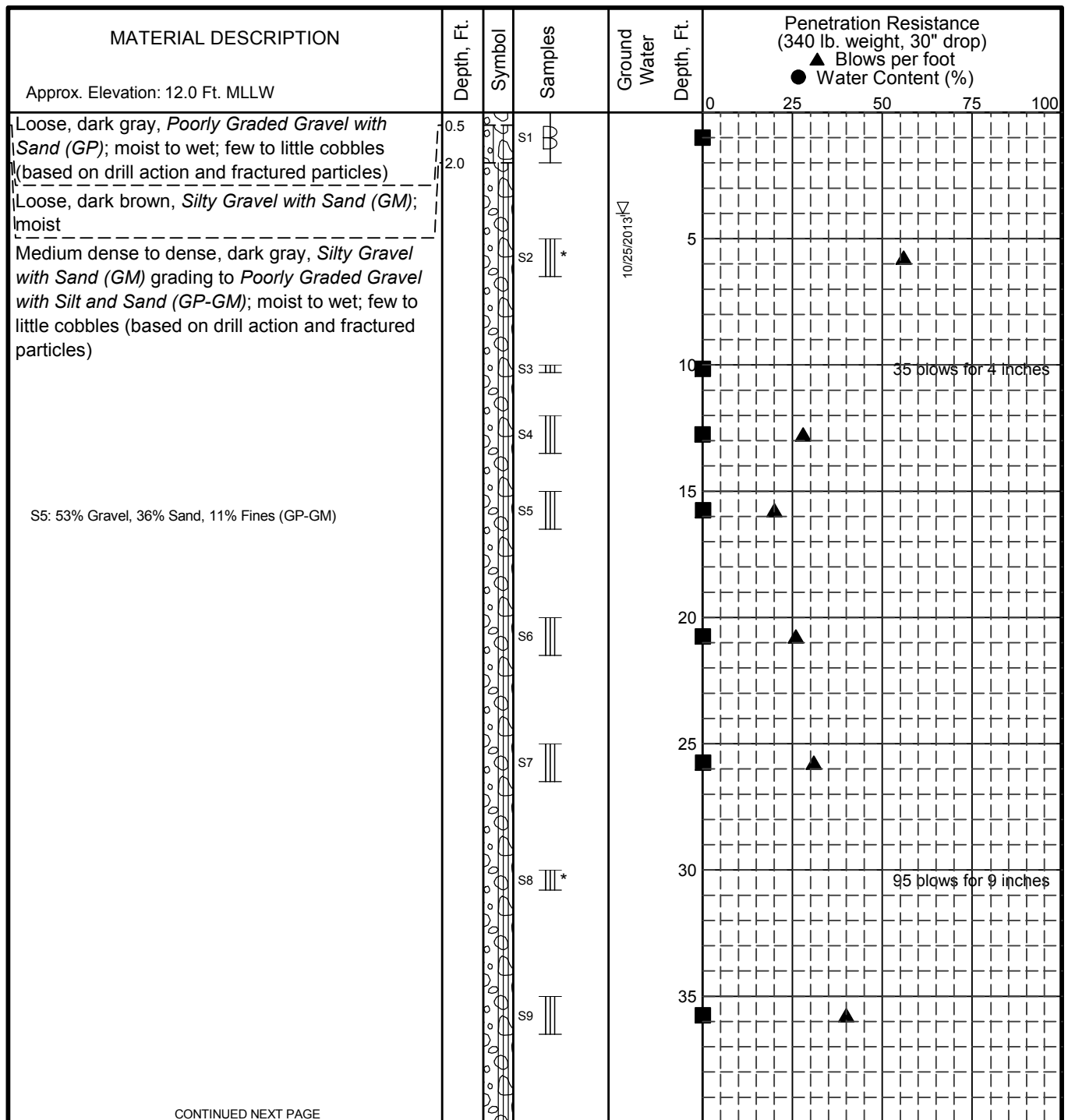
LOG OF BORING B-01

August 2017

32-1-02348-001

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. A-2



CONTINUED NEXT PAGE

LEGEND

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

Ground Water Level At Time Of Drilling

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

NOTES

1. The stratification lines represent the approximate boundaries between soil types, and the transition may be gradual.
2. The discussion in the text of this report is necessary for a proper understanding of the nature of subsurface materials.
3. Water level, if indicated above, is for the date specified and may vary.
4. PP (Pocket Penetrometer) tests estimate Unconfined Compressive Strength of Cohesive Soils. TV (Torvane) tests estimate the Undrained Shear Strength of Cohesive Soils. All measurements in tons per square foot.

Navigational Improvements Study
 Head of Passage Canal, Whittier, Alaska

LOG OF BORING B-02

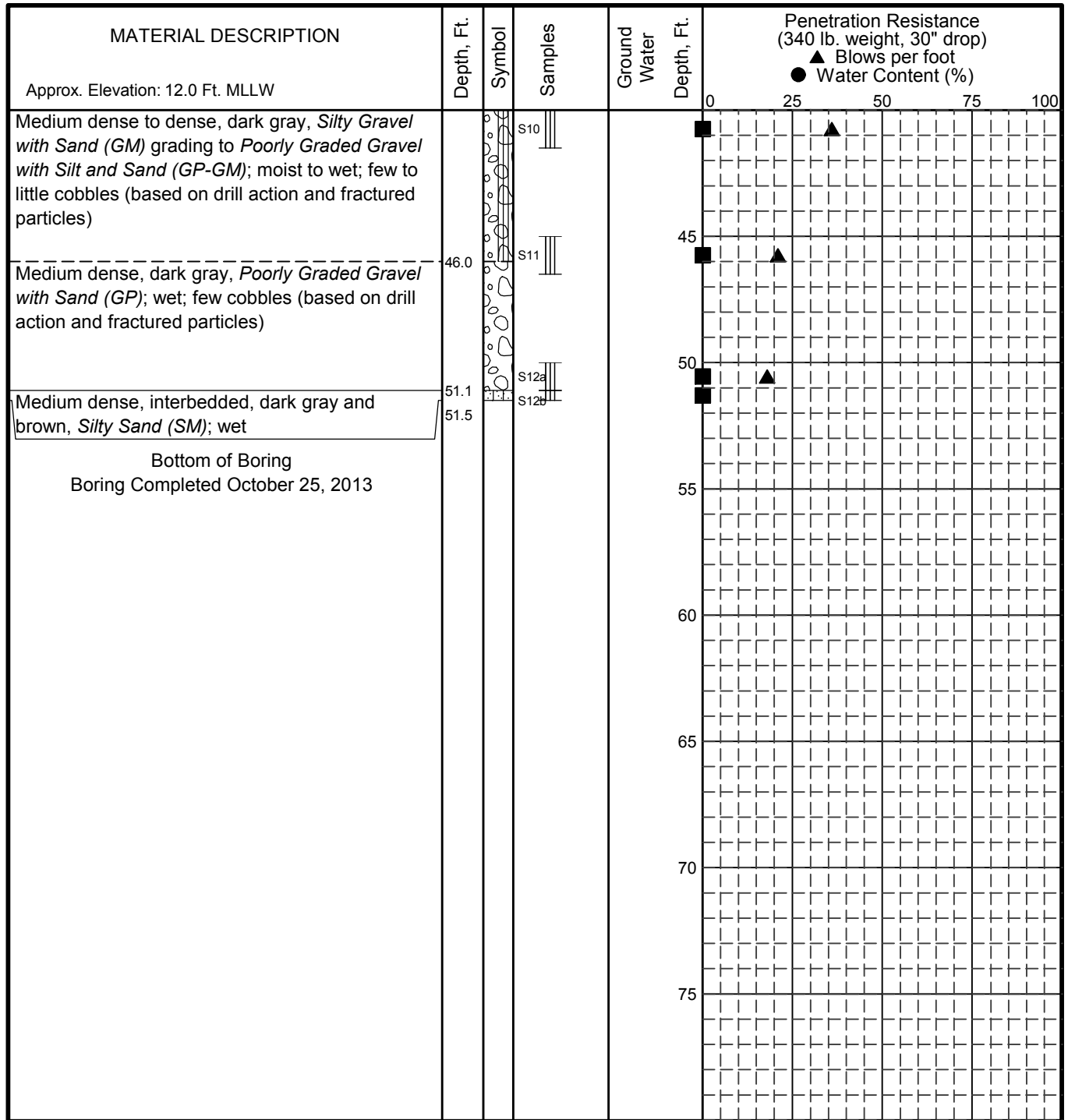
August 2017

32-1-02348-001

SHANNON & WILSON, INC.
 Geotechnical and Environmental Consultants

FIG. A-3
 Sheet 1 of 2

GEOTECHNICAL LOG 02348 LOGS.GPJ S&W GEO1.GDT 8/9/17



LEGEND

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

∇ Ground Water Level At Time Of Drilling

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

NOTES

- The stratification lines represent the approximate boundaries between soil types, and the transition may be gradual.
- The discussion in the text of this report is necessary for a proper understanding of the nature of subsurface materials.
- Water level, if indicated above, is for the date specified and may vary.
- PP (Pocket Penetrometer) tests estimate Unconfined Compressive Strength of Cohesive Soils. TV (Torvane) tests estimate the Undrained Shear Strength of Cohesive Soils. All measurements in tons per square foot.

Navigational Improvements Study
 Head of Passage Canal, Whittier, Alaska

LOG OF BORING B-02

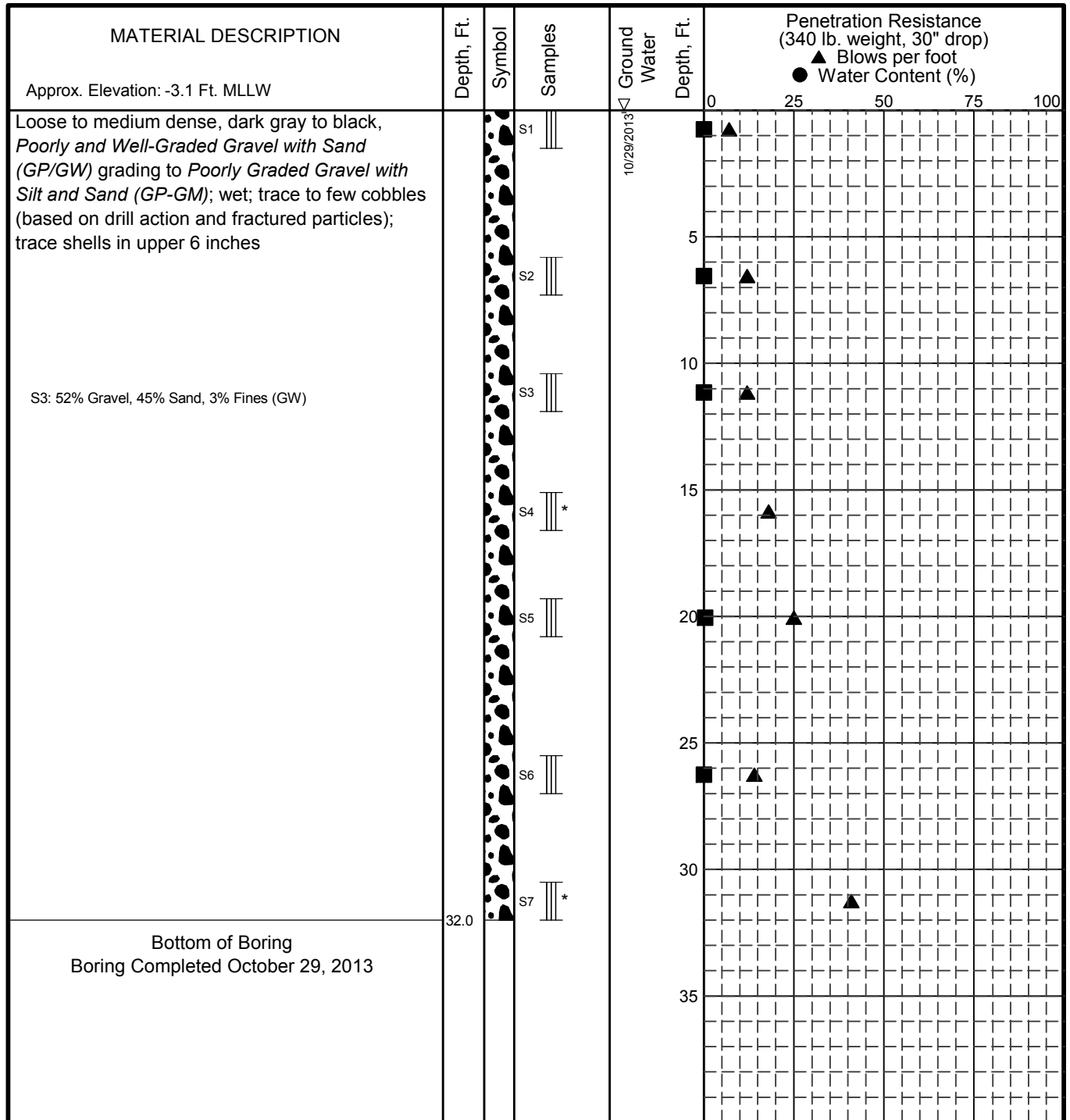
August 2017

32-1-02348-001

SHANNON & WILSON, INC.
 Geotechnical and Environmental Consultants

FIG. A-3
 Sheet 2 of 2

GEO TECHNICAL LOG 02348 LOGS.GPJ S&W GEO1.GDT 8/9/17



LEGEND

- * Sample Not Recovered
- ▭ Grab Sample
- ▧ 3" O.D. Split Spoon Sample
- ▽ Ground Water Level At Time Of Drilling
- PID Reading (ppm)
- Liquid Limit
- Plastic Limit
- Natural Water Content

NOTES

- The stratification lines represent the approximate boundaries between soil types, and the transition may be gradual.
- The discussion in the text of this report is necessary for a proper understanding of the nature of subsurface materials.
- Water level, if indicated above, is for the date specified and may vary.
- PP (Pocket Penetrometer) tests estimate Unconfined Compressive Strength of Cohesive Soils. TV (Torvane) tests estimate the Undrained Shear Strength of Cohesive Soils. All measurements in tons per square foot.

Navigational Improvements Study
Head of Passage Canal, Whittier, Alaska

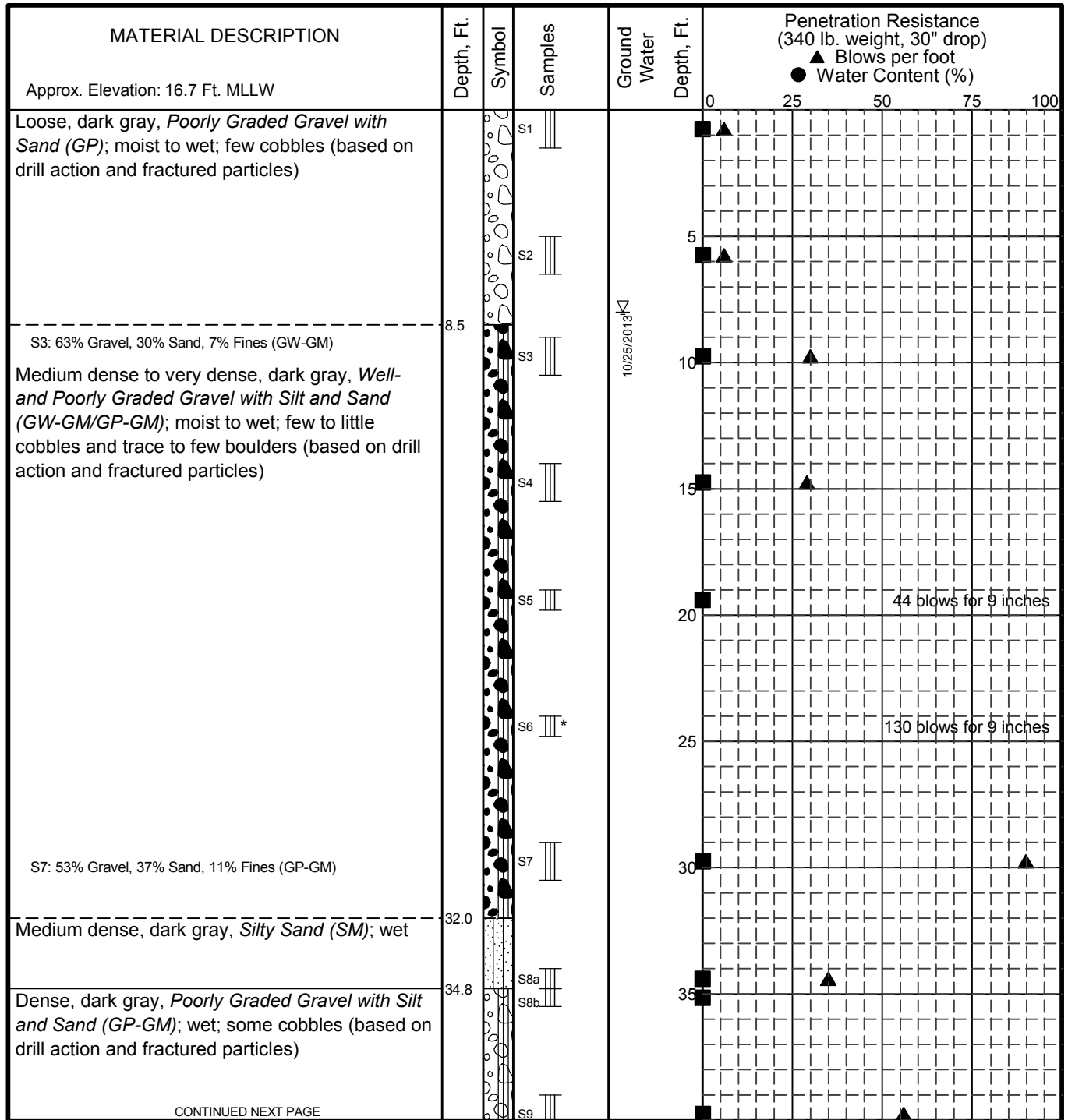
LOG OF BORING B-03

August 2017

32-1-02348-001

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. A-4



CONTINUED NEXT PAGE

LEGEND

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

∇ Ground Water Level At Time Of Drilling

- PID Reading (ppm)
- Plastic Limit
- Liquid Limit
- Natural Water Content

NOTES

- The stratification lines represent the approximate boundaries between soil types, and the transition may be gradual.
- The discussion in the text of this report is necessary for a proper understanding of the nature of subsurface materials.
- Water level, if indicated above, is for the date specified and may vary.
- PP (Pocket Penetrometer) tests estimate Unconfined Compressive Strength of Cohesive Soils. TV (Torvane) tests estimate the Undrained Shear Strength of Cohesive Soils. All measurements in tons per square foot.

Navigational Improvements Study
Head of Passage Canal, Whittier, Alaska

LOG OF BORING B-04

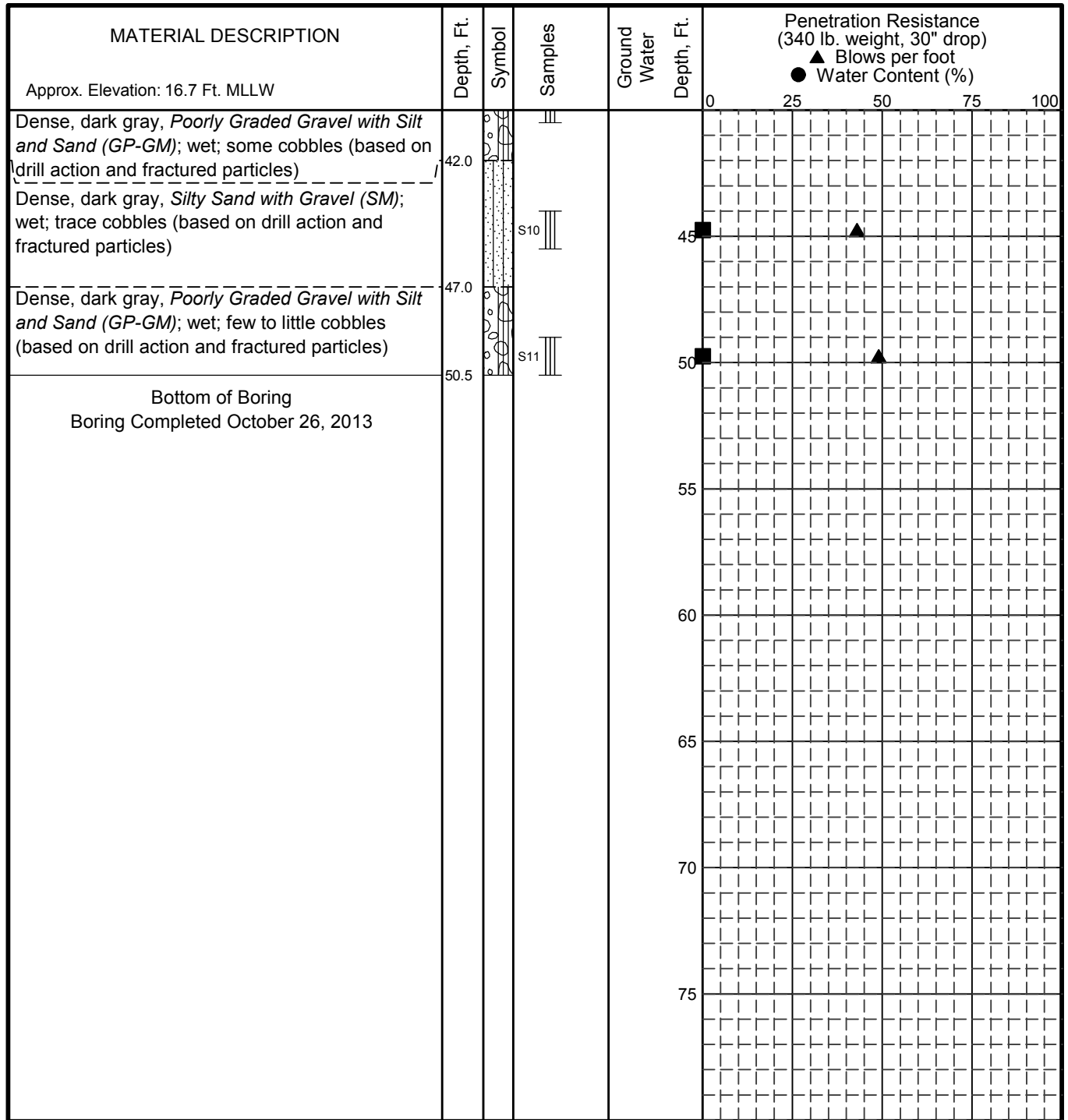
August 2017

32-1-02348-001

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. A-5
Sheet 1 of 2

GEOTECHNICAL LOG 02348 LOGS.GPJ S&W GEO1.GDT 8/9/17



LEGEND

- * Sample Not Recovered ∇ Ground Water Level At Time Of Drilling ■ PID Reading (ppm)
- Grab Sample Plastic Limit —●— Liquid Limit
- 3" O.D. Split Spoon Sample 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.
4. PP (Pocket Penetrometer) tests estimate Unconfined Compressive Strength of Cohesive Soils. TV (Torvane) tests estimate the Undrained Shear Strength of Cohesive Soils. All measurements in tons per square foot.

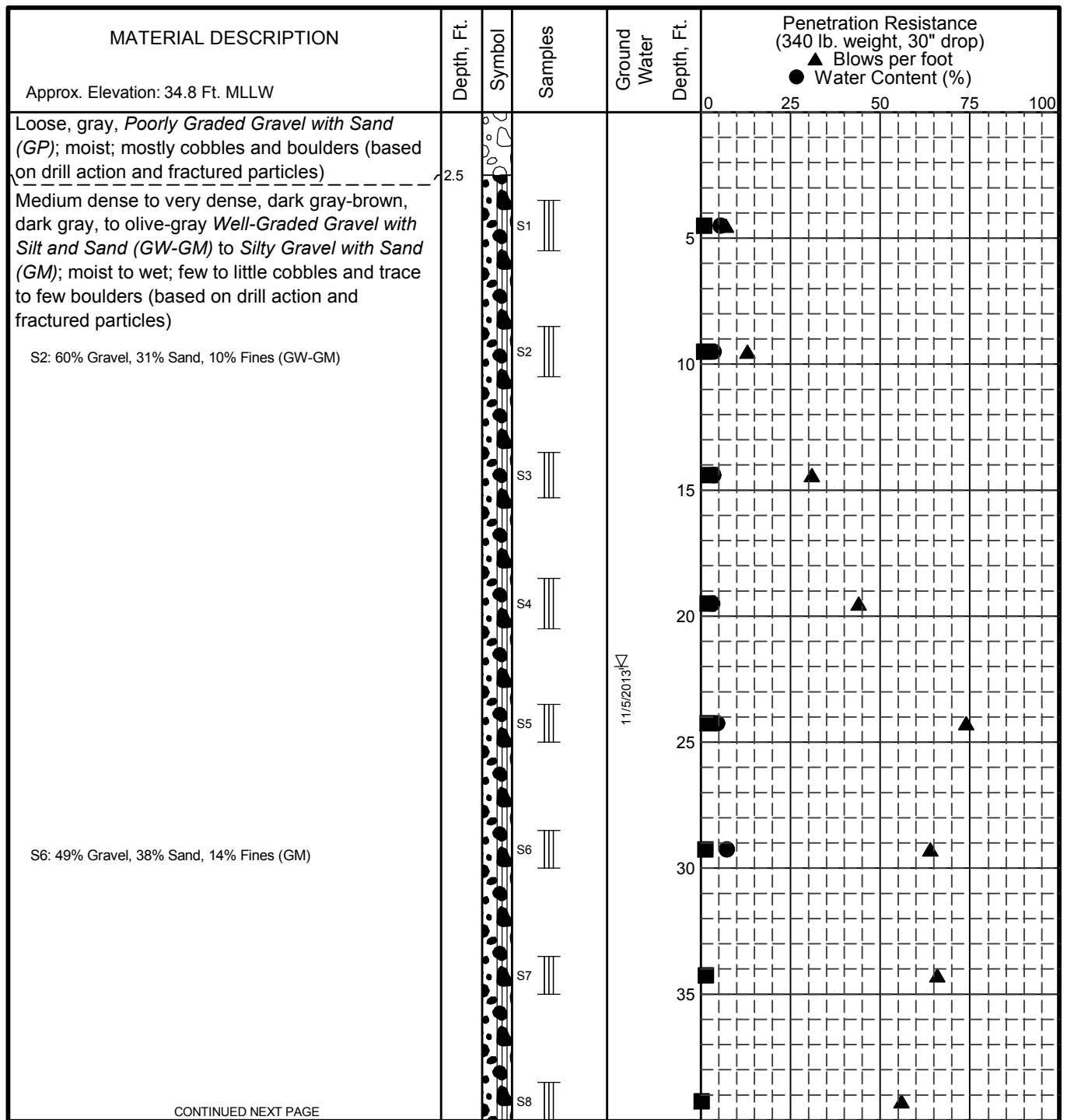
Navigational Improvements Study
Head of Passage Canal, Whittier, Alaska

LOG OF BORING B-04

August 2017

32-1-02348-001

GEOTECHNICAL LOG 02348 LOGS.GPJ S&W GEO1.GDT 8/9/17



CONTINUED NEXT PAGE

LEGEND

- * Sample Not Recovered ▽ Ground Water Level At Time Of Drilling
- ▤ Grab Sample
- ▤ 3" O.D. Split Spoon Sample
- PID Reading (ppm)
- Plastic Limit —●— Liquid Limit
- Natural Water Content

NOTES

1. The stratification lines represent the approximate boundaries between soil types, and the transition may be gradual.
2. The discussion in the text of this report is necessary for a proper understanding of the nature of subsurface materials.
3. Water level, if indicated above, is for the date specified and may vary.
4. PP (Pocket Penetrometer) tests estimate Unconfined Compressive Strength of Cohesive Soils. TV (Torvane) tests estimate the Undrained Shear Strength of Cohesive Soils. All measurements in tons per square foot.

Navigational Improvements Study
Head of Passage Canal, Whittier, Alaska

LOG OF BORING B-05

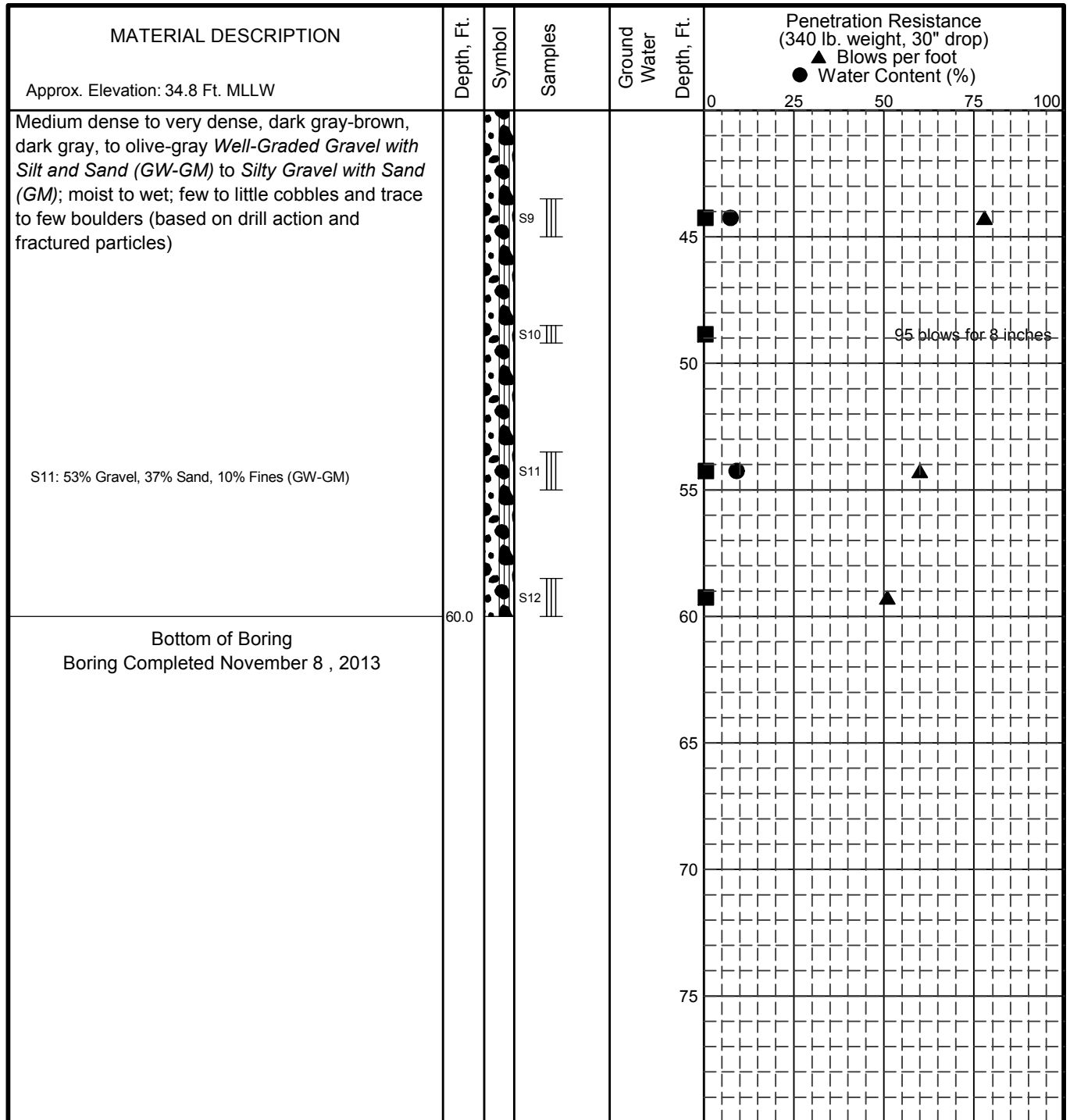
August 2017

32-1-02348-001

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. A-6
Sheet 1 of 2

GEOTECHNICAL LOG 02348 LOGS.GPJ S&W GEO1.GDT 8/9/17



LEGEND

- * Sample Not Recovered ∇ Ground Water Level At Time Of Drilling ■ PID Reading (ppm)
- ▤ Grab Sample Plastic Limit —●— Liquid Limit
- ▤ 3" O.D. Split Spoon Sample Natural Water Content

NOTES

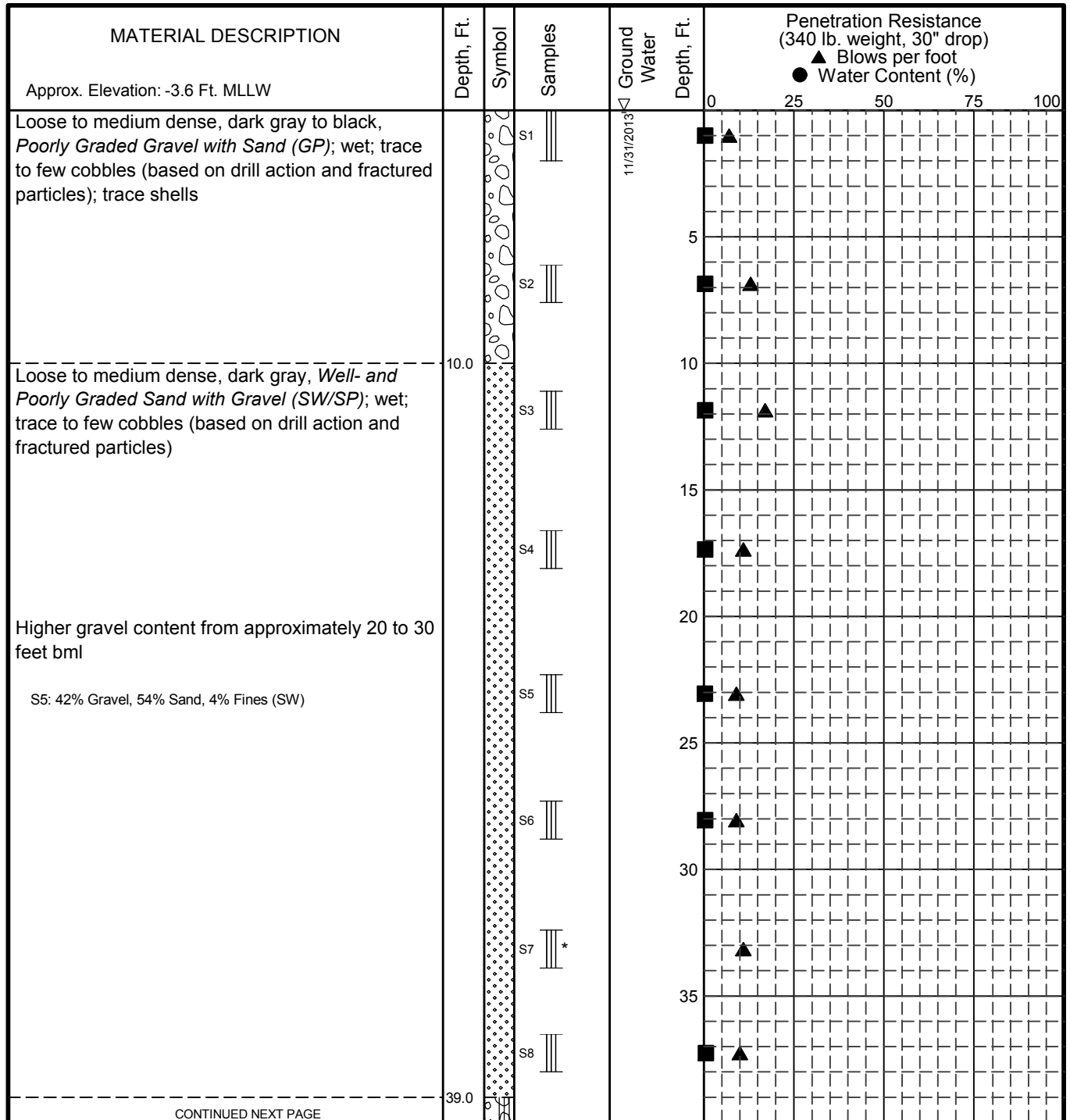
1. The stratification lines represent the approximate boundaries between soil types, and the transition may be gradual.
2. The discussion in the text of this report is necessary for a proper understanding of the nature of subsurface materials.
3. Water level, if indicated above, is for the date specified and may vary.
4. PP (Pocket Penetrometer) tests estimate Unconfined Compressive Strength of Cohesive Soils. TV (Torvane) tests estimate the Undrained Shear Strength of Cohesive Soils. All measurements in tons per square foot.

Navigational Improvements Study
 Head of Passage Canal, Whittier, Alaska

LOG OF BORING B-05

August 2017

32-1-02348-001



LEGEND

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

Ground Water Level At Time Of Drilling

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

NOTES

- The stratification lines represent the approximate boundaries between soil types, and the transition may be gradual.
- The discussion in the text of this report is necessary for a proper understanding of the nature of subsurface materials.
- Water level, if indicated above, is for the date specified and may vary.
- PP (Pocket Penetrometer) tests estimate Unconfined Compressive Strength of Cohesive Soils. TV (Torvane) tests estimate the Undrained Shear Strength of Cohesive Soils. All measurements in tons per square foot.

Navigation Improvements Study
Head of Passage Canal, Whittier, Alaska

LOG OF BORING B-06

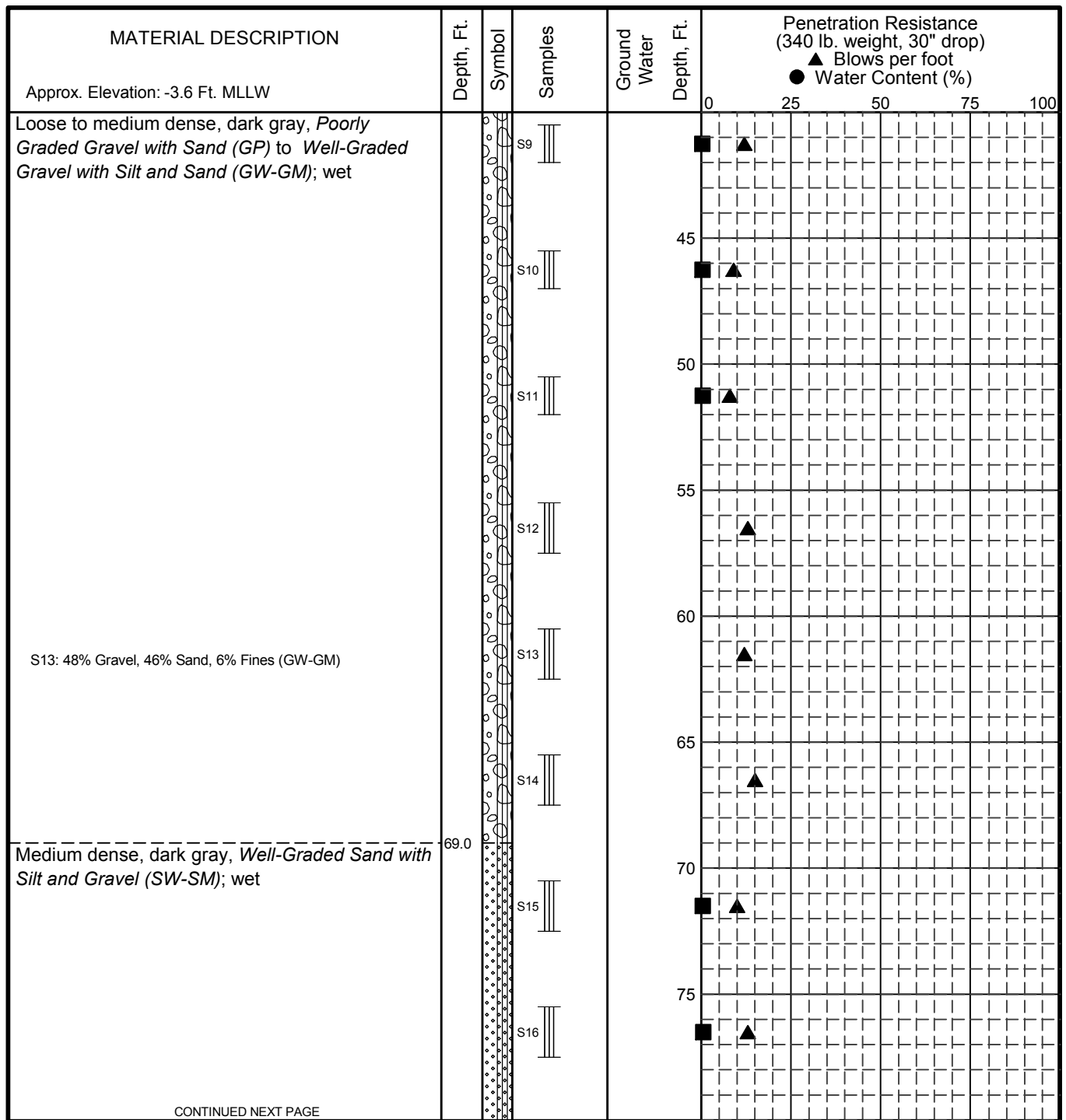
August 2017

32-1-02348-001

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. A-7
Sheet 1 of 3

GEOTECHNICAL LOG 02348 LOGS.GPJ S&W GEO1.GDT 8/9/17



CONTINUED NEXT PAGE

LEGEND

- * Sample Not Recovered
- Grab Sample
- 3" O.D. Split Spoon Sample
- Ground Water Level At Time Of Drilling
- PID Reading (ppm)
- Plastic Limit
- Liquid Limit
- Natural Water Content

NOTES

- The stratification lines represent the approximate boundaries between soil types, and the transition may be gradual.
- The discussion in the text of this report is necessary for a proper understanding of the nature of subsurface materials.
- Water level, if indicated above, is for the date specified and may vary.
- PP (Pocket Penetrometer) tests estimate Unconfined Compressive Strength of Cohesive Soils. TV (Torvane) tests estimate the Undrained Shear Strength of Cohesive Soils. All measurements in tons per square foot.

Navigational Improvements Study
Head of Passage Canal, Whittier, Alaska

LOG OF BORING B-06

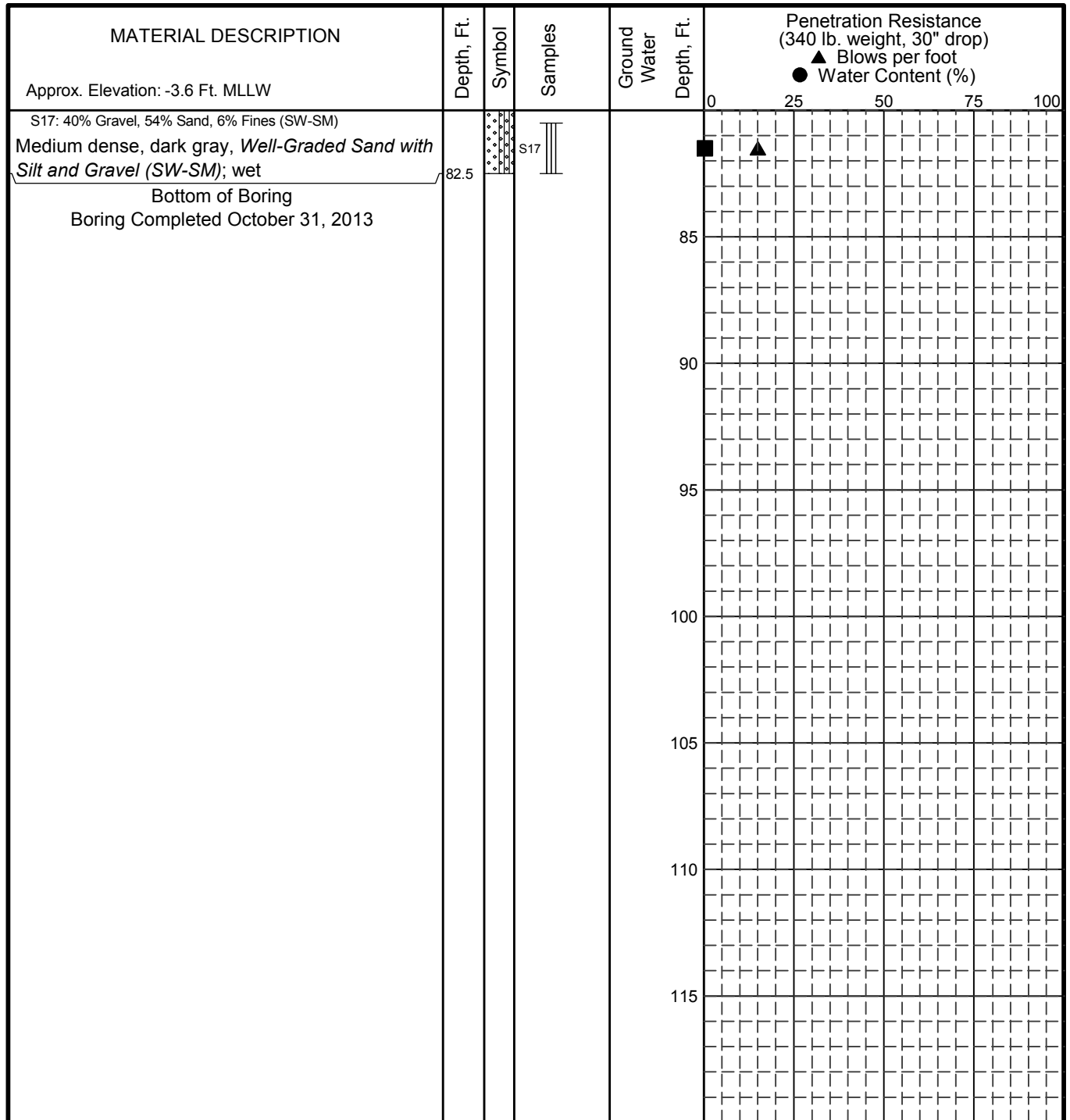
August 2017

32-1-02348-001

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. A-7
Sheet 2 of 3

GEOTECHNICAL LOG 02348 LOGS.GPJ S&W GEO1.GDT 8/9/17



LEGEND

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

Ground Water Level At Time Of Drilling

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

NOTES

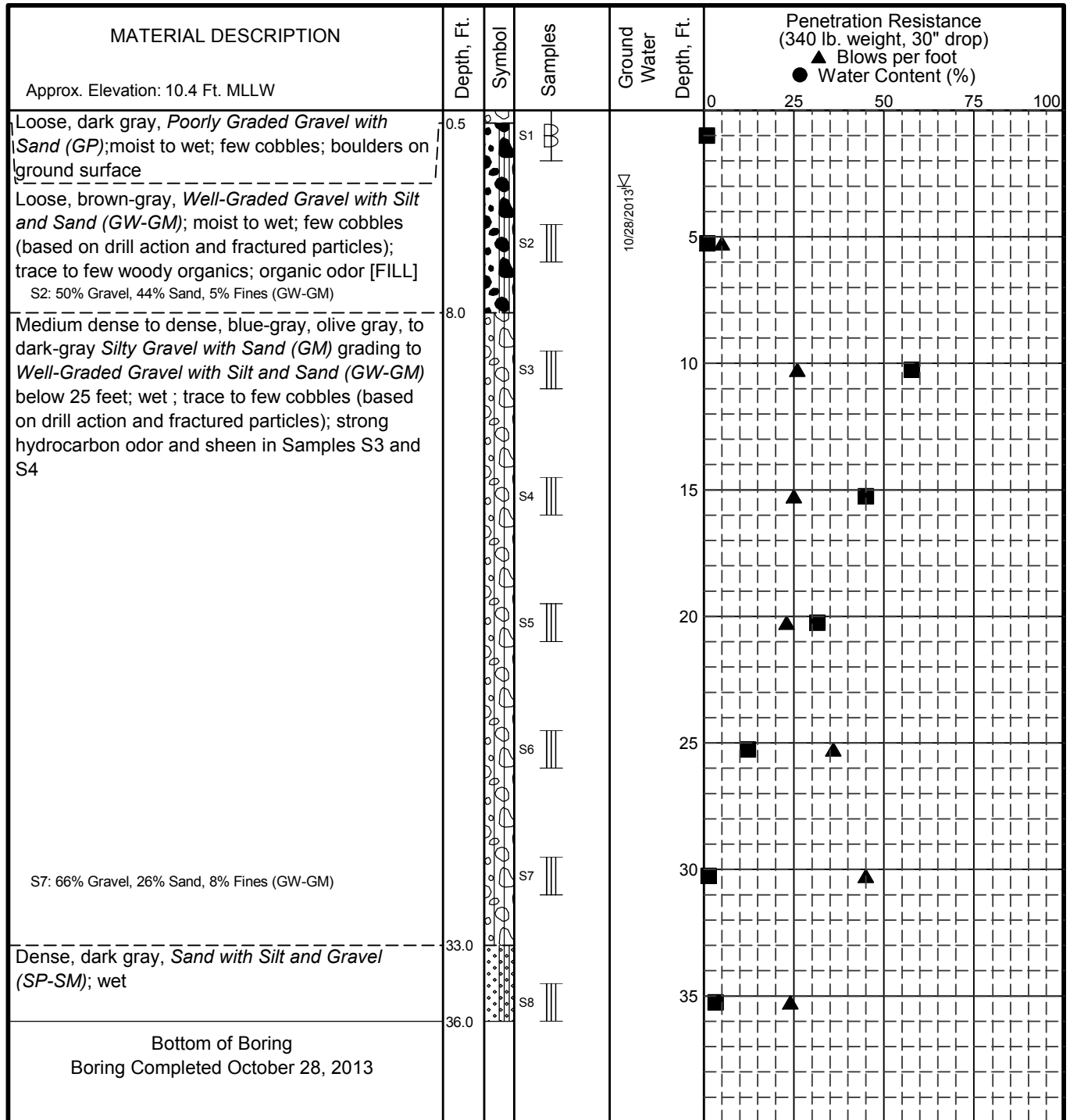
- The stratification lines represent the approximate boundaries between soil types, and the transition may be gradual.
- The discussion in the text of this report is necessary for a proper understanding of the nature of subsurface materials.
- Water level, if indicated above, is for the date specified and may vary.
- PP (Pocket Penetrometer) tests estimate Unconfined Compressive Strength of Cohesive Soils. TV (Torvane) tests estimate the Undrained Shear Strength of Cohesive Soils. All measurements in tons per square foot.

Navigational Improvements Study
 Head of Passage Canal, Whittier, Alaska

LOG OF BORING B-06

August 2017

32-1-02348-001



LEGEND

- * Sample Not Recovered
- Grab Sample
- 3" O.D. Split Spoon Sample
- Ground Water Level At Time Of Drilling
- PID Reading (ppm)
- Plastic Limit
- Liquid Limit
- Natural Water Content

NOTES

- The stratification lines represent the approximate boundaries between soil types, and the transition may be gradual.
- The discussion in the text of this report is necessary for a proper understanding of the nature of subsurface materials.
- Water level, if indicated above, is for the date specified and may vary.
- PP (Pocket Penetrometer) tests estimate Unconfined Compressive Strength of Cohesive Soils. TV (Torvane) tests estimate the Undrained Shear Strength of Cohesive Soils. All measurements in tons per square foot.

Navigational Improvements Study
Head of Passage Canal, Whittier, Alaska

LOG OF BORING B-07

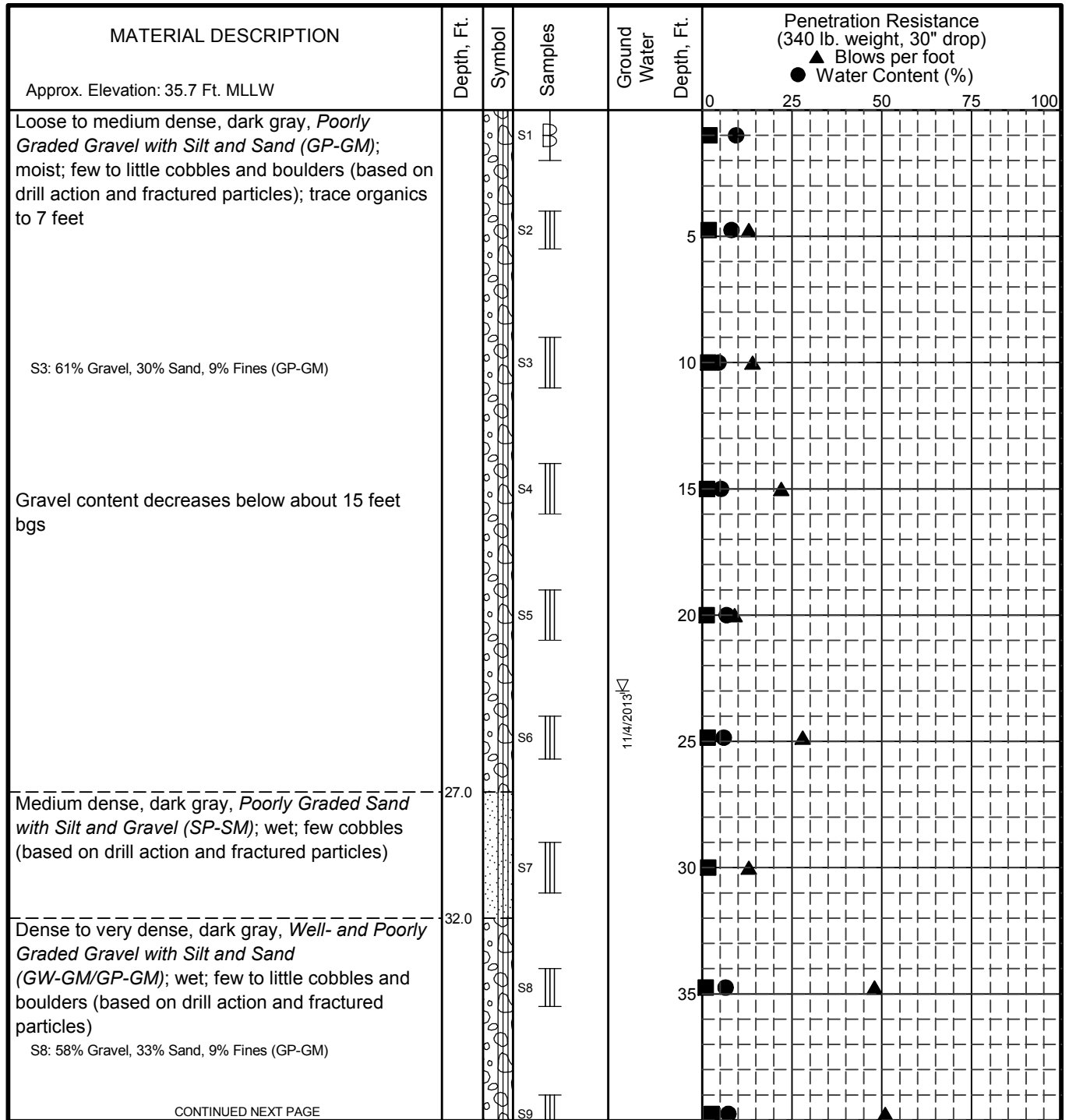
August 2017

32-1-02348-001

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. A-8

GEOTECHNICAL LOG 02348 LOGS.GPJ S&W GEO1.GDT 8/9/17



CONTINUED NEXT PAGE

LEGEND

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

∇ Ground Water Level At Time Of Drilling

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

NOTES

1. The stratification lines represent the approximate boundaries between soil types, and the transition may be gradual.
2. The discussion in the text of this report is necessary for a proper understanding of the nature of subsurface materials.
3. Water level, if indicated above, is for the date specified and may vary.
4. PP (Pocket Penetrometer) tests estimate Unconfined Compressive Strength of Cohesive Soils. TV (Torvane) tests estimate the Undrained Shear Strength of Cohesive Soils. All measurements in tons per square foot.

Navigational Improvements Study
 Head of Passage Canal, Whittier, Alaska

LOG OF BORING B-08

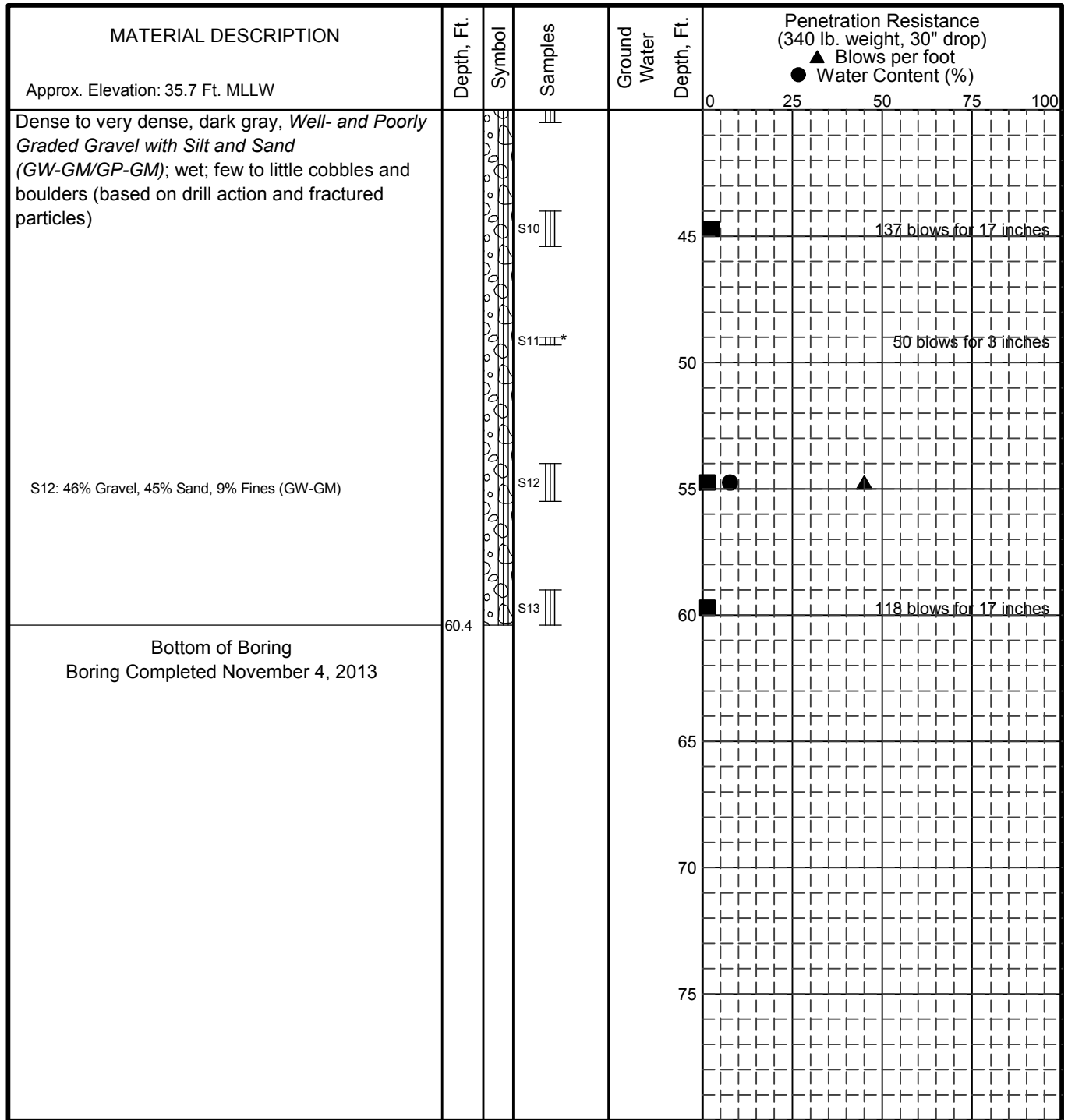
August 2017

32-1-02348-001

SHANNON & WILSON, INC.
 Geotechnical and Environmental Consultants

FIG. A-9
 Sheet 1 of 2

GEOTECHNICAL LOG 02348 LOGS.GPJ S&W GEO1.GDT 8/9/17



LEGEND

- * Sample Not Recovered ▽ Ground Water Level At Time Of Drilling
- Grab Sample
- 3" O.D. Split Spoon Sample
- PID Reading (ppm)
- Plastic Limit —●— Liquid Limit
- Natural Water Content

NOTES

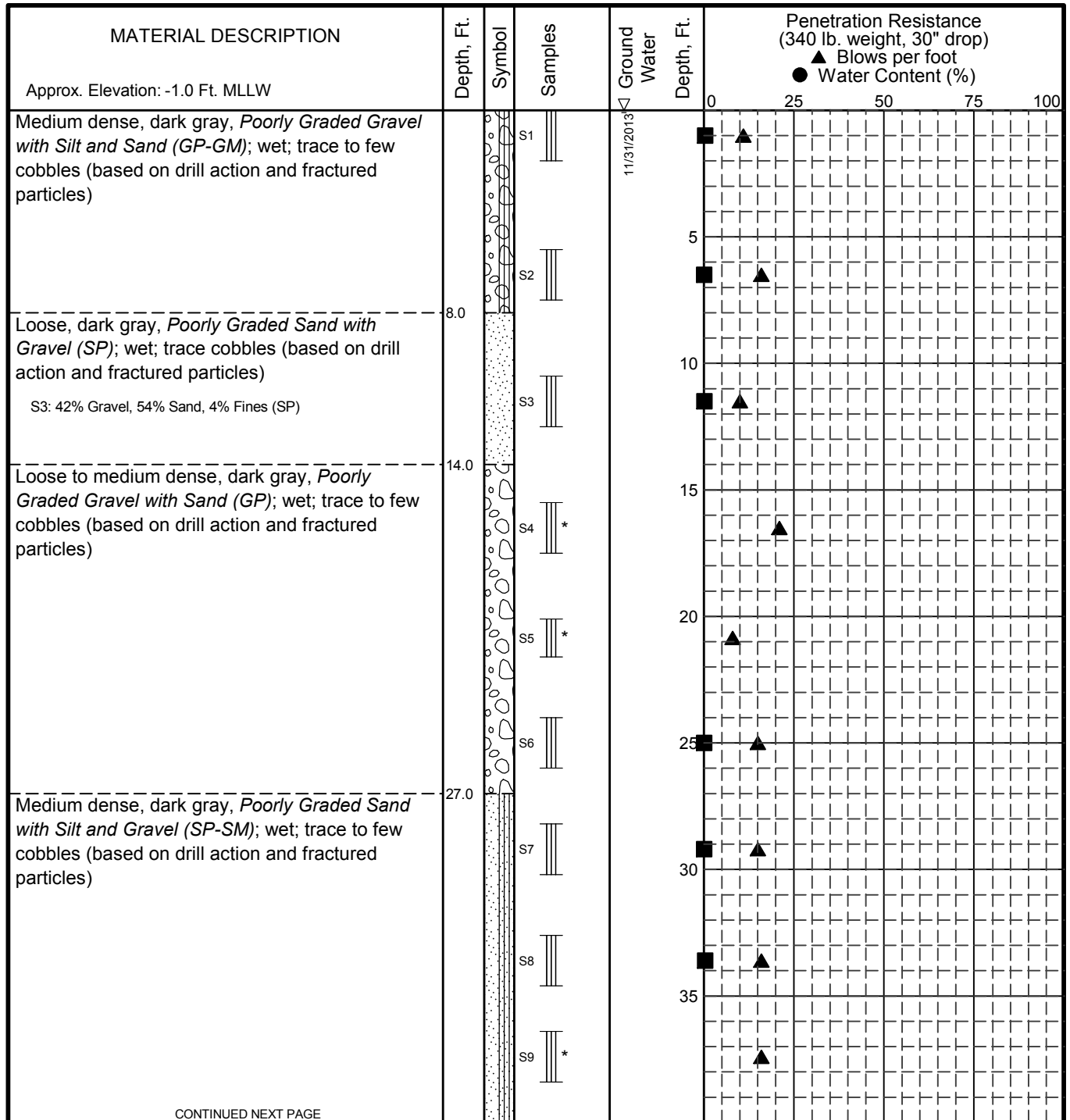
1. The stratification lines represent the approximate boundaries between soil types, and the transition may be gradual.
2. The discussion in the text of this report is necessary for a proper understanding of the nature of subsurface materials.
3. Water level, if indicated above, is for the date specified and may vary.
4. PP (Pocket Penetrometer) tests estimate Unconfined Compressive Strength of Cohesive Soils. TV (Torvane) tests estimate the Undrained Shear Strength of Cohesive Soils. All measurements in tons per square foot.

Navigational Improvements Study
Head of Passage Canal, Whittier, Alaska

LOG OF BORING B-08

August 2017

32-1-02348-001



CONTINUED NEXT PAGE

LEGEND

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

Ground Water Level At Time Of Drilling

- PID Reading (ppm)
- Plastic Limit
- Liquid Limit
- Natural Water Content

NOTES

1. The stratification lines represent the approximate boundaries between soil types, and the transition may be gradual.
2. The discussion in the text of this report is necessary for a proper understanding of the nature of subsurface materials.
3. Water level, if indicated above, is for the date specified and may vary.
4. PP (Pocket Penetrometer) tests estimate Unconfined Compressive Strength of Cohesive Soils. TV (Torvane) tests estimate the Undrained Shear Strength of Cohesive Soils. All measurements in tons per square foot.

Navigational Improvements Study
Head of Passage Canal, Whittier, Alaska

LOG OF BORING B-09

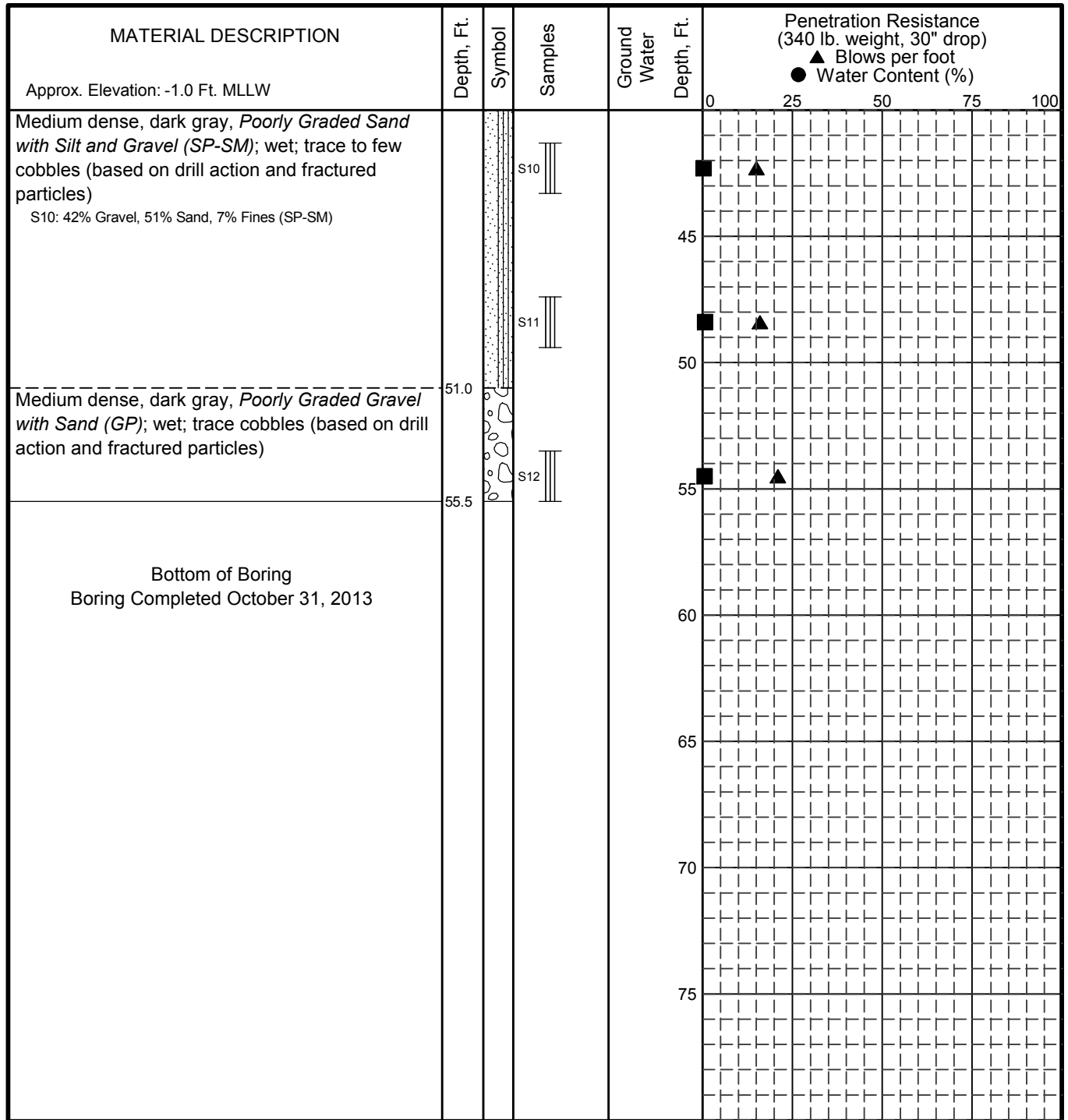
August 2017

32-1-02348-001

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. A-10
Sheet 1 of 2

GEOTECHNICAL LOG 02348 LOGS.GPJ S&W GEO1.GDT 8/9/17



LEGEND

- * Sample Not Recovered ▽ Ground Water Level At Time Of Drilling
- ▩ Grab Sample
- ▧ 3" O.D. Split Spoon Sample
- PID Reading (ppm)
- Plastic Limit —●— Liquid Limit
- Natural Water Content

NOTES

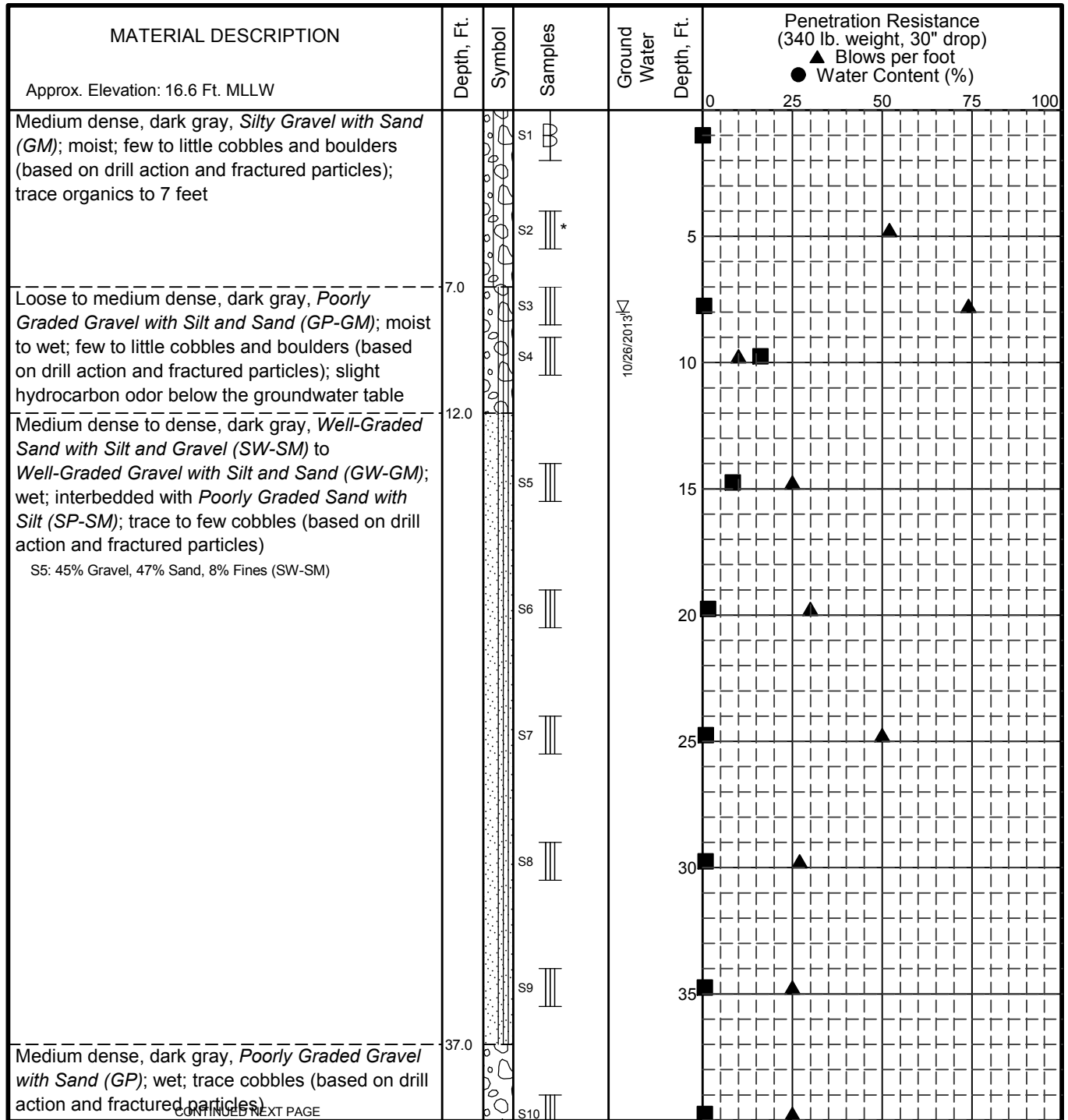
1. The stratification lines represent the approximate boundaries between soil types, and the transition may be gradual.
2. The discussion in the text of this report is necessary for a proper understanding of the nature of subsurface materials.
3. Water level, if indicated above, is for the date specified and may vary.
4. PP (Pocket Penetrometer) tests estimate Unconfined Compressive Strength of Cohesive Soils. TV (Torvane) tests estimate the Undrained Shear Strength of Cohesive Soils. All measurements in tons per square foot.

Navigational Improvements Study
Head of Passage Canal, Whittier, Alaska

LOG OF BORING B-09

August 2017

32-1-02348-001



CONTINUED NEXT PAGE

LEGEND

- * Sample Not Recovered
- ☒ Grab Sample
- ☒ 3" O.D. Split Spoon Sample
- ▽ Ground Water Level At Time Of Drilling
- PID Reading (ppm)
- Plastic Limit
- Liquid Limit
- Natural Water Content

NOTES

- The stratification lines represent the approximate boundaries between soil types, and the transition may be gradual.
- The discussion in the text of this report is necessary for a proper understanding of the nature of subsurface materials.
- Water level, if indicated above, is for the date specified and may vary.
- PP (Pocket Penetrometer) tests estimate Unconfined Compressive Strength of Cohesive Soils. TV (Torvane) tests estimate the Undrained Shear Strength of Cohesive Soils. All measurements in tons per square foot.

Navigational Improvements Study
Head of Passage Canal, Whittier, Alaska

LOG OF BORING B-10

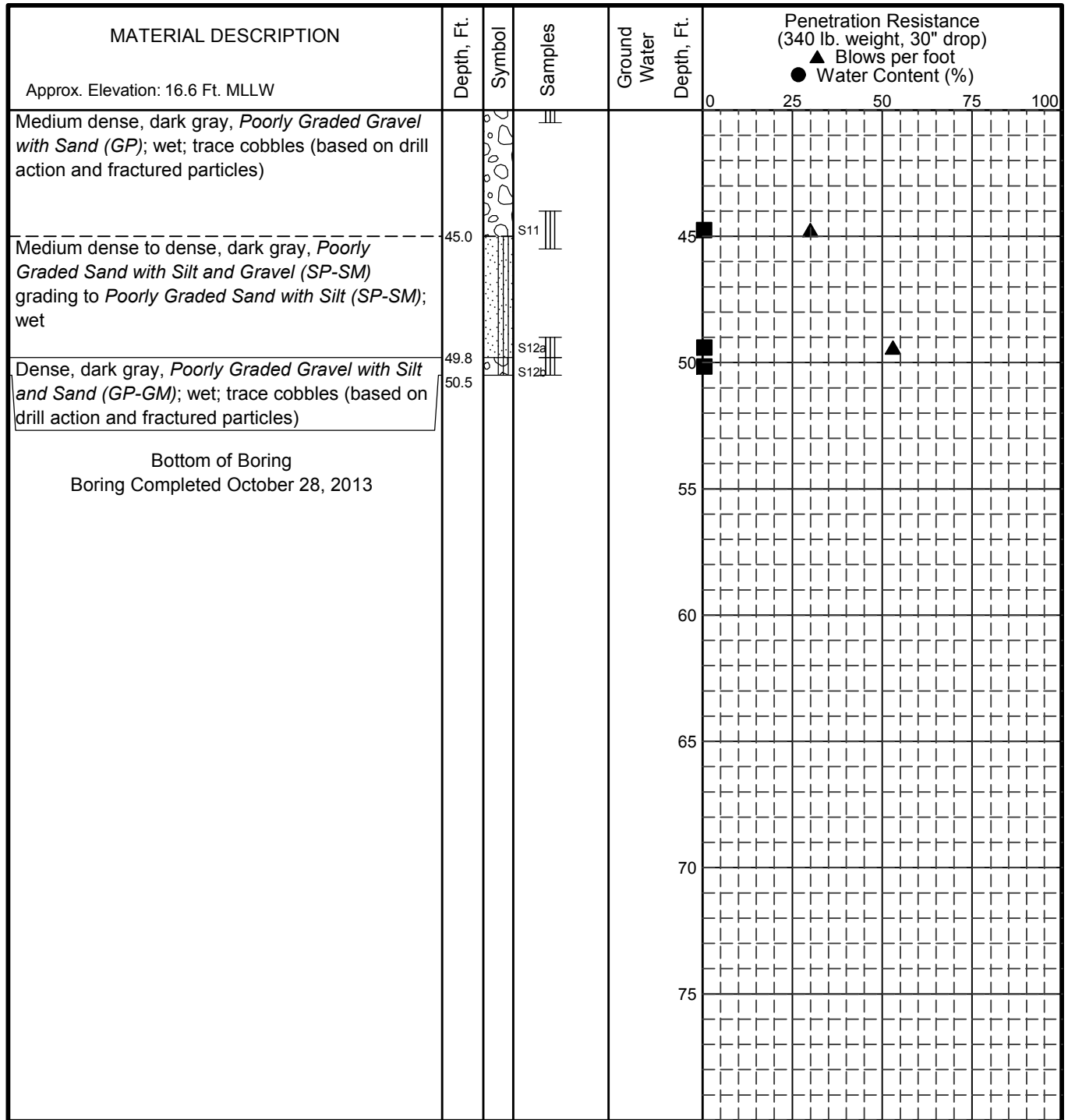
August 2017

32-1-02348-001

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. A-11
Sheet 1 of 2

GEOTECHNICAL LOG 02348 LOGS.GPJ S&W GEO1.GDT 8/9/17



LEGEND

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

- PID Reading (ppm)
- Liquid Limit
- Natural Water Content

NOTES

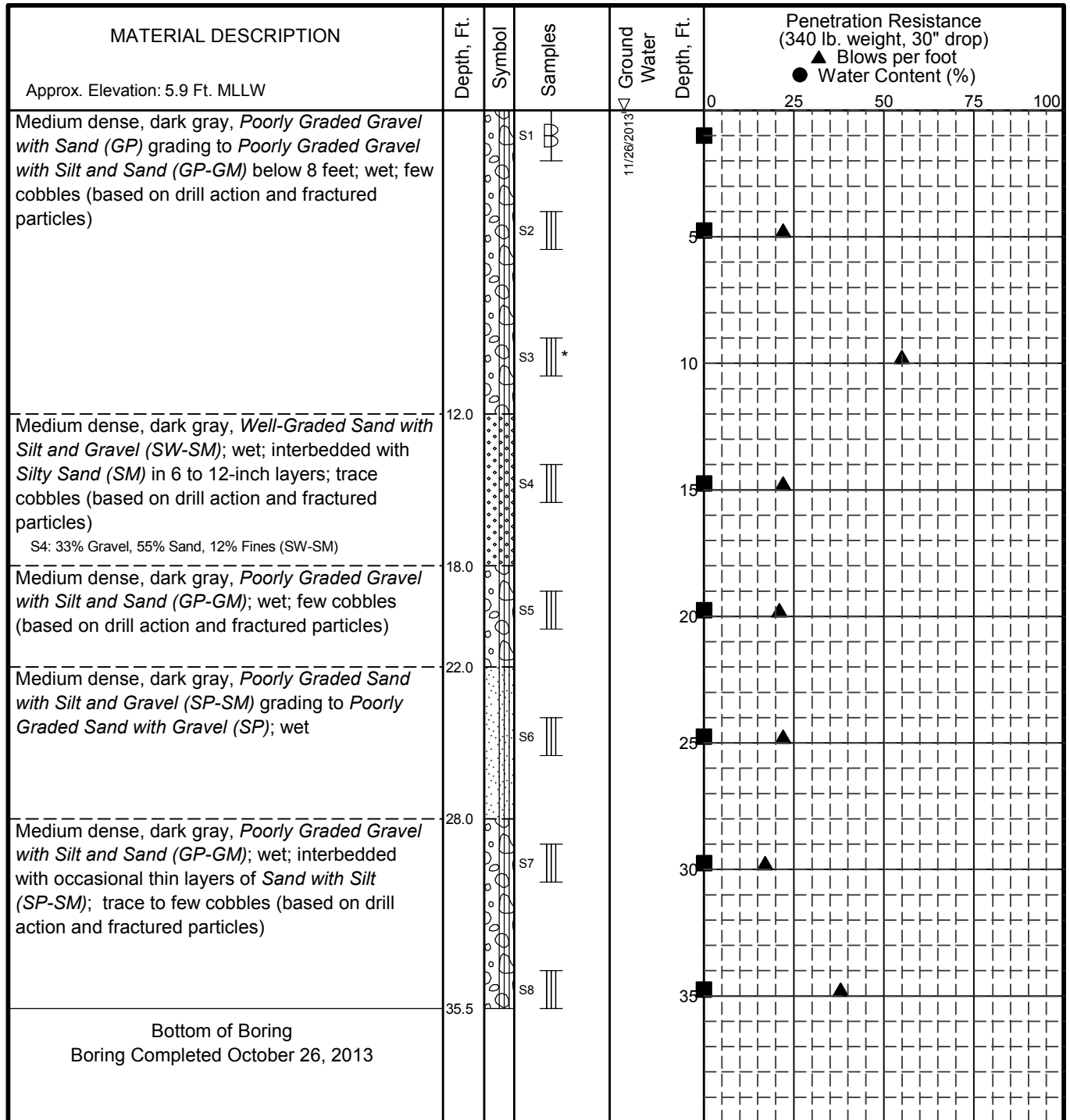
- The stratification lines represent the approximate boundaries between soil types, and the transition may be gradual.
- The discussion in the text of this report is necessary for a proper understanding of the nature of subsurface materials.
- Water level, if indicated above, is for the date specified and may vary.
- PP (Pocket Penetrometer) tests estimate Unconfined Compressive Strength of Cohesive Soils. TV (Torvane) tests estimate the Undrained Shear Strength of Cohesive Soils. All measurements in tons per square foot.

Navigational Improvements Study
Head of Passage Canal, Whittier, Alaska

LOG OF BORING B-10

August 2017

32-1-02348-001



LEGEND

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

∇ Ground Water Level At Time Of Drilling

■ PID Reading (ppm)

—●— Liquid Limit
Natural Water Content

NOTES

- The stratification lines represent the approximate boundaries between soil types, and the transition may be gradual.
- The discussion in the text of this report is necessary for a proper understanding of the nature of subsurface materials.
- Water level, if indicated above, is for the date specified and may vary.
- PP (Pocket Penetrometer) tests estimate Unconfined Compressive Strength of Cohesive Soils. TV (Torvane) tests estimate the Undrained Shear Strength of Cohesive Soils. All measurements in tons per square foot.

Navigational Improvements Study
Head of Passage Canal, Whittier, Alaska

LOG OF BORING B-11

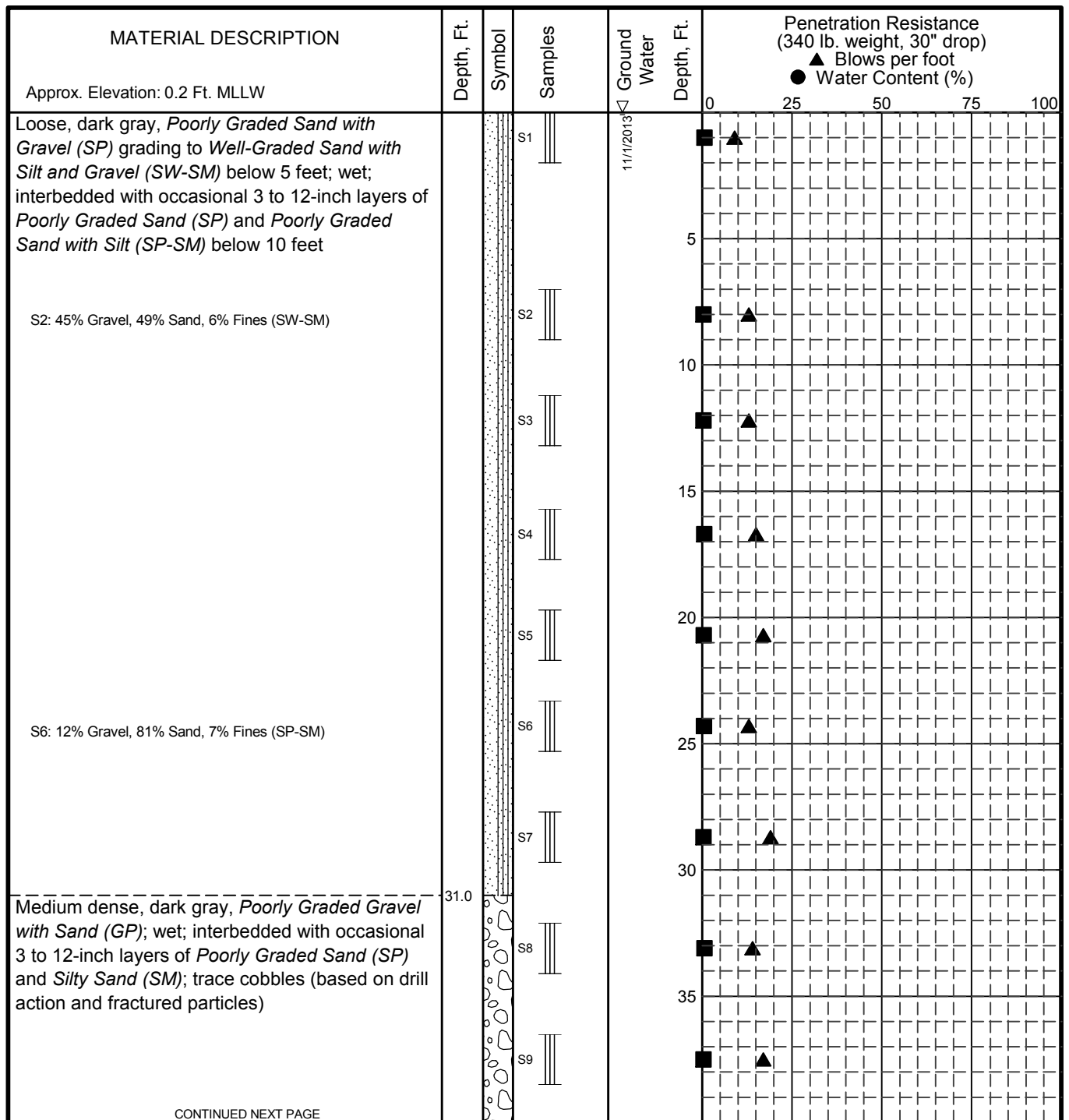
August 2017

32-1-02348-001

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. A-12

GEOTECHNICAL LOG 02348 LOGS.GPJ S&W GEO1.GDT 8/9/17



CONTINUED NEXT PAGE

LEGEND

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

▽ Ground Water Level At Time Of Drilling

- PID Reading (ppm)
- Plastic Limit
- Liquid Limit
- Natural Water Content

NOTES

- The stratification lines represent the approximate boundaries between soil types, and the transition may be gradual.
- The discussion in the text of this report is necessary for a proper understanding of the nature of subsurface materials.
- Water level, if indicated above, is for the date specified and may vary.
- PP (Pocket Penetrometer) tests estimate Unconfined Compressive Strength of Cohesive Soils. TV (Torvane) tests estimate the Undrained Shear Strength of Cohesive Soils. All measurements in tons per square foot.

Navigational Improvements Study
Head of Passage Canal, Whittier, Alaska

LOG OF BORING B-12

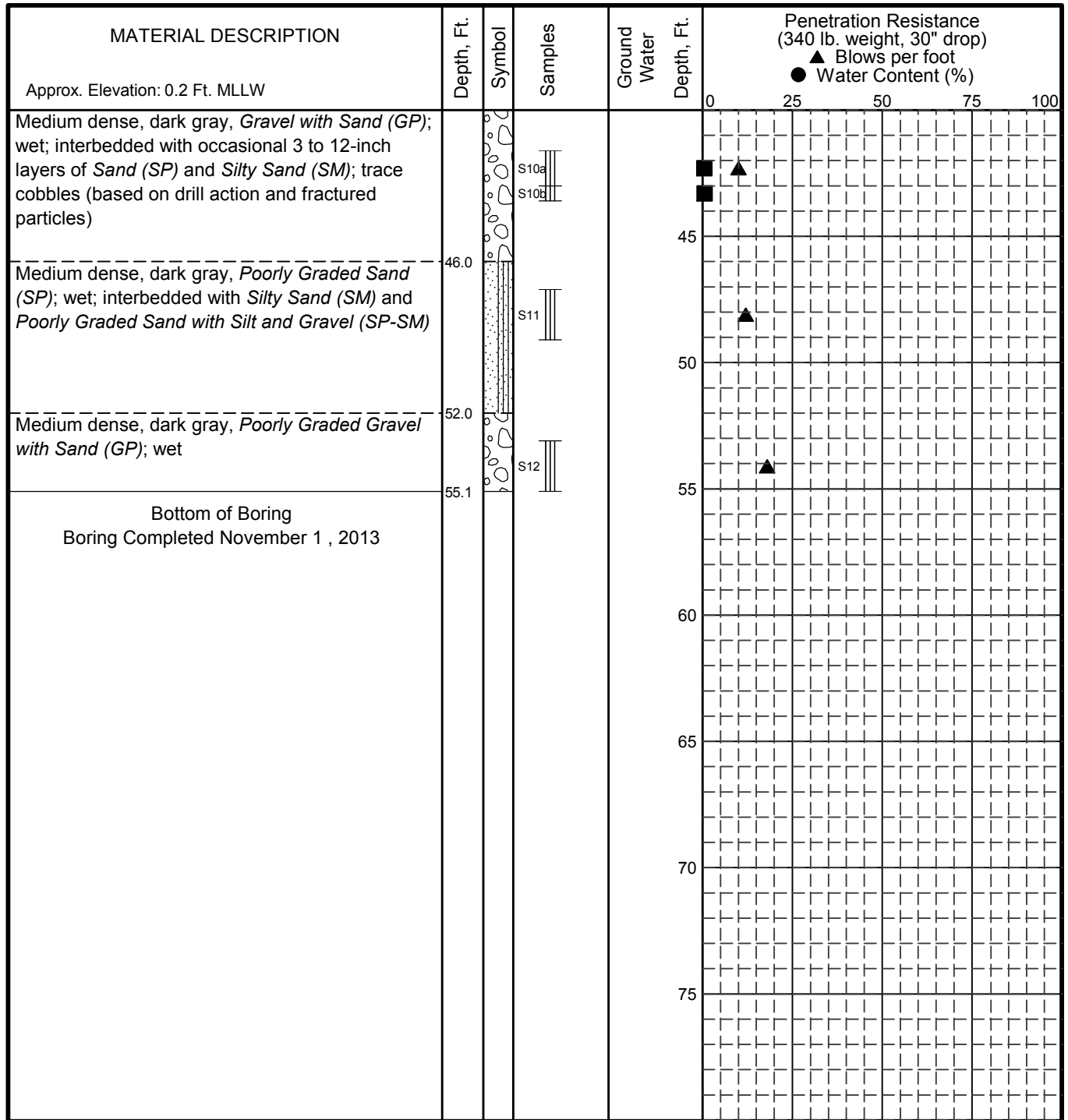
August 2017

32-1-02348-001

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. A-13
Sheet 1 of 2

GEOTECHNICAL LOG 02348 LOGS.GPJ S&W GEO1.GDT 8/9/17



LEGEND

- * Sample Not Recovered ∇ Ground Water Level At Time Of Drilling ■ PID Reading (ppm)
- Grab Sample Plastic Limit —●— Liquid Limit
- 3" O.D. Split Spoon Sample 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.
4. PP (Pocket Penetrometer) tests estimate Unconfined Compressive Strength of Cohesive Soils. TV (Torvane) tests estimate the Undrained Shear Strength of Cohesive Soils. All measurements in tons per square foot.

Navigational Improvements Study
Head of Passage Canal, Whittier, Alaska

LOG OF BORING B-12

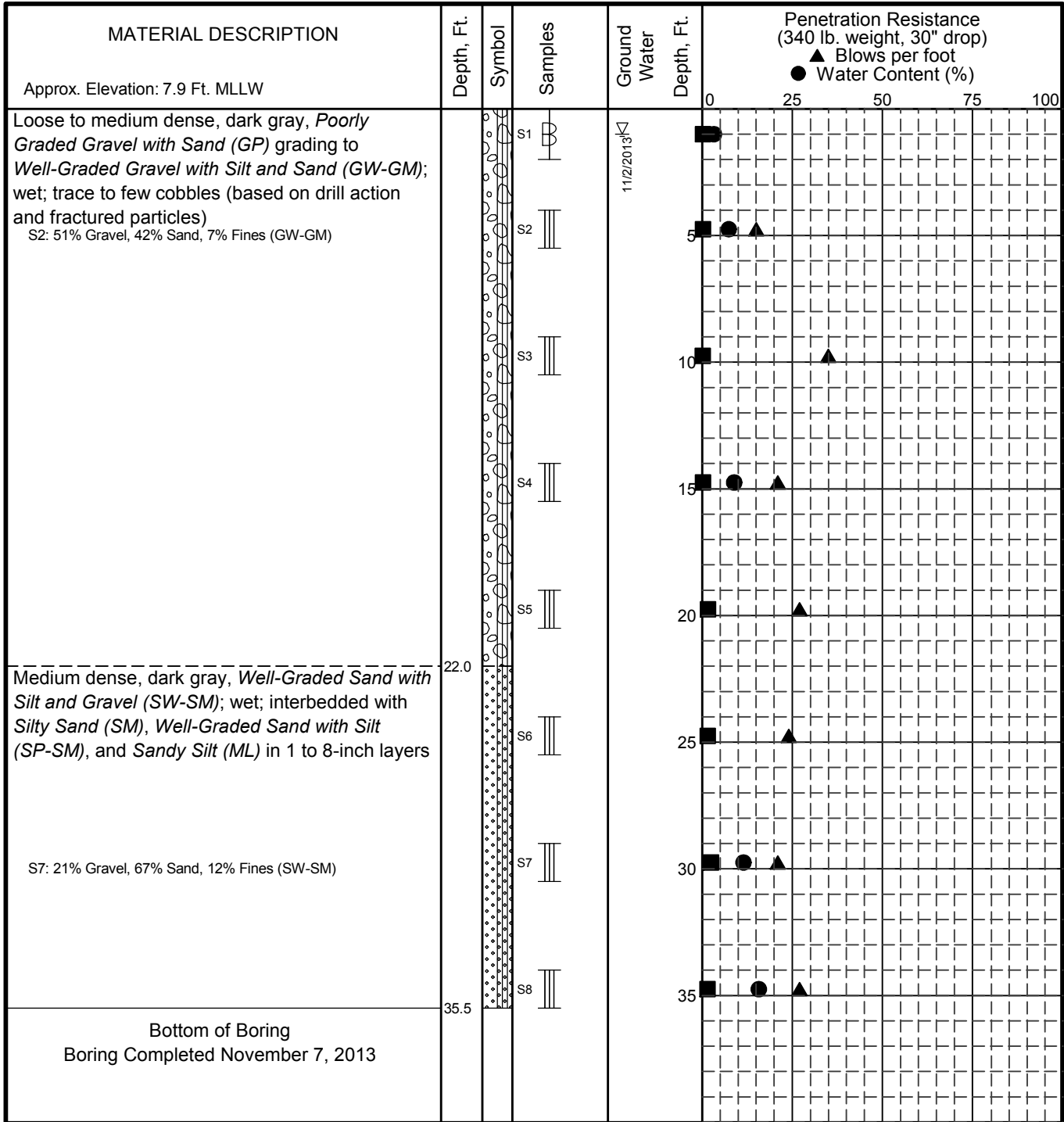
August 2017

32-1-02348-001

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. A-13
Sheet 2 of 2

GEOTECHNICAL LOG 02348 LOGS.GPJ S&W GEO1.GDT 8/9/17



LEGEND

- * Sample Not Recovered
- ▣ Grab Sample
- ▤ 3" O.D. Split Spoon Sample
- ▽ Ground Water Level At Time Of Drilling
- PID Reading (ppm)
- Plastic Limit
- Liquid Limit
- Natural Water Content

NOTES

- The stratification lines represent the approximate boundaries between soil types, and the transition may be gradual.
- The discussion in the text of this report is necessary for a proper understanding of the nature of subsurface materials.
- Water level, if indicated above, is for the date specified and may vary.
- PP (Pocket Penetrometer) tests estimate Unconfined Compressive Strength of Cohesive Soils. TV (Torvane) tests estimate the Undrained Shear Strength of Cohesive Soils. All measurements in tons per square foot.

Navigational Improvements Study
Head of Passage Canal, Whittier, Alaska

LOG OF BORING B-13

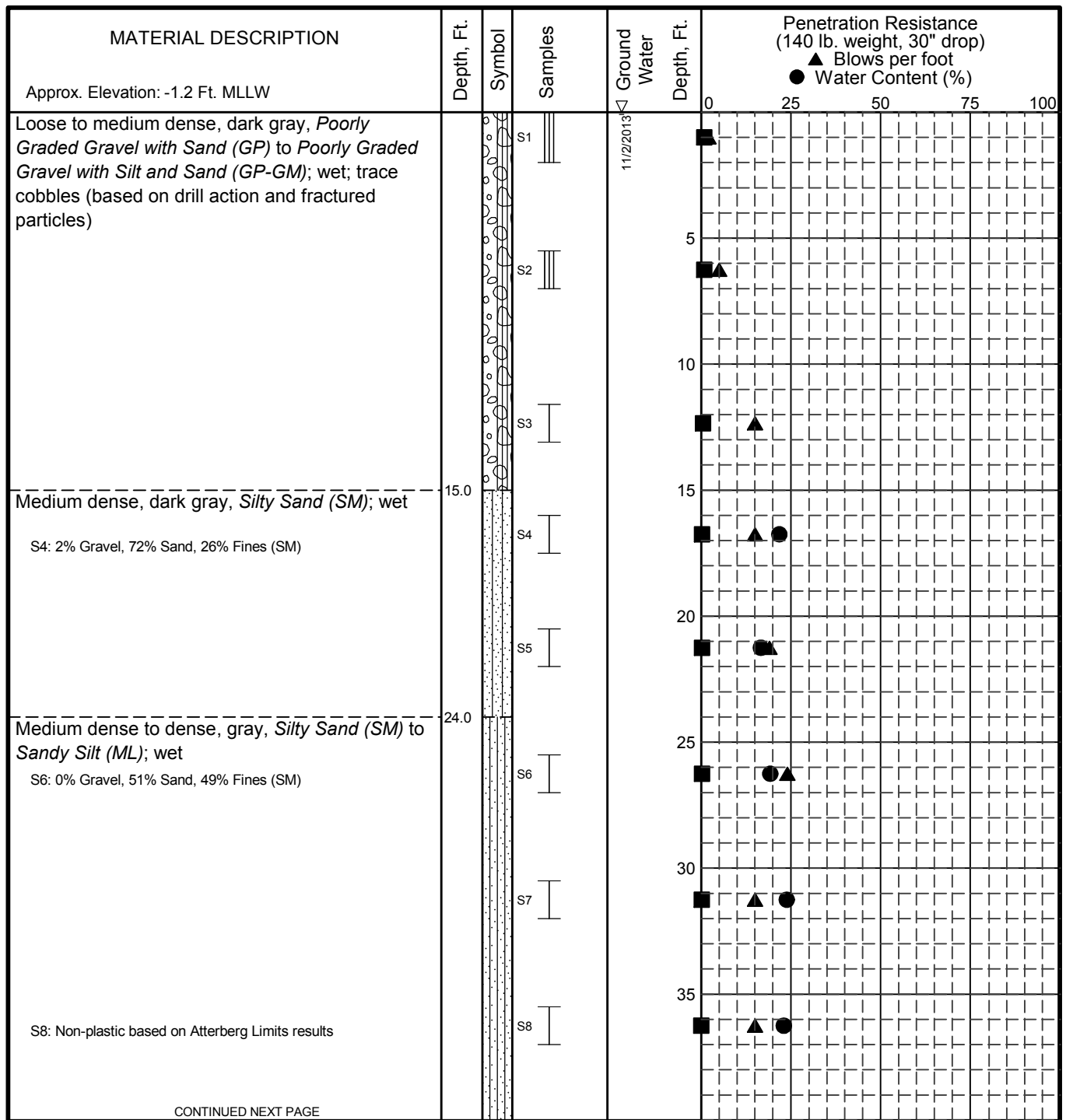
August 2017

32-1-02348-001

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. A-14

GEOTECHNICAL LOG 02348 LOGS.GPJ S&W GEO1.GDT 8/9/17



CONTINUED NEXT PAGE

LEGEND

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

∇ Ground Water Level At Time Of Drilling

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

NOTES

- The stratification lines represent the approximate boundaries between soil types, and the transition may be gradual.
- The discussion in the text of this report is necessary for a proper understanding of the nature of subsurface materials.
- Water level, if indicated above, is for the date specified and may vary.
- PP (Pocket Penetrometer) tests estimate Unconfined Compressive Strength of Cohesive Soils. TV (Torvane) tests estimate the Undrained Shear Strength of Cohesive Soils. All measurements in tons per square foot.

Navigational Improvements Study
 Head of Passage Canal, Whittier, Alaska

LOG OF BORING B-14

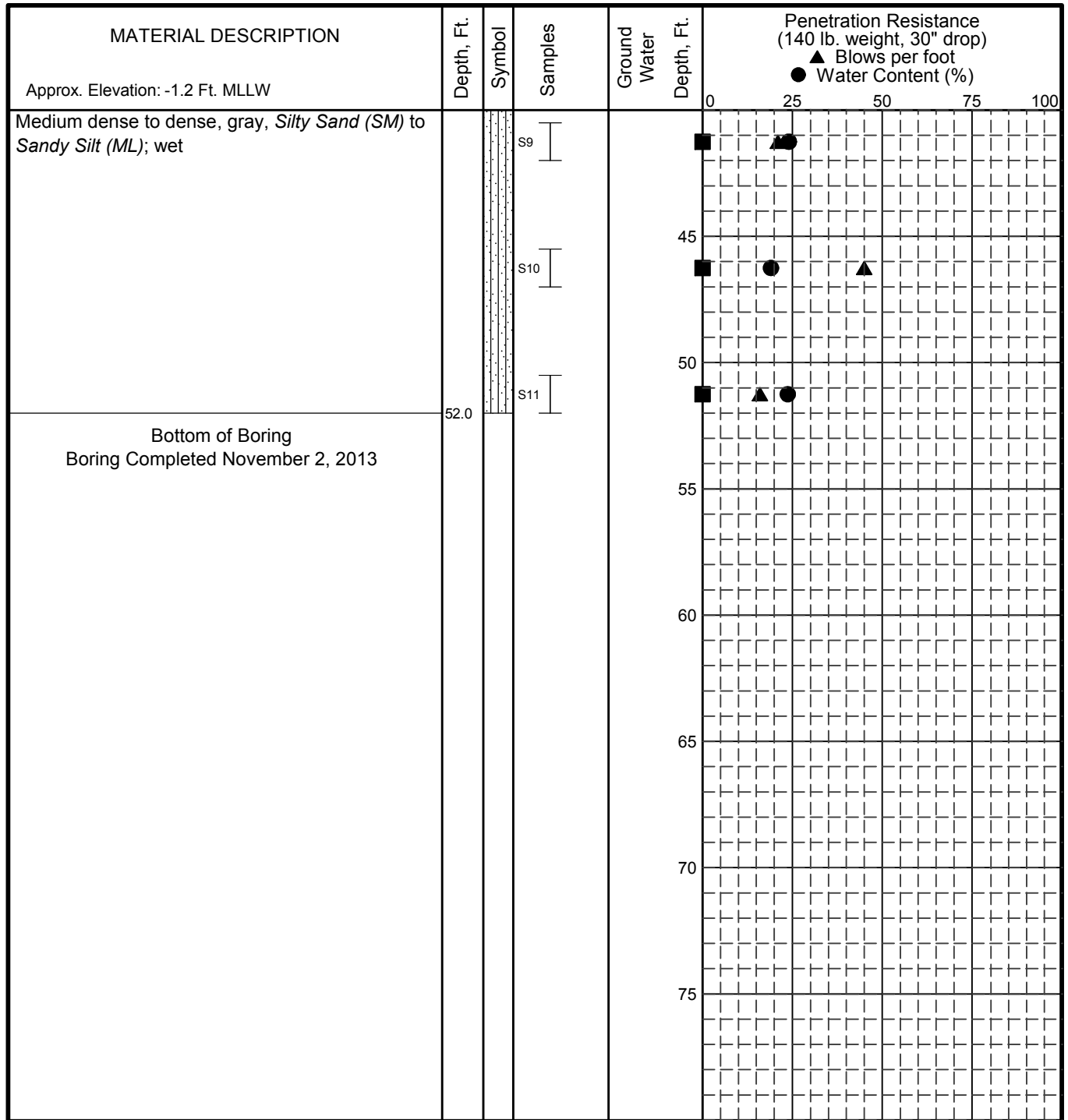
August 2017

32-1-02348-001

SHANNON & WILSON, INC.
 Geotechnical and Environmental Consultants

FIG. A-15
 Sheet 1 of 2

GEOTECHNICAL LOG 02348 LOGS.GPJ S&W GEO1.GDT 8/9/17



LEGEND

- * Sample Not Recovered ▽ Ground Water Level At Time Of Drilling
- ⊞ Grab Sample
- ⊞ 3" O.D. Split Spoon Sample
- ⊞ 2" O.D. Split Spoon Sample
- PID Reading (ppm)
- Liquid Limit
- Natural Water Content

NOTES

- The stratification lines represent the approximate boundaries between soil types, and the transition may be gradual.
- The discussion in the text of this report is necessary for a proper understanding of the nature of subsurface materials.
- Water level, if indicated above, is for the date specified and may vary.
- PP (Pocket Penetrometer) tests estimate Unconfined Compressive Strength of Cohesive Soils. TV (Torvane) tests estimate the Undrained Shear Strength of Cohesive Soils. All measurements in tons per square foot.

Navigational Improvements Study
Head of Passage Canal, Whittier, Alaska

LOG OF BORING B-14

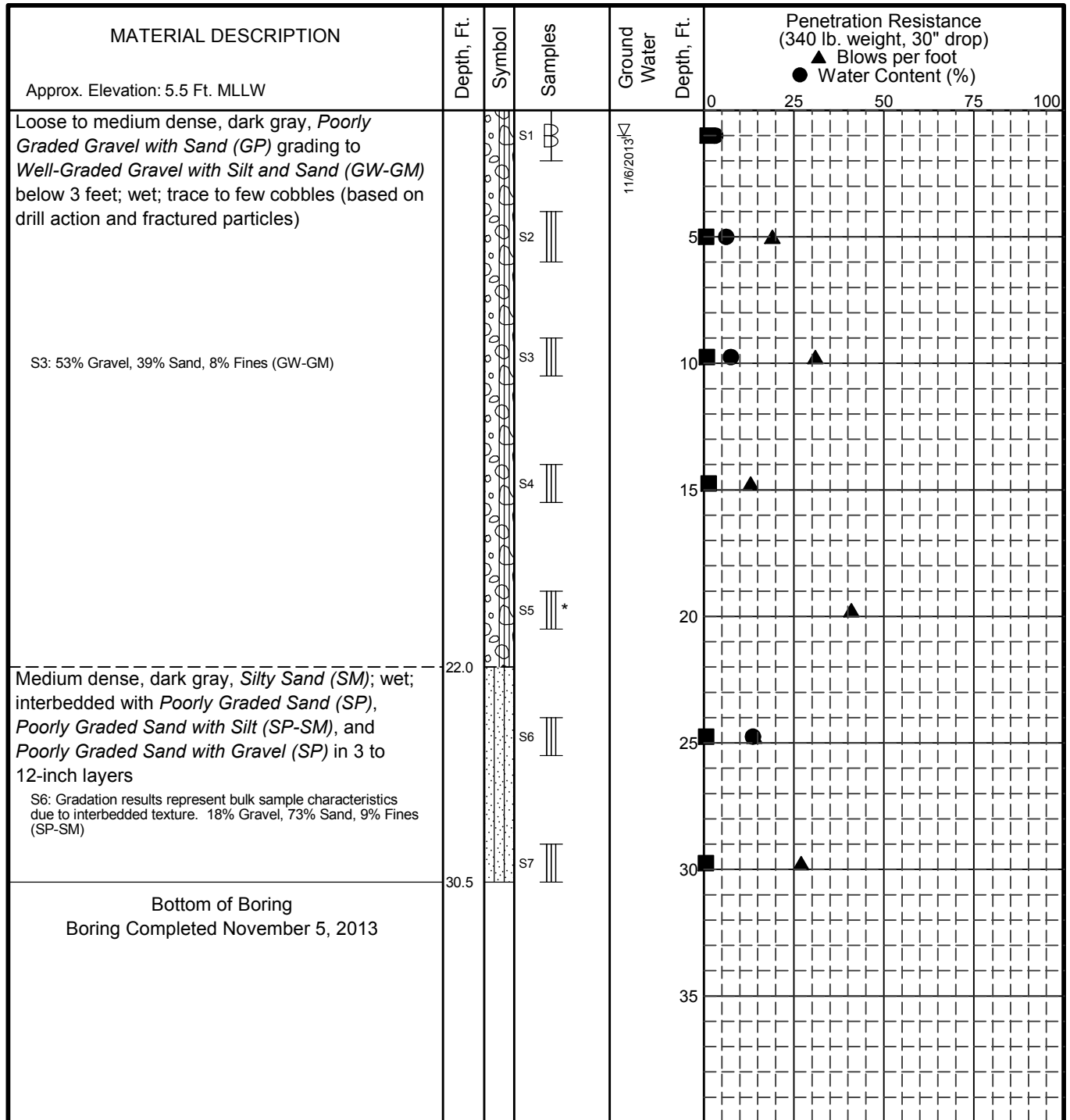
August 2017

32-1-02348-001

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. A-15
Sheet 2 of 2

GEOTECHNICAL LOG 02348 LOGS.GPJ S&W GEO1.GDT 8/9/17



LEGEND

- * Sample Not Recovered
- ▣ Grab Sample
- ▧ 3" O.D. Split Spoon Sample
- ∇ Ground Water Level At Time Of Drilling
- PID Reading (ppm)
- Liquid Limit
- Natural Water Content

NOTES

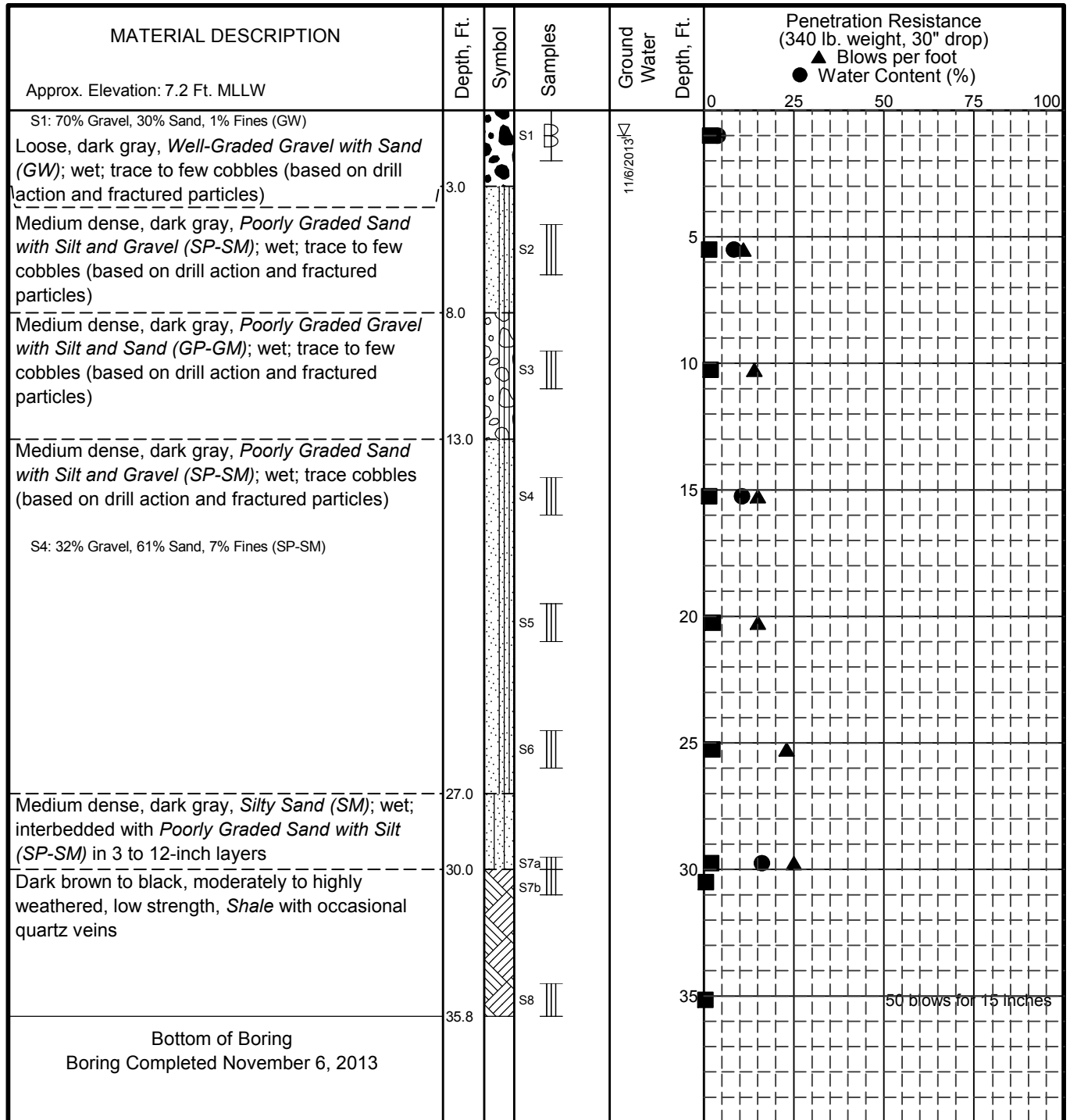
1. The stratification lines represent the approximate boundaries between soil types, and the transition may be gradual.
2. The discussion in the text of this report is necessary for a proper understanding of the nature of subsurface materials.
3. Water level, if indicated above, is for the date specified and may vary.
4. PP (Pocket Penetrometer) tests estimate Unconfined Compressive Strength of Cohesive Soils. TV (Torvane) tests estimate the Undrained Shear Strength of Cohesive Soils. All measurements in tons per square foot.

Navigational Improvements Study
Head of Passage Canal, Whittier, Alaska

LOG OF BORING B-15

August 2017

32-1-02348-001



LEGEND

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

Ground Water Level At Time Of Drilling

- PID Reading (ppm)
- Plastic Limit
- Liquid Limit
- Natural Water Content

NOTES

- The stratification lines represent the approximate boundaries between soil types, and the transition may be gradual.
- The discussion in the text of this report is necessary for a proper understanding of the nature of subsurface materials.
- Water level, if indicated above, is for the date specified and may vary.
- PP (Pocket Penetrometer) tests estimate Unconfined Compressive Strength of Cohesive Soils. TV (Torvane) tests estimate the Undrained Shear Strength of Cohesive Soils. All measurements in tons per square foot.

Navigational Improvements Study
Head of Passage Canal, Whittier, Alaska

LOG OF BORING B-16

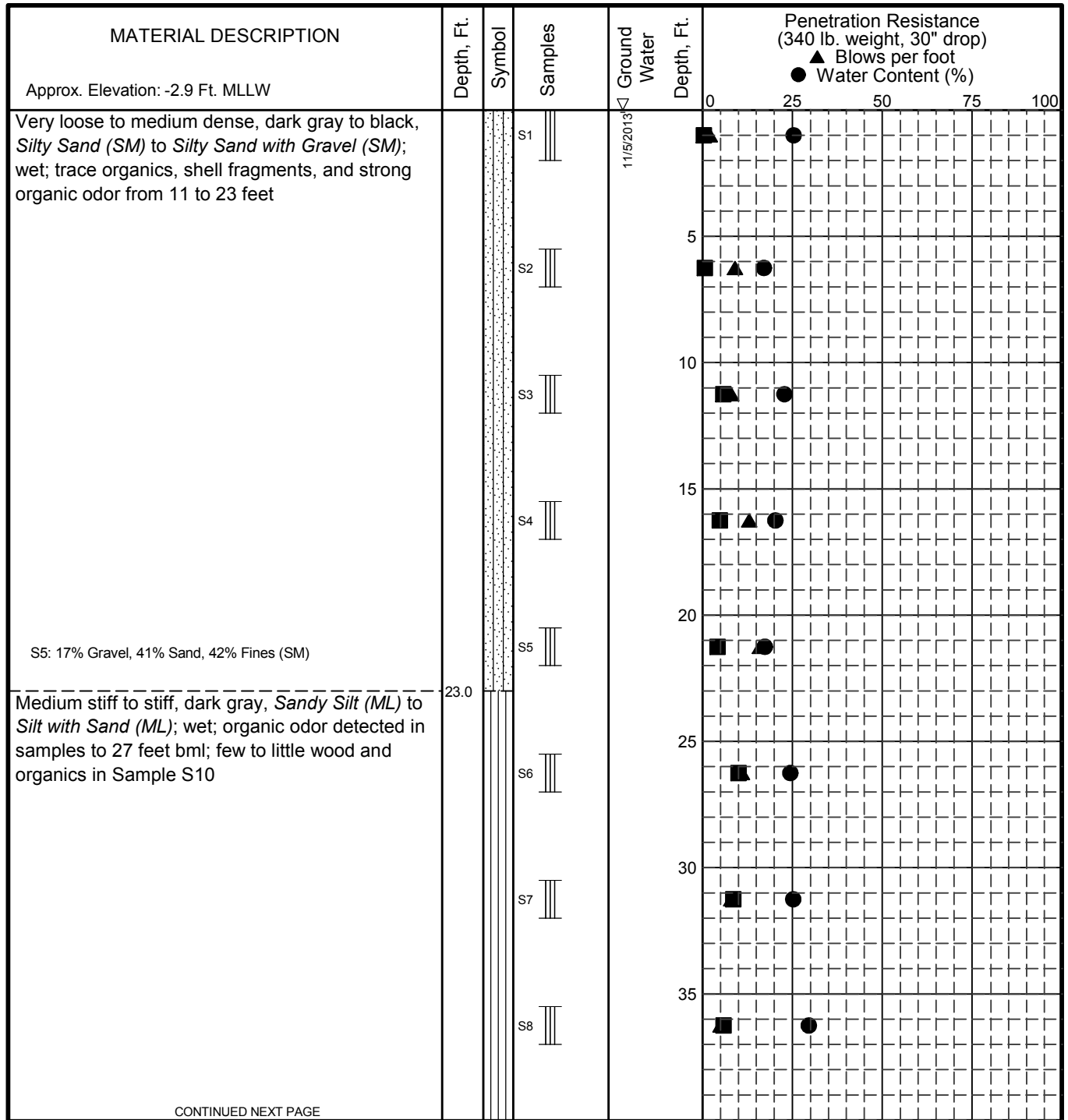
August 2017

32-1-02348-001

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. A-17

GEOTECHNICAL LOG 02348 LOGS.GPJ S&W GEO1.GDT 8/9/17



CONTINUED NEXT PAGE

LEGEND

- * Sample Not Recovered ▽ Ground Water Level At Time Of Drilling
- ▤ Grab Sample
- ▧ 3" O.D. Split Spoon Sample
- Shelby Tube
- PID Reading (ppm)
- Liquid Limit
- Plastic 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.
4. PP (Pocket Penetrometer) tests estimate Unconfined Compressive Strength of Cohesive Soils. TV (Torvane) tests estimate the Undrained Shear Strength of Cohesive Soils. All measurements in tons per square foot.

Navigational Improvements Study
Head of Passage Canal, Whittier, Alaska

LOG OF BORING B-17

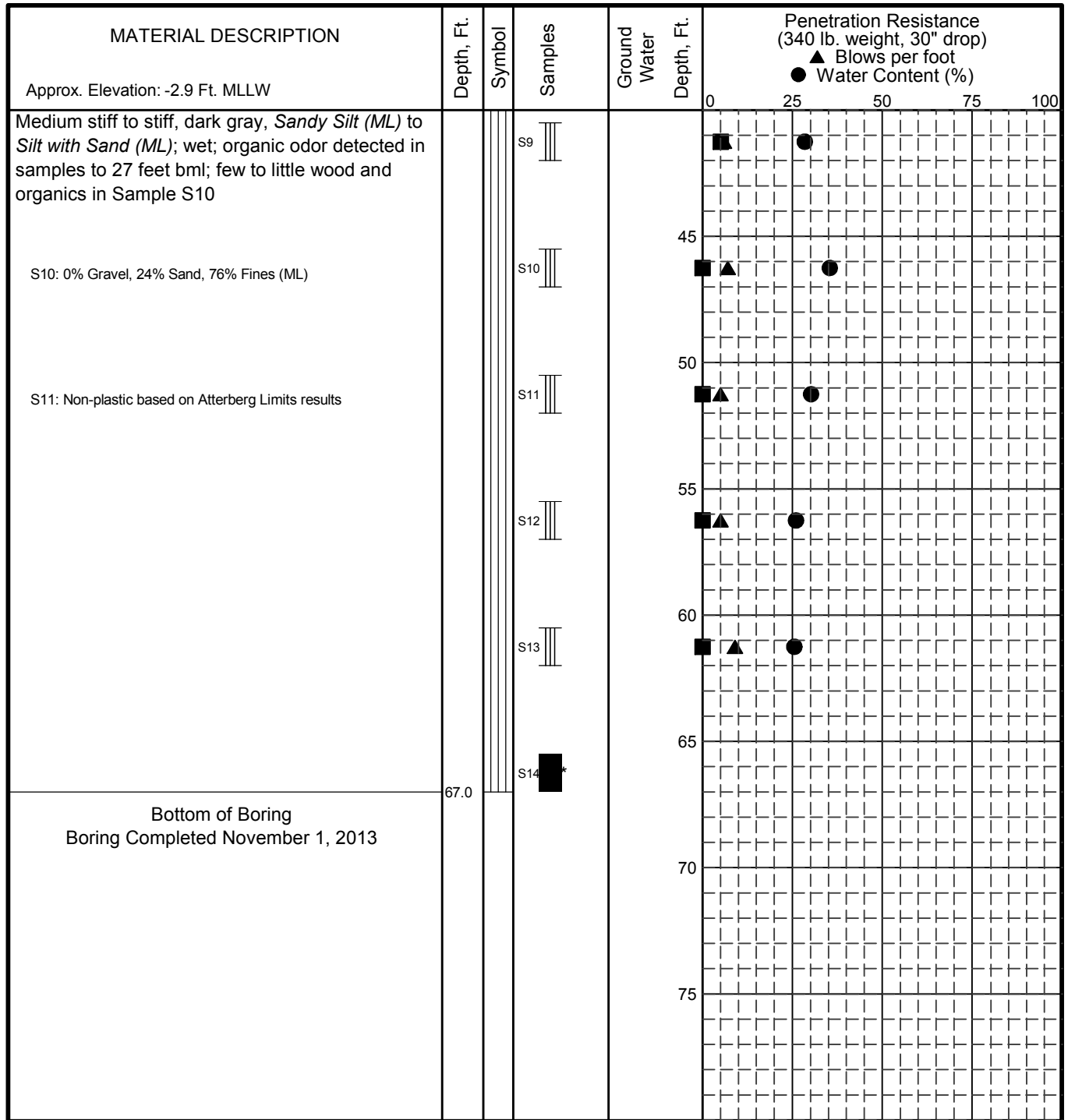
August 2017

32-1-02348-001

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. A-18
Sheet 1 of 2

GEOTECHNICAL LOG 02348 LOGS.GPJ S&W GEO1.GDT 8/9/17



LEGEND

- * Sample Not Recovered ▽ Ground Water Level At Time Of Drilling
- ▤ Grab Sample
- ▤ 3" O.D. Split Spoon Sample
- Shelby Tube
- PID Reading (ppm)
- Liquid Limit
- Natural Water Content

NOTES

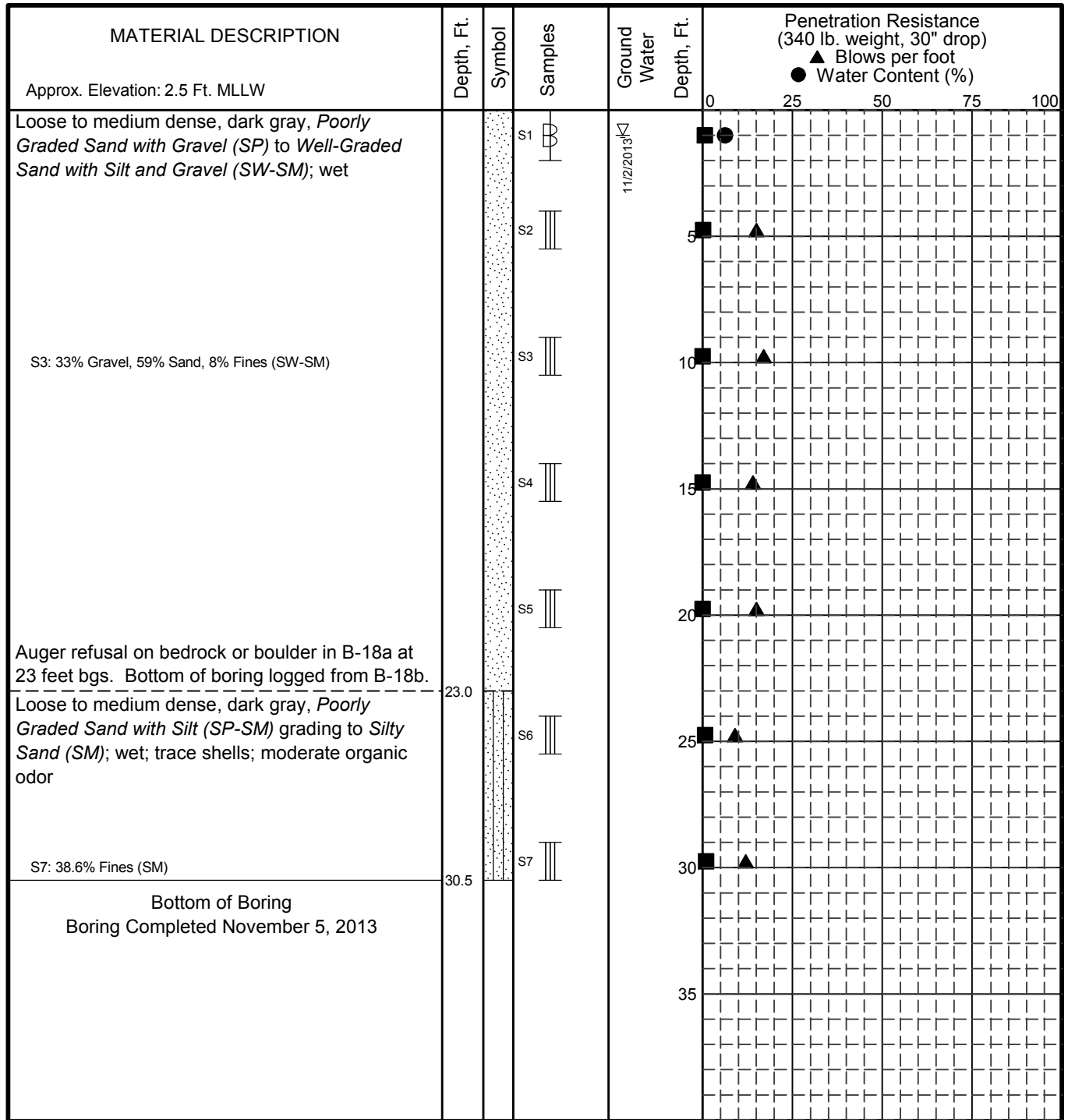
1. The stratification lines represent the approximate boundaries between soil types, and the transition may be gradual.
2. The discussion in the text of this report is necessary for a proper understanding of the nature of subsurface materials.
3. Water level, if indicated above, is for the date specified and may vary.
4. PP (Pocket Penetrometer) tests estimate Unconfined Compressive Strength of Cohesive Soils. TV (Torvane) tests estimate the Undrained Shear Strength of Cohesive Soils. All measurements in tons per square foot.

Navigational Improvements Study
Head of Passage Canal, Whittier, Alaska

LOG OF BORING B-17

August 2017

32-1-02348-001



LEGEND

- * Sample Not Recovered ∇ Ground Water Level At Time Of Drilling ■ PID Reading (ppm)
- ⊞ Grab Sample Plastic Limit —●— Liquid Limit
- ⊞ 3" O.D. Split Spoon Sample 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.
4. PP (Pocket Penetrometer) tests estimate Unconfined Compressive Strength of Cohesive Soils. TV (Torvane) tests estimate the Undrained Shear Strength of Cohesive Soils. All measurements in tons per square foot.

Navigational Improvements Study
Head of Passage Canal, Whittier, Alaska

LOG OF BORING B-18

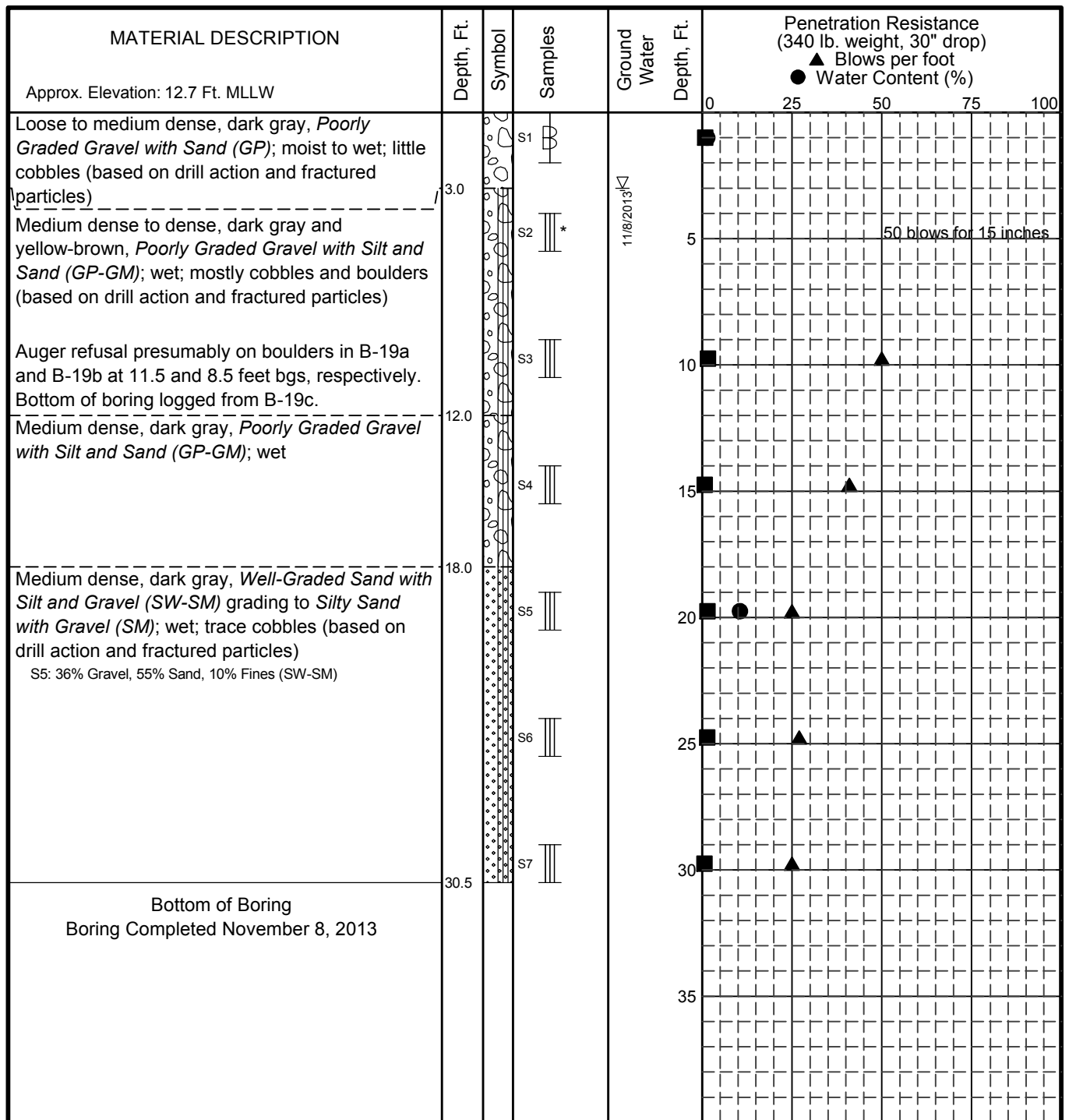
August 2017

32-1-02348-001

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. A-19

GEOTECHNICAL LOG 02348 LOGS.GPJ S&W GEO1.GDT 8/9/17



LEGEND

- * Sample Not Recovered
- Grab Sample
- 3" O.D. Split Spoon Sample
- Ground Water Level At Time Of Drilling
- PID Reading (ppm)
- Plastic Limit
- Liquid Limit
- Natural Water Content

NOTES

- The stratification lines represent the approximate boundaries between soil types, and the transition may be gradual.
- The discussion in the text of this report is necessary for a proper understanding of the nature of subsurface materials.
- Water level, if indicated above, is for the date specified and may vary.
- PP (Pocket Penetrometer) tests estimate Unconfined Compressive Strength of Cohesive Soils. TV (Torvane) tests estimate the Undrained Shear Strength of Cohesive Soils. All measurements in tons per square foot.

Navigational Improvements Study
Head of Passage Canal, Whittier, Alaska

LOG OF BORING B-19

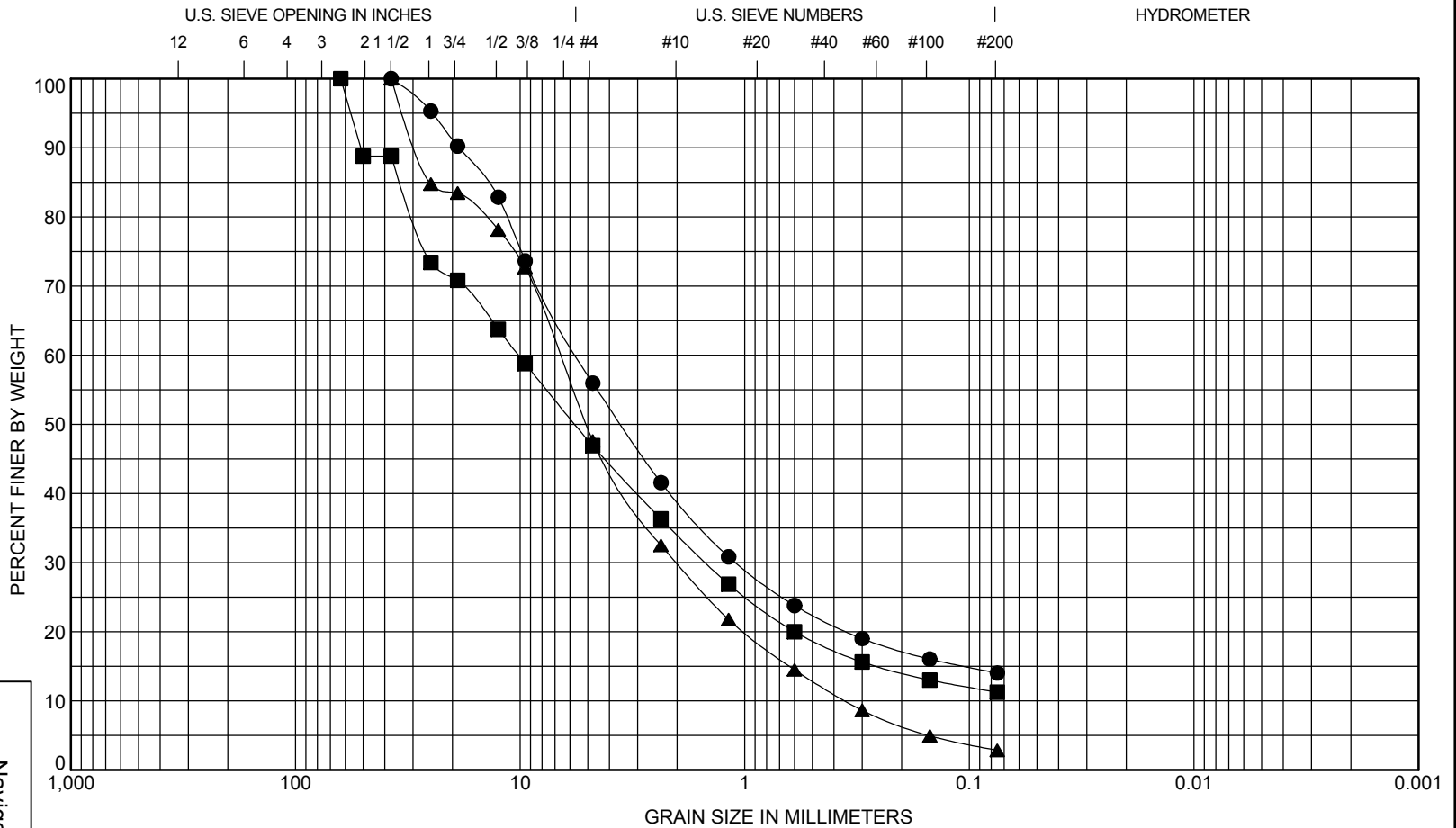
August 2017

32-1-02348-001

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. A-20

GEOTECHNICAL LOG 02348 LOGS.GPJ S&W GEO1.GDT 8/9/17



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Sample	Depth, Ft	Classification					LL	PL	PI	Cc	Cu
● B-01 S3	10.0 - 11.5	Silty Gravel with Sand (GM)									
■ B-02 S5	15.0 - 16.5	Poorly Graded Gravel with Silt and Sand (GP-GM)								4.8	223.2
▲ B-03 S3	10.4 - 11.9	Well-Graded Gravel with Sand (GW)								1.7	19.0
Sample	Depth, Ft	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay		
● B-01 S3	10.0 - 11.5	37.5	5.56	1.09		44	42		14		
■ B-02 S5	15.0 - 16.5	63	10.15	1.48		53	36		11		
▲ B-03 S3	10.4 - 11.9	37.5	6.69	2.01	0.35	52	45		3		

Navigational Improvements Study
Head of Passage Canal, Whittier, Alaska

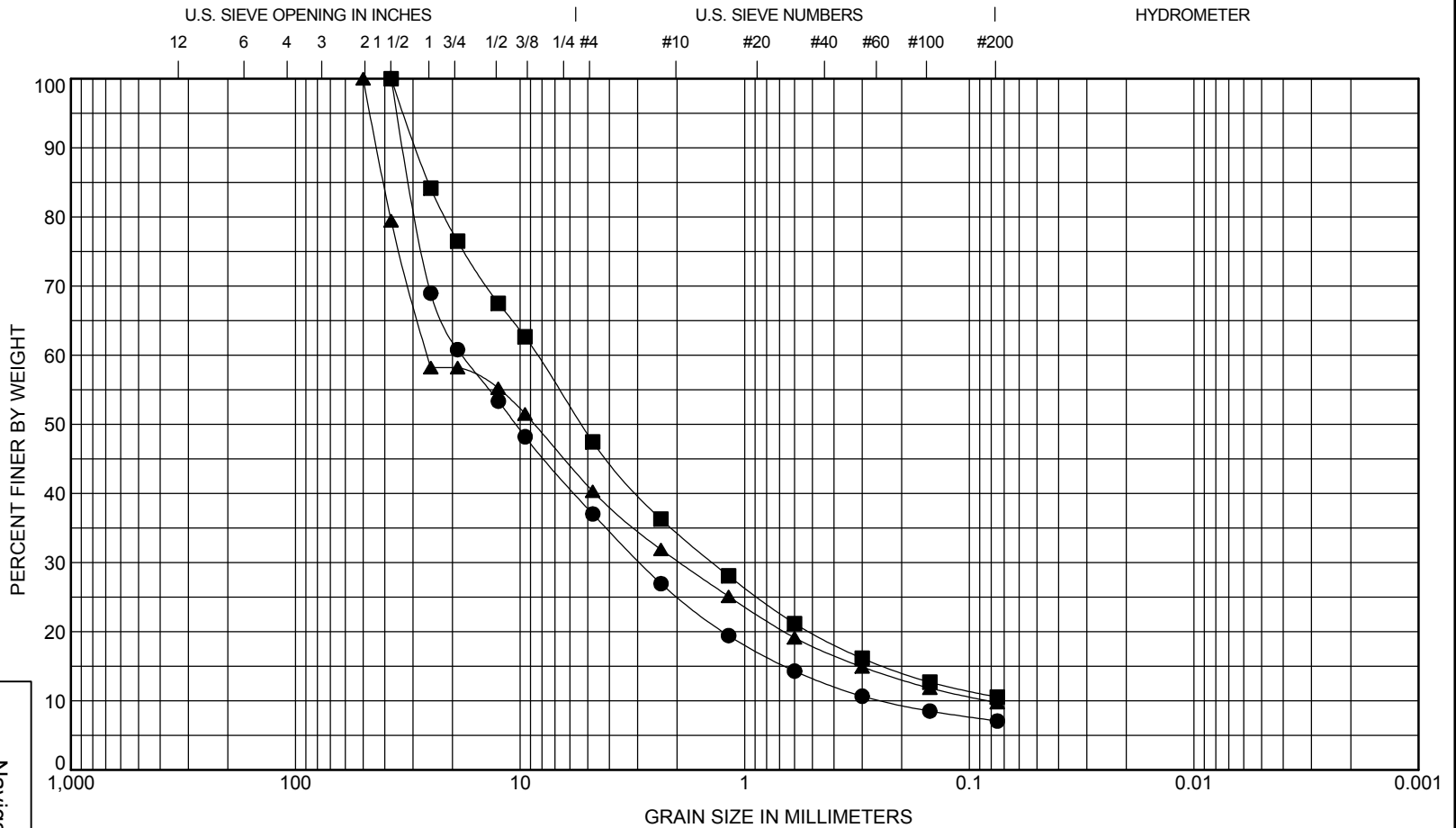
GRAIN SIZE CLASSIFICATION

August 2017

32-1-02348-001

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. A-21
Sheet 1 of 12



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

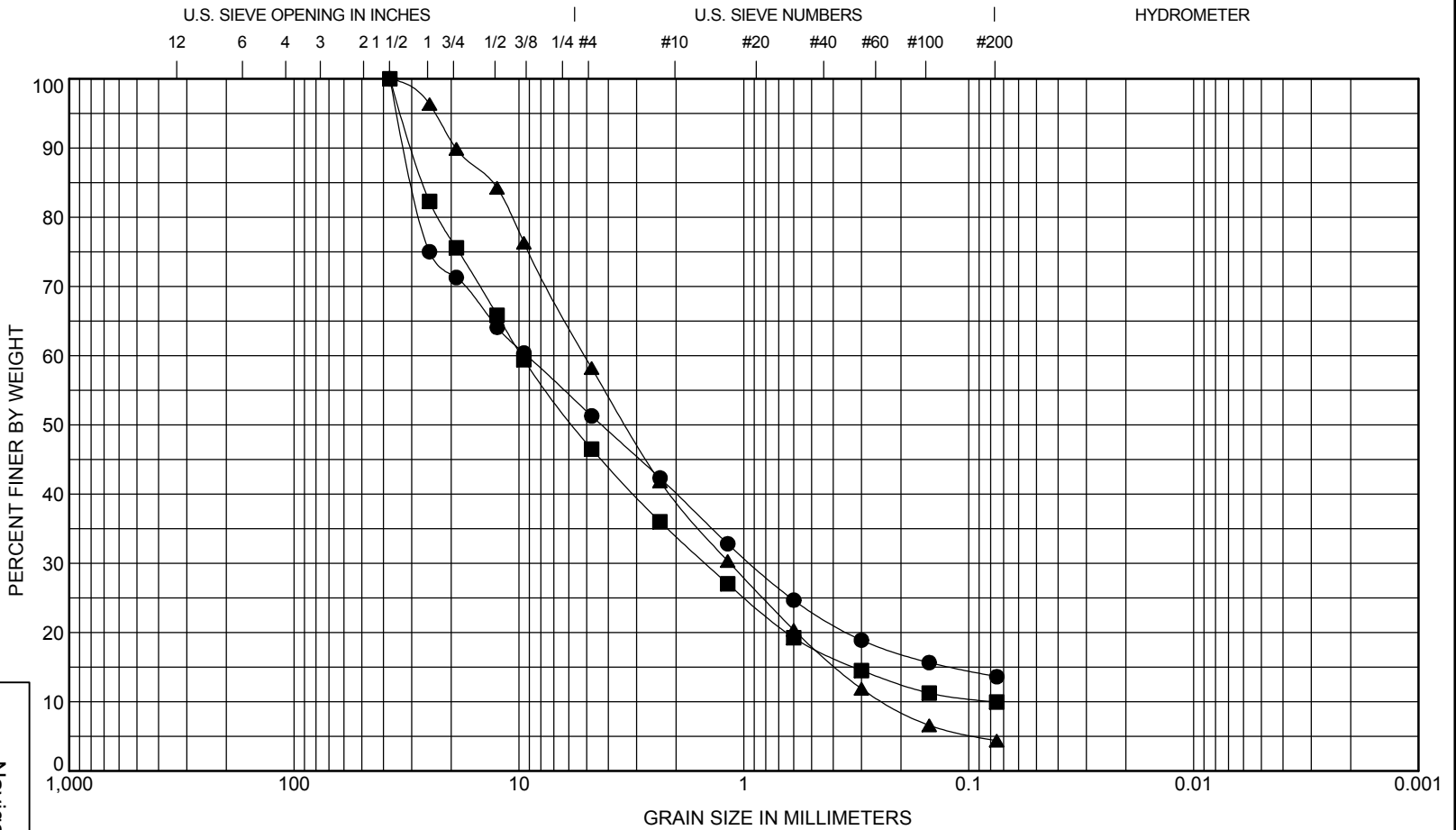
Sample	Depth, Ft	Classification					LL	PL	PI	Cc	Cu
● B-04 S3	9.0 - 10.5	Well-Graded Gravel with Silt and Sand (GW-GM)								1.9	75.1
■ B-04 S7	29.0 - 30.5	Poorly Graded Gravel with Silt and Sand (GP-GM)								3.6	133.3
▲ B-05 S2	8.5 - 10.0	Well-Graded Gravel with Silt and Sand (GW-GM)								1.8	315.1
Sample	Depth, Ft	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay		
● B-04 S3	9.0 - 10.5	37.5	18.16	2.92	0.24	63	30	7			
■ B-04 S7	29.0 - 30.5	37.5	8.42	1.39		53	37	11			
▲ B-05 S2	8.5 - 10.0	50	25.87	1.95	0.08	60	31	10			

Navigational Improvements Study
Head of Passage Canal, Whittier, Alaska

GRAIN SIZE CLASSIFICATION

August 2017

32-1-02348-001



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Sample	Depth, Ft	Classification					LL	PL	PI	Cc	Cu
● B-05 S6	28.5 - 30.0	Silty Gravel with Sand (GM)									
■ B-05 S11	53.5 - 55.0	Well-Graded Gravel with Silt and Sand (GW-GM)								2.9	127.1
▲ B-06 S5	22.3 - 23.8	Well-Graded Sand with Gravel (SW)								1.1	21.7
Sample	Depth, Ft	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay		
● B-05 S6	28.5 - 30.0	37.5	9.23	0.93		49	38	14			
■ B-05 S11	53.5 - 55.0	37.5	9.74	1.48	0.08	53	37	10			
▲ B-06 S5	22.3 - 23.8	37.5	5.09	1.15	0.23	42	54	4			

Navigational Improvements Study
 Head of Passage Canal, Whittier, Alaska

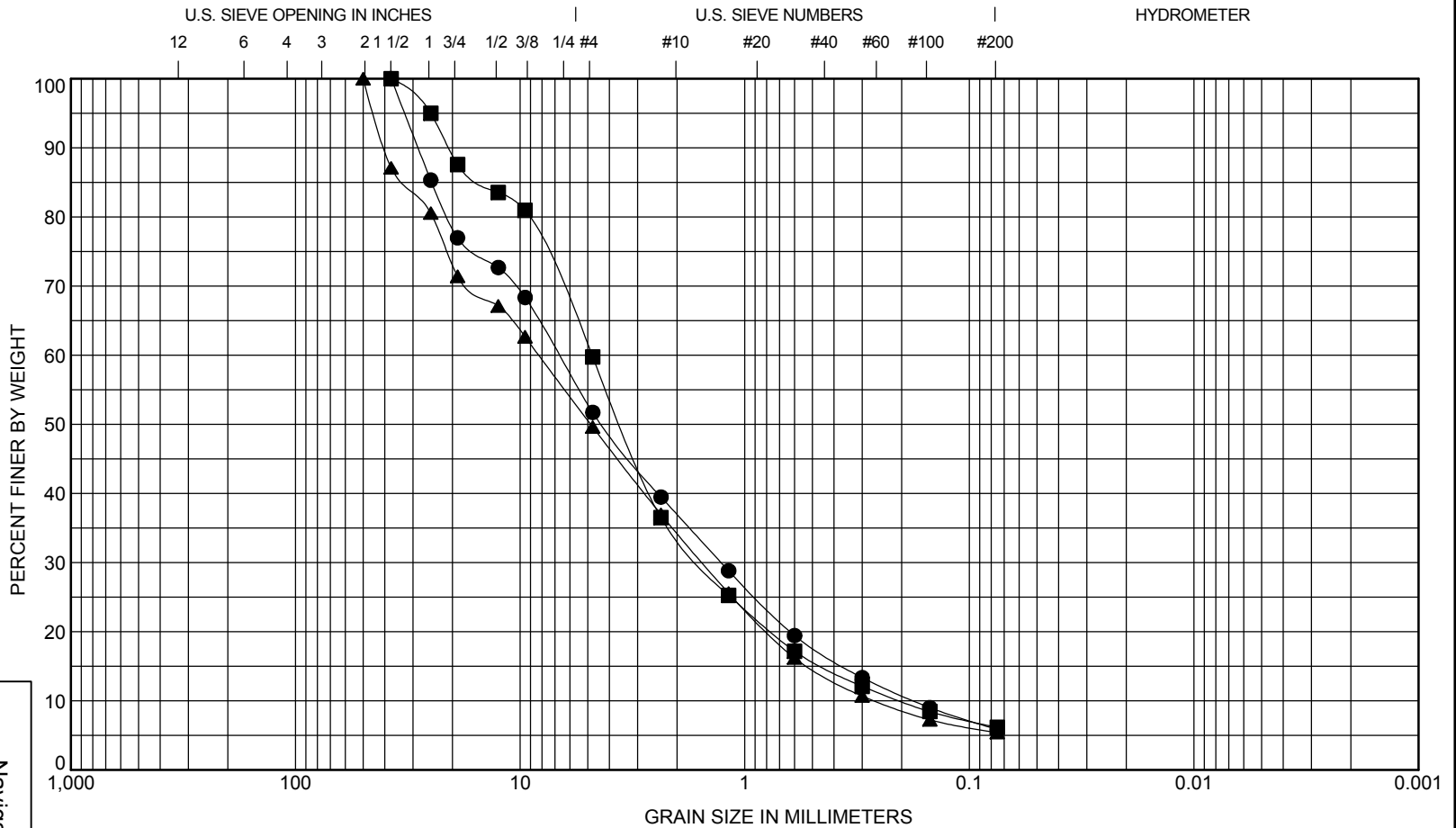
GRAIN SIZE CLASSIFICATION

August 2017

32-1-02348-001

SHANNON & WILSON, INC.
 Geotechnical and Environmental Consultants

FIG. A-21
 Sheet 3 of 12



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Sample	Depth, Ft	Classification					LL	PL	PI	Cc	Cu
● B-06 S13	60.5 - 62.0	Well-Graded Gravel with Silt and Sand (GW-GM)								1.4	38.2
■ B-06 S17	80.5 - 82.0	Well-Graded Sand with Silt and Gravel (SW-SM)								2.6	23.7
▲ B-07 S2	4.5 - 6.0	Well-Graded Gravel with Silt and Sand (GW-GM)								1.1	31.6
Sample	Depth, Ft	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay		
● B-06 S13	60.5 - 62.0	37.5	6.71	1.27	0.18	48	46	6			
■ B-06 S17	80.5 - 82.0	37.5	4.79	1.58	0.2	40	54	6			
▲ B-07 S2	4.5 - 6.0	50	8.25	1.54	0.26	50	44	5			

Navigational Improvements Study
Head of Passage Canal, Whittier, Alaska

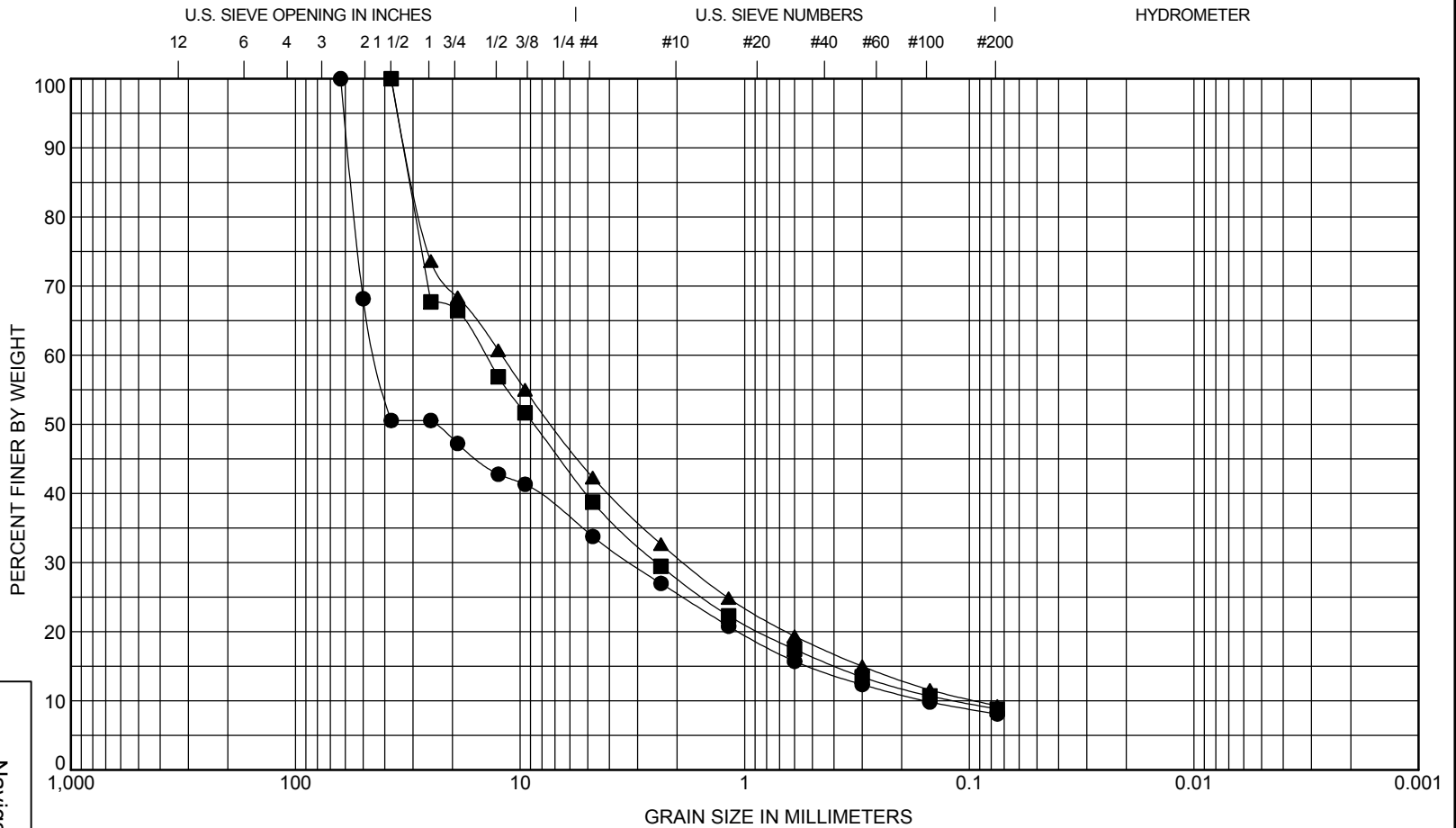
GRAIN SIZE CLASSIFICATION

August 2017

32-1-02348-001

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. A-21
Sheet 4 of 12



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Sample	Depth, Ft	Classification					LL	PL	PI	Cc	Cu
● B-07 S7	29.5 - 31.0	Well-Graded Gravel with Silt and Sand (GW-GM)								1.5	278.7
■ B-08 S3	9.0 - 10.5	Poorly Graded Gravel with Silt and Sand (GP-GM)								3.6	123.2
▲ B-08 S8	34.0 - 35.5	Poorly Graded Gravel with Silt and Sand (GP-GM)								3.1	129.6
Sample	Depth, Ft	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay		
● B-07 S7	29.5 - 31.0	63	43.76	3.22	0.16	66	26	8			
■ B-08 S3	9.0 - 10.5	37.5	14.33	2.46	0.12	61	30	9			
▲ B-08 S8	34.0 - 35.5	37.5	12.08	1.86	0.09	58	33	9			

Navigationl Improvements Study
Head of Passage Canal, Whittier, Alaska

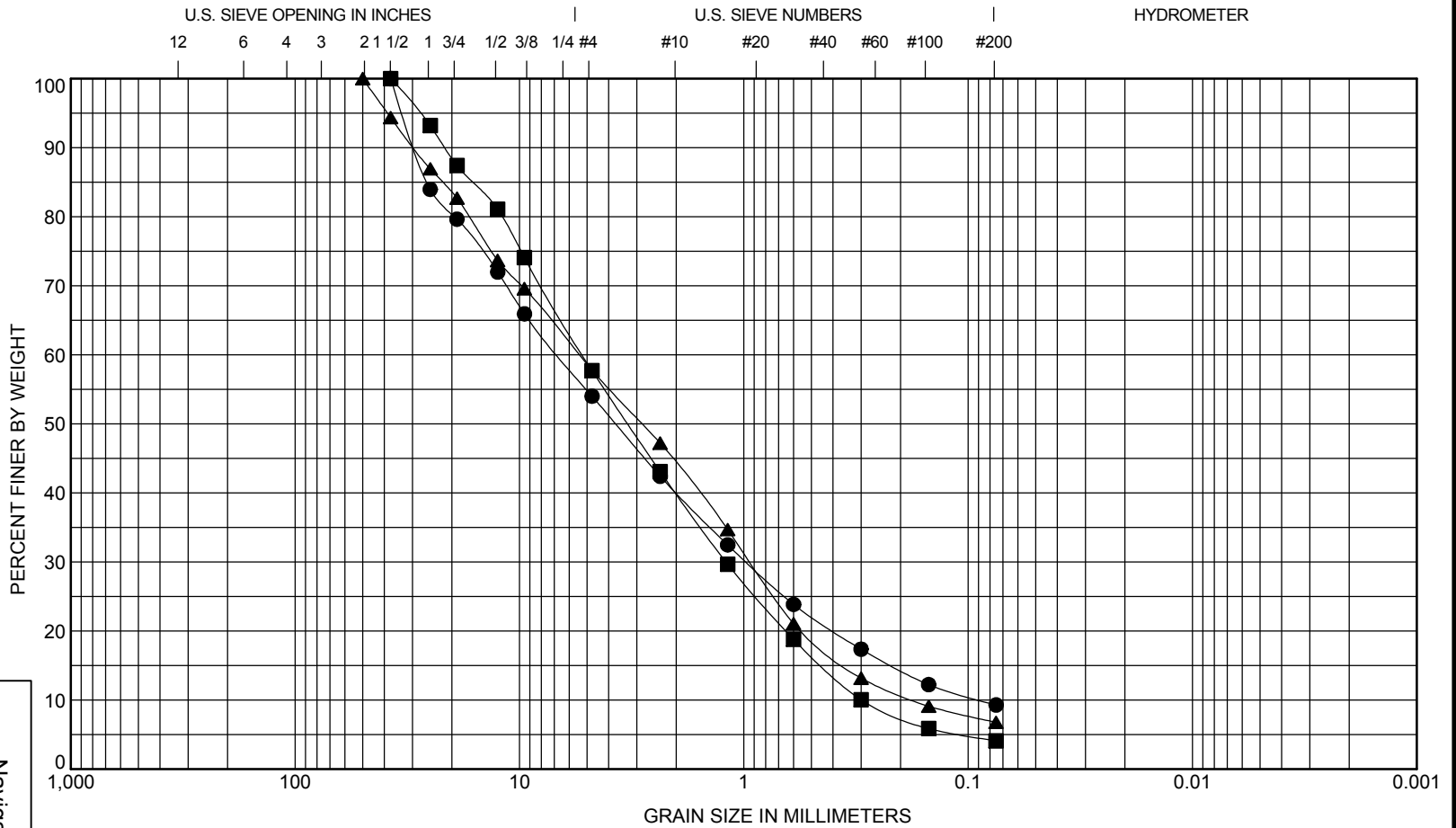
GRAIN SIZE CLASSIFICATION

August 2017

32-1-02348-001

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. A-21
Sheet 5 of 12

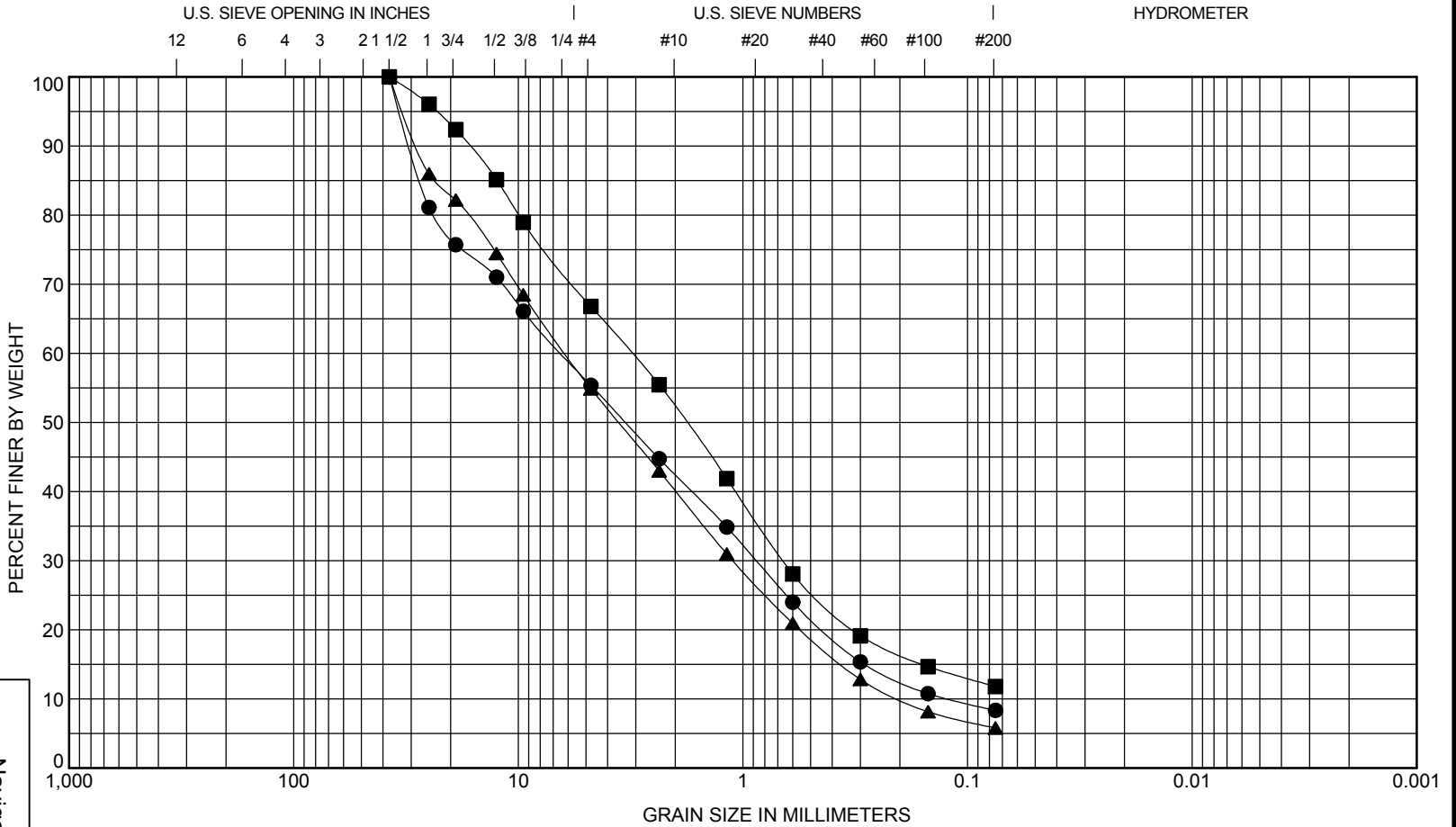


COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Sample	Depth, Ft	Classification					LL	PL	PI	Cc	Cu
● B-08 S12	54.0 - 55.5	Well-Graded Gravel with Silt and Sand (GW-GM)								1.6	75.9
■ B-09 S3	10.5 - 12.0	Poorly Graded Sand with Gravel (SP)								0.9	17.5
▲ B-09 S10	41.3 - 42.8	Poorly Graded Sand with Silt and Gravel (SP-SM)								0.9	31.0
Sample	Depth, Ft	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay		
● B-08 S12	54.0 - 55.5	37.5	6.73	0.97	0.09	46	45	9			
■ B-09 S3	10.5 - 12.0	37.5	5.24	1.2	0.3	42	54	4			
▲ B-09 S10	41.3 - 42.8	50	5.41	0.93	0.17	42	51	7			

GRAIN SIZE CLASSIFICATION

Navigationl Improvements Study
Head of Passage Canal, Whittier, Alaska



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

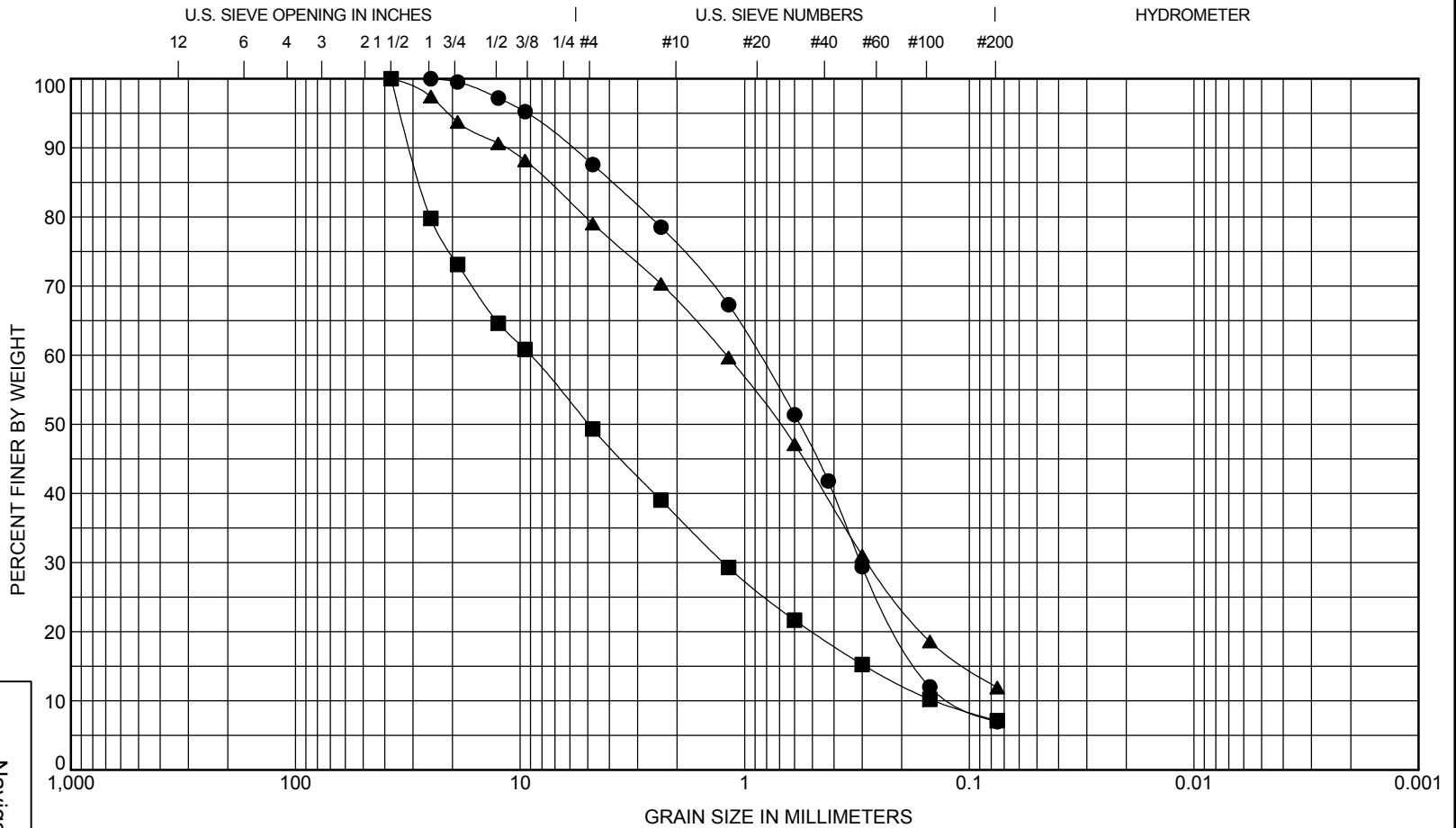
Sample	Depth, Ft	Classification					LL	PL	PI	Cc	Cu
● B-10 S5	14.0 - 15.5	Well-Graded Sand with Silt and Gravel (SW-SM)								1.0	53.2
■ B-11 S4	14.0 - 15.5	Well-Graded Sand with Silt and Gravel (SW-SM)								2.9	64.1
▲ B-12 S2	7.0 - 8.5	Well-Graded Sand with Silt and Gravel (SW-SM)								1.0	31.2
Sample	Depth, Ft	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay		
● B-10 S5	14.0 - 15.5	37.5	6.41	0.87	0.12	45	47	8			
■ B-11 S4	14.0 - 15.5	37.5	3.12	0.66		33	55	12			
▲ B-12 S2	7.0 - 8.5	37.5	6.17	1.11	0.2	45	49	6			

Navigation Improvements Study
 Head of Passage Canal, Whittier, Alaska

GRAIN SIZE CLASSIFICATION

August 2017

32-1-02348-001



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Sample	Depth, Ft	Classification					LL	PL	PI	Cc	Cu
● B-12 S6	23.3 - 24.8	Poorly Graded Sand with Silt (SP-SM)								0.9	7.6
■ B-13 S2	4.0 - 5.5	Well-Graded Gravel with Silt and Sand (GW-GM)								1.2	63.2
▲ B-13 S7	29.0 - 30.5	Well-Graded Sand with Silt and Gravel (SW-SM)								1.1	19.6
Sample	Depth, Ft	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay		
● B-12 S6	23.3 - 24.8	25	0.87	0.31	0.11	12	81	7			
■ B-13 S2	4.0 - 5.5	37.5	9.03	1.24	0.14	51	42	7			
▲ B-13 S7	29.0 - 30.5	37.5	1.21	0.28	0.07	21	67	12			

Navigational Improvements Study
Head of Passage Canal, Whittier, Alaska

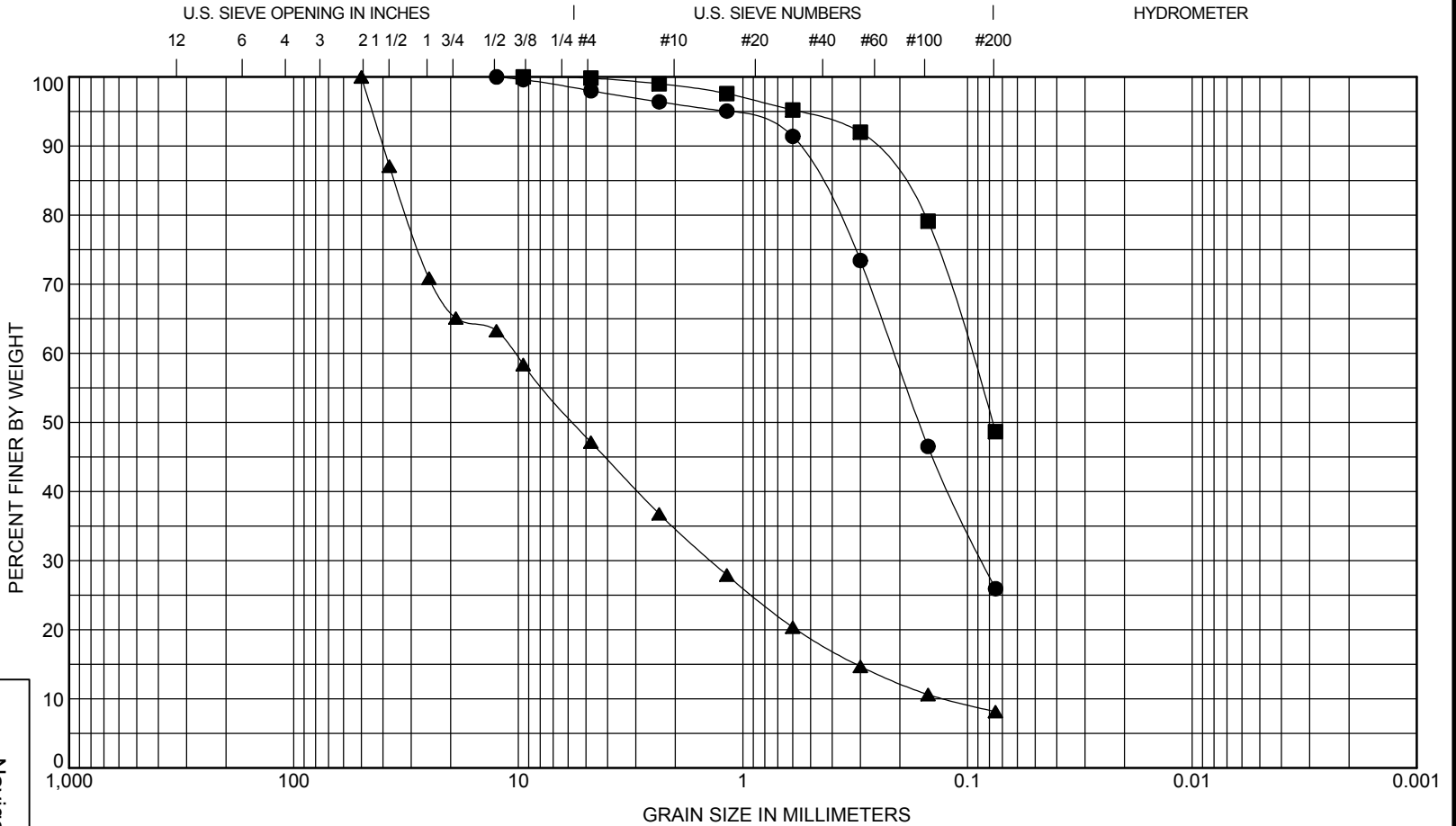
GRAIN SIZE CLASSIFICATION

August 2017

32-1-02348-001

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. A-21
Sheet 8 of 12



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Sample	Depth, Ft	Classification					LL	PL	PI	Cc	Cu
● B-14 S4	16.0 - 17.5	Silty Sand (SM)									
■ B-14 S6	25.5 - 27.0	Silty Sand (SM)									
▲ B-15 S3	9.0 - 10.5	Well-Graded Gravel with Silt and Sand (GW-GM)								1.5	82.7
Sample	Depth, Ft	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay		
● B-14 S4	16.0 - 17.5	12.5	0.21	0.09		2	72		26		
■ B-14 S6	25.5 - 27.0	9.5	0.1			0	51		49		
▲ B-15 S3	9.0 - 10.5	50	10.4	1.39	0.13	53	39		8		

Navigationl Improvements Study
Head of Passage Canal, Whittier, Alaska

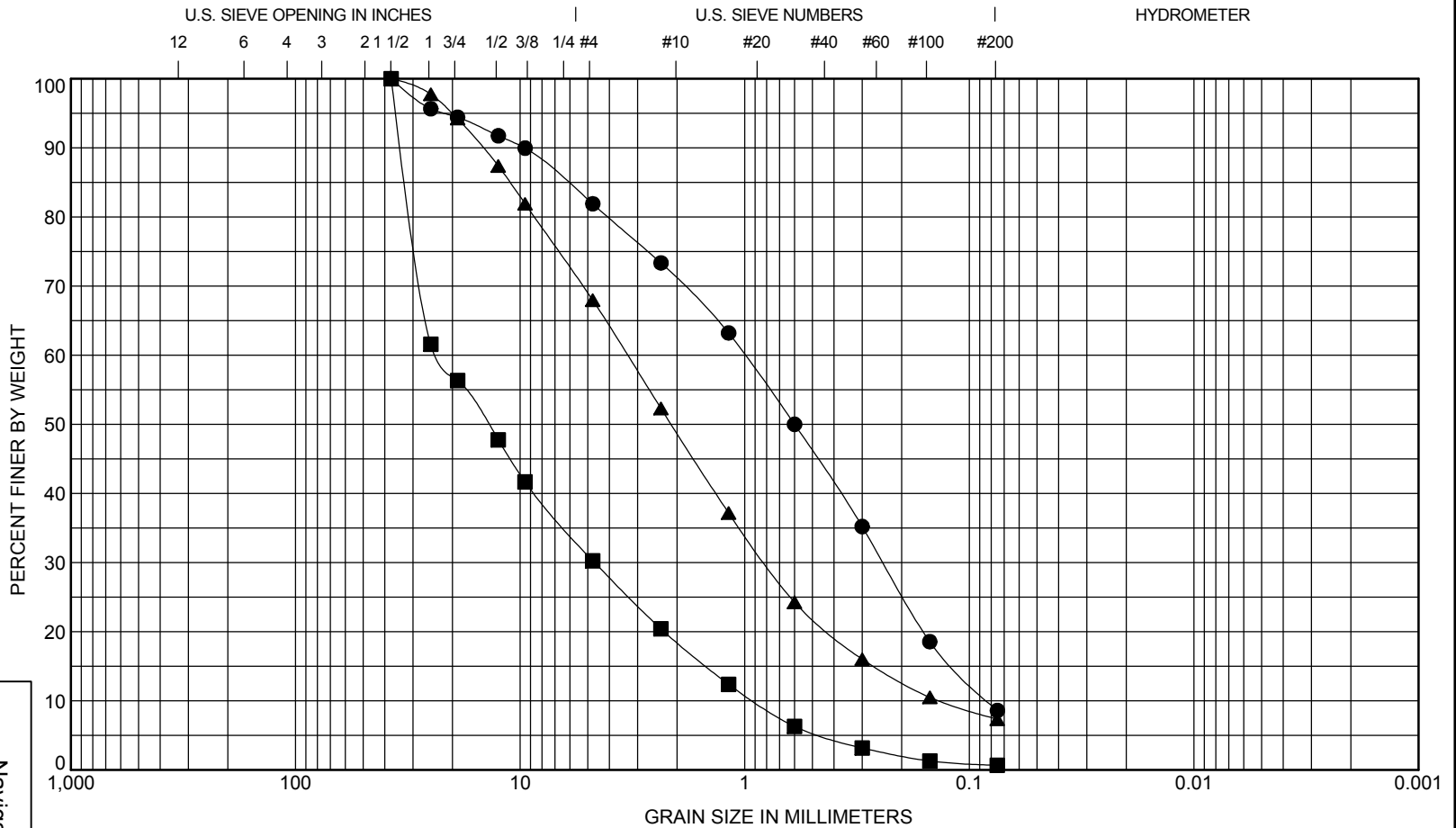
GRAIN SIZE CLASSIFICATION

August 2017

32-1-02348-001

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. A-21
Sheet 9 of 12



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

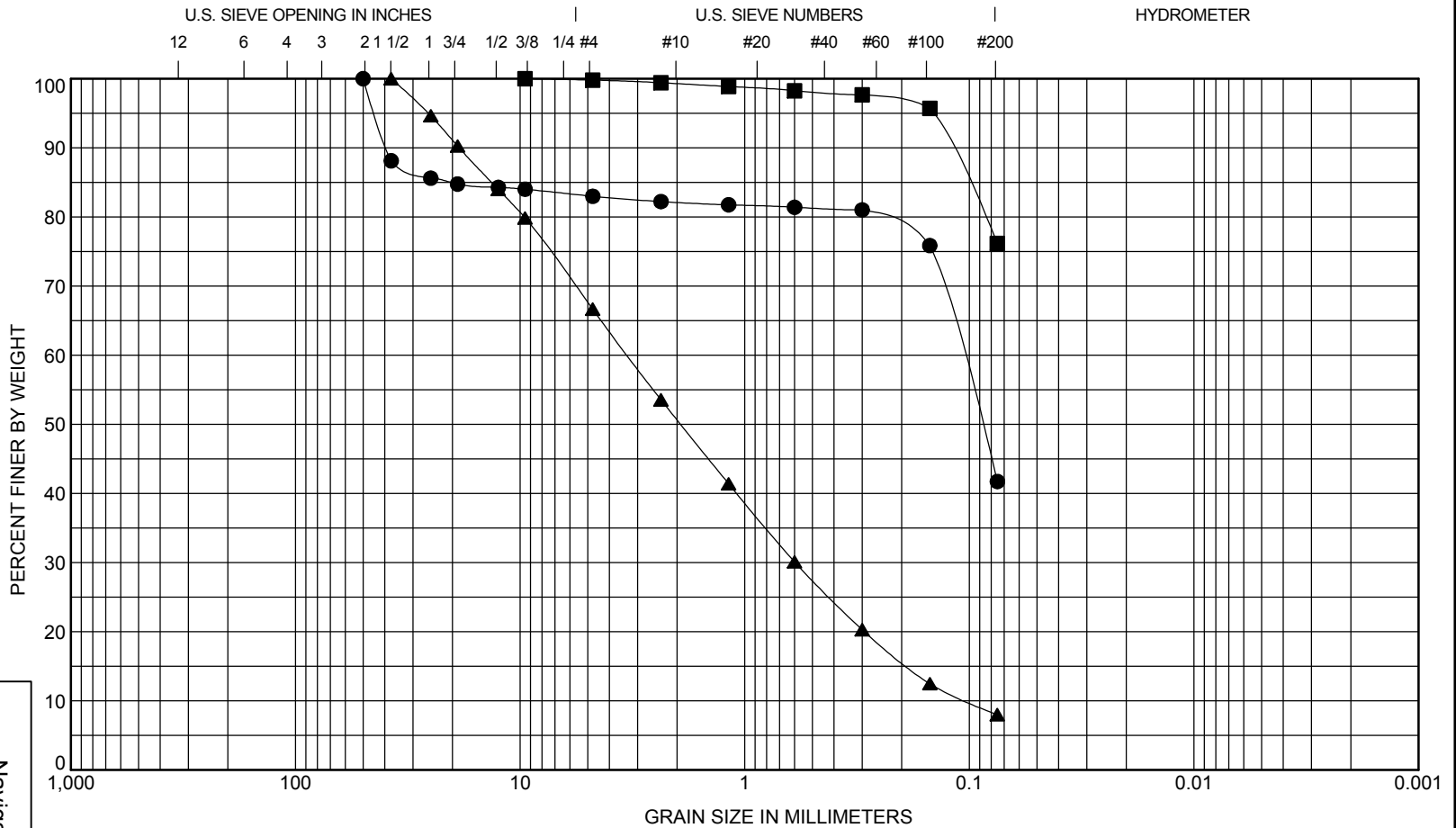
Sample	Depth, Ft	Classification					LL	PL	PI	Cc	Cu
● B-15 S6	24.0 - 25.5	Poorly Graded Sand with Silt and Gravel (SP-SM)								0.7	12.1
■ B-16 S1	0.0 - 1.5	Well-Graded Gravel with Sand (GW)								1.0	25.4
▲ B-16 S4	14.5 - 16.0	Poorly Graded Sand with Silt and Gravel (SP-SM)								1.5	24.7
Sample	Depth, Ft	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay		
● B-15 S6	24.0 - 25.5	37.5	1	0.24	0.08	18	73	9			
■ B-16 S1	0.0 - 1.5	37.5	23.01	4.66	0.91	70	30	1			
▲ B-16 S4	14.5 - 16.0	37.5	3.33	0.81	0.13	32	61	7			

Navigationl Improvements Study
Head of Passage Canal, Whittier, Alaska

GRAIN SIZE CLASSIFICATION

August 2017

32-1-02348-001



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Sample	Depth, Ft	Classification					LL	PL	PI	Cc	Cu
● B-17 S5	20.5 - 22.0	Silty Sand with Gravel (SM)									
■ B-17 S10	45.5 - 47.0	Silt with Sand (ML)									
▲ B-18 S3	10.0 - 11.5	Well-Graded Sand with Silt and Gravel (SW-SM)								1.0	32.6
Sample	Depth, Ft	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay		
● B-17 S5	20.5 - 22.0	50	0.11			17	41		42		
■ B-17 S10	45.5 - 47.0	9.5				0	24		76		
▲ B-18 S3	10.0 - 11.5	37.5	3.33	0.6	0.1	33	59		8		

GRAIN SIZE CLASSIFICATION

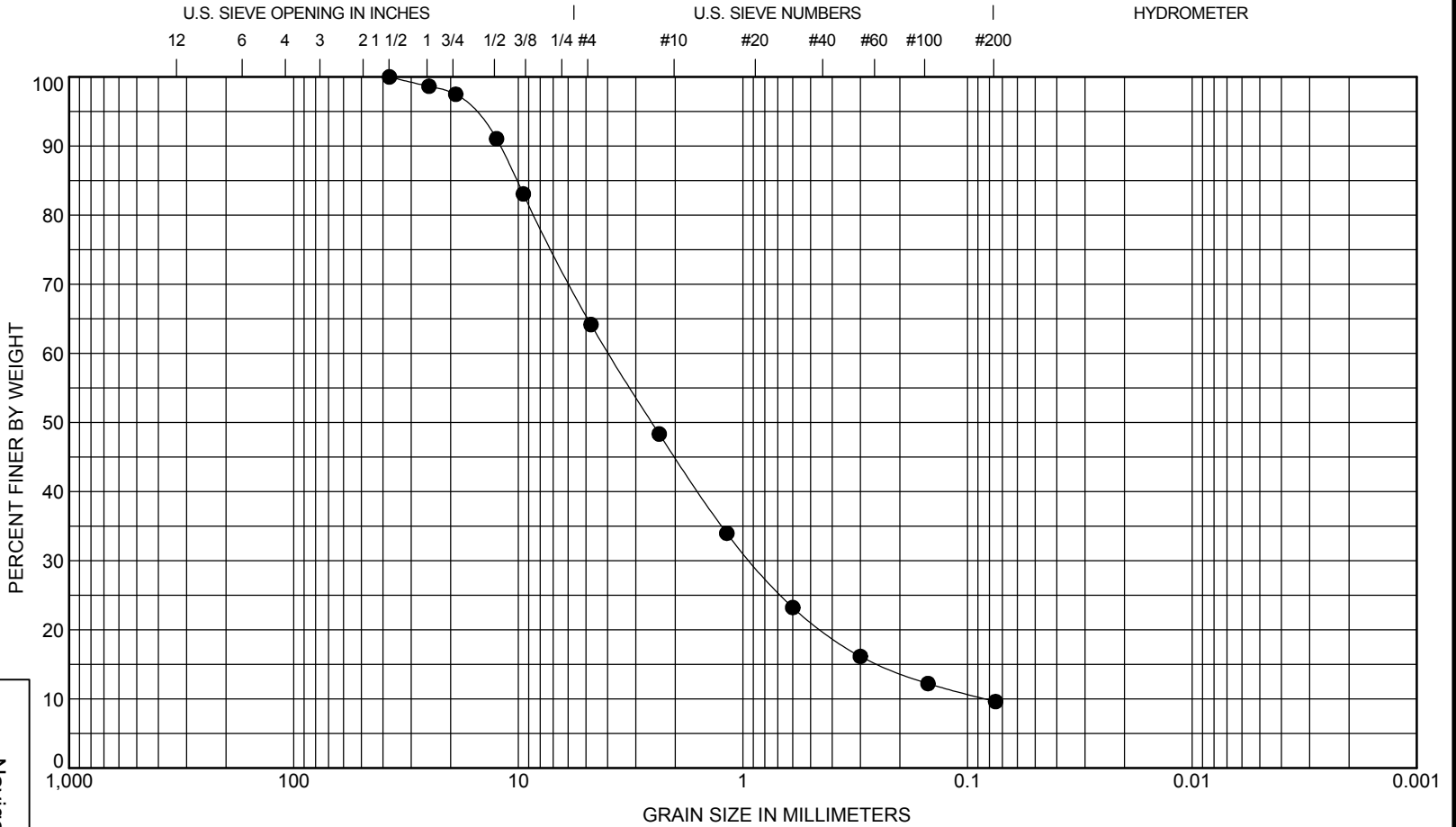
Navigationl Improvements Study
Head of Passage Canal, Whittier, Alaska

August 2017

32-1-02348-001

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. A-21
Sheet 11 of 12



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Sample	Depth, Ft	Classification					LL	PL	PI	Cc	Cu
● B-19 S5	19.0 - 20.5	Well-Graded Sand with Silt and Gravel (SW-SM)								2.6	47.5

Sample	Depth, Ft	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● B-19 S5	19.0 - 20.5	37.5	3.95	0.92	0.08	36	55	10	

GRAIN SIZE CLASSIFICATION

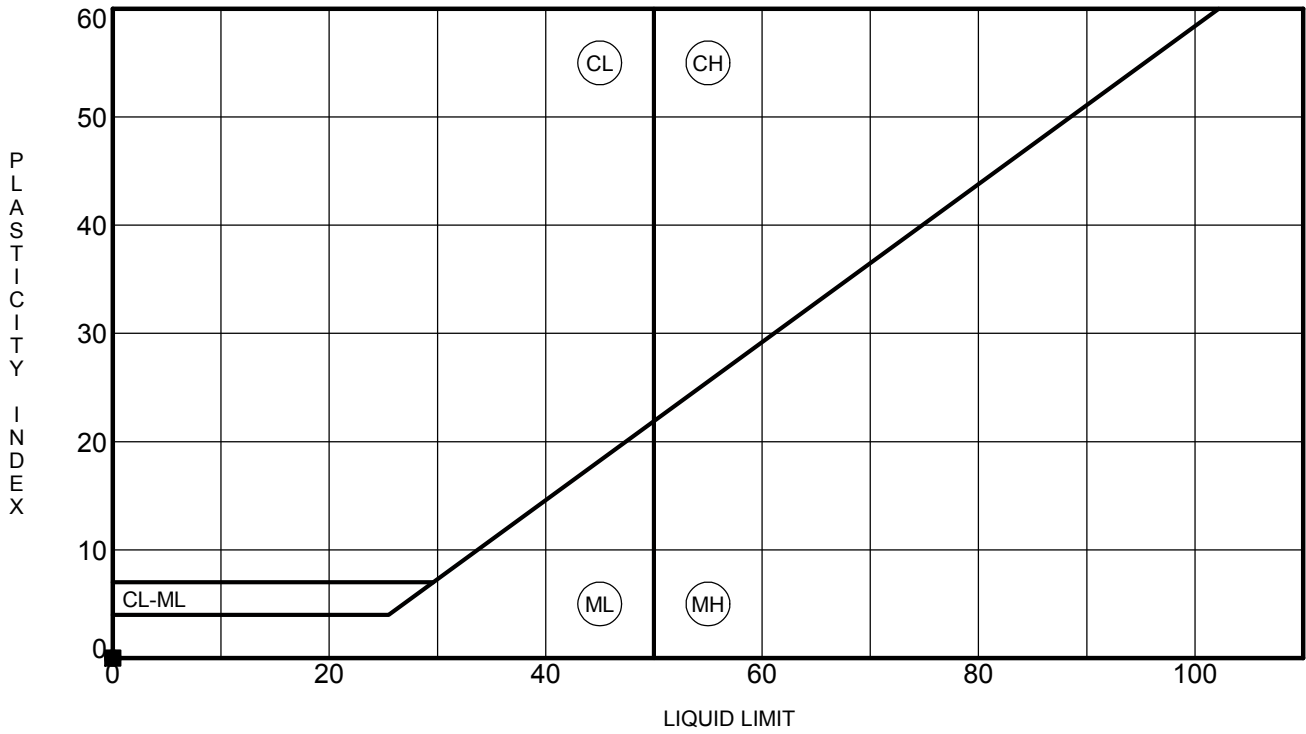
Navigationl Improvements Study
Head of Passage Canal, Whittier, Alaska

August 2017

32-1-02348-001



FIG. A-21
Sheet 12 of 12



Boring	Depth, Ft	LL	PL	PI	Fines	Classification
● B-14	35.5 - 37.0	NP	NP	NP		ML
■ B-17	50.5 - 52.0	NP	NP	NP		ML

Navigational Improvements Study
 Head of Passage Canal, Whittier, Alaska

ATTERBERG LIMITS RESULTS

August 2017 32-1-02348-001

SHANNON & WILSON, INC.
 Geotechnical and Environmental Consultants

FIG. A-22

APPENDIX B

**RESULTS OF ANALYTICAL TESTING BY
SGS NORTH AMERICA, INC. OF ANCHORAGE ALASKA
AND
ADEC LABORATORY DATA REVIEW CHECKLISTS**



Laboratory Report of Analysis

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

Report Number: **1135357**

Client Project: **32-1-02348 Whittier Navigation**

Dear Ryan Collins,

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 five 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 Steve 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.

Steve Crupi
Project Manager
steven.crupi@sgs.com

Date

Print Date: 11/13/2013 2:40:39PM

Case Narrative

Customer: SHANNOT

Shannon & Wilson, Inc.

Project: 1135357

32-1-02348 Whittier Navigation

Refer to the sample receipt form for information on sample condition.

1135357005 PS

2348-B04-S2

AK103 - Unknown hydrocarbon with several peaks is present.

1135357009 PS

2348-B07-S3

AK101 - BFB (surrogate) recovery does not meet QC criteria (biased high) due to matrix interference.

AK102 - The pattern is consistent with a weathered middle distillate.

8270D SIM- Surrogate (2-fluorobiphenyl) recovery is outside of QC criteria due to sample dilution.

8270D SIM - LOQs are elevated due to sample dilution. Sample analyzed at a dilution due to matrix interference with internal standards.

1135357011 PS

2348-B10-S4

AK102 - The pattern is consistent with a weathered middle distillate.

1135357012 PS

2348-B11-S1

AK103 - Unknown hydrocarbon with several peaks is present.

1189684 MS

1135434012MS

6020 - Metals - MS/MSD recoveries for barium were outside of acceptance criteria. Post digestion spike was successful.

1189685 MSD

1135434012MSD

6020 - Metals - MS/MSD recoveries for barium were outside of acceptance criteria. Post digestion spike was successful.

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. If you have any questions regarding this report, or if we can be of any other assistance, please contact your SGS Project Manager at 907-562-2343. All work is provided under SGS general terms and conditions (<http://www.sgs.com/terms_and_conditions.htm>), unless other written agreements have been accepted by both parties.

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: 1020A, 1311, 3010A, 3050B, 3520C, 3550C, 5030B, 5035B, 6020, 7470A, 7471B, 8021B, 8082A, 8260B, 8270D, 8270D-SIM, 9040B, 9045C, 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
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., 2xDL)
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

<u>Client Sample ID</u>	<u>Lab Sample ID</u>	<u>Collected</u>	<u>Received</u>	<u>Matrix</u>
2348-B01-S1	1135357001	10/24/2013	10/29/2013	Soil/Solid (dry weight)
2348-B02-S1	1135357002	10/25/2013	10/29/2013	Soil/Solid (dry weight)
2348-B02-S7	1135357003	10/25/2013	10/29/2013	Soil/Solid (dry weight)
2348-B04-S1	1135357004	10/25/2013	10/29/2013	Soil/Solid (dry weight)
2348-B04-S2	1135357005	10/25/2013	10/29/2013	Soil/Solid (dry weight)
2348-B04-S7	1135357006	10/25/2013	10/29/2013	Soil/Solid (dry weight)
2348-B07-S1	1135357007	10/28/2013	10/29/2013	Soil/Solid (dry weight)
2348-B07-S2	1135357008	10/28/2013	10/29/2013	Soil/Solid (dry weight)
2348-B07-S3	1135357009	10/28/2013	10/29/2013	Soil/Solid (dry weight)
2348-B07-S7	1135357010	10/28/2013	10/29/2013	Soil/Solid (dry weight)
2348-B10-S4	1135357011	10/26/2013	10/29/2013	Soil/Solid (dry weight)
2348-B11-S1	1135357012	10/26/2013	10/29/2013	Soil/Solid (dry weight)
2348-B11-S2	1135357013	10/26/2013	10/29/2013	Soil/Solid (dry weight)
2348-B07-S21	1135357014	10/28/2013	10/29/2013	Soil/Solid (dry weight)
2348-TB	1135357015	10/24/2013	10/29/2013	Soil/Solid (dry weight)
B07-S20	1135357016	10/28/2013	10/29/2013	Soil/Solid (dry weight)
B07-S8	1135357017	10/28/2013	10/29/2013	Soil/Solid (dry weight)

<u>Method</u>	<u>Method Description</u>
8270D SIMS (PAH)	8270 PAH SIM Semi-Volatiles GC/MS
AK101	AK101/8021 Combo. (S)
SW8021B	AK101/8021 Combo. (S)
AK102	Diesel/Residual Range Organics
AK103	Diesel/Residual Range Organics
SM21 2540G	Percent Solids SM2540G
SW6020	RCRA Metals by ICP-MS

Print Date: 11/13/2013 2:40:40PM

Detectable Results Summary

Client Sample ID: **2348-B04-S2**

Lab Sample ID: 1135357005

Semivolatile Organic Fuels

<u>Parameter</u>	<u>Result</u>	<u>Units</u>
Diesel Range Organics	19.5J	mg/Kg
Residual Range Organics	58.3	mg/Kg

Client Sample ID: **2348-B07-S3**

Lab Sample ID: 1135357009

Polynuclear Aromatics GC/MS

Semivolatile Organic Fuels

Volatile Fuels

<u>Parameter</u>	<u>Result</u>	<u>Units</u>
Benzo(a)Anthracene	11.5	ug/Kg
Benzo[a]pyrene	5.56	ug/Kg
Benzo[g,h,i]perylene	2.49J	ug/Kg
Chrysene	13.5	ug/Kg
Diesel Range Organics	4530	mg/Kg
Ethylbenzene	30.2	ug/Kg
Gasoline Range Organics	16.1	mg/Kg
o-Xylene	142	ug/Kg
P & M -Xylene	99.3	ug/Kg
Toluene	9.03J	ug/Kg

Client Sample ID: **2348-B07-S7**

Lab Sample ID: 1135357010

Metals by ICP/MS

Semivolatile Organic Fuels

Volatile Fuels

<u>Parameter</u>	<u>Result</u>	<u>Units</u>
Arsenic	12.6	mg/Kg
Barium	39.9	mg/Kg
Cadmium	0.0646J	mg/Kg
Chromium	56.7	mg/Kg
Lead	12.1	mg/Kg
Mercury	0.0473	mg/Kg
Silver	0.0696J	mg/Kg
Diesel Range Organics	8.74J	mg/Kg
Gasoline Range Organics	0.744J	mg/Kg

Client Sample ID: **2348-B10-S4**

Lab Sample ID: 1135357011

Metals by ICP/MS

Polynuclear Aromatics GC/MS

Semivolatile Organic Fuels

Volatile Fuels

<u>Parameter</u>	<u>Result</u>	<u>Units</u>
Arsenic	20.5	mg/Kg
Barium	37.7	mg/Kg
Cadmium	0.0781J	mg/Kg
Chromium	49.3	mg/Kg
Lead	11.4	mg/Kg
Mercury	0.0587	mg/Kg
Silver	0.0541J	mg/Kg
1-Methylnaphthalene	9.36	ug/Kg
2-Methylnaphthalene	16.9	ug/Kg
Phenanthrene	6.00	ug/Kg
Diesel Range Organics	66.9	mg/Kg
Gasoline Range Organics	0.897J	mg/Kg
o-Xylene	7.93J	ug/Kg

Detectable Results Summary

Client Sample ID: **2348-B11-S1**

Lab Sample ID: 1135357012

Semivolatile Organic Fuels

<u>Parameter</u>	<u>Result</u>	<u>Units</u>
Diesel Range Organics	7.54J	mg/Kg
Residual Range Organics	25.3	mg/Kg

Client Sample ID: **2348-B07-S21**

Lab Sample ID: 1135357014

Semivolatile Organic Fuels

Volatile Fuels

<u>Parameter</u>	<u>Result</u>	<u>Units</u>
Diesel Range Organics	10.4J	mg/Kg
Gasoline Range Organics	0.739J	mg/Kg



Results of **2348-B01-S1**

Client Sample ID: **2348-B01-S1**
Client Project ID: **32-1-02348 Whittier Navigation**
Lab Sample ID: 1135357001
Lab Project ID: 1135357

Collection Date: 10/24/13 10:25
Received Date: 10/29/13 10:36
Matrix: Soil/Solid (dry weight)
Solids (%): 92.4

Results by **Semivolatile Organic Fuels**

<u>Parameter</u>	<u>Result Qual</u>	<u>LOQ/CL</u>	<u>DL</u>	<u>Units</u>	<u>DF</u>	<u>Allowable Limits</u>	<u>Date Analyzed</u>
Diesel Range Organics	13.3 U	21.5	6.67	mg/Kg	1		11/01/13 11:55

Surrogates

5a Androstane	91	50-150		%	1		11/01/13 11:55
---------------	----	--------	--	---	---	--	----------------

Batch Information

Analytical Batch: XFC11149
Analytical Method: AK102
Analyst: EAB
Analytical Date/Time: 11/01/13 11:55
Container ID: 1135357001-A

Prep Batch: XXX30276
Prep Method: SW3550C
Prep Date/Time: 10/29/13 17:00
Prep Initial Wt./Vol.: 30.2 g
Prep Extract Vol: 1 mL

<u>Parameter</u>	<u>Result Qual</u>	<u>LOQ/CL</u>	<u>DL</u>	<u>Units</u>	<u>DF</u>	<u>Allowable Limits</u>	<u>Date Analyzed</u>
Residual Range Organics	13.3 U	21.5	6.67	mg/Kg	1		11/01/13 11:55

Surrogates

n-Triacontane-d62	90.6	50-150		%	1		11/01/13 11:55
-------------------	------	--------	--	---	---	--	----------------

Batch Information

Analytical Batch: XFC11149
Analytical Method: AK103
Analyst: EAB
Analytical Date/Time: 11/01/13 11:55
Container ID: 1135357001-A

Prep Batch: XXX30276
Prep Method: SW3550C
Prep Date/Time: 10/29/13 17:00
Prep Initial Wt./Vol.: 30.2 g
Prep Extract Vol: 1 mL

Print Date: 11/13/2013 2:40:42PM



Results of 2348-B01-S1

Client Sample ID: **2348-B01-S1**
Client Project ID: **32-1-02348 Whittier Navigation**
Lab Sample ID: 1135357001
Lab Project ID: 1135357

Collection Date: 10/24/13 10:25
Received Date: 10/29/13 10:36
Matrix: Soil/Solid (dry weight)
Solids (%): 92.4

Results by Volatile Fuels

<u>Parameter</u>	<u>Result Qual</u>	<u>LOQ/CL</u>	<u>DL</u>	<u>Units</u>	<u>DF</u>	<u>Allowable Limits</u>	<u>Date Analyzed</u>
Gasoline Range Organics	1.43 U	2.38	0.715	mg/Kg	1		10/29/13 23:00

Surrogates

4-Bromofluorobenzene	69.4	50-150		%	1		10/29/13 23:00
----------------------	------	--------	--	---	---	--	----------------

Batch Information

Analytical Batch: VFC11704
Analytical Method: AK101
Analyst: ST
Analytical Date/Time: 10/29/13 23:00
Container ID: 1135357001-B

Prep Batch: VXX25400
Prep Method: SW5035A
Prep Date/Time: 10/24/13 10:25
Prep Initial Wt./Vol.: 68.593 g
Prep Extract Vol: 30.2205 mL

<u>Parameter</u>	<u>Result Qual</u>	<u>LOQ/CL</u>	<u>DL</u>	<u>Units</u>	<u>DF</u>	<u>Allowable Limits</u>	<u>Date Analyzed</u>
Benzene	7.62 U	11.9	3.81	ug/Kg	1		10/29/13 23:00
Ethylbenzene	14.9 U	23.8	7.44	ug/Kg	1		10/29/13 23:00
o-Xylene	14.9 U	23.8	7.44	ug/Kg	1		10/29/13 23:00
P & M -Xylene	28.6 U	47.7	14.3	ug/Kg	1		10/29/13 23:00
Toluene	14.9 U	23.8	7.44	ug/Kg	1		10/29/13 23:00

Surrogates

1,4-Difluorobenzene	94.3	72-119		%	1		10/29/13 23:00
---------------------	------	--------	--	---	---	--	----------------

Batch Information

Analytical Batch: VFC11704
Analytical Method: SW8021B
Analyst: ST
Analytical Date/Time: 10/29/13 23:00
Container ID: 1135357001-B

Prep Batch: VXX25400
Prep Method: SW5035A
Prep Date/Time: 10/24/13 10:25
Prep Initial Wt./Vol.: 68.593 g
Prep Extract Vol: 30.2205 mL

Print Date: 11/13/2013 2:40:42PM



Results of **2348-B02-S7**

Client Sample ID: **2348-B02-S7**
Client Project ID: **32-1-02348 Whittier Navigation**
Lab Sample ID: 1135357003
Lab Project ID: 1135357

Collection Date: 10/25/13 11:10
Received Date: 10/29/13 10:36
Matrix: Soil/Solid (dry weight)
Solids (%): 92.6

Results by **Semivolatile Organic Fuels**

<u>Parameter</u>	<u>Result Qual</u>	<u>LOQ/CL</u>	<u>DL</u>	<u>Units</u>	<u>DF</u>	<u>Allowable Limits</u>	<u>Date Analyzed</u>
Diesel Range Organics	13.3 U	21.4	6.64	mg/Kg	1		11/01/13 12:15

Surrogates

5a Androstane	90.3	50-150		%	1		11/01/13 12:15
---------------	------	--------	--	---	---	--	----------------

Batch Information

Analytical Batch: XFC11149
Analytical Method: AK102
Analyst: EAB
Analytical Date/Time: 11/01/13 12:15
Container ID: 1135357003-A

Prep Batch: XXX30276
Prep Method: SW3550C
Prep Date/Time: 10/29/13 17:00
Prep Initial Wt./Vol.: 30.27 g
Prep Extract Vol: 1 mL

<u>Parameter</u>	<u>Result Qual</u>	<u>LOQ/CL</u>	<u>DL</u>	<u>Units</u>	<u>DF</u>	<u>Allowable Limits</u>	<u>Date Analyzed</u>
Residual Range Organics	13.3 U	21.4	6.64	mg/Kg	1		11/01/13 12:15

Surrogates

n-Triacontane-d62	88.8	50-150		%	1		11/01/13 12:15
-------------------	------	--------	--	---	---	--	----------------

Batch Information

Analytical Batch: XFC11149
Analytical Method: AK103
Analyst: EAB
Analytical Date/Time: 11/01/13 12:15
Container ID: 1135357003-A

Prep Batch: XXX30276
Prep Method: SW3550C
Prep Date/Time: 10/29/13 17:00
Prep Initial Wt./Vol.: 30.27 g
Prep Extract Vol: 1 mL

Print Date: 11/13/2013 2:40:42PM



Results of 2348-B02-S7

Client Sample ID: **2348-B02-S7**
Client Project ID: **32-1-02348 Whittier Navigation**
Lab Sample ID: 1135357003
Lab Project ID: 1135357

Collection Date: 10/25/13 11:10
Received Date: 10/29/13 10:36
Matrix: Soil/Solid (dry weight)
Solids (%): 92.6

Results by Volatile Fuels

<u>Parameter</u>	<u>Result Qual</u>	<u>LOQ/CL</u>	<u>DL</u>	<u>Units</u>	<u>DF</u>	<u>Allowable Limits</u>	<u>Date Analyzed</u>
Gasoline Range Organics	1.15 U	1.92	0.576	mg/Kg	1		10/30/13 05:25

Surrogates

4-Bromofluorobenzene	79.9	50-150		%	1		10/30/13 05:25
----------------------	------	--------	--	---	---	--	----------------

Batch Information

Analytical Batch: VFC11704
Analytical Method: AK101
Analyst: ST
Analytical Date/Time: 10/30/13 05:25
Container ID: 1135357003-B

Prep Batch: VXX25400
Prep Method: SW5035A
Prep Date/Time: 10/25/13 11:10
Prep Initial Wt./Vol.: 88.856 g
Prep Extract Vol: 31.58 mL

<u>Parameter</u>	<u>Result Qual</u>	<u>LOQ/CL</u>	<u>DL</u>	<u>Units</u>	<u>DF</u>	<u>Allowable Limits</u>	<u>Date Analyzed</u>
Benzene	6.14 U	9.60	3.07	ug/Kg	1		10/30/13 05:25
Ethylbenzene	12.0 U	19.2	5.99	ug/Kg	1		10/30/13 05:25
o-Xylene	12.0 U	19.2	5.99	ug/Kg	1		10/30/13 05:25
P & M -Xylene	23.0 U	38.4	11.5	ug/Kg	1		10/30/13 05:25
Toluene	12.0 U	19.2	5.99	ug/Kg	1		10/30/13 05:25

Surrogates

1,4-Difluorobenzene	93.9	72-119		%	1		10/30/13 05:25
---------------------	------	--------	--	---	---	--	----------------

Batch Information

Analytical Batch: VFC11704
Analytical Method: SW8021B
Analyst: ST
Analytical Date/Time: 10/30/13 05:25
Container ID: 1135357003-B

Prep Batch: VXX25400
Prep Method: SW5035A
Prep Date/Time: 10/25/13 11:10
Prep Initial Wt./Vol.: 88.856 g
Prep Extract Vol: 31.58 mL

Print Date: 11/13/2013 2:40:42PM



Results of **2348-B04-S2**

Client Sample ID: **2348-B04-S2**
Client Project ID: **32-1-02348 Whittier Navigation**
Lab Sample ID: 1135357005
Lab Project ID: 1135357

Collection Date: 10/25/13 15:00
Received Date: 10/29/13 10:36
Matrix: Soil/Solid (dry weight)
Solids (%): 94.1

Results by **Semivolatile Organic Fuels**

<u>Parameter</u>	<u>Result Qual</u>	<u>LOQ/CL</u>	<u>DL</u>	<u>Units</u>	<u>DF</u>	<u>Allowable Limits</u>	<u>Date Analyzed</u>
Diesel Range Organics	19.5 J	21.2	6.58	mg/Kg	1		11/01/13 12:36

Surrogates

5a Androstane	99	50-150		%	1		11/01/13 12:36
---------------	----	--------	--	---	---	--	----------------

Batch Information

Analytical Batch: XFC11149
Analytical Method: AK102
Analyst: EAB
Analytical Date/Time: 11/01/13 12:36
Container ID: 1135357005-A

Prep Batch: XXX30276
Prep Method: SW3550C
Prep Date/Time: 10/29/13 17:00
Prep Initial Wt./Vol.: 30.029 g
Prep Extract Vol: 1 mL

<u>Parameter</u>	<u>Result Qual</u>	<u>LOQ/CL</u>	<u>DL</u>	<u>Units</u>	<u>DF</u>	<u>Allowable Limits</u>	<u>Date Analyzed</u>
Residual Range Organics	58.3	21.2	6.58	mg/Kg	1		11/01/13 12:36

Surrogates

n-Triacontane-d62	99.5	50-150		%	1		11/01/13 12:36
-------------------	------	--------	--	---	---	--	----------------

Batch Information

Analytical Batch: XFC11149
Analytical Method: AK103
Analyst: EAB
Analytical Date/Time: 11/01/13 12:36
Container ID: 1135357005-A

Prep Batch: XXX30276
Prep Method: SW3550C
Prep Date/Time: 10/29/13 17:00
Prep Initial Wt./Vol.: 30.029 g
Prep Extract Vol: 1 mL

Print Date: 11/13/2013 2:40:42PM



Results of 2348-B04-S2

Client Sample ID: **2348-B04-S2**
Client Project ID: **32-1-02348 Whittier Navigation**
Lab Sample ID: 1135357005
Lab Project ID: 1135357

Collection Date: 10/25/13 15:00
Received Date: 10/29/13 10:36
Matrix: Soil/Solid (dry weight)
Solids (%): 94.1

Results by Volatile Fuels

<u>Parameter</u>	<u>Result Qual</u>	<u>LOQ/CL</u>	<u>DL</u>	<u>Units</u>	<u>DF</u>	<u>Allowable Limits</u>	<u>Date Analyzed</u>
Gasoline Range Organics	1.06 U	1.77	0.530	mg/Kg	1		10/30/13 05:43

Surrogates

4-Bromofluorobenzene	92.4	50-150		%	1		10/30/13 05:43
----------------------	------	--------	--	---	---	--	----------------

Batch Information

Analytical Batch: VFC11704
Analytical Method: AK101
Analyst: ST
Analytical Date/Time: 10/30/13 05:43
Container ID: 1135357005-B

Prep Batch: VXX25400
Prep Method: SW5035A
Prep Date/Time: 10/25/13 15:00
Prep Initial Wt./Vol.: 91.142 g
Prep Extract Vol: 30.3387 mL

<u>Parameter</u>	<u>Result Qual</u>	<u>LOQ/CL</u>	<u>DL</u>	<u>Units</u>	<u>DF</u>	<u>Allowable Limits</u>	<u>Date Analyzed</u>
Benzene	5.66 U	8.84	2.83	ug/Kg	1		10/30/13 05:43
Ethylbenzene	11.0 U	17.7	5.52	ug/Kg	1		10/30/13 05:43
o-Xylene	11.0 U	17.7	5.52	ug/Kg	1		10/30/13 05:43
P & M -Xylene	21.2 U	35.4	10.6	ug/Kg	1		10/30/13 05:43
Toluene	11.0 U	17.7	5.52	ug/Kg	1		10/30/13 05:43

Surrogates

1,4-Difluorobenzene	93.8	72-119		%	1		10/30/13 05:43
---------------------	------	--------	--	---	---	--	----------------

Batch Information

Analytical Batch: VFC11704
Analytical Method: SW8021B
Analyst: ST
Analytical Date/Time: 10/30/13 05:43
Container ID: 1135357005-B

Prep Batch: VXX25400
Prep Method: SW5035A
Prep Date/Time: 10/25/13 15:00
Prep Initial Wt./Vol.: 91.142 g
Prep Extract Vol: 30.3387 mL

Print Date: 11/13/2013 2:40:42PM



Results of 2348-B07-S3

Client Sample ID: 2348-B07-S3
Client Project ID: 32-1-02348 Whittier Navigation
Lab Sample ID: 1135357009
Lab Project ID: 1135357

Collection Date: 10/28/13 14:55
Received Date: 10/29/13 10:36
Matrix: Soil/Solid (dry weight)
Solids (%): 90.3

Results by Polynuclear Aromatics GC/MS

Table with 8 columns: Parameter, Result Qual, LOQ/CL, DL, Units, DF, Allowable Limits, Date Analyzed. Lists various polynuclear aromatic hydrocarbons and their detection results.

Surrogates

Table with 8 columns: Parameter, Result Qual, LOQ/CL, DL, Units, DF, Allowable Limits, Date Analyzed. Lists surrogate compounds like 2-Fluorobiphenyl and Terphenyl-d14.

Batch Information

Analytical Batch: XMS7736
Analytical Method: 8270D SIMS (PAH)
Analyst: RTS
Analytical Date/Time: 10/30/13 21:15
Container ID: 1135357009-A

Prep Batch: XXX30282
Prep Method: SW3550C
Prep Date/Time: 10/30/13 15:20
Prep Initial Wt./Vol.: 22.541 g
Prep Extract Vol: 1 mL

Analytical Batch: XMS7750
Analytical Method: 8270D SIMS (PAH)
Analyst: RTS
Analytical Date/Time: 11/05/13 23:12
Container ID: 1135357009-A

Prep Batch: XXX30282
Prep Method: SW3550C
Prep Date/Time: 10/30/13 15:20
Prep Initial Wt./Vol.: 22.541 g
Prep Extract Vol: 1 mL

Print Date: 11/13/2013 2:40:42PM



Results of **2348-B07-S3**

Client Sample ID: **2348-B07-S3**
Client Project ID: **32-1-02348 Whittier Navigation**
Lab Sample ID: 1135357009
Lab Project ID: 1135357

Collection Date: 10/28/13 14:55
Received Date: 10/29/13 10:36
Matrix: Soil/Solid (dry weight)
Solids (%): 90.3

Results by **Semivolatile Organic Fuels**

<u>Parameter</u>	<u>Result Qual</u>	<u>LOQ/CL</u>	<u>DL</u>	<u>Units</u>	<u>DF</u>	<u>Allowable Limits</u>	<u>Date Analyzed</u>
Diesel Range Organics	4530	219	67.8	mg/Kg	10		11/01/13 14:17
Surrogates							
5a Androstane	88	50-150		%	10		11/01/13 14:17

Batch Information

Analytical Batch: XFC11149
Analytical Method: AK102
Analyst: EAB
Analytical Date/Time: 11/01/13 14:17
Container ID: 1135357009-A

Prep Batch: XXX30276
Prep Method: SW3550C
Prep Date/Time: 10/29/13 17:00
Prep Initial Wt./Vol.: 30.365 g
Prep Extract Vol: 1 mL

<u>Parameter</u>	<u>Result Qual</u>	<u>LOQ/CL</u>	<u>DL</u>	<u>Units</u>	<u>DF</u>	<u>Allowable Limits</u>	<u>Date Analyzed</u>
Residual Range Organics	136 U	219	67.8	mg/Kg	10		11/01/13 14:17
Surrogates							
n-Triacontane-d62	87.5	50-150		%	10		11/01/13 14:17

Batch Information

Analytical Batch: XFC11149
Analytical Method: AK103
Analyst: EAB
Analytical Date/Time: 11/01/13 14:17
Container ID: 1135357009-A

Prep Batch: XXX30276
Prep Method: SW3550C
Prep Date/Time: 10/29/13 17:00
Prep Initial Wt./Vol.: 30.365 g
Prep Extract Vol: 1 mL

Print Date: 11/13/2013 2:40:42PM



Results of 2348-B07-S3

Client Sample ID: **2348-B07-S3**
Client Project ID: **32-1-02348 Whittier Navigation**
Lab Sample ID: 1135357009
Lab Project ID: 1135357

Collection Date: 10/28/13 14:55
Received Date: 10/29/13 10:36
Matrix: Soil/Solid (dry weight)
Solids (%): 90.3

Results by Volatile Fuels

<u>Parameter</u>	<u>Result Qual</u>	<u>LOQ/CL</u>	<u>DL</u>	<u>Units</u>	<u>DF</u>	<u>Allowable Limits</u>	<u>Date Analyzed</u>
Gasoline Range Organics	16.1	2.20	0.661	mg/Kg	1		10/30/13 06:56

Surrogates

4-Bromofluorobenzene	172 *	50-150		%	1		10/30/13 06:56
----------------------	-------	--------	--	---	---	--	----------------

Batch Information

Analytical Batch: VFC11704
Analytical Method: AK101
Analyst: ST
Analytical Date/Time: 10/30/13 06:56
Container ID: 1135357009-B

Prep Batch: VXX25400
Prep Method: SW5035A
Prep Date/Time: 10/28/13 14:55
Prep Initial Wt./Vol.: 83.174 g
Prep Extract Vol: 33.0728 mL

<u>Parameter</u>	<u>Result Qual</u>	<u>LOQ/CL</u>	<u>DL</u>	<u>Units</u>	<u>DF</u>	<u>Allowable Limits</u>	<u>Date Analyzed</u>
Benzene	7.04 U	11.0	3.52	ug/Kg	1		10/30/13 06:56
Ethylbenzene	30.2	22.0	6.87	ug/Kg	1		10/30/13 06:56
o-Xylene	142	22.0	6.87	ug/Kg	1		10/30/13 06:56
P & M -Xylene	99.3	44.0	13.2	ug/Kg	1		10/30/13 06:56
Toluene	9.03 J	22.0	6.87	ug/Kg	1		10/30/13 06:56

Surrogates

1,4-Difluorobenzene	94.8	72-119		%	1		10/30/13 06:56
---------------------	------	--------	--	---	---	--	----------------

Batch Information

Analytical Batch: VFC11704
Analytical Method: SW8021B
Analyst: ST
Analytical Date/Time: 10/30/13 06:56
Container ID: 1135357009-B

Prep Batch: VXX25400
Prep Method: SW5035A
Prep Date/Time: 10/28/13 14:55
Prep Initial Wt./Vol.: 83.174 g
Prep Extract Vol: 33.0728 mL

Print Date: 11/13/2013 2:40:42PM



Results of 2348-B07-S7

Client Sample ID: **2348-B07-S7**
Client Project ID: **32-1-02348 Whittier Navigation**
Lab Sample ID: 1135357010
Lab Project ID: 1135357

Collection Date: 10/28/13 16:20
Received Date: 10/29/13 10:36
Matrix: Soil/Solid (dry weight)
Solids (%): 90.7

Results by Metals by ICP/MS

<u>Parameter</u>	<u>Result Qual</u>	<u>LOQ/CL</u>	<u>DL</u>	<u>Units</u>	<u>DF</u>	<u>Allowable Limits</u>	<u>Date Analyzed</u>
Arsenic	12.6	1.03	0.320	mg/Kg	10		11/11/13 15:28
Barium	39.9	0.310	0.0970	mg/Kg	10		11/11/13 15:28
Cadmium	0.0646 J	0.206	0.0640	mg/Kg	10		11/11/13 15:28
Chromium	56.7	0.413	0.124	mg/Kg	10		11/11/13 15:28
Lead	12.1	0.206	0.0640	mg/Kg	10		11/11/13 15:28
Mercury	0.0473	0.0413	0.0124	mg/Kg	10		11/11/13 15:28
Selenium	0.310 U	0.516	0.155	mg/Kg	10		11/11/13 15:28
Silver	0.0696 J	0.103	0.0320	mg/Kg	10		11/11/13 15:28

Batch Information

Analytical Batch: MMS8351
Analytical Method: SW6020
Analyst: ACF
Analytical Date/Time: 11/11/13 15:28
Container ID: 1135357010-A

Prep Batch: MXX27269
Prep Method: SW3050B
Prep Date/Time: 11/05/13 15:30
Prep Initial Wt./Vol.: 1.069 g
Prep Extract Vol: 50 mL

Print Date: 11/13/2013 2:40:42PM



Results of **2348-B07-S7**

Client Sample ID: **2348-B07-S7**
Client Project ID: **32-1-02348 Whittier Navigation**
Lab Sample ID: 1135357010
Lab Project ID: 1135357

Collection Date: 10/28/13 16:20
Received Date: 10/29/13 10:36
Matrix: Soil/Solid (dry weight)
Solids (%): 90.7

Results by **Semivolatile Organic Fuels**

<u>Parameter</u>	<u>Result Qual</u>	<u>LOQ/CL</u>	<u>DL</u>	<u>Units</u>	<u>DF</u>	<u>Allowable Limits</u>	<u>Date Analyzed</u>
Diesel Range Organics	8.74 J	21.9	6.79	mg/Kg	1		11/01/13 12:56
Surrogates							
5a Androstane	89.6	50-150		%	1		11/01/13 12:56

Batch Information

Analytical Batch: XFC11149
Analytical Method: AK102
Analyst: EAB
Analytical Date/Time: 11/01/13 12:56
Container ID: 1135357010-A

Prep Batch: XXX30276
Prep Method: SW3550C
Prep Date/Time: 10/29/13 17:00
Prep Initial Wt./Vol.: 30.233 g
Prep Extract Vol: 1 mL

<u>Parameter</u>	<u>Result Qual</u>	<u>LOQ/CL</u>	<u>DL</u>	<u>Units</u>	<u>DF</u>	<u>Allowable Limits</u>	<u>Date Analyzed</u>
Residual Range Organics	13.6 U	21.9	6.79	mg/Kg	1		11/01/13 12:56
Surrogates							
n-Triacontane-d62	88.7	50-150		%	1		11/01/13 12:56

Batch Information

Analytical Batch: XFC11149
Analytical Method: AK103
Analyst: EAB
Analytical Date/Time: 11/01/13 12:56
Container ID: 1135357010-A

Prep Batch: XXX30276
Prep Method: SW3550C
Prep Date/Time: 10/29/13 17:00
Prep Initial Wt./Vol.: 30.233 g
Prep Extract Vol: 1 mL

Print Date: 11/13/2013 2:40:42PM



Results of 2348-B07-S7

Client Sample ID: 2348-B07-S7
Client Project ID: 32-1-02348 Whittier Navigation
Lab Sample ID: 1135357010
Lab Project ID: 1135357

Collection Date: 10/28/13 16:20
Received Date: 10/29/13 10:36
Matrix: Soil/Solid (dry weight)
Solids (%): 90.7

Results by Volatile Fuels

Table with 8 columns: Parameter, Result Qual, LOQ/CL, DL, Units, DF, Allowable Limits, Date Analyzed. Row: Gasoline Range Organics, 0.744 J, 2.00, 0.600, mg/Kg, 1, 10/30/13 06:20

Surrogates

Table with 8 columns: Parameter, Result Qual, LOQ/CL, DL, Units, DF, Allowable Limits, Date Analyzed. Row: 4-Bromofluorobenzene, 108, 50-150, %, 1, 10/30/13 06:20

Batch Information

Analytical Batch: VFC11704
Analytical Method: AK101
Analyst: ST
Analytical Date/Time: 10/30/13 06:20
Container ID: 1135357010-B

Prep Batch: VXX25400
Prep Method: SW5035A
Prep Date/Time: 10/28/13 16:20
Prep Initial Wt./Vol.: 92.914 g
Prep Extract Vol: 33.6704 mL

Table with 8 columns: Parameter, Result Qual, LOQ/CL, DL, Units, DF, Allowable Limits, Date Analyzed. Rows: Benzene, Ethylbenzene, o-Xylene, P & M -Xylene, Toluene

Surrogates

Table with 8 columns: Parameter, Result Qual, LOQ/CL, DL, Units, DF, Allowable Limits, Date Analyzed. Row: 1,4-Difluorobenzene, 94.2, 72-119, %, 1, 10/30/13 06:20

Batch Information

Analytical Batch: VFC11704
Analytical Method: SW8021B
Analyst: ST
Analytical Date/Time: 10/30/13 06:20
Container ID: 1135357010-B

Prep Batch: VXX25400
Prep Method: SW5035A
Prep Date/Time: 10/28/13 16:20
Prep Initial Wt./Vol.: 92.914 g
Prep Extract Vol: 33.6704 mL

Print Date: 11/13/2013 2:40:42PM



Results of 2348-B10-S4

Client Sample ID: **2348-B10-S4**
Client Project ID: **32-1-02348 Whittier Navigation**
Lab Sample ID: 1135357011
Lab Project ID: 1135357

Collection Date: 10/26/13 14:55
Received Date: 10/29/13 10:36
Matrix: Soil/Solid (dry weight)
Solids (%): 87.5

Results by Metals by ICP/MS

<u>Parameter</u>	<u>Result Qual</u>	<u>LOQ/CL</u>	<u>DL</u>	<u>Units</u>	<u>DF</u>	<u>Allowable Limits</u>	<u>Date Analyzed</u>
Arsenic	20.5	1.04	0.322	mg/Kg	10		11/11/13 15:30
Barium	37.7	0.312	0.0977	mg/Kg	10		11/11/13 15:30
Cadmium	0.0781 J	0.208	0.0644	mg/Kg	10		11/11/13 15:30
Chromium	49.3	0.416	0.125	mg/Kg	10		11/11/13 15:30
Lead	11.4	0.208	0.0644	mg/Kg	10		11/11/13 15:30
Mercury	0.0587	0.0416	0.0125	mg/Kg	10		11/11/13 15:30
Selenium	0.312 U	0.520	0.156	mg/Kg	10		11/11/13 15:30
Silver	0.0541 J	0.104	0.0322	mg/Kg	10		11/11/13 15:30

Batch Information

Analytical Batch: MMS8351
Analytical Method: SW6020
Analyst: ACF
Analytical Date/Time: 11/11/13 15:30
Container ID: 1135357011-A

Prep Batch: MXX27269
Prep Method: SW3050B
Prep Date/Time: 11/05/13 15:30
Prep Initial Wt./Vol.: 1.099 g
Prep Extract Vol: 50 mL

Print Date: 11/13/2013 2:40:42PM



Results of 2348-B10-S4

Client Sample ID: **2348-B10-S4**
Client Project ID: **32-1-02348 Whittier Navigation**
Lab Sample ID: 1135357011
Lab Project ID: 1135357

Collection Date: 10/26/13 14:55
Received Date: 10/29/13 10:36
Matrix: Soil/Solid (dry weight)
Solids (%): 87.5

Results by Polynuclear Aromatics GC/MS

<u>Parameter</u>	<u>Result Qual</u>	<u>LOQ/CL</u>	<u>DL</u>	<u>Units</u>	<u>DF</u>	<u>Allowable Limits</u>	<u>Date Analyzed</u>
1-Methylnaphthalene	9.36	5.70	1.71	ug/Kg	1		10/30/13 21:29
2-Methylnaphthalene	16.9	5.70	1.71	ug/Kg	1		10/30/13 21:29
Acenaphthene	3.42 U	5.70	1.71	ug/Kg	1		10/30/13 21:29
Acenaphthylene	3.42 U	5.70	1.71	ug/Kg	1		10/30/13 21:29
Anthracene	3.42 U	5.70	1.71	ug/Kg	1		10/30/13 21:29
Benzo(a)Anthracene	3.42 U	5.70	1.71	ug/Kg	1		10/30/13 21:29
Benzo[a]pyrene	3.42 U	5.70	1.71	ug/Kg	1		10/30/13 21:29
Benzo[b]Fluoranthene	3.42 U	5.70	1.71	ug/Kg	1		10/30/13 21:29
Benzo[g,h,i]perylene	3.42 U	5.70	1.71	ug/Kg	1		10/30/13 21:29
Benzo[k]fluoranthene	3.42 U	5.70	1.71	ug/Kg	1		10/30/13 21:29
Chrysene	3.42 U	5.70	1.71	ug/Kg	1		10/30/13 21:29
Dibenzo[a,h]anthracene	3.42 U	5.70	1.71	ug/Kg	1		10/30/13 21:29
Fluoranthene	3.42 U	5.70	1.71	ug/Kg	1		10/30/13 21:29
Fluorene	3.42 U	5.70	1.71	ug/Kg	1		10/30/13 21:29
Indeno[1,2,3-c,d] pyrene	3.42 U	5.70	1.71	ug/Kg	1		10/30/13 21:29
Naphthalene	3.42 U	5.70	1.71	ug/Kg	1		10/30/13 21:29
Phenanthrene	6.00	5.70	1.71	ug/Kg	1		10/30/13 21:29
Pyrene	3.42 U	5.70	1.71	ug/Kg	1		10/30/13 21:29
Surrogates							
2-Fluorobiphenyl	99.2	45-105		%	1		10/30/13 21:29
Terphenyl-d14	103	30-125		%	1		10/30/13 21:29

Batch Information

Analytical Batch: XMS7736
Analytical Method: 8270D SIMS (PAH)
Analyst: RTS
Analytical Date/Time: 10/30/13 21:29
Container ID: 1135357011-A

Prep Batch: XXX30282
Prep Method: SW3550C
Prep Date/Time: 10/30/13 15:20
Prep Initial Wt./Vol.: 22.533 g
Prep Extract Vol: 1 mL

Print Date: 11/13/2013 2:40:42PM



Results of **2348-B10-S4**

Client Sample ID: **2348-B10-S4**
Client Project ID: **32-1-02348 Whittier Navigation**
Lab Sample ID: 1135357011
Lab Project ID: 1135357

Collection Date: 10/26/13 14:55
Received Date: 10/29/13 10:36
Matrix: Soil/Solid (dry weight)
Solids (%): 87.5

Results by **Semivolatile Organic Fuels**

<u>Parameter</u>	<u>Result Qual</u>	<u>LOQ/CL</u>	<u>DL</u>	<u>Units</u>	<u>DF</u>	<u>Allowable Limits</u>	<u>Date Analyzed</u>
Diesel Range Organics	66.9	22.6	6.99	mg/Kg	1		11/01/13 13:16
Surrogates							
5a Androstane	88.4	50-150		%	1		11/01/13 13:16

Batch Information

Analytical Batch: XFC11149
Analytical Method: AK102
Analyst: EAB
Analytical Date/Time: 11/01/13 13:16
Container ID: 1135357011-A

Prep Batch: XXX30276
Prep Method: SW3550C
Prep Date/Time: 10/29/13 17:00
Prep Initial Wt./Vol.: 30.391 g
Prep Extract Vol: 1 mL

<u>Parameter</u>	<u>Result Qual</u>	<u>LOQ/CL</u>	<u>DL</u>	<u>Units</u>	<u>DF</u>	<u>Allowable Limits</u>	<u>Date Analyzed</u>
Residual Range Organics	14.0 U	22.6	6.99	mg/Kg	1		11/01/13 13:16
Surrogates							
n-Triacontane-d62	88.4	50-150		%	1		11/01/13 13:16

Batch Information

Analytical Batch: XFC11149
Analytical Method: AK103
Analyst: EAB
Analytical Date/Time: 11/01/13 13:16
Container ID: 1135357011-A

Prep Batch: XXX30276
Prep Method: SW3550C
Prep Date/Time: 10/29/13 17:00
Prep Initial Wt./Vol.: 30.391 g
Prep Extract Vol: 1 mL

Print Date: 11/13/2013 2:40:42PM



Results of 2348-B10-S4

Client Sample ID: **2348-B10-S4**
Client Project ID: **32-1-02348 Whittier Navigation**
Lab Sample ID: 1135357011
Lab Project ID: 1135357

Collection Date: 10/26/13 14:55
Received Date: 10/29/13 10:36
Matrix: Soil/Solid (dry weight)
Solids (%): 87.5

Results by Volatile Fuels

<u>Parameter</u>	<u>Result Qual</u>	<u>LOQ/CL</u>	<u>DL</u>	<u>Units</u>	<u>DF</u>	<u>Allowable Limits</u>	<u>Date Analyzed</u>
Gasoline Range Organics	0.897 J	2.14	0.643	mg/Kg	1		10/30/13 06:38

Surrogates

4-Bromofluorobenzene	121	50-150		%	1		10/30/13 06:38
----------------------	-----	--------	--	---	---	--	----------------

Batch Information

Analytical Batch: VFC11704
Analytical Method: AK101
Analyst: ST
Analytical Date/Time: 10/30/13 06:38
Container ID: 1135357011-B

Prep Batch: VXX25400
Prep Method: SW5035A
Prep Date/Time: 10/26/13 14:55
Prep Initial Wt./Vol.: 99.797 g
Prep Extract Vol: 37.4379 mL

<u>Parameter</u>	<u>Result Qual</u>	<u>LOQ/CL</u>	<u>DL</u>	<u>Units</u>	<u>DF</u>	<u>Allowable Limits</u>	<u>Date Analyzed</u>
Benzene	6.86 U	10.7	3.43	ug/Kg	1		10/30/13 06:38
Ethylbenzene	13.4 U	21.4	6.69	ug/Kg	1		10/30/13 06:38
o-Xylene	7.93 J	21.4	6.69	ug/Kg	1		10/30/13 06:38
P & M -Xylene	25.8 U	42.9	12.9	ug/Kg	1		10/30/13 06:38
Toluene	13.4 U	21.4	6.69	ug/Kg	1		10/30/13 06:38

Surrogates

1,4-Difluorobenzene	94.3	72-119		%	1		10/30/13 06:38
---------------------	------	--------	--	---	---	--	----------------

Batch Information

Analytical Batch: VFC11704
Analytical Method: SW8021B
Analyst: ST
Analytical Date/Time: 10/30/13 06:38
Container ID: 1135357011-B

Prep Batch: VXX25400
Prep Method: SW5035A
Prep Date/Time: 10/26/13 14:55
Prep Initial Wt./Vol.: 99.797 g
Prep Extract Vol: 37.4379 mL

Print Date: 11/13/2013 2:40:42PM



Results of 2348-B11-S1

Client Sample ID: 2348-B11-S1
Client Project ID: 32-1-02348 Whittier Navigation
Lab Sample ID: 1135357012
Lab Project ID: 1135357

Collection Date: 10/26/13 13:20
Received Date: 10/29/13 10:36
Matrix: Soil/Solid (dry weight)
Solids (%): 91.8

Results by Semivolatile Organic Fuels

Table with 8 columns: Parameter, Result Qual, LOQ/CL, DL, Units, DF, Allowable Limits, Date Analyzed. Rows include Diesel Range Organics and Surrogates (5a Androstane).

Batch Information

Analytical Batch: XFC11149
Analytical Method: AK102
Analyst: EAB
Analytical Date/Time: 11/01/13 13:36
Container ID: 1135357012-A

Prep Batch: XXX30276
Prep Method: SW3550C
Prep Date/Time: 10/29/13 17:00
Prep Initial Wt./Vol.: 30.195 g
Prep Extract Vol: 1 mL

Table with 8 columns: Parameter, Result Qual, LOQ/CL, DL, Units, DF, Allowable Limits, Date Analyzed. Rows include Residual Range Organics and Surrogates (n-Triacontane-d62).

Batch Information

Analytical Batch: XFC11149
Analytical Method: AK103
Analyst: EAB
Analytical Date/Time: 11/01/13 13:36
Container ID: 1135357012-A

Prep Batch: XXX30276
Prep Method: SW3550C
Prep Date/Time: 10/29/13 17:00
Prep Initial Wt./Vol.: 30.195 g
Prep Extract Vol: 1 mL

Print Date: 11/13/2013 2:40:42PM



Results of 2348-B11-S1

Client Sample ID: 2348-B11-S1
Client Project ID: 32-1-02348 Whittier Navigation
Lab Sample ID: 1135357012
Lab Project ID: 1135357

Collection Date: 10/26/13 13:20
Received Date: 10/29/13 10:36
Matrix: Soil/Solid (dry weight)
Solids (%): 91.8

Results by Volatile Fuels

Table with 8 columns: Parameter, Result Qual, LOQ/CL, DL, Units, DF, Allowable Limits, Date Analyzed. Row: Gasoline Range Organics, 1.11 U, 1.86, 0.557, mg/Kg, 1, 10/31/13 00:44

Surrogates

Table with 8 columns: Parameter, Result Qual, LOQ/CL, DL, Units, DF, Allowable Limits, Date Analyzed. Row: 4-Bromofluorobenzene, 94.5, 50-150, %, 1, 10/31/13 00:44

Batch Information

Analytical Batch: VFC11709
Analytical Method: AK101
Analyst: ST
Analytical Date/Time: 10/31/13 00:44
Container ID: 1135357012-B

Prep Batch: VXX25408
Prep Method: SW5035A
Prep Date/Time: 10/26/13 13:20
Prep Initial Wt./Vol.: 96.442 g
Prep Extract Vol: 32.8686 mL

Table with 8 columns: Parameter, Result Qual, LOQ/CL, DL, Units, DF, Allowable Limits, Date Analyzed. Rows: Benzene, Ethylbenzene, o-Xylene, P & M -Xylene, Toluene

Surrogates

Table with 8 columns: Parameter, Result Qual, LOQ/CL, DL, Units, DF, Allowable Limits, Date Analyzed. Row: 1,4-Difluorobenzene, 93.5, 72-119, %, 1, 10/31/13 00:44

Batch Information

Analytical Batch: VFC11709
Analytical Method: SW8021B
Analyst: ST
Analytical Date/Time: 10/31/13 00:44
Container ID: 1135357012-B

Prep Batch: VXX25408
Prep Method: SW5035A
Prep Date/Time: 10/26/13 13:20
Prep Initial Wt./Vol.: 96.442 g
Prep Extract Vol: 32.8686 mL

Print Date: 11/13/2013 2:40:42PM



Results of **2348-B07-S21**

Client Sample ID: **2348-B07-S21**
Client Project ID: **32-1-02348 Whittier Navigation**
Lab Sample ID: 1135357014
Lab Project ID: 1135357

Collection Date: 10/28/13 16:20
Received Date: 10/29/13 10:36
Matrix: Soil/Solid (dry weight)
Solids (%): 88.8

Results by **Semivolatile Organic Fuels**

<u>Parameter</u>	<u>Result Qual</u>	<u>LOQ/CL</u>	<u>DL</u>	<u>Units</u>	<u>DF</u>	<u>Allowable Limits</u>	<u>Date Analyzed</u>
Diesel Range Organics	10.4 J	22.2	6.88	mg/Kg	1		10/30/13 19:42
Surrogates							
5a Androstane	93	50-150		%	1		10/30/13 19:42

Batch Information

Analytical Batch: XFC11147
Analytical Method: AK102
Analyst: EAB
Analytical Date/Time: 10/30/13 19:42
Container ID: 1135357014-A

Prep Batch: XXX30280
Prep Method: SW3550C
Prep Date/Time: 10/30/13 13:15
Prep Initial Wt./Vol.: 30.431 g
Prep Extract Vol: 1 mL

<u>Parameter</u>	<u>Result Qual</u>	<u>LOQ/CL</u>	<u>DL</u>	<u>Units</u>	<u>DF</u>	<u>Allowable Limits</u>	<u>Date Analyzed</u>
Residual Range Organics	13.8 U	22.2	6.88	mg/Kg	1		10/30/13 19:42
Surrogates							
n-Triacontane-d62	95.3	50-150		%	1		10/30/13 19:42

Batch Information

Analytical Batch: XFC11147
Analytical Method: AK103
Analyst: EAB
Analytical Date/Time: 10/30/13 19:42
Container ID: 1135357014-A

Prep Batch: XXX30280
Prep Method: SW3550C
Prep Date/Time: 10/30/13 13:15
Prep Initial Wt./Vol.: 30.431 g
Prep Extract Vol: 1 mL

Print Date: 11/13/2013 2:40:42PM



Results of 2348-B07-S21

Client Sample ID: **2348-B07-S21**
Client Project ID: **32-1-02348 Whittier Navigation**
Lab Sample ID: 1135357014
Lab Project ID: 1135357

Collection Date: 10/28/13 16:20
Received Date: 10/29/13 10:36
Matrix: Soil/Solid (dry weight)
Solids (%): 88.8

Results by Volatile Fuels

<u>Parameter</u>	<u>Result Qual</u>	<u>LOQ/CL</u>	<u>DL</u>	<u>Units</u>	<u>DF</u>	<u>Allowable Limits</u>	<u>Date Analyzed</u>
Gasoline Range Organics	0.739 J	1.94	0.583	mg/Kg	1		10/30/13 21:23

Surrogates

4-Bromofluorobenzene	102	50-150		%	1		10/30/13 21:23
----------------------	-----	--------	--	---	---	--	----------------

Batch Information

Analytical Batch: VFC11709
Analytical Method: AK101
Analyst: ST
Analytical Date/Time: 10/30/13 21:23
Container ID: 1135357014-B

Prep Batch: VXX25408
Prep Method: SW5035A
Prep Date/Time: 10/28/13 16:20
Prep Initial Wt./Vol.: 107.43 g
Prep Extract Vol: 37.0568 mL

<u>Parameter</u>	<u>Result Qual</u>	<u>LOQ/CL</u>	<u>DL</u>	<u>Units</u>	<u>DF</u>	<u>Allowable Limits</u>	<u>Date Analyzed</u>
Benzene	6.22 U	9.71	3.11	ug/Kg	1		10/30/13 21:23
Ethylbenzene	12.1 U	19.4	6.06	ug/Kg	1		10/30/13 21:23
o-Xylene	12.1 U	19.4	6.06	ug/Kg	1		10/30/13 21:23
P & M -Xylene	23.4 U	38.9	11.7	ug/Kg	1		10/30/13 21:23
Toluene	12.1 U	19.4	6.06	ug/Kg	1		10/30/13 21:23

Surrogates

1,4-Difluorobenzene	94.1	72-119		%	1		10/30/13 21:23
---------------------	------	--------	--	---	---	--	----------------

Batch Information

Analytical Batch: VFC11709
Analytical Method: SW8021B
Analyst: ST
Analytical Date/Time: 10/30/13 21:23
Container ID: 1135357014-B

Prep Batch: VXX25408
Prep Method: SW5035A
Prep Date/Time: 10/28/13 16:20
Prep Initial Wt./Vol.: 107.43 g
Prep Extract Vol: 37.0568 mL

Print Date: 11/13/2013 2:40:42PM



Results of 2348-TB

Client Sample ID: **2348-TB**
Client Project ID: **32-1-02348 Whittier Navigation**
Lab Sample ID: 1135357015
Lab Project ID: 1135357

Collection Date: 10/24/13 10:25
Received Date: 10/29/13 10:36
Matrix: Soil/Solid (dry weight)
Solids (%):

Results by Volatile Fuels

<u>Parameter</u>	<u>Result Qual</u>	<u>LOQ/CL</u>	<u>DL</u>	<u>Units</u>	<u>DF</u>	<u>Allowable Limits</u>	<u>Date Analyzed</u>
Gasoline Range Organics	1.48 U	2.47	0.740	mg/Kg	1		10/30/13 22:36

Surrogates

4-Bromofluorobenzene	96.7	50-150		%	1		10/30/13 22:36
----------------------	------	--------	--	---	---	--	----------------

Batch Information

Analytical Batch: VFC11709
Analytical Method: AK101
Analyst: ST
Analytical Date/Time: 10/30/13 22:36
Container ID: 1135357015-A

Prep Batch: VXX25408
Prep Method: SW5035A
Prep Date/Time: 10/24/13 10:25
Prep Initial Wt./Vol.: 50.706 g
Prep Extract Vol: 25 mL

<u>Parameter</u>	<u>Result Qual</u>	<u>LOQ/CL</u>	<u>DL</u>	<u>Units</u>	<u>DF</u>	<u>Allowable Limits</u>	<u>Date Analyzed</u>
Benzene	7.88 U	12.3	3.94	ug/Kg	1		10/30/13 22:36
Ethylbenzene	15.4 U	24.7	7.69	ug/Kg	1		10/30/13 22:36
o-Xylene	15.4 U	24.7	7.69	ug/Kg	1		10/30/13 22:36
P & M -Xylene	29.6 U	49.3	14.8	ug/Kg	1		10/30/13 22:36
Toluene	15.4 U	24.7	7.69	ug/Kg	1		10/30/13 22:36

Surrogates

1,4-Difluorobenzene	93.8	72-119		%	1		10/30/13 22:36
---------------------	------	--------	--	---	---	--	----------------

Batch Information

Analytical Batch: VFC11709
Analytical Method: SW8021B
Analyst: ST
Analytical Date/Time: 10/30/13 22:36
Container ID: 1135357015-A

Prep Batch: VXX25408
Prep Method: SW5035A
Prep Date/Time: 10/24/13 10:25
Prep Initial Wt./Vol.: 50.706 g
Prep Extract Vol: 25 mL

Print Date: 11/13/2013 2:40:42PM



Method Blank

Blank ID: MB for HBN 1491745 [MXX/27269]
Blank Lab ID: 1189681

Matrix: Soil/Solid (dry weight)

QC for Samples:
1135357010, 1135357011

Results by SW6020

<u>Parameter</u>	<u>Results</u>	<u>LOQ/CL</u>	<u>DL</u>	<u>Units</u>
Arsenic	0.620U	1.00	0.310	mg/Kg
Barium	0.188U	0.300	0.0940	mg/Kg
Cadmium	0.124U	0.200	0.0620	mg/Kg
Chromium	0.240U	0.400	0.120	mg/Kg
Lead	0.124U	0.200	0.0620	mg/Kg
Mercury	0.0240U	0.0400	0.0120	mg/Kg
Selenium	0.300U	0.500	0.150	mg/Kg
Silver	0.0620U	0.100	0.0310	mg/Kg

Batch Information

Analytical Batch: MMS8351
Analytical Method: SW6020
Instrument: Perkin Elmer Sciex ICP-MS P3
Analyst: ACF
Analytical Date/Time: 11/11/2013 3:06:35PM

Prep Batch: MXX27269
Prep Method: SW3050B
Prep Date/Time: 11/5/2013 3:30:00PM
Prep Initial Wt./Vol.: 1 g
Prep Extract Vol: 50 mL

Print Date: 11/13/2013 2:40:44PM

Blank Spike Summary

Blank Spike ID: LCS for HBN 1135357 [MXX27269]
 Blank Spike Lab ID: 1189682
 Date Analyzed: 11/11/2013 15:09

Matrix: Soil/Solid (dry weight)

QC for Samples: 1135357010, 1135357011

Results by SW6020

Parameter	Blank Spike (mg/Kg)			CL
	Spike	Result	Rec (%)	
Arsenic	50	49.1	98	(80-120)
Barium	50	47.5	95	(80-120)
Cadmium	5	4.87	98	(80-120)
Chromium	20	19.7	99	(80-120)
Lead	50	51.0	102	(80-120)
Mercury	0.5	0.500	100	(80-120)
Selenium	50	48.6	97	(80-120)
Silver	5	5.12	102	(80-120)

Batch Information

Analytical Batch: **MMS8351**
 Analytical Method: **SW6020**
 Instrument: **Perkin Elmer Sciex ICP-MS P3**
 Analyst: **ACF**

Prep Batch: **MXX27269**
 Prep Method: **SW3050B**
 Prep Date/Time: **11/05/2013 15:30**
 Spike Init Wt./Vol.: 50 mg/Kg Extract Vol: 50 mL
 Dupe Init Wt./Vol.: Extract Vol:

Matrix Spike Summary

Original Sample ID: 1135434012
 MS Sample ID: 1189684 MS
 MSD Sample ID: 1189685 MSD

Analysis Date: 11/11/2013 15:11
 Analysis Date: 11/11/2013 15:17
 Analysis Date: 11/11/2013 15:19
 Matrix: Soil/Solid (dry weight)

QC for Samples: 1135357010, 1135357011

Results by SW6020

Parameter	Sample	Matrix Spike (mg/Kg)			Spike Duplicate (mg/Kg)			CL	RPD (%)	RPD CL
		Spike	Result	Rec (%)	Spike	Result	Rec (%)			
Arsenic	7.68	62.5	68.9	98	56.4	61.5	95	80-120	11.40	(< 20)
Barium	32.4	62.5	81.9	79 *	56.4	73.6	73 *	80-120	10.70	(< 20)
Cadmium	0.145U	6.25	6.02	96	5.64	5.40	96	80-120	10.80	(< 20)
Chromium	47.2	24.9	71.3	97	22.5	67.8	91	80-120	5.19	(< 20)
Lead	6.82	62.5	68.3	98	56.4	61.2	97	80-120	10.90	(< 20)
Mercury	0.0242J	0.625	0.664	102	0.564	0.578	98	80-120	13.90	(< 20)
Selenium	0.350U	62.5	62.0	99	56.4	54.3	96	80-120	13.10	(< 20)
Silver	0.0726U	6.25	6.15	99	5.64	5.43	96	80-120	12.40	(< 20)

Batch Information

Analytical Batch: MMS8351
 Analytical Method: SW6020
 Instrument: Perkin Elmer Sciex ICP-MS P3
 Analyst: ACF
 Analytical Date/Time: 11/11/2013 3:17:18PM

Prep Batch: MXX27269
 Prep Method: Soils/Solids Digest for Metals by ICP-MS
 Prep Date/Time: 11/5/2013 3:30:00PM
 Prep Initial Wt./Vol.: 1.01g
 Prep Extract Vol: 50.00mL

Bench Spike Summary

Original Sample ID: 1135434012
 MS Sample ID: 1189686 BND
 MSD Sample ID:

Analysis Date: 11/11/2013 15:11
 Analysis Date: 11/11/2013 15:22
 Analysis Date:
 Matrix: Soil/Solid (dry weight)

QC for Samples: 1135357010, 1135357011

Results by SW6020

Parameter	Sample	Matrix Spike (mg/Kg)			Spike Duplicate (mg/Kg)			CL	RPD (%)	RPD CL
		Spike	Result	Rec (%)	Spike	Result	Rec (%)			
Barium	32.4	292	315	97				75-125		

Batch Information

Analytical Batch: MMS8351
 Analytical Method: SW6020
 Instrument: Perkin Elmer Sciex ICP-MS P3
 Analyst: ACF
 Analytical Date/Time: 11/11/2013 3:22:40PM

Prep Batch: MXX27269
 Prep Method: Soils/Solids Digest for Metals by ICP-MS
 Prep Date/Time: 11/5/2013 3:30:00PM
 Prep Initial Wt./Vol.: 1.08g
 Prep Extract Vol: 50.00mL

Print Date: 11/13/2013 2:40:45PM



Method Blank

Blank ID: MB for HBN 1491482 [SPT/9195]
Blank Lab ID: 1188550

Matrix: Soil/Solid (dry weight)

QC for Samples:

1135357001, 1135357003, 1135357005, 1135357009, 1135357010, 1135357011, 1135357012, 1135357014

Results by SM21 2540G

<u>Parameter</u>	<u>Results</u>	<u>LOQ/CL</u>	<u>DL</u>	<u>Units</u>
Total Solids	100			%

Batch Information

Analytical Batch: SPT9195
Analytical Method: SM21 2540G
Instrument:
Analyst: KRL
Analytical Date/Time: 10/29/2013 5:00:00PM

Print Date: 11/13/2013 2:40:46PM

Duplicate Sample Summary

Original Sample ID: 1138649002

Analysis Date: 10/29/2013 17:00

Duplicate Sample ID: 1188551

Matrix: Soil/Solid (dry weight)

QC for Samples:

1135357001, 1135357003, 1135357005, 1135357009, 1135357010, 1135357011, 1135357012, 1135357014

Results by SM21 2540G

<u>NAME</u>	<u>Original ()</u>	<u>Duplicate ()</u>	<u>RPD (%)</u>	<u>RPD CL</u>
Total Solids	91.3	92.5	1.20	15.00

Batch Information

Analytical Batch: SPT9195

Analytical Method: SM21 2540G

Instrument:

Analyst: KRL

Print Date: 11/13/2013 2:40:46PM



Method Blank

Blank ID: MB for HBN 1491500 [VXX/25400]
Blank Lab ID: 1188631

Matrix: Soil/Solid (dry weight)

QC for Samples:
1135357001, 1135357003, 1135357005, 1135357009, 1135357010, 1135357011

Results by AK101

<u>Parameter</u>	<u>Results</u>	<u>LOQ/CL</u>	<u>DL</u>	<u>Units</u>
Gasoline Range Organics	1.50U	2.50	0.750	mg/Kg
Surrogates				
4-Bromofluorobenzene	82.1	50-150		%

Batch Information

Analytical Batch: VFC11704
Analytical Method: AK101
Instrument: Agilent 7890 PID/FID
Analyst: ST
Analytical Date/Time: 10/29/2013 9:29:00PM

Prep Batch: VXX25400
Prep Method: SW5035A
Prep Date/Time: 10/28/2013 8:00:00AM
Prep Initial Wt./Vol.: 50 g
Prep Extract Vol: 25 mL

Print Date: 11/13/2013 2:40:47PM

Blank Spike Summary

Blank Spike ID: LCS for HBN 1135357 [VXX25400]
 Blank Spike Lab ID: 1188634
 Date Analyzed: 10/29/2013 22:24

Spike Duplicate ID: LCSD for HBN 1135357 [VXX25400]
 Spike Duplicate Lab ID: 1188635
 Matrix: Soil/Solid (dry weight)

QC for Samples: 1135357001, 1135357003, 1135357005, 1135357009, 1135357010, 1135357011

Results by AK101

Parameter	Blank Spike (mg/Kg)			Spike Duplicate (mg/Kg)			CL	RPD (%)	RPD CL
	Spike	Result	Rec (%)	Spike	Result	Rec (%)			
Gasoline Range Organics	10.0	10.2	102	10.0	9.70	97	(60-120)	5.00	(< 20)
Surrogates									
4-Bromofluorobenzene	1.25	82.6	83	1.25	79.7	80	(50-150)	3.50	

Batch Information

Analytical Batch: **VFC11704**
 Analytical Method: **AK101**
 Instrument: **Agilent 7890 PID/FID**
 Analyst: **ST**

Prep Batch: **VXX25400**
 Prep Method: **SW5035A**
 Prep Date/Time: **10/28/2013 08:00**
 Spike Init Wt./Vol.: 10.0 mg/Kg Extract Vol: 25 mL
 Dupe Init Wt./Vol.: 10.0 mg/Kg Extract Vol: 25 mL



Method Blank

Blank ID: MB for HBN 1491500 [VXX/25400]
Blank Lab ID: 1188631

Matrix: Soil/Solid (dry weight)

QC for Samples:
1135357001, 1135357003, 1135357005, 1135357009, 1135357010, 1135357011

Results by SW8021B

<u>Parameter</u>	<u>Results</u>	<u>LOQ/CL</u>	<u>DL</u>	<u>Units</u>
Benzene	8.00U	12.5	4.00	ug/Kg
Ethylbenzene	15.6U	25.0	7.80	ug/Kg
o-Xylene	15.6U	25.0	7.80	ug/Kg
P & M -Xylene	30.0U	50.0	15.0	ug/Kg
Toluene	8.00J	25.0	7.80	ug/Kg

Surrogates

1,4-Difluorobenzene	94.1	72-119		%
---------------------	------	--------	--	---

Batch Information

Analytical Batch: VFC11704
Analytical Method: SW8021B
Instrument: Agilent 7890 PID/FID
Analyst: ST
Analytical Date/Time: 10/29/2013 9:29:00PM

Prep Batch: VXX25400
Prep Method: SW5035A
Prep Date/Time: 10/28/2013 8:00:00AM
Prep Initial Wt./Vol.: 50 g
Prep Extract Vol: 25 mL

Print Date: 11/13/2013 2:40:48PM



Blank Spike Summary

Blank Spike ID: LCS for HBN 1135357 [VXX25400]
 Blank Spike Lab ID: 1188632
 Date Analyzed: 10/29/2013 21:48

Spike Duplicate ID: LCSD for HBN 1135357 [VXX25400]
 Spike Duplicate Lab ID: 1188633
 Matrix: Soil/Solid (dry weight)

QC for Samples: 1135357001, 1135357003, 1135357005, 1135357009, 1135357010, 1135357011

Results by SW8021B

Parameter	Blank Spike (ug/Kg)			Spike Duplicate (ug/Kg)					
	Spike	Result	Rec (%)	Spike	Result	Rec (%)	CL	RPD (%)	RPD CL
Benzene	1250	1530	122	1250	1350	108	(75-125)	12.60	(< 20)
Ethylbenzene	1250	1470	117	1250	1290	103	(75-125)	12.90	(< 20)
o-Xylene	1250	1450	116	1250	1270	102	(75-125)	13.00	(< 20)
P & M -Xylene	2500	2940	117	2500	2580	103	(80-125)	13.00	(< 20)
Toluene	1250	1470	118	1250	1290	103	(70-125)	12.90	(< 20)

Surrogates

1,4-Difluorobenzene	1250	98.1	98	1250	97.8	98	(72-119)	0.29	
---------------------	------	------	----	------	------	----	------------	------	--

Batch Information

Analytical Batch: VFC11704
 Analytical Method: SW8021B
 Instrument: Agilent 7890 PID/FID
 Analyst: ST

Prep Batch: VXX25400
 Prep Method: SW5035A
 Prep Date/Time: 10/28/2013 08:00
 Spike Init Wt./Vol.: 1250 ug/Kg Extract Vol: 25 mL
 Dupe Init Wt./Vol.: 1250 ug/Kg Extract Vol: 25 mL

Print Date: 11/13/2013 2:40:49PM



Matrix Spike Summary

Original Sample ID: 1135357001
MS Sample ID: 1188636 MS
MSD Sample ID: 1188637 MSD

Analysis Date: 10/29/2013 23:00
Analysis Date: 10/29/2013 23:19
Analysis Date: 10/29/2013 23:37
Matrix: Soil/Solid (dry weight)

QC for Samples: 1135357001, 1135357003, 1135357005, 1135357009, 1135357010, 1135357011

Results by SW8021B

Parameter	Sample	Matrix Spike (ug/Kg)			Spike Duplicate (ug/Kg)			CL	RPD (%)	RPD CL
		Spike	Result	Rec (%)	Spike	Result	Rec (%)			
Benzene	7.62U	986	1136	115	986	1082	110	75-125	4.50	(< 20)
Ethylbenzene	14.9U	986	1093	111	986	1043	106	75-125	4.40	(< 20)
o-Xylene	14.9U	986	1073	109	986	1027	104	75-125	4.30	(< 20)
P & M -Xylene	28.6U	1970	2175	110	1970	2089	106	80-125	4.40	(< 20)
Toluene	14.9U	986	1093	110	986	1042	106	70-125	4.30	(< 20)
Surrogates										
1,4-Difluorobenzene		986	965	98	986	964	98	72-119	0.20	

Batch Information

Analytical Batch: VFC11704
Analytical Method: SW8021B
Instrument: Agilent 7890 PID/FID
Analyst: ST
Analytical Date/Time: 10/29/2013 11:19:00PM

Prep Batch: VXX25400
Prep Method: AK101 Extraction (S)
Prep Date/Time: 10/28/2013 8:00:00AM
Prep Initial Wt./Vol.: 68.59g
Prep Extract Vol: 25.00mL

Print Date: 11/13/2013 2:40:50PM



Method Blank

Blank ID: MB for HBN 1491548 [VXX/25408]
Blank Lab ID: 1188874

Matrix: Soil/Solid (dry weight)

QC for Samples:
1135357012, 1135357014, 1135357015

Results by AK101

<u>Parameter</u>	<u>Results</u>	<u>LOQ/CL</u>	<u>DL</u>	<u>Units</u>
Gasoline Range Organics	1.50U	2.50	0.750	mg/Kg
Surrogates				
4-Bromofluorobenzene	76.5	50-150		%

Batch Information

Analytical Batch: VFC11709
Analytical Method: AK101
Instrument: Agilent 7890 PID/FID
Analyst: ST
Analytical Date/Time: 10/30/2013 7:51:00PM

Prep Batch: VXX25408
Prep Method: SW5035A
Prep Date/Time: 10/30/2013 8:00:00AM
Prep Initial Wt./Vol.: 50 g
Prep Extract Vol: 25 mL

Print Date: 11/13/2013 2:40:50PM

Blank Spike Summary

Blank Spike ID: LCS for HBN 1135357 [VXX25408]
 Blank Spike Lab ID: 1188877
 Date Analyzed: 10/30/2013 20:46

Spike Duplicate ID: LCSD for HBN 1135357 [VXX25408]
 Spike Duplicate Lab ID: 1188878
 Matrix: Soil/Solid (dry weight)

QC for Samples: 1135357012, 1135357014, 1135357015

Results by AK101

Parameter	Blank Spike (mg/Kg)			Spike Duplicate (mg/Kg)			CL	RPD (%)	RPD CL
	Spike	Result	Rec (%)	Spike	Result	Rec (%)			
Gasoline Range Organics	10.0	9.86	99	10.0	10.6	106	(60-120)	6.80	(< 20)
Surrogates									
4-Bromofluorobenzene	1.25	81.7	82	1.25	82.8	83	(50-150)	1.40	

Batch Information

Analytical Batch: **VFC11709**
 Analytical Method: **AK101**
 Instrument: **Agilent 7890 PID/FID**
 Analyst: **ST**

Prep Batch: **VXX25408**
 Prep Method: **SW5035A**
 Prep Date/Time: **10/30/2013 08:00**
 Spike Init Wt./Vol.: 10.0 mg/Kg Extract Vol: 25 mL
 Dupe Init Wt./Vol.: 10.0 mg/Kg Extract Vol: 25 mL

Print Date: 11/13/2013 2:40:51PM



Method Blank

Blank ID: MB for HBN 1491548 [VXX/25408]
Blank Lab ID: 1188874

Matrix: Soil/Solid (dry weight)

QC for Samples:
1135357012, 1135357014, 1135357015

Results by SW8021B

<u>Parameter</u>	<u>Results</u>	<u>LOQ/CL</u>	<u>DL</u>	<u>Units</u>
Benzene	8.00U	12.5	4.00	ug/Kg
Ethylbenzene	15.6U	25.0	7.80	ug/Kg
o-Xylene	15.6U	25.0	7.80	ug/Kg
P & M -Xylene	30.0U	50.0	15.0	ug/Kg
Toluene	15.6U	25.0	7.80	ug/Kg

Surrogates

1,4-Difluorobenzene	93.9	72-119		%
---------------------	------	--------	--	---

Batch Information

Analytical Batch: VFC11709
Analytical Method: SW8021B
Instrument: Agilent 7890 PID/FID
Analyst: ST
Analytical Date/Time: 10/30/2013 7:51:00PM

Prep Batch: VXX25408
Prep Method: SW5035A
Prep Date/Time: 10/30/2013 8:00:00AM
Prep Initial Wt./Vol.: 50 g
Prep Extract Vol: 25 mL

Print Date: 11/13/2013 2:40:52PM



Blank Spike Summary

Blank Spike ID: LCS for HBN 1135357 [VXX25408]
 Blank Spike Lab ID: 1188875
 Date Analyzed: 10/30/2013 20:09

Spike Duplicate ID: LCSD for HBN 1135357 [VXX25408]
 Spike Duplicate Lab ID: 1188876
 Matrix: Soil/Solid (dry weight)

QC for Samples: 1135357012, 1135357014, 1135357015

Results by SW8021B

Parameter	Blank Spike (ug/Kg)			Spike Duplicate (ug/Kg)					
	Spike	Result	Rec (%)	Spike	Result	Rec (%)	CL	RPD (%)	RPD CL
Benzene	1250	1520	122	1250	1480	118	(75-125)	2.80	(< 20)
Ethylbenzene	1250	1450	116	1250	1420	113	(75-125)	2.20	(< 20)
o-Xylene	1250	1410	113	1250	1400	112	(75-125)	1.10	(< 20)
P & M -Xylene	2500	2890	116	2500	2830	113	(80-125)	2.00	(< 20)
Toluene	1250	1460	117	1250	1420	114	(70-125)	2.70	(< 20)

Surrogates

1,4-Difluorobenzene	1250	97.7	98	1250	97.8	98	(72-119)	0.16	
---------------------	------	------	----	------	------	----	------------	------	--

Batch Information

Analytical Batch: **VFC11709**
 Analytical Method: **SW8021B**
 Instrument: **Agilent 7890 PID/FID**
 Analyst: **ST**

Prep Batch: **VXX25408**
 Prep Method: **SW5035A**
 Prep Date/Time: **10/30/2013 08:00**
 Spike Init Wt./Vol.: 1250 ug/Kg Extract Vol: 25 mL
 Dupe Init Wt./Vol.: 1250 ug/Kg Extract Vol: 25 mL

Print Date: 11/13/2013 2:40:53PM



Matrix Spike Summary

Original Sample ID: 1135357014
MS Sample ID: 1188879 MS
MSD Sample ID: 1188880 MSD

Analysis Date: 10/30/2013 21:23
Analysis Date: 10/30/2013 21:41
Analysis Date: 10/30/2013 21:59
Matrix: Soil/Solid (dry weight)

QC for Samples: 1135357012, 1135357014, 1135357015

Results by SW8021B

Parameter	Sample	Matrix Spike (ug/Kg)			Spike Duplicate (ug/Kg)			CL	RPD (%)	RPD CL
		Spike	Result	Rec (%)	Spike	Result	Rec (%)			
Benzene	6.22U	655	748	114	655	753	115	75-125	0.73	(< 20)
Ethylbenzene	12.1U	655	721	110	655	725	111	75-125	0.74	(< 20)
o-Xylene	12.1U	655	706	108	655	714	109	75-125	1.10	(< 20)
P & M -Xylene	23.4U	1306	1441	110	1306	1453	111	80-125	0.83	(< 20)
Toluene	12.1U	655	718	110	655	723	110	70-125	0.55	(< 20)
Surrogates										
1,4-Difluorobenzene		655	640	98	655	640	98	72-119	0.06	

Batch Information

Analytical Batch: VFC11709
Analytical Method: SW8021B
Instrument: Agilent 7890 PID/FID
Analyst: ST
Analytical Date/Time: 10/30/2013 9:41:00PM

Prep Batch: VXX25408
Prep Method: AK101 Extraction (S)
Prep Date/Time: 10/30/2013 8:00:00AM
Prep Initial Wt./Vol.: 107.43g
Prep Extract Vol: 25.00mL

Print Date: 11/13/2013 2:40:53PM



Method Blank

Blank ID: MB for HBN 1491475 [XXX/30276]
Blank Lab ID: 1188520

Matrix: Soil/Solid (dry weight)

QC for Samples:

1135357001, 1135357003, 1135357005, 1135357009, 1135357010, 1135357011, 1135357012

Results by AK102

<u>Parameter</u>	<u>Results</u>	<u>LOQ/CL</u>	<u>DL</u>	<u>Units</u>
Diesel Range Organics	12.4U	20.0	6.20	mg/Kg
Surrogates				
5a Androstane	91.5	60-120		%

Batch Information

Analytical Batch: XFC11149
Analytical Method: AK102
Instrument: HP 7890A FID SV E R
Analyst: EAB
Analytical Date/Time: 11/1/2013 5:33:00AM

Prep Batch: XXX30276
Prep Method: SW3550C
Prep Date/Time: 10/29/2013 5:00:00PM
Prep Initial Wt./Vol.: 30 g
Prep Extract Vol: 1 mL

Print Date: 11/13/2013 2:40:54PM

Blank Spike Summary

Blank Spike ID: LCS for HBN 1135357 [XXX30276]
 Blank Spike Lab ID: 1188521
 Date Analyzed: 11/01/2013 05:53

Spike Duplicate ID: LCSD for HBN 1135357 [XXX30276]
 Spike Duplicate Lab ID: 1188522
 Matrix: Soil/Solid (dry weight)

QC for Samples: 1135357001, 1135357003, 1135357005, 1135357009, 1135357010, 1135357011, 1135357012

Results by AK102

Parameter	Blank Spike (mg/Kg)			Spike Duplicate (mg/Kg)			CL	RPD (%)	RPD CL
	Spike	Result	Rec (%)	Spike	Result	Rec (%)			
Diesel Range Organics	167	183	110	167	181	108	(75-125)	1.60	(< 20)
Surrogates									
5a Androstane	3.33	95.7	96	3.33	93.1	93	(60-120)	2.80	

Batch Information

Analytical Batch: **XFC11149**
 Analytical Method: **AK102**
 Instrument: **HP 7890A FID SV E R**
 Analyst: **EAB**

Prep Batch: **XXX30276**
 Prep Method: **SW3550C**
 Prep Date/Time: **10/29/2013 17:00**
 Spike Init Wt./Vol.: 167 mg/Kg Extract Vol: 1 mL
 Dupe Init Wt./Vol.: 167 mg/Kg Extract Vol: 1 mL



Method Blank

Blank ID: MB for HBN 1491475 [XXX/30276]
Blank Lab ID: 1188520

Matrix: Soil/Solid (dry weight)

QC for Samples:

1135357001, 1135357003, 1135357005, 1135357009, 1135357010, 1135357011, 1135357012

Results by AK103

<u>Parameter</u>	<u>Results</u>	<u>LOQ/CL</u>	<u>DL</u>	<u>Units</u>
Residual Range Organics	12.4U	20.0	6.20	mg/Kg
Surrogates				
n-Triacontane-d62	94.4	60-120		%

Batch Information

Analytical Batch: XFC11149
Analytical Method: AK103
Instrument: HP 7890A FID SV E R
Analyst: EAB
Analytical Date/Time: 11/1/2013 5:33:00AM

Prep Batch: XXX30276
Prep Method: SW3550C
Prep Date/Time: 10/29/2013 5:00:00PM
Prep Initial Wt./Vol.: 30 g
Prep Extract Vol: 1 mL

Print Date: 11/13/2013 2:40:55PM

Blank Spike Summary

Blank Spike ID: LCS for HBN 1135357 [XXX30276]
 Blank Spike Lab ID: 1188521
 Date Analyzed: 11/01/2013 05:53

Spike Duplicate ID: LCSD for HBN 1135357 [XXX30276]
 Spike Duplicate Lab ID: 1188522
 Matrix: Soil/Solid (dry weight)

QC for Samples: 1135357001, 1135357003, 1135357005, 1135357009, 1135357010, 1135357011, 1135357012

Results by AK103

Parameter	Blank Spike (mg/Kg)			Spike Duplicate (mg/Kg)			CL	RPD (%)	RPD CL
	Spike	Result	Rec (%)	Spike	Result	Rec (%)			
Residual Range Organics	167	178	107	167	177	106	(60-120)	0.31	(< 20)
Surrogates									
n-Triacontane-d62	3.33	84.2	84	3.33	92.6	93	(60-120)	9.50	

Batch Information

Analytical Batch: **XFC11149**
 Analytical Method: **AK103**
 Instrument: **HP 7890A FID SV ER**
 Analyst: **EAB**

Prep Batch: **XXX30276**
 Prep Method: **SW3550C**
 Prep Date/Time: **10/29/2013 17:00**
 Spike Init Wt./Vol.: 167 mg/Kg Extract Vol: 1 mL
 Dupe Init Wt./Vol.: 167 mg/Kg Extract Vol: 1 mL

Method Blank

Blank ID: MB for HBN 1491499 [XXX/30280]

Blank Lab ID: 1188628

QC for Samples:

1135357014

Matrix: Soil/Solid (dry weight)

Results by AK102

<u>Parameter</u>	<u>Results</u>	<u>LOQ/CL</u>	<u>DL</u>	<u>Units</u>
Diesel Range Organics	12.4U	20.0	6.20	mg/Kg
Surrogates				
5a Androstane	93.7	60-120		%

Batch Information

Analytical Batch: XFC11147

Analytical Method: AK102

Instrument: HP 7890A FID SV E R

Analyst: EAB

Analytical Date/Time: 10/30/2013 5:02:00PM

Prep Batch: XXX30280

Prep Method: SW3550C

Prep Date/Time: 10/30/2013 1:15:00PM

Prep Initial Wt./Vol.: 30 g

Prep Extract Vol: 1 mL

Blank Spike Summary

Blank Spike ID: LCS for HBN 1135357 [XXX30280]
 Blank Spike Lab ID: 1188629
 Date Analyzed: 10/30/2013 17:22

Spike Duplicate ID: LCSD for HBN 1135357 [XXX30280]
 Spike Duplicate Lab ID: 1188630
 Matrix: Soil/Solid (dry weight)

QC for Samples: 1135357014

Results by AK102

Parameter	Blank Spike (mg/Kg)			Spike Duplicate (mg/Kg)			CL	RPD (%)	RPD CL
	Spike	Result	Rec (%)	Spike	Result	Rec (%)			
Diesel Range Organics	167	181	109	167	184	110	(75-125)	1.50	(< 20)
Surrogates									
5a Androstane	3.33	96	96	3.33	97.1	97	(60-120)	1.10	

Batch Information

Analytical Batch: **XFC11147**
 Analytical Method: **AK102**
 Instrument: **HP 7890A FID SV ER**
 Analyst: **EAB**

Prep Batch: **XXX30280**
 Prep Method: **SW3550C**
 Prep Date/Time: **10/30/2013 13:15**
 Spike Init Wt./Vol.: 167 mg/Kg Extract Vol: 1 mL
 Dupe Init Wt./Vol.: 167 mg/Kg Extract Vol: 1 mL

Print Date: 11/13/2013 2:40:57PM

Method Blank

Blank ID: MB for HBN 1491499 [XXX/30280]

Blank Lab ID: 1188628

QC for Samples:

1135357014

Matrix: Soil/Solid (dry weight)

Results by AK103

<u>Parameter</u>	<u>Results</u>	<u>LOQ/CL</u>	<u>DL</u>	<u>Units</u>
Residual Range Organics	12.4U	20.0	6.20	mg/Kg
Surrogates				
n-Triacontane-d62	99.5	60-120		%

Batch Information

Analytical Batch: XFC11147

Analytical Method: AK103

Instrument: HP 7890A FID SV E R

Analyst: EAB

Analytical Date/Time: 10/30/2013 5:02:00PM

Prep Batch: XXX30280

Prep Method: SW3550C

Prep Date/Time: 10/30/2013 1:15:00PM

Prep Initial Wt./Vol.: 30 g

Prep Extract Vol: 1 mL

Print Date: 11/13/2013 2:40:57PM

Blank Spike Summary

Blank Spike ID: LCS for HBN 1135357 [XXX30280]
 Blank Spike Lab ID: 1188629
 Date Analyzed: 10/30/2013 17:22

Spike Duplicate ID: LCSD for HBN 1135357 [XXX30280]
 Spike Duplicate Lab ID: 1188630
 Matrix: Soil/Solid (dry weight)

QC for Samples: 1135357014

Results by AK103

Parameter	Blank Spike (mg/Kg)			Spike Duplicate (mg/Kg)			CL	RPD (%)	RPD CL
	Spike	Result	Rec (%)	Spike	Result	Rec (%)			
Residual Range Organics	167	170	102	167	173	104	(60-120)	1.30	(< 20)
Surrogates									
n-Triacontane-d62	3.33	96.3	96	3.33	96	96	(60-120)	0.31	

Batch Information

Analytical Batch: **XFC11147**
 Analytical Method: **AK103**
 Instrument: **HP 7890A FID SV ER**
 Analyst: **EAB**

Prep Batch: **XXX30280**
 Prep Method: **SW3550C**
 Prep Date/Time: **10/30/2013 13:15**
 Spike Init Wt./Vol.: 167 mg/Kg Extract Vol: 1 mL
 Dupe Init Wt./Vol.: 167 mg/Kg Extract Vol: 1 mL

Method Blank

Blank ID: MB for HBN 1491509 [XXX/30282]

Blank Lab ID: 1188671

QC for Samples:

1135357009, 1135357011

Matrix: Soil/Solid (dry weight)

Results by 8270D SIMS (PAH)

<u>Parameter</u>	<u>Results</u>	<u>LOQ/CL</u>	<u>DL</u>	<u>Units</u>
1-Methylnaphthalene	3.00U	5.00	1.50	ug/Kg
2-Methylnaphthalene	3.00U	5.00	1.50	ug/Kg
Acenaphthene	3.00U	5.00	1.50	ug/Kg
Acenaphthylene	3.00U	5.00	1.50	ug/Kg
Anthracene	3.00U	5.00	1.50	ug/Kg
Benzo(a)Anthracene	3.00U	5.00	1.50	ug/Kg
Benzo[a]pyrene	3.00U	5.00	1.50	ug/Kg
Benzo[b]Fluoranthene	3.00U	5.00	1.50	ug/Kg
Benzo[g,h,i]perylene	3.00U	5.00	1.50	ug/Kg
Benzo[k]fluoranthene	3.00U	5.00	1.50	ug/Kg
Chrysene	3.00U	5.00	1.50	ug/Kg
Dibenzo[a,h]anthracene	3.00U	5.00	1.50	ug/Kg
Fluoranthene	3.00U	5.00	1.50	ug/Kg
Fluorene	3.00U	5.00	1.50	ug/Kg
Indeno[1,2,3-c,d] pyrene	3.00U	5.00	1.50	ug/Kg
Naphthalene	3.00U	5.00	1.50	ug/Kg
Phenanthrene	3.00U	5.00	1.50	ug/Kg
Pyrene	3.00U	5.00	1.50	ug/Kg
Surrogates				
2-Fluorobiphenyl	88.9	45-105		%
Terphenyl-d14	105	30-125		%

Batch Information

Analytical Batch: XMS7736

Analytical Method: 8270D SIMS (PAH)

Instrument: HP 6890/5973 MS SVQA

Analyst: RTS

Analytical Date/Time: 10/30/2013 8:47:00PM

Prep Batch: XXX30282

Prep Method: SW3550C

Prep Date/Time: 10/30/2013 3:20:00PM

Prep Initial Wt./Vol.: 22.5 g

Prep Extract Vol: 1 mL

Blank Spike Summary

Blank Spike ID: LCS for HBN 1135357 [XXX30282]
 Blank Spike Lab ID: 1188672
 Date Analyzed: 10/30/2013 21:01

Matrix: Soil/Solid (dry weight)

QC for Samples: 1135357009, 1135357011

Results by 8270D SIMS (PAH)

Parameter	Blank Spike (ug/Kg)			CL
	Spike	Result	Rec (%)	
1-Methylnaphthalene	22.2	18.5	83	(44-107)
2-Methylnaphthalene	22.2	18.1	81	(45-105)
Acenaphthene	22.2	18.8	85	(45-110)
Acenaphthylene	22.2	19.6	88	(45-105)
Anthracene	22.2	17.4	78	(55-105)
Benzo(a)Anthracene	22.2	19.9	90	(50-110)
Benzo[a]pyrene	22.2	16.1	72	(50-110)
Benzo[b]Fluoranthene	22.2	20.7	93	(45-115)
Benzo[g,h,i]perylene	22.2	21.2	95	(40-125)
Benzo[k]fluoranthene	22.2	22.0	99	(45-125)
Chrysene	22.2	22.6	102	(55-110)
Dibenzo[a,h]anthracene	22.2	21.0	95	(40-125)
Fluoranthene	22.2	21.2	95	(55-115)
Fluorene	22.2	19.9	89	(50-110)
Indeno[1,2,3-c,d] pyrene	22.2	21.1	95	(40-120)
Naphthalene	22.2	17.4	79	(40-105)
Phenanthrene	22.2	20.4	92	(50-110)
Pyrene	22.2	20.7	93	(45-125)
Surrogates				
2-Fluorobiphenyl	22.2	87.7	88	(45-105)
Terphenyl-d14	22.2	103	103	(30-125)

Batch Information

Analytical Batch: XMS7736
 Analytical Method: 8270D SIMS (PAH)
 Instrument: HP 6890/5973 MS SVQA
 Analyst: RTS

Prep Batch: XXX30282
 Prep Method: SW3550C
 Prep Date/Time: 10/30/2013 15:20
 Spike Init Wt./Vol.: 22.2 ug/Kg Extract Vol: 1 mL
 Dupe Init Wt./Vol.: Extract Vol:

Print Date: 11/13/2013 2:40:59PM



Matrix Spike Summary

Original Sample ID: 1135357011
 MS Sample ID: 1188673 MS
 MSD Sample ID: 1188674 MSD

Analysis Date: 10/30/2013 21:29
 Analysis Date: 10/30/2013 21:43
 Analysis Date: 10/30/2013 21:57
 Matrix: Soil/Solid (dry weight)

QC for Samples: 1135357009, 1135357011

Results by 8270D SIMS (PAH)

Parameter	Sample	Matrix Spike (ug/Kg)			Spike Duplicate (ug/Kg)			CL	RPD (%)	RPD CL
		Spike	Result	Rec (%)	Spike	Result	Rec (%)			
1-Methylnaphthalene	9.36	25.4	28.5	75	25.4	26.2	66	44-107	8.40	(< 30)
2-Methylnaphthalene	16.9	25.4	34.1	68	25.4	31.3	57	45-105	8.30	(< 30)
Acenaphthene	3.42U	25.4	22.3	88	25.4	20.7	82	45-110	7.60	(< 30)
Acenaphthylene	3.42U	25.4	24.3	96	25.4	23.7	93	45-105	3.10	(< 30)
Anthracene	3.42U	25.4	22.4	88	25.4	21.0	83	55-105	6.50	(< 30)
Benzo(a)Anthracene	3.42U	25.4	19.1	75	25.4	19.8	78	50-110	3.50	(< 30)
Benzo(a)pyrene	3.42U	25.4	14.7	58	25.4	14.3	56	50-110	2.90	(< 30)
Benzo(b)Fluoranthene	3.42U	25.4	17.1	68	25.4	16.7	66	45-115	2.80	(< 30)
Benzo(g,h,i)perylene	3.42U	25.4	13.3	52	25.4	12.1	48	40-125	9.10	(< 30)
Benzo(k)fluoranthene	3.42U	25.4	17.3	68	25.4	17.3	68	45-125	0.21	(< 30)
Chrysene	3.42U	25.4	20.2	80	25.4	20.7	82	55-110	2.30	(< 30)
Dibenzo(a,h)anthracene	3.42U	25.4	12.1	48	25.4	10.4	41	40-125	14.70	(< 30)
Fluoranthene	3.42U	25.4	23.2	92	25.4	22.6	89	55-115	2.60	(< 30)
Fluorene	3.42U	25.4	25.1	99	25.4	24.2	96	50-110	3.60	(< 30)
Indeno[1,2,3-c,d] pyrene	3.42U	25.4	12.5	49	25.4	11.4	45	40-120	8.40	(< 30)
Naphthalene	3.42U	25.4	22.1	87	25.4	22.7	90	40-105	2.90	(< 30)
Phenanthrene	6.00	25.4	28.0	87	25.4	26.4	80	50-110	6.00	(< 30)
Pyrene	3.42U	25.4	22.7	90	25.4	22.3	88	45-125	1.60	(< 30)
Surrogates										
2-Fluorobiphenyl		25.4	24.3	96	25.4	24.5	97	45-105	0.68	
Terphenyl-d14		25.4	25.3	100	25.4	26.5	105	30-125	4.70	

Batch Information

Analytical Batch: XMS7736
 Analytical Method: 8270D SIMS (PAH)
 Instrument: HP 6890/5973 MS SVQA
 Analyst: RTS
 Analytical Date/Time: 10/30/2013 9:43:00PM

Prep Batch: XXX30282
 Prep Method: Sonication Extraction Soil 8270 PAH SIM
 Prep Date/Time: 10/30/2013 3:20:00PM
 Prep Initial Wt./Vol.: 22.54g
 Prep Extract Vol: 1.00mL

Print Date: 11/13/2013 2:41:00PM

Charley, Stephanie (Anchorage)

From: Wesley, William (Anchorage)
Sent: Monday, November 04, 2013 2:11 PM
To: Env.Alaska.RcvgLogin
Subject: FW: Change Order: 1135357
Please make the changes in LIMS>

From: Homestead, Charles (Anchorage)
Sent: Monday, November 04, 2013 10:21 AM
To: Long, Alesha (Anchorage); Wesley, William (Anchorage)
Cc: Crupi, Steven R (Anchorage)
Subject: Change Order: 1135357



Please see change order request below. CGH

From: Stafford Glashan [mailto:SJG@shanwil.com]
Sent: Monday, November 04, 2013 9:40 AM
To: Homestead, Charles (Anchorage)
Cc: Ryan Collins
Subject: SGS 1135357

Chuck

Is it too late to add Total RCRA metals to samples B07-S7 (1135357010) and B10-S4 (1135357011)?

S



Stafford Glashan, P.E. | Vice President
5430 Fairbanks Street, Suite 3
Anchorage, Alaska 99518
www.shannonwilson.com
Phone: (907) 561-2120 Fax: (907) 561-4483
Direct: (907) 433-3214
sjg@shanwil.com

Excellence. Innovation. Service. Value.
We Help Our Clients Achieve Their Goals.



1135357



SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

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

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

2255 S.W. Canyon Road
Portland, OR 97201-2498
(503) 223-6147

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

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

1200 17th Street, Suite 1024
Denver, Co 80202
(303) 825-3800

CHAIN-OF-CUSTODY

Laboratory SGS
Attn: _____

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

Sample Identity	Lab No.	Time	Date Sampled	Comp.	Grab	GROBTEX	AK101/102/103/104/105	D10/AR0	AK 102 1103	PAT-STUNS	FPA-1020	Total Number of Containers	Remarks/Matrix
2348-B01-S1	① A+B	1025	10/24	X	X	X						2	Soil
B02-S1	② A+B	0930	10/25	X									HOLD
B02-S7	③ A+B	1110	10/25	X	X	X							HOLD
B04-S1	④ A+B	1450		X									HOLD
B04-S2	⑤ A+B	1500			X	X							HOLD
B04-S7	⑥ A+B	1640											HOLD
B07-S1	⑦ A+B	1410	10/28										HOLD
B07-S2	⑧ A+B	1435											HOLD
B07-S3	⑨ A+B	1455			X	X	X						HOLD
B07-S7	⑩ A+B	1620			X	X							HOLD

Project Information		Sample Receipt		Relinquished By: 1.		Relinquished By: 2.		Relinquished By: 3.	
Project Number: <u>32-1-02348</u>		Total Number of Containers: <u>59</u>		Signature: <u>[Signature]</u> Time: <u>0900</u>		Signature: <u>[Signature]</u> Time: <u>1036</u>		Signature: _____ Time: _____	
Project Name: <u>WATFIER NAVIGATIONAL IMPROVEMENTS</u>		COC Seals/Intact? Y/N/NA		Printed Name: _____ Date: <u>10/29</u>		Printed Name: <u>Steph Glesin</u> Date: _____		Printed Name: _____ Date: _____	
Contact: <u>Ryan Collins / Staffed</u>		Received Good Cond./Cold		Company: <u>Siw</u>		Company: <u>Siw</u>		Company: _____	
Ongoing Project? Yes <input checked="" type="checkbox"/> No <input type="checkbox"/>		Delivery Method:		Received By: 1.		Received By: 2.		Received By: 3.	
Sampler: <u>Ryan Collins / THOMAS KEATT</u>		(attach shipping bill, if any)		Signature: <u>[Signature]</u> Time: <u>0800</u>		Signature: _____ Time: _____		Signature: <u>[Signature]</u> Time: <u>10:30</u>	
Instructions				Printed Name: <u>Steph Glesin</u> Date: <u>10/29</u>		Printed Name: _____ Date: _____		Printed Name: <u>Stephanie Chirley</u> Date: <u>10/29/11</u>	
Requested Turnaround Time: <u>STANDARD 10-DAY</u>				Company: <u>Siw</u>		Company: _____		Company: <u>SGS</u>	
Special Instructions: <u>LEVEL II DELIVERABLES</u>									

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

1135357



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

303 Wellsian Way
Richland, WA 99352
(509) 946-6309

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

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

2255 S.W. Canyon Road
Portland, OR 97201-2498
(503) 223-6147

1200 17th Street, Suite 1024
Denver, Co 80202
(303) 825-3800

CHA

RECORD

Laboratory SGS Page 2 of 2
Attn: _____

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

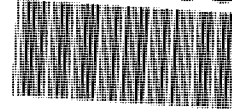
Sample Identity	Lab No.	Time	Date Sampled	Comp.	Grab	GR01BTX	AK101/00213	DPO/TKO	AK102/103	PAH 5113	EPA 0070	Total Number of Containers	Remarks/Matrix
2348-B10-S4	(11) A+B	1455	10/26	X	X	X	X					2	Soil
↓ -B11-S1	(12) A+B	1320	↓	↓	↓	↓	↓					↓	↓
↓ -B11-S2	(13) A+B	1115	↓	↓	↓	↓	↓					↓	HOLD
↓ -B07-S21	(14) A+B	1620	10/28	↓	X	X						↓	Soil
TB	(15) A	NA	NA	↓	X							1	

Project Information	Sample Receipt
Project Number: <u>32-102348</u>	Total Number of Containers
Project Name: <u>Whittier</u>	COC Seals/Intact? Y/N/NA
Contact: <u>Ryan Collins</u>	Received Good Cond./Cold
Ongoing Project? Yes <input checked="" type="checkbox"/> No <input type="checkbox"/>	Delivery Method:
Sampler: <u>RDC</u>	(attach shipping bill, if any)

Instructions
Requested Turnaround Time:
Special Instructions:

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

Relinquished By: 1.	Relinquished By: 2.	Relinquished By: 3.
Signature: _____ Time: _____	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: _____	Signature: _____ Time: _____	Signature: _____ Time: <u>10:35</u>
Printed Name: _____ Date: _____	Printed Name: _____ Date: _____	Printed Name: <u>Stephanie Cheryl</u> Date: <u>10/29/13</u>
Company: _____	Company: _____	Company: <u>SGS</u>



SAMPLE RECEIPT FORM

Review Criteria:	Condition:	Comments/Action Taken:
Were custody seals intact? Note # & location, if applicable. COC accompanied samples?	Yes No <input checked="" type="radio"/> N/A <input checked="" type="radio"/> Yes No N/A	
Temperature blank compliant* (i.e., 0-6°C after CF)? <i>* Note: Exemption permitted for chilled samples collected less than 8 hours ago.</i> Cooler ID: _____ @ _____ w/ Therm.ID: _____ Cooler ID: _____ @ _____ w/ Therm.ID: _____ Cooler ID: _____ @ _____ w/ Therm.ID: _____ Cooler ID: _____ @ _____ w/ Therm.ID: _____ <i>Note: If non-compliant, use form FS-0029 to document affected samples/analyses.</i> If samples are received <u>without</u> 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 <u>nor</u> cooler temp can be obtained, note "ambient" or "chilled." If temperature(s) <0°C, were all sample containers ice free?	Yes No <input checked="" type="radio"/> N/A Yes No N/A Yes No <input checked="" type="radio"/> N/A	
Delivery method (specify all that apply): <input checked="" type="radio"/> Client USPS Alert Courier C&D Delivery AK Air Lynden Carlile ERA PenAir FedEx UPS NAC Other: → For WO# with airbills, was the WO# & airbill info recorded in the Front Counter eLog?	Note ABN/ tracking # See Attached or <input checked="" type="radio"/> N/A Yes No <input checked="" type="radio"/> N/A	
→ For samples received with payment, note amount (\$) and cash / check / CC (circle one) or note: <input checked="" type="radio"/> N/A → For samples received in FBKS, ANCH staff will verify all criteria are reviewed. SRF Initiated by: SLC N/A		
Were samples received within hold time? <i>Note: Refer to form F-083 "Sample Guide" for hold time information.</i> Do samples match COC* (i.e., sample IDs, dates/times collected)? <i>* Note: Exemption permitted if times differ <1hr; in that case, use times on COC.</i> Were analyses requested unambiguous?	<input checked="" type="radio"/> Yes No N/A Yes <input checked="" type="radio"/> No N/A <input checked="" type="radio"/> Yes No N/A	There are 2 extra samples w/ the IDs B07-520 and B07-58. Both sample have 2 soil jars, one w/ methanol
Were samples in good condition (no leaks/cracks/breakage)? Packing material used (specify all that apply): Bubble Wrap Separate plastic bags Vermiculite <input checked="" type="radio"/> Other: Box	<input checked="" type="radio"/> Yes No N/A <input checked="" type="radio"/> Yes No N/A	One without. No date/t. mean jars.
Were all VOA vials free of headspace (i.e., bubbles ≤6 mm)? Were all soil VOAs field extracted with MeOH+BFB?	Yes No <input checked="" type="radio"/> N/A <input checked="" type="radio"/> Yes No N/A	
Were proper containers (type/mass/volume/preservative*) used? <i>* Note: Exemption permitted for waters to be analyzed for metals.</i> Were Trip Blanks (i.e., VOAs, LL-Hg) in cooler with samples?	<input checked="" type="radio"/> Yes No N/A <input checked="" type="radio"/> Yes No N/A	
For special handling (e.g., "MP" or foreign soils, lab filter, limited volume, Ref Lab), were bottles/paperwork flagged (e.g., sticker)?	Yes No <input checked="" type="radio"/> N/A	
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)?	Yes No <input checked="" type="radio"/> N/A Yes No <input checked="" type="radio"/> N/A	
For RUSH/SHORT Hold Time, were COC/Bottles flagged accordingly? Was Rush/Short HT email sent, if applicable?	Yes No <input checked="" type="radio"/> N/A	
For SITE-SPECIFIC QC, e.g. BMS/BMSD/BDUP, were containers / paperwork flagged accordingly?	Yes No <input checked="" type="radio"/> N/A	
For any question answered "No," has the PM been notified and the problem resolved (or paperwork put in their bin)?	<input checked="" type="radio"/> Yes No N/A	SRF Completed by: SLC 10/29/13 PM = SRC N/A
Was PEER REVIEW of sample numbering/labeling completed?	Yes No <input checked="" type="radio"/> N/A	Peer Reviewed by: <input checked="" type="radio"/> N/A

Additional notes (if applicable): SLC 10/29/13

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

LABORATORY DATA REVIEW CHECKLIST

CS Report Name: Navigational Improvements, Whittier, Alaska,

Date: December 2013

Laboratory Report Date: November 13, 2013

Consultant Firm: Shannon & Wilson, Inc.

Completed by: Jessa H. Tibbetts

Title: Environmental Scientist

Laboratory Name: SGS North America, Inc.

Work Order Number: 1135357

ADEC File Number: NA

ADEC RecKey Number: NA

(NOTE: NA = not applicable; Text in *italics* added by Shannon & Wilson, Inc.)

1. Laboratory

- a. Did an ADEC CS approved laboratory receive and perform all of the submitted sample analyses? **Yes** / No / NA (Please explain.)

Comments:

- b. If the samples were transferred to another "network" laboratory or sub-contracted to an alternate laboratory, was the laboratory performing the analyses ADEC CS-approved?

Yes / No / **NA**

Comments: *Samples were not transferred.*

2. Chain of Custody (COC)

- a. COC information completed, signed, and dated (including released/received by)?

Yes / No / NA (Please explain.)

Comments:

- b. Correct analyses requested? **Yes** / **No** / NA (Please explain.)

Comments: *A request for a metals analysis was not documented on the COC. A request for a Total RCRA metals analysis on Samples B07-S7 and B10-S4 was sent to the laboratory via an email dated November 4, 2013, included in the laboratory report.*

3. Laboratory Sample Receipt Documentation

- a. Sample/cooler temperature documented and within range at receipt ($4^{\circ} \pm 2^{\circ} \text{C}$)? **Yes** / No / NA (Please explain.)
Comments: *The temperature of the cooler was documented at 2.7° C.*
- b. Sample preservation acceptable - acidified waters, Methanol-preserved VOC soil (GRO, BTEX, VOCs, etc.)? **Yes** / No / NA (Please explain.)
Comments:
- c. Sample condition documented - broken, leaking (soil MeOH), zero headspace (VOC vials)? **Yes** / No / NA (Please explain.)
Comments: *No undesirable sample conditions noted.*
- d. If there were any discrepancies, were they documented (e.g., incorrect sample containers/preservation, sample temperatures outside range, insufficient sample size, missing samples)? **Yes** / No / NA (Please explain.)
Comments: *It was documented on the COC that "There are 2 extra samples with the IDs B07-S20 and B07-S8. Both samples have 2 sample jars, one with MeOH and one without. No date/time on jars." These samples were field screening samples and not meant to be submitted as analytical samples.*
- e. Data quality or usability affected? (Please Explain.)
Comments: *Extra sample jars were not submitted for analysis. In our opinion, this does not affect the data quality or usability.*

4. Case Narrative

- a. Present and understandable? **Yes** / No / NA (Please explain.)
Comments:
- b. Discrepancies, errors, or QC failures noted by the lab? **Yes** / No / NA (Please explain.)
Comments: *The following discrepancies, errors, or QC failures are listed in the case narrative:*
- *The 2-fluorobiphenyl (surrogate) recovery did not meet QC criteria (biased low) for Sample B07-S3.*
 - *The 4-bromofluorobenzene (surrogate) recovery did not meet QC criteria (biased high) for Sample B07-S3.*
 - *In Sample B07-S3, the LOQs for PAHs analysis are elevated due to sample dilution. The sample was diluted due to matrix interference with laboratory internal standards.*
 - *The MS and MSD recoveries for barium did not meet the QC criteria.*
- c. Were corrective actions documented? **Yes** / No / NA (Please explain.)
Comments: *The post digestion spike was successful for the failed barium MS/MSD recoveries.*

- d. What is the effect on data quality/usability, according to the case narrative?

Comments: *Although the MS/MSD for barium did not meet QC criteria, the LCS recoveries were within acceptable QC criteria. Therefore data quality/usability should not be affected. Other QC discrepancies are discussed in other sections of the laboratory data review checklist.*

5. Sample Results

- a. Correct analyses performed/reported as requested on COC? **Yes**/ No / NA (Please explain.)

Comments: *See the comments in Question 2.b. regarding Total RCRA metals analysis on Samples B07-S7 and B10-S4.*

- b. All applicable holding times met? **Yes**/ No / NA (Please explain.)

Comments:

- c. All soils reported on a dry-weight basis? **Yes**/ No / NA (Please explain.)

Comments:

- d. Are the reported LOQs less than the Cleanup Level or the minimum required detection level for the project? **Yes**/ No / NA (Please explain.)

Comments:

- e. Data quality or usability affected? (Please explain.) **No**

Comments: *The LOQs for PAHs analysis are elevated in Sample B07-S3 due to sample dilution. The sample was diluted due to matrix interference with laboratory internal standards. Even though the LOQs are elevated, they are still less than the applicable ADEC cleanup levels. Therefore we do not consider data quality or usability affected.*

6. QC Samples

a. Method Blank

- i. One method blank reported per matrix, analysis, and 20 samples?

Yes/ No / NA (Please explain.)

Comments:

- ii. All method blank results less than LOQ? **Yes**/ No / NA (Please explain.)

Comments: *Toluene was detected at an estimated concentration of 0.00800 mg/kg, which is less than the LOQ (0.0250 mg/Kg).*

- iii. If above LOQ, what samples are affected?

Comments: *The estimated concentration toluene detected in Sample B07-S3 is within 5 times the concentration measured in the method blank, therefore it is considered non-detect at the LOQ value and flagged "B."*

- iv. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes No / NA

Comments: *The affected sample is not flagged in the laboratory report, but qualified with a "B" in Table 1.*

- v. Data quality or usability affected? **(Please explain.)**

Comments:

b. Laboratory Control Sample/Duplicate (LCS/LCSD)

- i. Organics - One LCS/LCSD reported per matrix, analysis, and 20 samples?

(LCS/LCSD required per AK methods, LCS required per SW846) Yes / No / NA **(Please explain.)**

Comments:

- ii. Metals/Inorganics - One LCS and one sample duplicate reported per matrix, analysis and 20 samples? Yes / No / NA **(Please explain.)**

Comments:

- iii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits? And project specified DQOs, if applicable. (AK petroleum methods: AK101 60%-120%, AK102 75%-125%, AK103 60%-120%; all other analyses see the laboratory QC pages) Yes / No / NA **(Please explain.)**

Comments:

- iv. Precision – All relative percent differences (RPDs) reported and less than method or laboratory limits? And project specified DQOs, if applicable. RPD reported from LCS/LCSD, MS/MSD, and or sample/sample duplicate. (AK Petroleum methods 20%; all other analyses see the laboratory QC pages) Yes / No / NA **(Please explain.)**

Comments:

- v. If %R or RPD is outside of acceptable limits, what samples are affected? NA

Comments:

- vi. Do the affected samples(s) have data flags? If so, are the data flags clearly defined?

Yes No / NA

Comments:

- vii. Data quality or usability affected? Explain. NA

Comments:

c. Surrogates - Organics Only

- i. Are surrogate recoveries reported for organic analyses, field, QC and laboratory samples? Yes / No / NA **(Please explain.)**

Comments:

- ii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits? And project specified DQOs if applicable. (AK Petroleum methods 50-150 %R; all other analyses see the laboratory report pages) Yes / **No** / NA (Please explain.)

Comments: *Two surrogates associated with Sample B07-S3 failed QC criteria.*

- *The 2-fluorobiphenyl (PAH surrogate) percent recovery was absent due to sample dilution.*
- *The 4-bromofluorobenzene (GRO surrogate) percent recovery was above the specified DQO.*

- iii. Do the sample results with failed surrogate recoveries have data flags? If so, are the data flags clearly defined? Yes / **No** / NA (Please explain.)

Comments:

- iv. Data quality or usability affected? **Yes** / No / NA (Please explain.)

Comments:

- *The PAH analytes associated with the failed 2-fluorobiphenyl surrogate are non-detect at the elevated LOQ, which is less than the applicable ADEC cleanup levels. Although non-detect, the affected PAH analytes are biased low and flagged with a “J-“ on Table 1.*
- *The GRO concentration detected in sample B07-S3 is biased high due to surrogate QC failure and is and flagged “J+” on Table 1.*

d. Trip Blank - Volatile analyses only (GRO, BTEX, VOCs, etc.) Water and Soil

- i. One trip blank reported per matrix, analysis and cooler? **Yes** / No / NA (Please explain.)

Comments:

- ii. Is the cooler used to transport the trip blank and volatile samples clearly indicated on the COC? Yes / **No** / NA (Please explain if NA or no.)

Comments: *Only one cooler submitted for this work order.*

- iii. All results less than LOQ? **Yes** / No / NA (Please explain.)

Comments:

- iv. If above LOQ, what samples are affected? **NA**

Comments:

- v. Data quality or usability affected? Explain **NA**

Comments:

e. Field Duplicate

- i. One field duplicate submitted per matrix, analysis and 10 project samples?
Yes / No / NA (Please explain.)
Comments: *Sample B07-S21 is the field duplicate for Sample B07-S7.*
- ii. Were the field duplicates submitted blind to the lab? **Yes** / No / NA (Please explain.)
Comments:
- iii. Precision – All relative percent differences (RPDs) less than specified DQOs?
(Recommended: 30% for water, 50% for soil) **Yes** / No / NA (Please explain.)
Comments: *The duplicate sample (B07-S21) was not analyzed for metals, therefore the RPD for those analytes could not be calculated. All other RPDs are less than the specified DQOs.*
- iv. Data quality or usability affected? Explain. **NA**
Comments:

f. Decontamination or Equipment Blank (if not applicable, a comment stating why must be entered below)
Yes / No / **NA** (Please explain.) *A decontamination/equipment blank was not included as part of the project scope.*

- i. All results less than LOQ? **Yes** / No / **NA** (Please explain.)
Comments:
- ii. If results are above LOQ, what samples are affected? **NA**
Comments:
- iii. Data quality or usability affected? Explain. **NA**
Comments:

7. Other Data Flags/Qualifiers (ACOE, AFCEE, Lab-specific, etc.)

- a. Are they defined and appropriate? **Yes** / No / NA
Comments: *A key is provided on page 4 of the laboratory results.*

Laboratory Report of Analysis

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

Report Number: **1135434**

Client Project: **32-1-02348 Whittier Navigation**

Dear Ryan Collins,

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 five 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 Steve 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.

Steve Crupi
Project Manager
steven.crupi@sgs.com

Date

Case Narrative

Customer: SHANNOT

Shannon & Wilson, Inc.

Project: 1135434

32-1-02348 Whittier Navigation

Refer to the sample receipt form for information on sample condition.

1189492 LCS

XXX/30319

8270D SIM - LCS recovery for chrysene is outside of QC criteria (biased high). This analyte was not detected above the LOQ in the associated samples.

1189684 MS

1135434012MS

6020 - Metals - MS/MSD recoveries for barium were outside of acceptance criteria. Post digestion spike was successful.

1189685 MSD

1135434012MSD

6020 - Metals - MS/MSD recoveries for barium were outside of acceptance criteria. Post digestion spike was successful.

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. If you have any questions regarding this report, or if we can be of any other assistance, please contact your SGS Project Manager at 907-562-2343. All work is provided under SGS general terms and conditions (<http://www.sgs.com/terms_and_conditions.htm>), unless other written agreements have been accepted by both parties.

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: 1020A, 1311, 3010A, 3050B, 3520C, 3550C, 5030B, 5035B, 6020, 7470A, 7471B, 8021B, 8082A, 8260B, 8270D, 8270D-SIM, 9040B, 9045C, 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
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., 2xDL)
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

<u>Client Sample ID</u>	<u>Lab Sample ID</u>	<u>Collected</u>	<u>Received</u>	<u>Matrix</u>
2348-B03-S1	1135434001	10/29/2013	11/04/2013	Soil/Solid (dry weight)
2348-B06-S1	1135434002	10/30/2013	11/04/2013	Soil/Solid (dry weight)
2348-B06-S2	1135434003	10/30/2013	11/04/2013	Soil/Solid (dry weight)
2348-B09-S1	1135434004	10/31/2013	11/04/2013	Soil/Solid (dry weight)
2348-B09-S2	1135434005	10/31/2013	11/04/2013	Soil/Solid (dry weight)
2348-B12-S1	1135434006	11/01/2013	11/04/2013	Soil/Solid (dry weight)
2348-B12-S20	1135434007	11/01/2013	11/04/2013	Soil/Solid (dry weight)
2348-B14-S1	1135434008	11/01/2013	11/04/2013	Soil/Solid (dry weight)
2348-B14-S2	1135434009	11/01/2013	11/04/2013	Soil/Solid (dry weight)
2348-B17-S1	1135434010	10/31/2013	11/04/2013	Soil/Solid (dry weight)
2348-B17-S2	1135434011	10/31/2013	11/04/2013	Soil/Solid (dry weight)
2348-B17-S4	1135434012	10/31/2013	11/04/2013	Soil/Solid (dry weight)
2348-B18-S1	1135434013	11/02/2013	11/04/2013	Soil/Solid (dry weight)
2348-TB	1135434014	10/29/2013	11/04/2013	Soil/Solid (dry weight)
2348-B17-S3	1135434015	10/31/2013	11/04/2013	Soil/Solid (dry weight)

<u>Method</u>	<u>Method Description</u>
8270D SIMS (PAH)	8270 PAH SIM Semi-Volatiles GC/MS
AK101	AK101/8021 Combo. (S)
SW8021B	AK101/8021 Combo. (S)
AK102	Diesel/Residual Range Organics
AK103	Diesel/Residual Range Organics
SM21 2540G	Percent Solids SM2540G
SW6020	RCRA Metals by ICP-MS

Print Date: 11/13/2013 2:41:41PM

Detectable Results Summary

Client Sample ID: **2348-B06-S2**

Lab Sample ID: 1135434003

Metals by ICP/MS

<u>Parameter</u>	<u>Result</u>	<u>Units</u>
Arsenic	10.6	mg/Kg
Barium	24.7	mg/Kg
Chromium	42.0	mg/Kg
Lead	8.97	mg/Kg
Mercury	0.0324J	mg/Kg
Silver	0.0754J	mg/Kg

Client Sample ID: **2348-B14-S1**

Lab Sample ID: 1135434008

Metals by ICP/MS

<u>Parameter</u>	<u>Result</u>	<u>Units</u>
Arsenic	10.1	mg/Kg
Barium	30.1	mg/Kg
Chromium	40.8	mg/Kg
Lead	10.0	mg/Kg
Mercury	0.0213J	mg/Kg
Silver	0.0440J	mg/Kg

Client Sample ID: **2348-B17-S4**

Lab Sample ID: 1135434012

Metals by ICP/MS

<u>Parameter</u>	<u>Result</u>	<u>Units</u>
Arsenic	7.68	mg/Kg
Barium	32.4	mg/Kg
Chromium	47.2	mg/Kg
Lead	6.82	mg/Kg
Mercury	0.0242J	mg/Kg

Client Sample ID: **2348-TB**

Lab Sample ID: 1135434014

Volatile Fuels

<u>Parameter</u>	<u>Result</u>	<u>Units</u>
Toluene	11.3J	ug/Kg



Results of 2348-B06-S2

Client Sample ID: 2348-B06-S2
Client Project ID: 32-1-02348 Whittier Navigation
Lab Sample ID: 1135434003
Lab Project ID: 1135434

Collection Date: 10/30/13 10:00
Received Date: 11/04/13 09:52
Matrix: Soil/Solid (dry weight)
Solids (%): 87.3

Results by Metals by ICP/MS

<u>Parameter</u>	<u>Result Qual</u>	<u>LOQ/CL</u>	<u>DL</u>	<u>Units</u>	<u>DF</u>	<u>Allowable Limits</u>	<u>Date Analyzed</u>
Arsenic	10.6	0.951	0.295	mg/Kg	10		11/11/13 15:38
Barium	24.7	0.285	0.0894	mg/Kg	10		11/11/13 15:38
Cadmium	0.118 U	0.190	0.0590	mg/Kg	10		11/11/13 15:38
Chromium	42.0	0.380	0.114	mg/Kg	10		11/11/13 15:38
Lead	8.97	0.190	0.0590	mg/Kg	10		11/11/13 15:38
Mercury	0.0324 J	0.0380	0.0114	mg/Kg	10		11/11/13 15:38
Selenium	0.286 U	0.475	0.143	mg/Kg	10		11/11/13 15:38
Silver	0.0754 J	0.0951	0.0295	mg/Kg	10		11/11/13 15:38

Batch Information

Analytical Batch: MMS8351
Analytical Method: SW6020
Analyst: ACF
Analytical Date/Time: 11/11/13 15:38
Container ID: 1135434003-A

Prep Batch: MXX27269
Prep Method: SW3050B
Prep Date/Time: 11/05/13 15:30
Prep Initial Wt./Vol.: 1.204 g
Prep Extract Vol: 50 mL

Print Date: 11/13/2013 2:41:42PM



Results of 2348-B06-S2

Client Sample ID: 2348-B06-S2
Client Project ID: 32-1-02348 Whittier Navigation
Lab Sample ID: 1135434003
Lab Project ID: 1135434

Collection Date: 10/30/13 10:00
Received Date: 11/04/13 09:52
Matrix: Soil/Solid (dry weight)
Solids (%): 87.3

Results by Polynuclear Aromatics GC/MS

Table with 8 columns: Parameter, Result Qual, LOQ/CL, DL, Units, DF, Allowable Limits, Date Analyzed. Lists various polynuclear aromatic hydrocarbons and their detection results.

Batch Information

Analytical Batch: XMS7750
Analytical Method: 8270D SIMS (PAH)
Analyst: RTS
Analytical Date/Time: 11/06/13 02:41
Container ID: 1135434003-A

Prep Batch: XXX30319
Prep Method: SW3550C
Prep Date/Time: 11/05/13 10:05
Prep Initial Wt./Vol.: 23.004 g
Prep Extract Vol: 1 mL

Print Date: 11/13/2013 2:41:42PM



Results of 2348-B06-S2

Client Sample ID: 2348-B06-S2
Client Project ID: 32-1-02348 Whittier Navigation
Lab Sample ID: 1135434003
Lab Project ID: 1135434

Collection Date: 10/30/13 10:00
Received Date: 11/04/13 09:52
Matrix: Soil/Solid (dry weight)
Solids (%): 87.3

Results by Semivolatile Organic Fuels

Table with 8 columns: Parameter, Result Qual, LOQ/CL, DL, Units, DF, Allowable Limits, Date Analyzed. Rows include Diesel Range Organics and Surrogates (5a Androstane).

Batch Information

Analytical Batch: XFC11157
Analytical Method: AK102
Analyst: EAB
Analytical Date/Time: 11/07/13 13:31
Container ID: 1135434003-A
Prep Batch: XXX30316
Prep Method: SW3550C
Prep Date/Time: 11/05/13 09:00
Prep Initial Wt./Vol.: 30.027 g
Prep Extract Vol: 1 mL

Table with 8 columns: Parameter, Result Qual, LOQ/CL, DL, Units, DF, Allowable Limits, Date Analyzed. Rows include Residual Range Organics and Surrogates (n-Triacontane-d62).

Batch Information

Analytical Batch: XFC11157
Analytical Method: AK103
Analyst: EAB
Analytical Date/Time: 11/07/13 13:31
Container ID: 1135434003-A
Prep Batch: XXX30316
Prep Method: SW3550C
Prep Date/Time: 11/05/13 09:00
Prep Initial Wt./Vol.: 30.027 g
Prep Extract Vol: 1 mL

Print Date: 11/13/2013 2:41:42PM



Results of 2348-B06-S2

Client Sample ID: **2348-B06-S2**
Client Project ID: **32-1-02348 Whittier Navigation**
Lab Sample ID: 1135434003
Lab Project ID: 1135434

Collection Date: 10/30/13 10:00
Received Date: 11/04/13 09:52
Matrix: Soil/Solid (dry weight)
Solids (%): 87.3

Results by Volatile Fuels

<u>Parameter</u>	<u>Result Qual</u>	<u>LOQ/CL</u>	<u>DL</u>	<u>Units</u>	<u>DF</u>	<u>Allowable Limits</u>	<u>Date Analyzed</u>
Gasoline Range Organics	1.45 U	2.41	0.723	mg/Kg	1		11/06/13 14:34

Surrogates

4-Bromofluorobenzene	72.7	50-150		%	1		11/06/13 14:34
----------------------	------	--------	--	---	---	--	----------------

Batch Information

Analytical Batch: VFC11720
Analytical Method: AK101
Analyst: ST
Analytical Date/Time: 11/06/13 14:34
Container ID: 1135434003-B

Prep Batch: VXX25437
Prep Method: SW5035A
Prep Date/Time: 10/30/13 10:00
Prep Initial Wt./Vol.: 84.901 g
Prep Extract Vol: 35.7481 mL

<u>Parameter</u>	<u>Result Qual</u>	<u>LOQ/CL</u>	<u>DL</u>	<u>Units</u>	<u>DF</u>	<u>Allowable Limits</u>	<u>Date Analyzed</u>
Benzene	7.72 U	12.1	3.86	ug/Kg	1		11/06/13 14:34
Ethylbenzene	15.0 U	24.1	7.52	ug/Kg	1		11/06/13 14:34
o-Xylene	15.0 U	24.1	7.52	ug/Kg	1		11/06/13 14:34
P & M -Xylene	29.0 U	48.2	14.5	ug/Kg	1		11/06/13 14:34
Toluene	15.0 U	24.1	7.52	ug/Kg	1		11/06/13 14:34

Surrogates

1,4-Difluorobenzene	92.6	72-119		%	1		11/06/13 14:34
---------------------	------	--------	--	---	---	--	----------------

Batch Information

Analytical Batch: VFC11720
Analytical Method: SW8021B
Analyst: ST
Analytical Date/Time: 11/06/13 14:34
Container ID: 1135434003-B

Prep Batch: VXX25437
Prep Method: SW5035A
Prep Date/Time: 10/30/13 10:00
Prep Initial Wt./Vol.: 84.901 g
Prep Extract Vol: 35.7481 mL

Print Date: 11/13/2013 2:41:42PM



Results of 2348-B14-S1

Client Sample ID: **2348-B14-S1**
Client Project ID: **32-1-02348 Whittier Navigation**
Lab Sample ID: 1135434008
Lab Project ID: 1135434

Collection Date: 11/01/13 12:30
Received Date: 11/04/13 09:52
Matrix: Soil/Solid (dry weight)
Solids (%): 83.9

Results by Metals by ICP/MS

<u>Parameter</u>	<u>Result Qual</u>	<u>LOQ/CL</u>	<u>DL</u>	<u>Units</u>	<u>DF</u>	<u>Allowable Limits</u>	<u>Date Analyzed</u>
Arsenic	10.1	1.11	0.343	mg/Kg	10		11/11/13 15:41
Barium	30.1	0.332	0.104	mg/Kg	10		11/11/13 15:41
Cadmium	0.137 U	0.221	0.0686	mg/Kg	10		11/11/13 15:41
Chromium	40.8	0.443	0.133	mg/Kg	10		11/11/13 15:41
Lead	10.0	0.221	0.0686	mg/Kg	10		11/11/13 15:41
Mercury	0.0213 J	0.0443	0.0133	mg/Kg	10		11/11/13 15:41
Selenium	0.332 U	0.554	0.166	mg/Kg	10		11/11/13 15:41
Silver	0.0440 J	0.111	0.0343	mg/Kg	10		11/11/13 15:41

Batch Information

Analytical Batch: MMS8351
Analytical Method: SW6020
Analyst: ACF
Analytical Date/Time: 11/11/13 15:41
Container ID: 1135434008-A

Prep Batch: MXX27269
Prep Method: SW3050B
Prep Date/Time: 11/05/13 15:30
Prep Initial Wt./Vol.: 1.077 g
Prep Extract Vol: 50 mL

Print Date: 11/13/2013 2:41:42PM



Results of 2348-B14-S1

Client Sample ID: 2348-B14-S1
Client Project ID: 32-1-02348 Whittier Navigation
Lab Sample ID: 1135434008
Lab Project ID: 1135434

Collection Date: 11/01/13 12:30
Received Date: 11/04/13 09:52
Matrix: Soil/Solid (dry weight)
Solids (%): 83.9

Results by Polynuclear Aromatics GC/MS

Table with 8 columns: Parameter, Result Qual, LOQ/CL, DL, Units, DF, Allowable Limits, Date Analyzed. Lists various polynuclear aromatic hydrocarbons and their detection results.

Batch Information

Analytical Batch: XMS7750
Analytical Method: 8270D SIMS (PAH)
Analyst: RTS
Analytical Date/Time: 11/06/13 03:23
Container ID: 1135434008-A

Prep Batch: XXX30319
Prep Method: SW3550C
Prep Date/Time: 11/05/13 10:05
Prep Initial Wt./Vol.: 22.518 g
Prep Extract Vol: 1 mL

Print Date: 11/13/2013 2:41:42PM



Results of 2348-B14-S1

Client Sample ID: 2348-B14-S1
Client Project ID: 32-1-02348 Whittier Navigation
Lab Sample ID: 1135434008
Lab Project ID: 1135434

Collection Date: 11/01/13 12:30
Received Date: 11/04/13 09:52
Matrix: Soil/Solid (dry weight)
Solids (%): 83.9

Results by Semivolatile Organic Fuels

Table with 8 columns: Parameter, Result Qual, LOQ/CL, DL, Units, DF, Allowable Limits, Date Analyzed. Rows include Diesel Range Organics and Surrogates (5a Androstane).

Batch Information

Analytical Batch: XFC11157
Analytical Method: AK102
Analyst: EAB
Analytical Date/Time: 11/07/13 13:41
Container ID: 1135434008-A
Prep Batch: XXX30316
Prep Method: SW3550C
Prep Date/Time: 11/05/13 09:00
Prep Initial Wt./Vol.: 32.305 g
Prep Extract Vol: 1 mL

Table with 8 columns: Parameter, Result Qual, LOQ/CL, DL, Units, DF, Allowable Limits, Date Analyzed. Rows include Residual Range Organics and Surrogates (n-Triacontane-d62).

Batch Information

Analytical Batch: XFC11157
Analytical Method: AK103
Analyst: EAB
Analytical Date/Time: 11/07/13 13:41
Container ID: 1135434008-A
Prep Batch: XXX30316
Prep Method: SW3550C
Prep Date/Time: 11/05/13 09:00
Prep Initial Wt./Vol.: 32.305 g
Prep Extract Vol: 1 mL

Print Date: 11/13/2013 2:41:42PM



Results of 2348-B14-S1

Client Sample ID: 2348-B14-S1
Client Project ID: 32-1-02348 Whittier Navigation
Lab Sample ID: 1135434008
Lab Project ID: 1135434

Collection Date: 11/01/13 12:30
Received Date: 11/04/13 09:52
Matrix: Soil/Solid (dry weight)
Solids (%): 83.9

Results by Volatile Fuels

Table with 8 columns: Parameter, Result Qual, LOQ/CL, DL, Units, DF, Allowable Limits, Date Analyzed. Row: Gasoline Range Organics, 1.56 U, 2.59, 0.778, mg/Kg, 1, 11/06/13 14:16

Surrogates

Table with 8 columns: Parameter, Result Qual, LOQ/CL, DL, Units, DF, Allowable Limits, Date Analyzed. Row: 4-Bromofluorobenzene, 77.2, 50-150, %, 1, 11/06/13 14:16

Batch Information

Analytical Batch: VFC11720
Analytical Method: AK101
Analyst: ST
Analytical Date/Time: 11/06/13 14:16
Container ID: 1135434008-B

Prep Batch: VXX25437
Prep Method: SW5035A
Prep Date/Time: 11/01/13 12:30
Prep Initial Wt./Vol.: 91.392 g
Prep Extract Vol: 39.7468 mL

Table with 8 columns: Parameter, Result Qual, LOQ/CL, DL, Units, DF, Allowable Limits, Date Analyzed. Rows: Benzene, Ethylbenzene, o-Xylene, P & M -Xylene, Toluene

Surrogates

Table with 8 columns: Parameter, Result Qual, LOQ/CL, DL, Units, DF, Allowable Limits, Date Analyzed. Row: 1,4-Difluorobenzene, 92.7, 72-119, %, 1, 11/06/13 14:16

Batch Information

Analytical Batch: VFC11720
Analytical Method: SW8021B
Analyst: ST
Analytical Date/Time: 11/06/13 14:16
Container ID: 1135434008-B

Prep Batch: VXX25437
Prep Method: SW5035A
Prep Date/Time: 11/01/13 12:30
Prep Initial Wt./Vol.: 91.392 g
Prep Extract Vol: 39.7468 mL

Print Date: 11/13/2013 2:41:42PM



Results of 2348-B17-S4

Client Sample ID: 2348-B17-S4
Client Project ID: 32-1-02348 Whittier Navigation
Lab Sample ID: 1135434012
Lab Project ID: 1135434

Collection Date: 10/31/13 21:17
Received Date: 11/04/13 09:52
Matrix: Soil/Solid (dry weight)
Solids (%): 79.4

Results by Metals by ICP/MS

<u>Parameter</u>	<u>Result Qual</u>	<u>LOQ/CL</u>	<u>DL</u>	<u>Units</u>	<u>DF</u>	<u>Allowable Limits</u>	<u>Date Analyzed</u>
Arsenic	7.68	1.17	0.363	mg/Kg	10		11/11/13 15:11
Barium	32.4	0.351	0.110	mg/Kg	10		11/11/13 15:11
Cadmium	0.145 U	0.234	0.0725	mg/Kg	10		11/11/13 15:11
Chromium	47.2	0.468	0.140	mg/Kg	10		11/11/13 15:11
Lead	6.82	0.234	0.0725	mg/Kg	10		11/11/13 15:11
Mercury	0.0242 J	0.0468	0.0140	mg/Kg	10		11/11/13 15:11
Selenium	0.350 U	0.585	0.175	mg/Kg	10		11/11/13 15:11
Silver	0.0726 U	0.117	0.0363	mg/Kg	10		11/11/13 15:11

Batch Information

Analytical Batch: MMS8351
Analytical Method: SW6020
Analyst: ACF
Analytical Date/Time: 11/11/13 15:11
Container ID: 1135434012-A

Prep Batch: MXX27269
Prep Method: SW3050B
Prep Date/Time: 11/05/13 15:30
Prep Initial Wt./Vol.: 1.077 g
Prep Extract Vol: 50 mL

Print Date: 11/13/2013 2:41:42PM



Results of 2348-B17-S4

Client Sample ID: **2348-B17-S4**
 Client Project ID: **32-1-02348 Whittier Navigation**
 Lab Sample ID: 1135434012
 Lab Project ID: 1135434

Collection Date: 10/31/13 21:17
 Received Date: 11/04/13 09:52
 Matrix: Soil/Solid (dry weight)
 Solids (%): 79.4

Results by Polynuclear Aromatics GC/MS

<u>Parameter</u>	<u>Result Qual</u>	<u>LOQ/CL</u>	<u>DL</u>	<u>Units</u>	<u>DF</u>	<u>Allowable Limits</u>	<u>Date Analyzed</u>
1-Methylnaphthalene	3.78 U	6.29	1.89	ug/Kg	1		11/06/13 03:37
2-Methylnaphthalene	3.78 U	6.29	1.89	ug/Kg	1		11/06/13 03:37
Acenaphthene	3.78 U	6.29	1.89	ug/Kg	1		11/06/13 03:37
Acenaphthylene	3.78 U	6.29	1.89	ug/Kg	1		11/06/13 03:37
Anthracene	3.78 U	6.29	1.89	ug/Kg	1		11/06/13 03:37
Benzo(a)Anthracene	3.78 U	6.29	1.89	ug/Kg	1		11/06/13 03:37
Benzo[a]pyrene	3.78 U	6.29	1.89	ug/Kg	1		11/06/13 03:37
Benzo[b]Fluoranthene	3.78 U	6.29	1.89	ug/Kg	1		11/06/13 03:37
Benzo[g,h,i]perylene	3.78 U	6.29	1.89	ug/Kg	1		11/06/13 03:37
Benzo[k]fluoranthene	3.78 U	6.29	1.89	ug/Kg	1		11/06/13 03:37
Chrysene	3.78 U	6.29	1.89	ug/Kg	1		11/06/13 03:37
Dibenzo[a,h]anthracene	3.78 U	6.29	1.89	ug/Kg	1		11/06/13 03:37
Fluoranthene	3.78 U	6.29	1.89	ug/Kg	1		11/06/13 03:37
Fluorene	3.78 U	6.29	1.89	ug/Kg	1		11/06/13 03:37
Indeno[1,2,3-c,d] pyrene	3.78 U	6.29	1.89	ug/Kg	1		11/06/13 03:37
Naphthalene	3.78 U	6.29	1.89	ug/Kg	1		11/06/13 03:37
Phenanthrene	3.78 U	6.29	1.89	ug/Kg	1		11/06/13 03:37
Pyrene	3.78 U	6.29	1.89	ug/Kg	1		11/06/13 03:37
Surrogates							
2-Fluorobiphenyl	99.3	45-105		%	1		11/06/13 03:37
Terphenyl-d14	106	30-125		%	1		11/06/13 03:37

Batch Information

Analytical Batch: XMS7750
 Analytical Method: 8270D SIMS (PAH)
 Analyst: RTS
 Analytical Date/Time: 11/06/13 03:37
 Container ID: 1135434012-A

Prep Batch: XXX30319
 Prep Method: SW3550C
 Prep Date/Time: 11/05/13 10:05
 Prep Initial Wt./Vol.: 22.521 g
 Prep Extract Vol: 1 mL

Print Date: 11/13/2013 2:41:42PM



Results of 2348-B17-S4

Client Sample ID: 2348-B17-S4
Client Project ID: 32-1-02348 Whittier Navigation
Lab Sample ID: 1135434012
Lab Project ID: 1135434

Collection Date: 10/31/13 21:17
Received Date: 11/04/13 09:52
Matrix: Soil/Solid (dry weight)
Solids (%): 79.4

Results by Semivolatile Organic Fuels

Table with 8 columns: Parameter, Result Qual, LOQ/CL, DL, Units, DF, Allowable Limits, Date Analyzed. Rows include Diesel Range Organics and Surrogates (5a Androstane).

Batch Information

Analytical Batch: XFC11157
Analytical Method: AK102
Analyst: EAB
Analytical Date/Time: 11/07/13 13:51
Container ID: 1135434012-A

Prep Batch: XXX30316
Prep Method: SW3550C
Prep Date/Time: 11/05/13 09:00
Prep Initial Wt./Vol.: 30.628 g
Prep Extract Vol: 1 mL

Table with 8 columns: Parameter, Result Qual, LOQ/CL, DL, Units, DF, Allowable Limits, Date Analyzed. Rows include Residual Range Organics and Surrogates (n-Triacontane-d62).

Batch Information

Analytical Batch: XFC11157
Analytical Method: AK103
Analyst: EAB
Analytical Date/Time: 11/07/13 13:51
Container ID: 1135434012-A

Prep Batch: XXX30316
Prep Method: SW3550C
Prep Date/Time: 11/05/13 09:00
Prep Initial Wt./Vol.: 30.628 g
Prep Extract Vol: 1 mL

Print Date: 11/13/2013 2:41:42PM



Results of 2348-B17-S4

Client Sample ID: **2348-B17-S4**
Client Project ID: **32-1-02348 Whittier Navigation**
Lab Sample ID: 1135434012
Lab Project ID: 1135434

Collection Date: 10/31/13 21:17
Received Date: 11/04/13 09:52
Matrix: Soil/Solid (dry weight)
Solids (%): 79.4

Results by Volatile Fuels

<u>Parameter</u>	<u>Result Qual</u>	<u>LOQ/CL</u>	<u>DL</u>	<u>Units</u>	<u>DF</u>	<u>Allowable Limits</u>	<u>Date Analyzed</u>
Gasoline Range Organics	1.98 U	3.31	0.992	mg/Kg	1		11/06/13 12:08

Surrogates

4-Bromofluorobenzene	89.6	50-150		%	1		11/06/13 12:08
----------------------	------	--------	--	---	---	--	----------------

Batch Information

Analytical Batch: VFC11720
Analytical Method: AK101
Analyst: ST
Analytical Date/Time: 11/06/13 12:08
Container ID: 1135434012-B

Prep Batch: VXX25437
Prep Method: SW5035A
Prep Date/Time: 10/31/13 21:17
Prep Initial Wt./Vol.: 78.385 g
Prep Extract Vol: 41.1537 mL

<u>Parameter</u>	<u>Result Qual</u>	<u>LOQ/CL</u>	<u>DL</u>	<u>Units</u>	<u>DF</u>	<u>Allowable Limits</u>	<u>Date Analyzed</u>
Benzene	10.6 U	16.5	5.29	ug/Kg	1		11/06/13 12:08
Ethylbenzene	20.6 U	33.1	10.3	ug/Kg	1		11/06/13 12:08
o-Xylene	20.6 U	33.1	10.3	ug/Kg	1		11/06/13 12:08
P & M -Xylene	39.6 U	66.1	19.8	ug/Kg	1		11/06/13 12:08
Toluene	20.6 U	33.1	10.3	ug/Kg	1		11/06/13 12:08

Surrogates

1,4-Difluorobenzene	92.7	72-119		%	1		11/06/13 12:08
---------------------	------	--------	--	---	---	--	----------------

Batch Information

Analytical Batch: VFC11720
Analytical Method: SW8021B
Analyst: ST
Analytical Date/Time: 11/06/13 12:08
Container ID: 1135434012-B

Prep Batch: VXX25437
Prep Method: SW5035A
Prep Date/Time: 10/31/13 21:17
Prep Initial Wt./Vol.: 78.385 g
Prep Extract Vol: 41.1537 mL

Print Date: 11/13/2013 2:41:42PM



Results of **2348-TB**

Client Sample ID: **2348-TB**
Client Project ID: **32-1-02348 Whittier Navigation**
Lab Sample ID: 1135434014
Lab Project ID: 1135434

Collection Date: 10/29/13 17:40
Received Date: 11/04/13 09:52
Matrix: Soil/Solid (dry weight)
Solids (%):

Results by **Volatile Fuels**

<u>Parameter</u>	<u>Result Qual</u>	<u>LOQ/CL</u>	<u>DL</u>	<u>Units</u>	<u>DF</u>	<u>Allowable Limits</u>	<u>Date Analyzed</u>
Gasoline Range Organics	1.54 U	2.56	0.769	mg/Kg	1		11/06/13 13:21

Surrogates

4-Bromofluorobenzene	97.3	50-150		%	1		11/06/13 13:21
----------------------	------	--------	--	---	---	--	----------------

Batch Information

Analytical Batch: VFC11720
Analytical Method: AK101
Analyst: ST
Analytical Date/Time: 11/06/13 13:21
Container ID: 1135434014-A

Prep Batch: VXX25437
Prep Method: SW5035A
Prep Date/Time: 10/29/13 17:40
Prep Initial Wt./Vol.: 48.792 g
Prep Extract Vol: 25 mL

<u>Parameter</u>	<u>Result Qual</u>	<u>LOQ/CL</u>	<u>DL</u>	<u>Units</u>	<u>DF</u>	<u>Allowable Limits</u>	<u>Date Analyzed</u>
Benzene	8.20 U	12.8	4.10	ug/Kg	1		11/06/13 13:21
Ethylbenzene	16.0 U	25.6	7.99	ug/Kg	1		11/06/13 13:21
o-Xylene	16.0 U	25.6	7.99	ug/Kg	1		11/06/13 13:21
P & M -Xylene	30.8 U	51.2	15.4	ug/Kg	1		11/06/13 13:21
Toluene	11.3 J	25.6	7.99	ug/Kg	1		11/06/13 13:21

Surrogates

1,4-Difluorobenzene	93	72-119		%	1		11/06/13 13:21
---------------------	----	--------	--	---	---	--	----------------

Batch Information

Analytical Batch: VFC11720
Analytical Method: SW8021B
Analyst: ST
Analytical Date/Time: 11/06/13 13:21
Container ID: 1135434014-A

Prep Batch: VXX25437
Prep Method: SW5035A
Prep Date/Time: 10/29/13 17:40
Prep Initial Wt./Vol.: 48.792 g
Prep Extract Vol: 25 mL

Print Date: 11/13/2013 2:41:42PM

Method Blank

Blank ID: MB for HBN 1491745 [MXX/27269]
 Blank Lab ID: 1189681

Matrix: Soil/Solid (dry weight)

QC for Samples:
 1135434003, 1135434008, 1135434012

Results by SW6020

<u>Parameter</u>	<u>Results</u>	<u>LOQ/CL</u>	<u>DL</u>	<u>Units</u>
Arsenic	0.620U	1.00	0.310	mg/Kg
Barium	0.188U	0.300	0.0940	mg/Kg
Cadmium	0.124U	0.200	0.0620	mg/Kg
Chromium	0.240U	0.400	0.120	mg/Kg
Lead	0.124U	0.200	0.0620	mg/Kg
Mercury	0.0240U	0.0400	0.0120	mg/Kg
Selenium	0.300U	0.500	0.150	mg/Kg
Silver	0.0620U	0.100	0.0310	mg/Kg

Batch Information

Analytical Batch: MMS8351
 Analytical Method: SW6020
 Instrument: Perkin Elmer Sciex ICP-MS P3
 Analyst: ACF
 Analytical Date/Time: 11/11/2013 3:06:35PM

Prep Batch: MXX27269
 Prep Method: SW3050B
 Prep Date/Time: 11/5/2013 3:30:00PM
 Prep Initial Wt./Vol.: 1 g
 Prep Extract Vol: 50 mL

Blank Spike Summary

Blank Spike ID: LCS for HBN 1135434 [MXX27269]
 Blank Spike Lab ID: 1189682
 Date Analyzed: 11/11/2013 15:09

Matrix: Soil/Solid (dry weight)

QC for Samples: 1135434003, 1135434008, 1135434012

Results by SW6020

Parameter	Blank Spike (mg/Kg)			CL
	Spike	Result	Rec (%)	
Arsenic	50	49.1	98	(80-120)
Barium	50	47.5	95	(80-120)
Cadmium	5	4.87	98	(80-120)
Chromium	20	19.7	99	(80-120)
Lead	50	51.0	102	(80-120)
Mercury	0.5	0.500	100	(80-120)
Selenium	50	48.6	97	(80-120)
Silver	5	5.12	102	(80-120)

Batch Information

Analytical Batch: **MMS8351**
 Analytical Method: **SW6020**
 Instrument: **Perkin Elmer Sciex ICP-MS P3**
 Analyst: **ACF**

Prep Batch: **MXX27269**
 Prep Method: **SW3050B**
 Prep Date/Time: **11/05/2013 15:30**
 Spike Init Wt./Vol.: 50 mg/Kg Extract Vol: 50 mL
 Dupe Init Wt./Vol.: Extract Vol:



Matrix Spike Summary

Original Sample ID: 1135434012
MS Sample ID: 1189684 MS
MSD Sample ID: 1189685 MSD

Analysis Date: 11/11/2013 15:11
Analysis Date: 11/11/2013 15:17
Analysis Date: 11/11/2013 15:19
Matrix: Soil/Solid (dry weight)

QC for Samples: 1135434003, 1135434008, 1135434012

Results by SW6020

Parameter	Sample	Matrix Spike (mg/Kg)			Spike Duplicate (mg/Kg)			CL	RPD (%)	RPD CL
		Spike	Result	Rec (%)	Spike	Result	Rec (%)			
Arsenic	7.68	62.5	68.9	98	56.4	61.5	95	80-120	11.40	(< 20)
Barium	32.4	62.5	81.9	79 *	56.4	73.6	73 *	80-120	10.70	(< 20)
Cadmium	0.145U	6.25	6.02	96	5.64	5.40	96	80-120	10.80	(< 20)
Chromium	47.2	24.9	71.3	97	22.5	67.8	91	80-120	5.19	(< 20)
Lead	6.82	62.5	68.3	98	56.4	61.2	97	80-120	10.90	(< 20)
Mercury	0.0242J	0.625	0.664	102	0.564	0.578	98	80-120	13.90	(< 20)
Selenium	0.350U	62.5	62.0	99	56.4	54.3	96	80-120	13.10	(< 20)
Silver	0.0726U	6.25	6.15	99	5.64	5.43	96	80-120	12.40	(< 20)

Batch Information

Analytical Batch: MMS8351
Analytical Method: SW6020
Instrument: Perkin Elmer Sciex ICP-MS P3
Analyst: ACF
Analytical Date/Time: 11/11/2013 3:17:18PM

Prep Batch: MXX27269
Prep Method: Soils/Solids Digest for Metals by ICP-MS
Prep Date/Time: 11/5/2013 3:30:00PM
Prep Initial Wt./Vol.: 1.01g
Prep Extract Vol: 50.00mL

Print Date: 11/13/2013 2:41:45PM

Bench Spike Summary

Original Sample ID: 1135434012
 MS Sample ID: 1189686 BND
 MSD Sample ID:

Analysis Date: 11/11/2013 15:11
 Analysis Date: 11/11/2013 15:22
 Analysis Date:
 Matrix: Soil/Solid (dry weight)

QC for Samples: 1135434003, 1135434008, 1135434012

Results by SW6020

Parameter	Sample	Matrix Spike (mg/Kg)			Spike Duplicate (mg/Kg)			CL	RPD (%)	RPD CL
		Spike	Result	Rec (%)	Spike	Result	Rec (%)			
Barium	32.4	292	315	97				75-125		

Batch Information

Analytical Batch: MMS8351
 Analytical Method: SW6020
 Instrument: Perkin Elmer Sciex ICP-MS P3
 Analyst: ACF
 Analytical Date/Time: 11/11/2013 3:22:40PM

Prep Batch: MXX27269
 Prep Method: Soils/Solids Digest for Metals by ICP-MS
 Prep Date/Time: 11/5/2013 3:30:00PM
 Prep Initial Wt./Vol.: 1.08g
 Prep Extract Vol: 50.00mL

Print Date: 11/13/2013 2:41:45PM

Method Blank

Blank ID: MB for HBN 1491723 [SPT/9199]

Blank Lab ID: 1189475

QC for Samples:

1135434003, 1135434008, 1135434012

Matrix: Soil/Solid (dry weight)

Results by SM21 2540G

<u>Parameter</u>	<u>Results</u>	<u>LOQ/CL</u>	<u>DL</u>	<u>Units</u>
Total Solids	100			%

Batch Information

Analytical Batch: SPT9199

Analytical Method: SM21 2540G

Instrument:

Analyst: RKJ

Analytical Date/Time: 11/4/2013 5:30:00PM

Print Date: 11/13/2013 2:41:46PM

Duplicate Sample Summary

Original Sample ID: 1135435001

Duplicate Sample ID: 1189476

QC for Samples:

1135434003, 1135434008, 1135434012

Analysis Date: 11/04/2013 17:30

Matrix: Soil/Solid (dry weight)

Results by SM21 2540G

<u>NAME</u>	<u>Original ()</u>	<u>Duplicate ()</u>	<u>RPD (%)</u>	<u>RPD CL</u>
Total Solids	88.6	88.7	0.10	15.00

Batch Information

Analytical Batch: SPT9199

Analytical Method: SM21 2540G

Instrument:

Analyst: RKJ

Print Date: 11/13/2013 2:41:46PM



Method Blank

Blank ID: MB for HBN 1491885 [VXX/25437]
Blank Lab ID: 1190235

Matrix: Soil/Solid (dry weight)

QC for Samples:
1135434003, 1135434008, 1135434012, 1135434014

Results by AK101

<u>Parameter</u>	<u>Results</u>	<u>LOQ/CL</u>	<u>DL</u>	<u>Units</u>
Gasoline Range Organics	1.50U	2.50	0.750	mg/Kg
Surrogates				
4-Bromofluorobenzene	75.4	50-150		%

Batch Information

Analytical Batch: VFC11720
Analytical Method: AK101
Instrument: Agilent 7890 PID/FID
Analyst: ST
Analytical Date/Time: 11/6/2013 10:33:00AM

Prep Batch: VXX25437
Prep Method: SW5035A
Prep Date/Time: 11/6/2013 8:00:00AM
Prep Initial Wt./Vol.: 50 g
Prep Extract Vol: 25 mL

Print Date: 11/13/2013 2:41:47PM

Blank Spike Summary

Blank Spike ID: LCS for HBN 1135434 [VXX25437]
 Blank Spike Lab ID: 1190238
 Date Analyzed: 11/06/2013 11:28

Spike Duplicate ID: LCSD for HBN 1135434
 [VXX25437]
 Spike Duplicate Lab ID: 1190239
 Matrix: Soil/Solid (dry weight)

QC for Samples: 1135434003, 1135434008, 1135434012, 1135434014

Results by AK101

Parameter	Blank Spike (mg/Kg)			Spike Duplicate (mg/Kg)			CL	RPD (%)	RPD CL
	Spike	Result	Rec (%)	Spike	Result	Rec (%)			
Gasoline Range Organics	10.0	9.36	94	10.0	9.90	99	(60-120)	5.60	(< 20)
Surrogates									
4-Bromofluorobenzene	1.25	69.6	70	1.25	74.8	75	(50-150)	7.30	

Batch Information

Analytical Batch: **VFC11720**
 Analytical Method: **AK101**
 Instrument: **Agilent 7890 PID/FID**
 Analyst: **ST**

Prep Batch: **VXX25437**
 Prep Method: **SW5035A**
 Prep Date/Time: **11/06/2013 08:00**
 Spike Init Wt./Vol.: 10.0 mg/Kg Extract Vol: 25 mL
 Dupe Init Wt./Vol.: 10.0 mg/Kg Extract Vol: 25 mL



Method Blank

Blank ID: MB for HBN 1491885 [VXX/25437]
Blank Lab ID: 1190235

Matrix: Soil/Solid (dry weight)

QC for Samples:
1135434003, 1135434008, 1135434012, 1135434014

Results by SW8021B

<u>Parameter</u>	<u>Results</u>	<u>LOQ/CL</u>	<u>DL</u>	<u>Units</u>
Benzene	8.00U	12.5	4.00	ug/Kg
Ethylbenzene	15.6U	25.0	7.80	ug/Kg
o-Xylene	15.6U	25.0	7.80	ug/Kg
P & M -Xylene	30.0U	50.0	15.0	ug/Kg
Toluene	15.6U	25.0	7.80	ug/Kg

Surrogates

1,4-Difluorobenzene	92.4	72-119		%
---------------------	------	--------	--	---

Batch Information

Analytical Batch: VFC11720
Analytical Method: SW8021B
Instrument: Agilent 7890 PID/FID
Analyst: ST
Analytical Date/Time: 11/6/2013 10:33:00AM

Prep Batch: VXX25437
Prep Method: SW5035A
Prep Date/Time: 11/6/2013 8:00:00AM
Prep Initial Wt./Vol.: 50 g
Prep Extract Vol: 25 mL

Blank Spike Summary

Blank Spike ID: LCS for HBN 1135434 [VXX25437]
 Blank Spike Lab ID: 1190236
 Date Analyzed: 11/06/2013 10:51

Spike Duplicate ID: LCSD for HBN 1135434 [VXX25437]
 Spike Duplicate Lab ID: 1190237
 Matrix: Soil/Solid (dry weight)

QC for Samples: 1135434003, 1135434008, 1135434012, 1135434014

Results by SW8021B

Parameter	Blank Spike (ug/Kg)			Spike Duplicate (ug/Kg)			CL	RPD (%)	RPD CL
	Spike	Result	Rec (%)	Spike	Result	Rec (%)			
Benzene	1250	1470	117	1250	1440	116	(75-125)	1.70	(< 20)
Ethylbenzene	1250	1390	111	1250	1370	109	(75-125)	1.60	(< 20)
o-Xylene	1250	1370	110	1250	1350	108	(75-125)	1.60	(< 20)
P & M -Xylene	2500	2770	111	2500	2730	109	(80-125)	1.70	(< 20)
Toluene	1250	1410	112	1250	1380	110	(70-125)	2.00	(< 20)
Surrogates									
1,4-Difluorobenzene	1250	96.8	97	1250	97.1	97	(72-119)	0.27	

Batch Information

Analytical Batch: **VFC11720**
 Analytical Method: **SW8021B**
 Instrument: **Agilent 7890 PID/FID**
 Analyst: **ST**

Prep Batch: **VXX25437**
 Prep Method: **SW5035A**
 Prep Date/Time: **11/06/2013 08:00**
 Spike Init Wt./Vol.: 1250 ug/Kg Extract Vol: 25 mL
 Dupe Init Wt./Vol.: 1250 ug/Kg Extract Vol: 25 mL



Matrix Spike Summary

Original Sample ID: 1135434012
MS Sample ID: 1190240 MS
MSD Sample ID: 1190241 MSD

Analysis Date: 11/06/2013 12:08
Analysis Date: 11/06/2013 12:26
Analysis Date: 11/06/2013 12:45
Matrix: Soil/Solid (dry weight)

QC for Samples: 1135434003, 1135434008, 1135434012, 1135434014

Results by SW8021B

Parameter	Sample	Matrix Spike (ug/Kg)			Spike Duplicate (ug/Kg)			CL	RPD (%)	RPD CL
		Spike	Result	Rec (%)	Spike	Result	Rec (%)			
Benzene	10.6U	1004	1126	112	1004	1088	108	75-125	3.40	(< 20)
Ethylbenzene	20.6U	1004	1079	107	1004	1050	105	75-125	2.70	(< 20)
o-Xylene	20.6U	1004	1072	107	1004	1049	105	75-125	2.10	(< 20)
P & M -Xylene	39.6U	2003	2141	107	2003	2103	105	80-125	1.90	(< 20)
Toluene	20.6U	1004	1078	107	1004	1049	104	70-125	2.70	(< 20)
Surrogates										
1,4-Difluorobenzene		1004	976	97	1004	971	97	72-119	0.52	

Batch Information

Analytical Batch: VFC11720
Analytical Method: SW8021B
Instrument: Agilent 7890 PID/FID
Analyst: ST
Analytical Date/Time: 11/6/2013 12:26:00PM

Prep Batch: VXX25437
Prep Method: AK101 Extraction (S)
Prep Date/Time: 11/6/2013 8:00:00AM
Prep Initial Wt./Vol.: 78.39g
Prep Extract Vol: 25.00mL

Print Date: 11/13/2013 2:41:50PM



Method Blank

Blank ID: MB for HBN 1491722 [XXX/30316]
Blank Lab ID: 1189462

Matrix: Soil/Solid (dry weight)

QC for Samples:
1135434003, 1135434008, 1135434012

Results by AK102

<u>Parameter</u>	<u>Results</u>	<u>LOQ/CL</u>	<u>DL</u>	<u>Units</u>
Diesel Range Organics	12.4U	20.0	6.20	mg/Kg
Surrogates				
5a Androstane	83.5	60-120		%

Batch Information

Analytical Batch: XFC11157
Analytical Method: AK102
Instrument: HP 6890 Series II FID SV D R
Analyst: EAB
Analytical Date/Time: 11/7/2013 1:00:00PM

Prep Batch: XXX30316
Prep Method: SW3550C
Prep Date/Time: 11/5/2013 9:00:00AM
Prep Initial Wt./Vol.: 30 g
Prep Extract Vol: 1 mL

Print Date: 11/13/2013 2:41:50PM

Blank Spike Summary

Blank Spike ID: LCS for HBN 1135434 [XXX30316]
 Blank Spike Lab ID: 1189463
 Date Analyzed: 11/07/2013 13:10

Spike Duplicate ID: LCSD for HBN 1135434 [XXX30316]
 Spike Duplicate Lab ID: 1189464
 Matrix: Soil/Solid (dry weight)

QC for Samples: 1135434003, 1135434008, 1135434012

Results by AK102

Parameter	Blank Spike (mg/Kg)			Spike Duplicate (mg/Kg)			CL	RPD (%)	RPD CL
	Spike	Result	Rec (%)	Spike	Result	Rec (%)			
Diesel Range Organics	167	160	96	167	160	96	(75-125)	0.13	(< 20)
Surrogates									
5a Androstane	3.33	101	101	3.33	101	101	(60-120)	0.64	

Batch Information

Analytical Batch: **XFC11157**
 Analytical Method: **AK102**
 Instrument: **HP 6890 Series II FID SV D R**
 Analyst: **EAB**

Prep Batch: **XXX30316**
 Prep Method: **SW3550C**
 Prep Date/Time: **11/05/2013 09:00**
 Spike Init Wt./Vol.: 167 mg/Kg Extract Vol: 1 mL
 Dupe Init Wt./Vol.: 167 mg/Kg Extract Vol: 1 mL

Print Date: 11/13/2013 2:41:51PM



Method Blank

Blank ID: MB for HBN 1491722 [XXX/30316]
Blank Lab ID: 1189462

Matrix: Soil/Solid (dry weight)

QC for Samples:
1135434003, 1135434008, 1135434012

Results by AK103

<u>Parameter</u>	<u>Results</u>	<u>LOQ/CL</u>	<u>DL</u>	<u>Units</u>
Residual Range Organics	12.4U	20.0	6.20	mg/Kg
Surrogates				
n-Triacontane-d62	95.1	60-120		%

Batch Information

Analytical Batch: XFC11157
Analytical Method: AK103
Instrument: HP 6890 Series II FID SV D R
Analyst: EAB
Analytical Date/Time: 11/7/2013 1:00:00PM

Prep Batch: XXX30316
Prep Method: SW3550C
Prep Date/Time: 11/5/2013 9:00:00AM
Prep Initial Wt./Vol.: 30 g
Prep Extract Vol: 1 mL

Print Date: 11/13/2013 2:41:52PM

Blank Spike Summary

Blank Spike ID: LCS for HBN 1135434 [XXX30316]
 Blank Spike Lab ID: 1189463
 Date Analyzed: 11/07/2013 13:10

Spike Duplicate ID: LCSD for HBN 1135434 [XXX30316]
 Spike Duplicate Lab ID: 1189464
 Matrix: Soil/Solid (dry weight)

QC for Samples: 1135434003, 1135434008, 1135434012

Results by AK103

Parameter	Blank Spike (mg/Kg)			Spike Duplicate (mg/Kg)			CL	RPD (%)	RPD CL
	Spike	Result	Rec (%)	Spike	Result	Rec (%)			
Residual Range Organics	167	163	98	167	167	100	(60-120)	2.40	(< 20)
Surrogates									
n-Triacontane-d62	3.33	97	97	3.33	96.8	97	(60-120)	0.16	

Batch Information

Analytical Batch: **XFC11157**
 Analytical Method: **AK103**
 Instrument: **HP 6890 Series II FID SV D R**
 Analyst: **EAB**

Prep Batch: **XXX30316**
 Prep Method: **SW3550C**
 Prep Date/Time: **11/05/2013 09:00**
 Spike Init Wt./Vol.: 167 mg/Kg Extract Vol: 1 mL
 Dupe Init Wt./Vol.: 167 mg/Kg Extract Vol: 1 mL

Method Blank

Blank ID: MB for HBN 1491728 [XXX/30319]
 Blank Lab ID: 1189491

Matrix: Soil/Solid (dry weight)

QC for Samples:
 1135434003, 1135434008, 1135434012

Results by 8270D SIMS (PAH)

<u>Parameter</u>	<u>Results</u>	<u>LOQ/CL</u>	<u>DL</u>	<u>Units</u>
1-Methylnaphthalene	3.00U	5.00	1.50	ug/Kg
2-Methylnaphthalene	3.00U	5.00	1.50	ug/Kg
Acenaphthene	3.00U	5.00	1.50	ug/Kg
Acenaphthylene	3.00U	5.00	1.50	ug/Kg
Anthracene	3.00U	5.00	1.50	ug/Kg
Benzo(a)Anthracene	3.00U	5.00	1.50	ug/Kg
Benzo[a]pyrene	3.00U	5.00	1.50	ug/Kg
Benzo[b]Fluoranthene	3.00U	5.00	1.50	ug/Kg
Benzo[g,h,i]perylene	3.00U	5.00	1.50	ug/Kg
Benzo[k]fluoranthene	3.00U	5.00	1.50	ug/Kg
Chrysene	3.00U	5.00	1.50	ug/Kg
Dibenzo[a,h]anthracene	3.00U	5.00	1.50	ug/Kg
Fluoranthene	3.00U	5.00	1.50	ug/Kg
Fluorene	3.00U	5.00	1.50	ug/Kg
Indeno[1,2,3-c,d] pyrene	3.00U	5.00	1.50	ug/Kg
Naphthalene	3.00U	5.00	1.50	ug/Kg
Phenanthrene	3.00U	5.00	1.50	ug/Kg
Pyrene	3.00U	5.00	1.50	ug/Kg
Surrogates				
2-Fluorobiphenyl	95	45-105		%
Terphenyl-d14	111	30-125		%

Batch Information

Analytical Batch: XMS7750
 Analytical Method: 8270D SIMS (PAH)
 Instrument: HP 6890/5973 MS SVQA
 Analyst: RTS
 Analytical Date/Time: 11/6/2013 2:13:00AM

Prep Batch: XXX30319
 Prep Method: SW3550C
 Prep Date/Time: 11/5/2013 10:05:00AM
 Prep Initial Wt./Vol.: 22.5 g
 Prep Extract Vol: 1 mL



Blank Spike Summary

Blank Spike ID: LCS for HBN 1135434 [XXX30319]
Blank Spike Lab ID: 1189492
Date Analyzed: 11/06/2013 02:27

Matrix: Soil/Solid (dry weight)

QC for Samples: 1135434003, 1135434008, 1135434012

Results by 8270D SIMS (PAH)

Parameter	Blank Spike (ug/Kg)			CL
	Spike	Result	Rec (%)	
1-Methylnaphthalene	22.2	20.8	94	(44-107)
2-Methylnaphthalene	22.2	20.2	91	(45-105)
Acenaphthene	22.2	21.5	97	(45-110)
Acenaphthylene	22.2	20.8	94	(45-105)
Anthracene	22.2	16.7	75	(55-105)
Benzo(a)Anthracene	22.2	22.6	102	(50-110)
Benzo[a]pyrene	22.2	13.8	62	(50-110)
Benzo[b]Fluoranthene	22.2	23.6	106	(45-115)
Benzo[g,h,i]perylene	22.2	22.1	99	(40-125)
Benzo[k]fluoranthene	22.2	24.8	112	(45-125)
Chrysene	22.2	24.6	111	(55-110) *
Dibenzo[a,h]anthracene	22.2	22.4	101	(40-125)
Fluoranthene	22.2	24.4	110	(55-115)
Fluorene	22.2	22.1	99	(50-110)
Indeno[1,2,3-c,d] pyrene	22.2	23.9	108	(40-120)
Naphthalene	22.2	20.2	91	(40-105)
Phenanthrene	22.2	23.3	105	(50-110)
Pyrene	22.2	23.6	106	(45-125)
Surrogates				
2-Fluorobiphenyl	22.2	95.6	96	(45-105)
Terphenyl-d14	22.2	109	109	(30-125)

Batch Information

Analytical Batch: XMS7750
Analytical Method: 8270D SIMS (PAH)
Instrument: HP 6890/5973 MS SVQA
Analyst: RTS

Prep Batch: XXX30319
Prep Method: SW3550C
Prep Date/Time: 11/05/2013 10:05
Spike Init Wt./Vol.: 22.2 ug/Kg Extract Vol: 1 mL
Dupe Init Wt./Vol.: Extract Vol:

Print Date: 11/13/2013 2:41:54PM



Matrix Spike Summary

Original Sample ID: 1135434003
 MS Sample ID: 1189493 MS
 MSD Sample ID: 1189494 MSD

Analysis Date: 11/06/2013 2:41
 Analysis Date: 11/06/2013 2:55
 Analysis Date: 11/06/2013 3:09
 Matrix: Soil/Solid (dry weight)

QC for Samples: 1135434003, 1135434008, 1135434012

Results by 8270D SIMS (PAH)

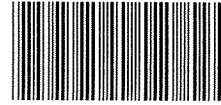
Parameter	Sample	Matrix Spike (ug/Kg)			Spike Duplicate (ug/Kg)			CL	RPD (%)	RPD CL
		Spike	Result	Rec (%)	Spike	Result	Rec (%)			
1-Methylnaphthalene	3.36U	25.1	21.9	87	25.1	21.8	87	44-107	0.82	(< 30)
2-Methylnaphthalene	3.36U	25.1	20.4	81	25.1	21.5	86	45-105	5.70	(< 30)
Acenaphthene	3.36U	25.1	21.5	86	25.1	22.7	91	45-110	5.20	(< 30)
Acenaphthylene	3.36U	25.1	21.2	84	25.1	23.1	92	45-105	9.00	(< 30)
Anthracene	3.36U	25.1	23.1	92	25.1	22.2	89	55-105	4.40	(< 30)
Benzo(a)Anthracene	3.36U	25.1	21.9	87	25.1	23.3	93	50-110	6.00	(< 30)
Benzo(a)pyrene	3.36U	25.1	17.6	70	25.1	17.0	68	50-110	4.30	(< 30)
Benzo(b)Fluoranthene	3.36U	25.1	21.2	84	25.1	21.1	84	45-115	0.70	(< 30)
Benzo(g,h,i)perylene	3.36U	25.1	14.5	58	25.1	14.5	58	40-125	0.57	(< 30)
Benzo(k)fluoranthene	3.36U	25.1	18.4	73	25.1	20.6	82	45-125	11.20	(< 30)
Chrysene	3.36U	25.1	22.2	88	25.1	23.4	93	55-110	5.10	(< 30)
Dibenzo(a,h)anthracene	3.36U	25.1	12.4	49	25.1	12.6	50	40-125	1.90	(< 30)
Fluoranthene	3.36U	25.1	24.7	98	25.1	25.4	101	55-115	2.80	(< 30)
Fluorene	3.36U	25.1	22.6	90	25.1	22.7	90	50-110	0.37	(< 30)
Indeno[1,2,3-c,d] pyrene	3.36U	25.1	13.5	54	25.1	13.4	54	40-120	0.48	(< 30)
Naphthalene	3.36U	25.1	20.2	80	25.1	22.0	88	40-105	8.30	(< 30)
Phenanthrene	3.36U	25.1	23.4	93	25.1	24.4	97	50-110	4.40	(< 30)
Pyrene	3.36U	25.1	23.9	95	25.1	24.7	99	45-125	3.70	(< 30)
Surrogates										
2-Fluorobiphenyl		25.1	22.6	90	25.1	23.3	93	45-105	3.10	
Terphenyl-d14		25.1	26.5	106	25.1	27.3	109	30-125	2.90	

Batch Information

Analytical Batch: XMS7750
 Analytical Method: 8270D SIMS (PAH)
 Instrument: HP 6890/5973 MS SVQA
 Analyst: RTS
 Analytical Date/Time: 11/6/2013 2:55:00AM

Prep Batch: XXX30319
 Prep Method: Sonication Extraction Soil 8270 PAH SIM
 Prep Date/Time: 11/5/2013 10:05:00AM
 Prep Initial Wt./Vol.: 22.82g
 Prep Extract Vol: 1.00mL

Print Date: 11/13/2013 2:41:54PM



SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

CHAIN-OF-CUSTODY RECORD

Laboratory SGS
Attn: _____

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

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

2255 S.W. Canyon Road
Portland, OR 97201-2498
(503) 223-6147

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

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

1200 17th Street, Suite 1024
Denver, Co 80202
(303) 825-3800

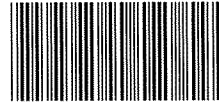
303 Wellsian Way
Richland, WA 99352
(509) 946-6309

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

Sample Identity	Lab No.	Time	Date Sampled	Comp.	Grab	GR01/BTEX	AK-101/EMASOLUB	DR0/BRO	AK102/103	RECAF METALS	EMAF 6020	PART SIMS	EMAF 8220	Total Number of Containers	Remarks/Matrix
2348-R03-S1	① A-B	1740	10/29		X									2	SOIL Hold
B06-S1	② A-B	1533	10/30											1	Hold
B06-S2	③ A-B	1600	10/30			X	X	X	X					1	Hold
B09-S1	④ A-B	0629	10/31											1	Hold
B09-S2	⑤ A-B	0656	10/31											1	Hold
B12-S1	⑥ A-B	0909	11/1											1	Hold
B12-S20	⑦ A-B	0910	11/1											1	Hold
B14-S1	⑧ A-B	1230	11/1			X	X	X	X					1	Hold
B14-S2	⑨ A-B	1800	11/1											1	Hold
B17-S1	⑩ A-B	2010	10/31											1	Hold

Project Information		Sample Receipt		Relinquished By: 1.		Relinquished By: 2.		Relinquished By: 3.	
Project Number: <u>32-1-02348</u>		Total Number of Containers: _____		Signature: _____ Time: <u>0800</u>		Signature: _____ Time: <u>0952</u>		Signature: _____ Time: _____	
Project Name: <u>WATER MAINS IMPROVEMENTS</u>		COC Seals/Intact? Y/N/NA: _____		Printed Name: _____ Date: <u>11/4/13</u>		Printed Name: _____ Date: <u>11/4/13</u>		Printed Name: _____ Date: _____	
Contact: <u>Ryan Cousins / Shannon & Wilson</u>		Received Good Cond./Cold: _____		Company: _____ <u>S&W</u>		Company: _____ <u>S&W</u>		Company: _____	
Ongoing Project? Yes <input checked="" type="checkbox"/> No <input type="checkbox"/>		Delivery Method: _____		Received By: 1.		Received By: 2.		Received By: 3.	
Sampler: <u>Ryan Cousins / Shannon & Wilson</u>		(attach shipping bill, if any)		Signature: _____ Time: <u>0800</u>		Signature: _____ Time: _____		Signature: _____ Time: <u>0952</u>	
Instructions				Printed Name: _____ Date: <u>11/4/13</u>		Printed Name: _____ Date: _____		Printed Name: _____ Date: <u>11/4/13</u>	
Requested Turnaround Time: <u>STANDARD 10-DAY</u>				Company: _____ <u>S&W</u>		Company: _____		Company: _____ <u>SGS</u>	
Special Instructions: <u>LEVEL II DELIVERABLES</u>									

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



CHAIN-OF-CUSTODY RECORD

Laboratory SGS

Attn: _____

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

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

303 Wellisian Way
Richland, WA 99352
(509) 946-6309

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

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

2255 S.W. Canyon Road
Portland, OR 97201-2498
(503) 223-6147

1200 17th Street, Suite 1024
Denver, Co 80202
(303) 825-3800

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

Sample Identity	Lab No.	Time	Date Sampled	Comp.	Grab	GRAB (BTEX)	ML101/EM-90218	DIB/ARQ	ML102/103	PLUET METALS	EM-6020	PNT SIMS	EM-8220	Total Number of Containers	Remarks/Matrix
2348-B17-52	(11) A-B	2037	10/31		X									2	SOIL HOLD
B17-54	(12) A-B	2117	10/31			X	X	X	X					↓	↓ HOLD
B18-51	(13) A-B	0611	11/2											↓	↓ HOLD
-TB	(14) A-B	N/A	N/A											1	
	(15) A-B														

Project Information		Sample Receipt	
Project Number: <u>321-02348</u>	Total Number of Containers: _____	COC Seals/Intact? <u>Y</u> /N/NA	Received Good Cond./Cold
Project Name: <u>WATER MAIN</u>	Delivery Method: _____	(attach shipping bill, if any)	
Contact: <u>Ryan Collins</u>	Ongoing Project? Yes <input checked="" type="checkbox"/> No <input type="checkbox"/>	Sampler: <u>RSL</u>	

Instructions	
Requested Turnaround Time: _____	Special Instructions: _____

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

Relinquished By: 1.		Relinquished By: 2.		Relinquished By: 3.	
Signature: _____	Time: _____	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: _____	Signature: _____	Time: _____	Signature: _____	Time: <u>09:52</u>
Printed Name: _____	Date: _____	Printed Name: _____	Date: _____	Printed Name: <u>MAGIE DE ZETTER</u>	Date: <u>11/13</u>
Company: _____		Company: _____		Company: <u>SGS</u>	



SAMPLE RECEIPT FORM

Review Criteria:	Condition:	Comments/Action Taken:
Were custody seals intact? Note # & location, if applicable. COC accompanied samples?	Yes No <u>N/A</u> <u>Yes</u> No N/A	Absent
Temperature blank compliant* (i.e., 0-6°C after CF)? <i>* Note: Exemption permitted for chilled samples collected less than 8 hours ago.</i> Cooler ID: _____ @ <u>4.2</u> w/ Therm.ID: <u>240</u> Cooler ID: _____ @ _____ w/ Therm.ID: _____ Cooler ID: _____ @ _____ w/ Therm.ID: _____ Cooler ID: _____ @ _____ w/ Therm.ID: _____ Cooler ID: _____ @ _____ w/ Therm.ID: _____ <i>Note: If non-compliant, use form FS-0029 to document affected samples/analyses.</i> If samples are received <u>without</u> 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 <u>nor</u> cooler temp can be obtained, note "ambient" or "chilled."	<u>Yes</u> No N/A	
If temperature(s) <0°C, were all sample containers ice free?	Yes No <u>N/A</u>	
Delivery method (specify all that apply): <u>Client</u> USPS Alert Courier C&D Delivery AK Air Lynden Carlile ERA PenAir FedEx UPS NAC Other: → For WO# with airbills, was the WO# & airbill info recorded in the Front Counter eLog?	Note ABN/tracking # See Attached or <u>N/A</u> Yes No <u>N/A</u>	
→ For samples received with payment, note amount (\$) and cash / check / CC (circle one) or note: → For samples received in FBKS, ANCH staff will verify all criteria are reviewed.		<u>N/A</u> SRF Initiated by: <u>MD</u> N/A
Were samples received within hold time? <i>Note: Refer to form F-083 "Sample Guide" for hold time information.</i> Do samples match COC* (i.e., sample IDs, dates/times collected)? <i>* Note: Exemption permitted if times differ <1hr; in that case, use times on COC.</i> Were analyses requested unambiguous?	<u>Yes</u> No N/A Yes <u>No</u> N/A <u>Yes</u> No N/A	• Sample ID on <u>(1)B</u> jar label is "2348-B17-S1" taken 10-31-13 at 08:37am ID on jar lid and COC is " 2348 " "2348-B17-S2" taken 10-31-13
Were samples in good condition (no leaks/cracks/breakage)? Packing material used (specify all that apply): Bubble Wrap Separate plastic bags Vermiculite Other:	<u>Yes</u> No N/A	at 20:37, logged in per COC in accordance with collection date and time.
Were all VOA vials free of headspace (i.e., bubbles ≤6 mm)? Were all soil VOAs field extracted with MeOH+BFB?	Yes No <u>N/A</u> <u>Yes</u> No N/A	
Were proper containers (type/mass/volume/preservative*) used? <i>* Note: Exemption permitted for waters to be analyzed for metals.</i> Were Trip Blanks (i.e., VOAs, LL-Hg) in cooler with samples?	<u>Yes</u> No N/A <u>Yes</u> No N/A	
For special handling (e.g., "MI" or foreign soils, lab filter, limited volume, Ref Lab), were bottles/paperwork flagged (e.g., sticker)?	Yes No <u>N/A</u>	
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)?	Yes No <u>N/A</u> Yes No <u>N/A</u>	
For RUSH/SHORT Hold Time, were COC/Bottles flagged accordingly? Was Rush/Short HT email sent, if applicable?	Yes No <u>N/A</u>	
For SITE-SPECIFIC QC, e.g. BMS/BMSD/BDUP, were containers / paperwork flagged accordingly?	Yes No <u>N/A</u>	
For any question answered "No," has the PM been notified and the problem resolved (or paperwork put in their bin)?	<u>Yes</u> No N/A	SRF Completed by: <u>MD</u> 11/04/13 PM = <u>SRC</u> N/A
Was PEER REVIEW of sample numbering/labeling completed?	Yes No <u>N/A</u>	Peer Reviewed by: <u>N/A</u>

Additional notes (if applicable):

• 1 4oz amber jar and 1 4oz amber jar w/ septa pres. with MeOH received with sample ID "2348-B17-S3" taken 10-31-13 at ~~20:55~~ 20:55. logged in as (15) A-B and placed on hold.

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

LABORATORY DATA REVIEW CHECKLIST

CS Report Name: Navigational Improvements, Whittier, Alaska,

Date: December 2013

Laboratory Report Date: November 14, 2013

Consultant Firm: Shannon & Wilson, Inc.

Completed by: Jessa H. Tibbetts

Title: Environmental Scientist

Laboratory Name: SGS North America, Inc.

Work Order Number: 1135434

ADEC File Number: NA

ADEC RecKey Number: NA

(NOTE: NA = not applicable; Text in *italics* added by Shannon & Wilson, Inc.)

1. Laboratory

- a. Did an ADEC CS approved laboratory receive and perform all of the submitted sample analyses? **Yes** / No / NA (Please explain.)

Comments:

- b. If the samples were transferred to another "network" laboratory or sub-contracted to an alternate laboratory, was the laboratory performing the analyses ADEC CS-approved?

Yes / No / **NA**

Comments: *Samples were not transferred.*

2. Chain of Custody (COC)

- a. COC information completed, signed, and dated (including released/received by)?

Yes / No / NA (Please explain.)

Comments:

- b. Correct analyses requested? **Yes** / No / NA (Please explain.)

Comments:

3. Laboratory Sample Receipt Documentation

- a. Sample/cooler temperature documented and within range at receipt ($4^{\circ} \pm 2^{\circ}$ C)?

Yes / No / NA (Please explain.)

Comments: *The temperature of the cooler was documented at 4.2° C.*

- b. Sample preservation acceptable - acidified waters, Methanol-preserved VOC soil (GRO, BTEX, VOCs, etc.)? **Yes** / No / NA (Please explain.)

Comments:

- c. Sample condition documented - broken, leaking (soil MeOH), zero headspace (VOC vials)? **Yes** / No / NA (Please explain.)

Comments: *No undesirable sample conditions noted.*

- d. If there were any discrepancies, were they documented (e.g., incorrect sample containers/preservation, sample temperatures outside range, insufficient sample size, missing samples)? **Yes** / No / NA (Please explain.)

Comments:

- *It is documented on the COC that the ID for the sample jar for Sample B17-S2 was labeled "2348B17S1" taken on 10/31/13 at 08:37 pm, but sample ID with the corresponding collection date and time on the COC is listed as 2348-B17-2. The sample was logged by the laboratory per the COC in accordance with collection date and time.*
- *Sample 2348-B17-S3 was not included on the COC but was in the cooler. This sample was logged in and put on hold.*

- e. Data quality or usability affected? (Please Explain.)

Comments: *The incorrectly labeled sample and the extra sample were put on hold and not submitted for analysis. In our opinion, this does not affect the data quality or usability.*

4. Case Narrative

- a. Present and understandable? **Yes** / No / NA (Please explain.)

Comments:

- b. Discrepancies, errors, or QC failures noted by the lab? **Yes** / No / NA (Please explain.)

Comments: *The following discrepancies, errors, or QC failures are listed in the case narrative:*

- *The LCS recovery for chrysene is outside of QC criteria (biased high).*
- *The MS and MSD recoveries for barium do not meet the QC criteria.*

- c. Were corrective actions documented? **Yes** / No / NA (Please explain.)

Comments: *For the failed barium MS/MSD recoveries, the post digestion spike was successful.*

- d. What is the effect on data quality/usability, according to the case narrative?

Comments: *Although the MS/MSD for barium did not meet QC criteria, the LCS recoveries were within acceptable QC criteria. Therefore data quality/usability should not be affected. Other QC discrepancies are discussed in other sections of the laboratory data review checklist.*

5. Sample Results

- a. Correct analyses performed/reported as requested on COC? **Yes**/ No / NA (Please explain.)
Comments:
- b. All applicable holding times met? **Yes**/ No / NA (Please explain.)
Comments:
- c. All soils reported on a dry-weight basis? **Yes**/ No / NA (Please explain.)
Comments:
- d. Are the reported LOQs less than the Cleanup Level or the minimum required detection level for the project? **Yes**/ No / NA (Please explain.)
Comments:
- e. Data quality or usability affected? (Please explain.) **NA**
Comments:

6. QC Samples

a. Method Blank

- i. One method blank reported per matrix, analysis, and 20 samples?
Yes/ No / NA (Please explain.)
Comments:
- ii. All method blank results less than LOQ? **Yes**/ No / NA (Please explain.)
Comments:
- iii. If above LOQ, what samples are affected? **NA**
Comments:
- iv. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?
Yes **No** / NA
Comments:
- v. Data quality or usability affected? **NA**
Comments:

b. Laboratory Control Sample/Duplicate (LCS/LCSD)

- i. Organics - One LCS/LCSD reported per matrix, analysis, and 20 samples? (LCS/LCSD required per AK methods, LCS required per SW846) **Yes** / No / NA (Please explain.)
Comments:
- ii. Metals/Inorganics - One LCS and one sample duplicate reported per matrix, analysis and 20 samples? **Yes** / No / NA (Please explain.)
Comments:
- iii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits? And project specified DQOs, if applicable. (AK petroleum methods: AK101 60%-120%, AK102 75%-125%, AK103 60%-120%; all other analyses see the laboratory QC pages) Yes / **No** / NA (Please explain.)
Comments: *The LCS %R for chrysene was outside of QC criteria (biased high).*
- iv. Precision – All relative percent differences (RPDs) reported and less than method or laboratory limits? And project specified DQOs, if applicable. RPD reported from LCS/LCSD, MS/MSD, and or sample/sample duplicate. (AK Petroleum methods 20%; all other analyses see the laboratory QC pages) **Yes** / No / NA (Please explain.)
Comments:
- v. If %R or RPD is outside of acceptable limits, what samples are affected?
Comments: *Each project sample may be affected.*
- vi. Do the affected samples(s) have data flags? If so, are the data flags clearly defined?
Yes / **No** / NA
Comments:
- vii. Data quality or usability affected? (Please explain.)
Comments: *While each project sample may be affected, chrysene was not detected above the LOQ in any of associated samples. Therefore, it is our opinion the data quality or usability are unaffected.*

c. Surrogates - Organics Only

- i. Are surrogate recoveries reported for organic analyses, field, QC and laboratory samples? **Yes** / No / NA (Please explain.)
Comments:
- ii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits? And project specified DQOs if applicable. (AK Petroleum methods 50-150 %R; all other analyses see the laboratory report pages) **Yes** / No / NA (Please explain.)
Comments:

iii. Do the sample results with failed surrogate recoveries have data flags? If so, are the data flags clearly defined? **Yes / No / NA (Please explain.)**
Comments:

iv. Data quality or usability affected? **Yes / No / NA (Please explain.)**
Comments:

d. Trip Blank - Volatile analyses only (GRO, BTEX, VOCs, etc.) Water and Soil

i. One trip blank reported per matrix, analysis and cooler? **Yes / No / NA (Please explain.)**
Comments:

ii. Is the cooler used to transport the trip blank and volatile samples clearly indicated on the COC? **Yes / No / NA (Please explain if NA or no.)**
Comments: *Only one cooler submitted for this work order.*

iii. All results less than LOQ? **Yes / No / NA (Please explain.)**
Comments: *Although less than the LOQ, toluene was reported at an estimated concentration in the trip blank.*

iv. If above LOQ, what samples are affected? **NA**
Comments: *Although the trip blank detection was less than the LOQs, each project sample may be potentially affected.*

v. Data quality or usability affected? Explain. **NA**
Comments: *While each project sample may be affected, toluene was not detected above the LOQ in any of associated samples. Therefore, it is our opinion the data quality or usability are unaffected.*

e. Field Duplicate

i. One field duplicate submitted per matrix, analysis and 10 project samples? **Yes / No / NA (Please explain.)**
Comments: *A field duplicate was not collected.*

ii. Were the field duplicates submitted blind to the lab? **Yes / No / NA (Please explain.)**
Comments:

iii. Precision – All relative percent differences (RPDs) less than specified DQOs? (Recommended: 30% for water, 50% for soil) **Yes / No / NA (Please explain.)**
Comments:

iv. Data quality or usability affected? Explain. **NA**
Comments:

- f. Decontamination or Equipment Blank** (if not applicable, a comment stating why must be entered below)

Yes / No / NA (Please explain.) *A decontamination/equipment blank was not included as part of the project scope.*

- i. All results less than LOQ? Yes / No / NA (Please explain.)**

Comments:

- ii. If results are above LOQ, what samples are affected? NA**

Comments:

- iii. Data quality or usability affected? Explain. NA**

Comments:

7. Other Data Flags/Qualifiers (ACOE, AFCEE, Lab-specific, etc.)

- a. Are they defined and appropriate? Yes / No / NA**

Comments: *A key is provided on page 4 of the laboratory results.*

Laboratory Report of Analysis

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

Report Number: **1135553**

Client Project: **32-1-02348 Whittier Nav**

Dear Ryan Collins,

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 five 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 Steve 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.

Steve Crupi
Project Manager
steven.crupi@sgs.com

Date

Case Narrative

Customer: SHANNOT **Shannon & Wilson, Inc.**
Project: 1135553 **32-1-02348 Whittier Nav**

Refer to the sample receipt form for information on sample condition.

- 1135553001 PS** **02348-B15S1**
8270D SIM - LCS recovery for benzo(a)pyrene is outside of QC criteria (biased low). Sample was re-extracted and reported outside of hold time for this analyte, in which the LCS met QC criteria.
- 1135553002 PS** **02348-B15S21**
8270D SIM - LCS recovery for benzo(a)pyrene is outside of QC criteria (biased low). Sample was re-extracted and reported outside of hold time for this analyte, in which the LCS met QC criteria.
- 1135553003 PS** **02348-B05S3**
8270D SIM - LCS recovery for benzo(a)pyrene is outside of QC criteria (biased low). Sample was re-extracted and reported outside of hold time for this analyte, in which the LCS met QC criteria.
- 1190501 LCS** **XXX/30357**
8270D SIM - LCS recovery for benzo(a)pyrene is outside of QC criteria (biased low). Associated samples were re-extracted.
- 1191047 MSD** **1135551002MSD**
6020 - Metals - MSD recovery for chromium was outside of acceptance criteria. Post digestion spike was successful.
- 1191584 LCS** **XXX/30387**
8270D SIM - LCS/LCSD recovery for anthracene and benzo(a)pyrene is outside of QC criteria (biased low). All associated samples will be re-extracted.
- 1191585 LCSD** **XXX/3038**
8270D SIM - LCS/LCSD recovery for anthracene and benzo(a)pyrene is outside of QC criteria (biased low). All associated samples will be re-extracted.
8270D SIM - LCS/LCSD RPD for benzo(a)pyrene does not meet QC criteria.
- 1192670 MS** **1135644005MS**
8270D SIM - MS recovery for benzo(a)pyrene was outside of QC criteria. Refer to LCS for accuracy information.
8270D SIM - Sample analyzed at a dilution due to matrix interference with internal standards.
- 1192671 MSD** **1135644005MSD**
8270D SIM - Surrogate (2-fluorobiphenyl) recovery is outside of QC criteria due to sample dilution.
8270D SIM - MSD recovery for benzo(a)pyrene was outside of QC criteria. Refer to LCS for accuracy information.
8270D SIM - Sample analyzed at a dilution due to matrix interference with internal standards.

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

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. If you have any questions regarding this report, or if we can be of any other assistance, please contact your SGS Project Manager at 907-562-2343. All work is provided under SGS general terms and conditions (<http://www.sgs.com/terms_and_conditions.htm>), unless other written agreements have been accepted by both parties.

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: 1020A, 1311, 3010A, 3050B, 3520C, 3550C, 5030B, 5035B, 6020, 7470A, 7471B, 8021B, 8082A, 8260B, 8270D, 8270D-SIM, 9040B, 9045C, 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
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

<u>Client Sample ID</u>	<u>Lab Sample ID</u>	<u>Collected</u>	<u>Received</u>	<u>Matrix</u>
02348-B15S1	1135553001	11/05/2013	11/09/2013	Soil/Solid (dry weight)
02348-B15S21	1135553002	11/05/2013	11/09/2013	Soil/Solid (dry weight)
02348-B05S3	1135553003	11/05/2013	11/09/2013	Soil/Solid (dry weight)
02348-B08S2	1135553004	11/04/2013	11/09/2013	Soil/Solid (dry weight)
02348-B08S3	1135553005	11/04/2013	11/09/2013	Soil/Solid (dry weight)
02348-B08S4	1135553006	11/04/2013	11/09/2013	Soil/Solid (dry weight)
02348-B08S5	1135553007	11/04/2013	11/09/2013	Soil/Solid (dry weight)
02348-B08S6	1135553008	11/04/2013	11/09/2013	Soil/Solid (dry weight)
02348-B15S2	1135553009	11/05/2013	11/09/2013	Soil/Solid (dry weight)
02348-B05S1	1135553010	11/05/2013	11/09/2013	Soil/Solid (dry weight)
02348-B05S2	1135553011	11/05/2013	11/09/2013	Soil/Solid (dry weight)
02348-B05S4	1135553012	11/05/2013	11/09/2013	Soil/Solid (dry weight)
02348-B05S5	1135553013	11/05/2013	11/09/2013	Soil/Solid (dry weight)
02348-B13S1	1135553014	11/02/2013	11/09/2013	Soil/Solid (dry weight)
02348-B13S3	1135553015	11/02/2013	11/09/2013	Soil/Solid (dry weight)
02348-B15S6	1135553016	11/05/2013	11/09/2013	Soil/Solid (dry weight)
02348-B16S1	1135553017	11/06/2013	11/09/2013	Soil/Solid (dry weight)
02348-B16S2	1135553018	11/06/2013	11/09/2013	Soil/Solid (dry weight)
02348-B16S3	1135553019	11/06/2013	11/09/2013	Soil/Solid (dry weight)
02348-TB	1135553020	11/02/2013	11/09/2013	Soil/Solid (dry weight)
02348-B19S1	1135553021	11/07/2013	11/09/2013	Soil/Solid (dry weight)
02348-B19S2	1135553022	11/07/2013	11/09/2013	Soil/Solid (dry weight)
02348-B19S3	1135553023	11/07/2013	11/09/2013	Soil/Solid (dry weight)
02348-B16S5	1135553024	11/06/2013	11/09/2013	Soil/Solid (dry weight)

<u>Method</u>	<u>Method Description</u>
8270D SIMS (PAH)	8270 PAH SIM Semi-Volatiles GC/MS
AK101	AK101/8021 Combo. (S)
SW8021B	AK101/8021 Combo. (S)
AK102	Diesel/Residual Range Organics
AK103	Diesel/Residual Range Organics
SM21 2540G	Percent Solids SM2540G
SW6020	RCRA Metals by ICP-MS

Print Date: 12/03/2013 12:52:17PM

Detectable Results Summary

Client Sample ID: **02348-B15S1**

Lab Sample ID: 1135553001

Metals by ICP/MS

<u>Parameter</u>	<u>Result</u>	<u>Units</u>
Arsenic	9.12	mg/Kg
Barium	23.0	mg/Kg
Chromium	33.2	mg/Kg
Lead	9.79	mg/Kg
Mercury	0.0245J	mg/Kg
Silver	0.0438J	mg/Kg

Volatile Fuels

Ethylbenzene	7.50J	ug/Kg
Gasoline Range Organics	1.22J	mg/Kg
o-Xylene	7.92J	ug/Kg
P & M -Xylene	15.2J	ug/Kg
Toluene	190	ug/Kg

Client Sample ID: **02348-B15S21**

Lab Sample ID: 1135553002

Metals by ICP/MS

<u>Parameter</u>	<u>Result</u>	<u>Units</u>
Arsenic	8.52	mg/Kg
Barium	23.3	mg/Kg
Chromium	32.6	mg/Kg
Lead	11.1	mg/Kg
Mercury	0.0251J	mg/Kg
Silver	0.0472J	mg/Kg

Volatile Fuels

Gasoline Range Organics	1.57J	mg/Kg
Toluene	190	ug/Kg

Client Sample ID: **02348-B05S3**

Lab Sample ID: 1135553003

Metals by ICP/MS

<u>Parameter</u>	<u>Result</u>	<u>Units</u>
Arsenic	20.4	mg/Kg
Barium	40.4	mg/Kg
Cadmium	0.133J	mg/Kg
Chromium	48.7	mg/Kg
Lead	14.8	mg/Kg
Mercury	0.0513	mg/Kg
Silver	0.0651J	mg/Kg

Volatile Fuels

Gasoline Range Organics	1.23J	mg/Kg
-------------------------	-------	-------

Client Sample ID: **02348-TB**

Lab Sample ID: 1135553020

Volatile Fuels

<u>Parameter</u>	<u>Result</u>	<u>Units</u>
Gasoline Range Organics	1.58J	mg/Kg
o-Xylene	9.65J	ug/Kg
Toluene	8.66J	ug/Kg



Results of 02348-B15S1

Client Sample ID: **02348-B15S1**
Client Project ID: **32-1-02348 Whittier Nav**
Lab Sample ID: 1135553001
Lab Project ID: 1135553

Collection Date: 11/05/13 18:42
Received Date: 11/09/13 10:34
Matrix: Soil/Solid (dry weight)
Solids (%): 91.3

Results by Metals by ICP/MS

<u>Parameter</u>	<u>Result Qual</u>	<u>LOQ/CL</u>	<u>DL</u>	<u>Units</u>	<u>DF</u>	<u>Allowable Limits</u>	<u>Date Analyzed</u>
Arsenic	9.12	1.09	0.339	mg/Kg	10		11/15/13 15:23
Barium	23.0	0.328	0.103	mg/Kg	10		11/15/13 15:23
Cadmium	0.110 U	0.219	0.0679	mg/Kg	10		11/15/13 15:23
Chromium	33.2	0.438	0.131	mg/Kg	10		11/15/13 15:23
Lead	9.79	0.219	0.0679	mg/Kg	10		11/15/13 15:23
Mercury	0.0245 J	0.0438	0.0131	mg/Kg	10		11/15/13 15:23
Selenium	0.274 U	0.547	0.164	mg/Kg	10		11/15/13 15:23
Silver	0.0438 J	0.109	0.0339	mg/Kg	10		11/15/13 15:23

Batch Information

Analytical Batch: MMS8356
Analytical Method: SW6020
Analyst: ACF
Analytical Date/Time: 11/15/13 15:23
Container ID: 1135553001-A

Prep Batch: MXX27286
Prep Method: SW3050B
Prep Date/Time: 11/13/13 10:37
Prep Initial Wt./Vol.: 1.001 g
Prep Extract Vol: 50 mL

Print Date: 12/03/2013 12:52:18PM



Results of **02348-B15S1**

Client Sample ID: **02348-B15S1**
Client Project ID: **32-1-02348 Whittier Nav**
Lab Sample ID: 1135553001
Lab Project ID: 1135553

Collection Date: 11/05/13 18:42
Received Date: 11/09/13 10:34
Matrix: Soil/Solid (dry weight)
Solids (%): 91.3

Results by **Polynuclear Aromatics GC/MS**

<u>Parameter</u>	<u>Result Qual</u>	<u>LOQ/CL</u>	<u>DL</u>	<u>Units</u>	<u>DF</u>	<u>Allowable Limits</u>	<u>Date Analyzed</u>
1-Methylnaphthalene	2.71 U	5.43	1.63	ug/Kg	1		11/12/13 12:45
2-Methylnaphthalene	2.71 U	5.43	1.63	ug/Kg	1		11/12/13 12:45
Acenaphthene	2.71 U	5.43	1.63	ug/Kg	1		11/12/13 12:45
Acenaphthylene	2.71 U	5.43	1.63	ug/Kg	1		11/12/13 12:45
Anthracene	2.71 U	5.43	1.63	ug/Kg	1		11/12/13 12:45
Benzo(a)Anthracene	2.71 U	5.43	1.63	ug/Kg	1		11/12/13 12:45
Benzo[a]pyrene	2.71 U	5.43	1.63	ug/Kg	1		11/26/13 18:15
Benzo[b]Fluoranthene	2.71 U	5.43	1.63	ug/Kg	1		11/12/13 12:45
Benzo[g,h,i]perylene	2.71 U	5.43	1.63	ug/Kg	1		11/12/13 12:45
Benzo[k]fluoranthene	2.71 U	5.43	1.63	ug/Kg	1		11/12/13 12:45
Chrysene	2.71 U	5.43	1.63	ug/Kg	1		11/12/13 12:45
Dibenzo[a,h]anthracene	2.71 U	5.43	1.63	ug/Kg	1		11/12/13 12:45
Fluoranthene	2.71 U	5.43	1.63	ug/Kg	1		11/12/13 12:45
Fluorene	2.71 U	5.43	1.63	ug/Kg	1		11/12/13 12:45
Indeno[1,2,3-c,d] pyrene	2.71 U	5.43	1.63	ug/Kg	1		11/12/13 12:45
Naphthalene	2.71 U	5.43	1.63	ug/Kg	1		11/12/13 12:45
Phenanthrene	2.71 U	5.43	1.63	ug/Kg	1		11/12/13 12:45
Pyrene	2.71 U	5.43	1.63	ug/Kg	1		11/12/13 12:45
Surrogates							
2-Fluorobiphenyl	86.8	45-105		%	1		11/12/13 12:45
Terphenyl-d14	99.6	30-125		%	1		11/12/13 12:45

Batch Information

Analytical Batch: XMS7764
Analytical Method: 8270D SIMS (PAH)
Analyst: RTS
Analytical Date/Time: 11/12/13 12:45
Container ID: 1135553001-A

Prep Batch: XXX30357
Prep Method: SW3550C
Prep Date/Time: 11/11/13 15:50
Prep Initial Wt./Vol.: 22.717 g
Prep Extract Vol: 1 mL

Analytical Batch: XMS7791
Analytical Method: 8270D SIMS (PAH)
Analyst: RTS
Analytical Date/Time: 11/26/13 18:15
Container ID: 1135553001-A

Prep Batch: XXX30421
Prep Method: SW3550C
Prep Date/Time: 11/26/13 13:00
Prep Initial Wt./Vol.: 22.703 g
Prep Extract Vol: 1 mL

Print Date: 12/03/2013 12:52:18PM



Results of **02348-B15S1**

Client Sample ID: **02348-B15S1**
Client Project ID: **32-1-02348 Whittier Nav**
Lab Sample ID: 1135553001
Lab Project ID: 1135553

Collection Date: 11/05/13 18:42
Received Date: 11/09/13 10:34
Matrix: Soil/Solid (dry weight)
Solids (%): 91.3

Results by **Semivolatile Organic Fuels**

<u>Parameter</u>	<u>Result Qual</u>	<u>LOQ/CL</u>	<u>DL</u>	<u>Units</u>	<u>DF</u>	<u>Allowable Limits</u>	<u>Date Analyzed</u>
Diesel Range Organics	10.8 U	21.5	6.66	mg/Kg	1		11/14/13 14:56

Surrogates

5a Androstane	85	50-150		%	1		11/14/13 14:56
---------------	----	--------	--	---	---	--	----------------

Batch Information

Analytical Batch: XFC11169
Analytical Method: AK102
Analyst: EAB
Analytical Date/Time: 11/14/13 14:56
Container ID: 1135553001-A

Prep Batch: XXX30354
Prep Method: SW3550C
Prep Date/Time: 11/11/13 08:45
Prep Initial Wt./Vol.: 30.623 g
Prep Extract Vol: 1 mL

<u>Parameter</u>	<u>Result Qual</u>	<u>LOQ/CL</u>	<u>DL</u>	<u>Units</u>	<u>DF</u>	<u>Allowable Limits</u>	<u>Date Analyzed</u>
Residual Range Organics	10.8 U	21.5	6.66	mg/Kg	1		11/14/13 14:56

Surrogates

n-Triacontane-d62	94	50-150		%	1		11/14/13 14:56
-------------------	----	--------	--	---	---	--	----------------

Batch Information

Analytical Batch: XFC11169
Analytical Method: AK103
Analyst: EAB
Analytical Date/Time: 11/14/13 14:56
Container ID: 1135553001-A

Prep Batch: XXX30354
Prep Method: SW3550C
Prep Date/Time: 11/11/13 08:45
Prep Initial Wt./Vol.: 30.623 g
Prep Extract Vol: 1 mL

Print Date: 12/03/2013 12:52:18PM



Results of 02348-B15S1

Client Sample ID: 02348-B15S1
Client Project ID: 32-1-02348 Whittier Nav
Lab Sample ID: 1135553001
Lab Project ID: 1135553

Collection Date: 11/05/13 18:42
Received Date: 11/09/13 10:34
Matrix: Soil/Solid (dry weight)
Solids (%): 91.3

Results by Volatile Fuels

Table with 8 columns: Parameter, Result Qual, LOQ/CL, DL, Units, DF, Allowable Limits, Date Analyzed. Row: Gasoline Range Organics, 1.22 J, 2.08, 0.625, mg/Kg, 1, 11/11/13 16:17

Surrogates

Table with 8 columns: Parameter, Result Qual, LOQ/CL, DL, Units, DF, Allowable Limits, Date Analyzed. Row: 4-Bromofluorobenzene, 62.1, 50-150, %, 1, 11/11/13 16:17

Batch Information

Analytical Batch: VFC11728
Analytical Method: AK101
Analyst: ST
Analytical Date/Time: 11/11/13 16:17
Container ID: 1135553001-B

Prep Batch: VXX25450
Prep Method: SW5035A
Prep Date/Time: 11/05/13 18:42
Prep Initial Wt./Vol.: 85.348 g
Prep Extract Vol: 32.4548 mL

Table with 8 columns: Parameter, Result Qual, LOQ/CL, DL, Units, DF, Allowable Limits, Date Analyzed. Rows: Benzene, Ethylbenzene, o-Xylene, P & M -Xylene, Toluene

Surrogates

Table with 8 columns: Parameter, Result Qual, LOQ/CL, DL, Units, DF, Allowable Limits, Date Analyzed. Row: 1,4-Difluorobenzene, 96.5, 72-119, %, 1, 11/11/13 16:17

Batch Information

Analytical Batch: VFC11728
Analytical Method: SW8021B
Analyst: ST
Analytical Date/Time: 11/11/13 16:17
Container ID: 1135553001-B

Prep Batch: VXX25450
Prep Method: SW5035A
Prep Date/Time: 11/05/13 18:42
Prep Initial Wt./Vol.: 85.348 g
Prep Extract Vol: 32.4548 mL

Print Date: 12/03/2013 12:52:18PM



Results of 02348-B15S21

Client Sample ID: **02348-B15S21**
Client Project ID: **32-1-02348 Whittier Nav**
Lab Sample ID: 1135553002
Lab Project ID: 1135553

Collection Date: 11/05/13 18:44
Received Date: 11/09/13 10:34
Matrix: Soil/Solid (dry weight)
Solids (%): 88.9

Results by Metals by ICP/MS

<u>Parameter</u>	<u>Result Qual</u>	<u>LOQ/CL</u>	<u>DL</u>	<u>Units</u>	<u>DF</u>	<u>Allowable Limits</u>	<u>Date Analyzed</u>
Arsenic	8.52	1.08	0.334	mg/Kg	10		11/15/13 15:26
Barium	23.3	0.323	0.101	mg/Kg	10		11/15/13 15:26
Cadmium	0.108 U	0.215	0.0668	mg/Kg	10		11/15/13 15:26
Chromium	32.6	0.431	0.129	mg/Kg	10		11/15/13 15:26
Lead	11.1	0.215	0.0668	mg/Kg	10		11/15/13 15:26
Mercury	0.0251 J	0.0431	0.0129	mg/Kg	10		11/15/13 15:26
Selenium	0.270 U	0.539	0.162	mg/Kg	10		11/15/13 15:26
Silver	0.0472 J	0.108	0.0334	mg/Kg	10		11/15/13 15:26

Batch Information

Analytical Batch: MMS8356
Analytical Method: SW6020
Analyst: ACF
Analytical Date/Time: 11/15/13 15:26
Container ID: 1135553002-A

Prep Batch: MXX27286
Prep Method: SW3050B
Prep Date/Time: 11/13/13 10:37
Prep Initial Wt./Vol.: 1.044 g
Prep Extract Vol: 50 mL

Print Date: 12/03/2013 12:52:18PM



Results of 02348-B15S21

Client Sample ID: 02348-B15S21
Client Project ID: 32-1-02348 Whittier Nav
Lab Sample ID: 1135553002
Lab Project ID: 1135553

Collection Date: 11/05/13 18:44
Received Date: 11/09/13 10:34
Matrix: Soil/Solid (dry weight)
Solids (%): 88.9

Results by Polynuclear Aromatics GC/MS

Table with 8 columns: Parameter, Result Qual, LOQ/CL, DL, Units, DF, Allowable Limits, Date Analyzed. Lists various polynuclear aromatic hydrocarbons and their detection results.

Batch Information

Analytical Batch: XMS7764
Analytical Method: 8270D SIMS (PAH)
Analyst: RTS
Analytical Date/Time: 11/12/13 13:27
Container ID: 1135553002-A

Prep Batch: XXX30357
Prep Method: SW3550C
Prep Date/Time: 11/11/13 15:50
Prep Initial Wt./Vol.: 22.818 g
Prep Extract Vol: 1 mL

Analytical Batch: XMS7791
Analytical Method: 8270D SIMS (PAH)
Analyst: RTS
Analytical Date/Time: 11/26/13 18:29
Container ID: 1135553002-A

Prep Batch: XXX30421
Prep Method: SW3550C
Prep Date/Time: 11/26/13 13:00
Prep Initial Wt./Vol.: 22.956 g
Prep Extract Vol: 1 mL

Print Date: 12/03/2013 12:52:18PM



Results of **02348-B15S21**

Client Sample ID: **02348-B15S21**
Client Project ID: **32-1-02348 Whittier Nav**
Lab Sample ID: 1135553002
Lab Project ID: 1135553

Collection Date: 11/05/13 18:44
Received Date: 11/09/13 10:34
Matrix: Soil/Solid (dry weight)
Solids (%): 88.9

Results by **Semivolatile Organic Fuels**

<u>Parameter</u>	<u>Result Qual</u>	<u>LOQ/CL</u>	<u>DL</u>	<u>Units</u>	<u>DF</u>	<u>Allowable Limits</u>	<u>Date Analyzed</u>
Diesel Range Organics	11.1 U	22.2	6.87	mg/Kg	1		11/14/13 15:06
Surrogates							
5a Androstane	86.6	50-150		%	1		11/14/13 15:06

Batch Information

Analytical Batch: XFC11169
Analytical Method: AK102
Analyst: EAB
Analytical Date/Time: 11/14/13 15:06
Container ID: 1135553002-A

Prep Batch: XXX30354
Prep Method: SW3550C
Prep Date/Time: 11/11/13 08:45
Prep Initial Wt./Vol.: 30.449 g
Prep Extract Vol: 1 mL

<u>Parameter</u>	<u>Result Qual</u>	<u>LOQ/CL</u>	<u>DL</u>	<u>Units</u>	<u>DF</u>	<u>Allowable Limits</u>	<u>Date Analyzed</u>
Residual Range Organics	11.1 U	22.2	6.87	mg/Kg	1		11/14/13 15:06
Surrogates							
n-Triacontane-d62	95.8	50-150		%	1		11/14/13 15:06

Batch Information

Analytical Batch: XFC11169
Analytical Method: AK103
Analyst: EAB
Analytical Date/Time: 11/14/13 15:06
Container ID: 1135553002-A

Prep Batch: XXX30354
Prep Method: SW3550C
Prep Date/Time: 11/11/13 08:45
Prep Initial Wt./Vol.: 30.449 g
Prep Extract Vol: 1 mL

Print Date: 12/03/2013 12:52:18PM



Results of **02348-B15S21**

Client Sample ID: **02348-B15S21**
Client Project ID: **32-1-02348 Whittier Nav**
Lab Sample ID: 1135553002
Lab Project ID: 1135553

Collection Date: 11/05/13 18:44
Received Date: 11/09/13 10:34
Matrix: Soil/Solid (dry weight)
Solids (%): 88.9

Results by **Volatile Fuels**

<u>Parameter</u>	<u>Result Qual</u>	<u>LOQ/CL</u>	<u>DL</u>	<u>Units</u>	<u>DF</u>	<u>Allowable Limits</u>	<u>Date Analyzed</u>
Gasoline Range Organics	1.57 J	2.44	0.731	mg/Kg	1		11/11/13 15:59

Surrogates

4-Bromofluorobenzene	62.2	50-150		%	1		11/11/13 15:59
----------------------	------	--------	--	---	---	--	----------------

Batch Information

Analytical Batch: VFC11728
Analytical Method: AK101
Analyst: ST
Analytical Date/Time: 11/11/13 15:59
Container ID: 1135553002-B

Prep Batch: VXX25450
Prep Method: SW5035A
Prep Date/Time: 11/05/13 18:44
Prep Initial Wt./Vol.: 77.611 g
Prep Extract Vol: 33.6168 mL

<u>Parameter</u>	<u>Result Qual</u>	<u>LOQ/CL</u>	<u>DL</u>	<u>Units</u>	<u>DF</u>	<u>Allowable Limits</u>	<u>Date Analyzed</u>
Benzene	6.10 U	12.2	3.90	ug/Kg	1		11/11/13 15:59
Ethylbenzene	12.2 U	24.4	7.60	ug/Kg	1		11/11/13 15:59
o-Xylene	12.2 U	24.4	7.60	ug/Kg	1		11/11/13 15:59
P & M -Xylene	24.4 U	48.7	14.6	ug/Kg	1		11/11/13 15:59
Toluene	190	24.4	7.60	ug/Kg	1		11/11/13 15:59

Surrogates

1,4-Difluorobenzene	96.5	72-119		%	1		11/11/13 15:59
---------------------	------	--------	--	---	---	--	----------------

Batch Information

Analytical Batch: VFC11728
Analytical Method: SW8021B
Analyst: ST
Analytical Date/Time: 11/11/13 15:59
Container ID: 1135553002-B

Prep Batch: VXX25450
Prep Method: SW5035A
Prep Date/Time: 11/05/13 18:44
Prep Initial Wt./Vol.: 77.611 g
Prep Extract Vol: 33.6168 mL

Print Date: 12/03/2013 12:52:18PM



Results of 02348-B05S3

Client Sample ID: **02348-B05S3**
Client Project ID: **32-1-02348 Whittier Nav**
Lab Sample ID: 1135553003
Lab Project ID: 1135553

Collection Date: 11/05/13 12:22
Received Date: 11/09/13 10:34
Matrix: Soil/Solid (dry weight)
Solids (%): 93.1

Results by Metals by ICP/MS

<u>Parameter</u>	<u>Result Qual</u>	<u>LOQ/CL</u>	<u>DL</u>	<u>Units</u>	<u>DF</u>	<u>Allowable Limits</u>	<u>Date Analyzed</u>
Arsenic	20.4	0.991	0.307	mg/Kg	10		11/15/13 15:29
Barium	40.4	0.297	0.0932	mg/Kg	10		11/15/13 15:29
Cadmium	0.133 J	0.198	0.0615	mg/Kg	10		11/15/13 15:29
Chromium	48.7	0.397	0.119	mg/Kg	10		11/15/13 15:29
Lead	14.8	0.198	0.0615	mg/Kg	10		11/15/13 15:29
Mercury	0.0513	0.0397	0.0119	mg/Kg	10		11/15/13 15:29
Selenium	0.248 U	0.496	0.149	mg/Kg	10		11/15/13 15:29
Silver	0.0651 J	0.0991	0.0307	mg/Kg	10		11/15/13 15:29

Batch Information

Analytical Batch: MMS8356
Analytical Method: SW6020
Analyst: ACF
Analytical Date/Time: 11/15/13 15:29
Container ID: 1135553003-A

Prep Batch: MXX27286
Prep Method: SW3050B
Prep Date/Time: 11/13/13 10:37
Prep Initial Wt./Vol.: 1.083 g
Prep Extract Vol: 50 mL

Print Date: 12/03/2013 12:52:18PM



Results of 02348-B05S3

Client Sample ID: 02348-B05S3
Client Project ID: 32-1-02348 Whittier Nav
Lab Sample ID: 1135553003
Lab Project ID: 1135553

Collection Date: 11/05/13 12:22
Received Date: 11/09/13 10:34
Matrix: Soil/Solid (dry weight)
Solids (%): 93.1

Results by Polynuclear Aromatics GC/MS

Table with 8 columns: Parameter, Result Qual, LOQ/CL, DL, Units, DF, Allowable Limits, Date Analyzed. Lists various polynuclear aromatic hydrocarbons and their detection results.

Batch Information

Analytical Batch: XMS7764
Analytical Method: 8270D SIMS (PAH)
Analyst: RTS
Analytical Date/Time: 11/12/13 13:41
Container ID: 1135553003-A

Prep Batch: XXX30357
Prep Method: SW3550C
Prep Date/Time: 11/11/13 15:50
Prep Initial Wt./Vol.: 22.86 g
Prep Extract Vol: 1 mL

Analytical Batch: XMS7791
Analytical Method: 8270D SIMS (PAH)
Analyst: RTS
Analytical Date/Time: 11/26/13 18:43
Container ID: 1135553003-A

Prep Batch: XXX30421
Prep Method: SW3550C
Prep Date/Time: 11/26/13 13:00
Prep Initial Wt./Vol.: 22.566 g
Prep Extract Vol: 1 mL

Print Date: 12/03/2013 12:52:18PM



Results of **02348-B05S3**

Client Sample ID: **02348-B05S3**
Client Project ID: **32-1-02348 Whittier Nav**
Lab Sample ID: 1135553003
Lab Project ID: 1135553

Collection Date: 11/05/13 12:22
Received Date: 11/09/13 10:34
Matrix: Soil/Solid (dry weight)
Solids (%): 93.1

Results by **Semivolatile Organic Fuels**

<u>Parameter</u>	<u>Result Qual</u>	<u>LOQ/CL</u>	<u>DL</u>	<u>Units</u>	<u>DF</u>	<u>Allowable Limits</u>	<u>Date Analyzed</u>
Diesel Range Organics	10.6 U	21.1	6.54	mg/Kg	1		11/14/13 15:16
Surrogates							
5a Androstane	81.9	50-150		%	1		11/14/13 15:16

Batch Information

Analytical Batch: XFC11169
Analytical Method: AK102
Analyst: EAB
Analytical Date/Time: 11/14/13 15:16
Container ID: 1135553003-A

Prep Batch: XXX30354
Prep Method: SW3550C
Prep Date/Time: 11/11/13 08:45
Prep Initial Wt./Vol.: 30.514 g
Prep Extract Vol: 1 mL

<u>Parameter</u>	<u>Result Qual</u>	<u>LOQ/CL</u>	<u>DL</u>	<u>Units</u>	<u>DF</u>	<u>Allowable Limits</u>	<u>Date Analyzed</u>
Residual Range Organics	10.6 U	21.1	6.54	mg/Kg	1		11/14/13 15:16
Surrogates							
n-Triacontane-d62	90	50-150		%	1		11/14/13 15:16

Batch Information

Analytical Batch: XFC11169
Analytical Method: AK103
Analyst: EAB
Analytical Date/Time: 11/14/13 15:16
Container ID: 1135553003-A

Prep Batch: XXX30354
Prep Method: SW3550C
Prep Date/Time: 11/11/13 08:45
Prep Initial Wt./Vol.: 30.514 g
Prep Extract Vol: 1 mL

Print Date: 12/03/2013 12:52:18PM



Results of **02348-B05S3**

Client Sample ID: **02348-B05S3**
Client Project ID: **32-1-02348 Whittier Nav**
Lab Sample ID: 1135553003
Lab Project ID: 1135553

Collection Date: 11/05/13 12:22
Received Date: 11/09/13 10:34
Matrix: Soil/Solid (dry weight)
Solids (%): 93.1

Results by **Volatile Fuels**

<u>Parameter</u>	<u>Result Qual</u>	<u>LOQ/CL</u>	<u>DL</u>	<u>Units</u>	<u>DF</u>	<u>Allowable Limits</u>	<u>Date Analyzed</u>
Gasoline Range Organics	1.23 J	2.13	0.639	mg/Kg	1		11/11/13 15:41

Surrogates

4-Bromofluorobenzene	79.5	50-150		%	1		11/11/13 15:41
----------------------	------	--------	--	---	---	--	----------------

Batch Information

Analytical Batch: VFC11728
Analytical Method: AK101
Analyst: ST
Analytical Date/Time: 11/11/13 15:41
Container ID: 1135553003-B

Prep Batch: VXX25450
Prep Method: SW5035A
Prep Date/Time: 11/05/13 12:22
Prep Initial Wt./Vol.: 76.189 g
Prep Extract Vol: 30.219 mL

<u>Parameter</u>	<u>Result Qual</u>	<u>LOQ/CL</u>	<u>DL</u>	<u>Units</u>	<u>DF</u>	<u>Allowable Limits</u>	<u>Date Analyzed</u>
Benzene	5.30 U	10.6	3.41	ug/Kg	1		11/11/13 15:41
Ethylbenzene	10.7 U	21.3	6.64	ug/Kg	1		11/11/13 15:41
o-Xylene	10.7 U	21.3	6.64	ug/Kg	1		11/11/13 15:41
P & M -Xylene	21.3 U	42.6	12.8	ug/Kg	1		11/11/13 15:41
Toluene	10.7 U	21.3	6.64	ug/Kg	1		11/11/13 15:41

Surrogates

1,4-Difluorobenzene	96.6	72-119		%	1		11/11/13 15:41
---------------------	------	--------	--	---	---	--	----------------

Batch Information

Analytical Batch: VFC11728
Analytical Method: SW8021B
Analyst: ST
Analytical Date/Time: 11/11/13 15:41
Container ID: 1135553003-B

Prep Batch: VXX25450
Prep Method: SW5035A
Prep Date/Time: 11/05/13 12:22
Prep Initial Wt./Vol.: 76.189 g
Prep Extract Vol: 30.219 mL

Print Date: 12/03/2013 12:52:18PM



Results of 02348-TB

Client Sample ID: 02348-TB
Client Project ID: 32-1-02348 Whittier Nav
Lab Sample ID: 1135553020
Lab Project ID: 1135553

Collection Date: 11/02/13 07:43
Received Date: 11/09/13 10:34
Matrix: Soil/Solid (dry weight)
Solids (%):

Results by Volatile Fuels

Table with 8 columns: Parameter, Result Qual, LOQ/CL, DL, Units, DF, Allowable Limits, Date Analyzed. Row: Gasoline Range Organics, 1.58 J, 2.48, 0.743, mg/Kg, 1, 11/11/13 15:23

Surrogates

Table with 8 columns: Parameter, Result Qual, LOQ/CL, DL, Units, DF, Allowable Limits, Date Analyzed. Row: 4-Bromofluorobenzene, 97.2, 50-150, %, 1, 11/11/13 15:23

Batch Information

Analytical Batch: VFC11728
Analytical Method: AK101
Analyst: ST
Analytical Date/Time: 11/11/13 15:23
Container ID: 1135553020-A

Prep Batch: VXX25450
Prep Method: SW5035A
Prep Date/Time: 11/02/13 07:43
Prep Initial Wt./Vol.: 50.503 g
Prep Extract Vol: 25 mL

Table with 8 columns: Parameter, Result Qual, LOQ/CL, DL, Units, DF, Allowable Limits, Date Analyzed. Rows: Benzene, Ethylbenzene, o-Xylene, P & M -Xylene, Toluene

Surrogates

Table with 8 columns: Parameter, Result Qual, LOQ/CL, DL, Units, DF, Allowable Limits, Date Analyzed. Row: 1,4-Difluorobenzene, 97, 72-119, %, 1, 11/11/13 15:23

Batch Information

Analytical Batch: VFC11728
Analytical Method: SW8021B
Analyst: ST
Analytical Date/Time: 11/11/13 15:23
Container ID: 1135553020-A

Prep Batch: VXX25450
Prep Method: SW5035A
Prep Date/Time: 11/02/13 07:43
Prep Initial Wt./Vol.: 50.503 g
Prep Extract Vol: 25 mL

Print Date: 12/03/2013 12:52:18PM



Method Blank

Blank ID: MB for HBN 1492186 [MXX/27286]

Blank Lab ID: 1191043

QC for Samples:

113553001, 113553002, 113553003

Matrix: Soil/Solid (dry weight)

Results by SW6020

<u>Parameter</u>	<u>Results</u>	<u>LOQ/CL</u>	<u>DL</u>	<u>Units</u>
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	0.123J	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	0.250U	0.500	0.150	mg/Kg
Silver	0.0500U	0.100	0.0310	mg/Kg

Batch Information

Analytical Batch: MMS8356

Analytical Method: SW6020

Instrument: Perkin Elmer Sciex ICP-MS P3

Analyst: ACF

Analytical Date/Time: 11/15/2013 3:44:10PM

Prep Batch: MXX27286

Prep Method: SW3050B

Prep Date/Time: 11/13/2013 10:37:00AM

Prep Initial Wt./Vol.: 1 g

Prep Extract Vol: 50 mL

Print Date: 12/03/2013 12:52:20PM

Blank Spike Summary

Blank Spike ID: LCS for HBN 1135553 [MXX27286]

Blank Spike Lab ID: 1191044

Date Analyzed: 11/15/2013 15:46

Matrix: Soil/Solid (dry weight)

QC for Samples: 1135553001, 1135553002, 1135553003

Results by SW6020

Parameter	Blank Spike (mg/Kg)			CL
	Spike	Result	Rec (%)	
Arsenic	50	51.9	104	(80-120)
Barium	50	52.1	104	(80-120)
Cadmium	5	5.51	110	(80-120)
Chromium	20	20.8	104	(80-120)
Lead	50	54.5	109	(80-120)
Mercury	0.5	0.539	108	(80-120)
Selenium	50	51.8	104	(80-120)
Silver	5	5.18	104	(80-120)

Batch Information

Analytical Batch: **MMS8356**

Analytical Method: **SW6020**

Instrument: **Perkin Elmer Sciex ICP-MS P3**

Analyst: **ACF**

Prep Batch: **MXX27286**

Prep Method: **SW3050B**

Prep Date/Time: **11/13/2013 10:37**

Spike Init Wt./Vol.: 50 mg/Kg Extract Vol: 50 mL

Dupe Init Wt./Vol.: Extract Vol:

Print Date: 12/03/2013 12:52:21PM

Matrix Spike Summary

Original Sample ID: 1191527
 MS Sample ID: 1191046 MS
 MSD Sample ID: 1191047 MSD

Analysis Date: 11/15/2013 14:46
 Analysis Date: 11/15/2013 14:51
 Analysis Date: 11/15/2013 14:54
 Matrix: Soil/Solid (dry weight)

QC for Samples: 1135553001, 1135553002, 1135553003

Results by SW6020

Parameter	Sample	Matrix Spike (mg/Kg)			Spike Duplicate (mg/Kg)			CL	RPD (%)	RPD CL
		Spike	Result	Rec (%)	Spike	Result	Rec (%)			
Arsenic	7.78	46.3	55	102	49.1	59.5	105	80-120	7.93	(< 20)
Barium	93.3	46.3	147	116	49.1	152	120	80-120	3.59	(< 20)
Cadmium	0.0920U	4.63	4.94	107	4.91	5.24	107	80-120	5.85	(< 20)
Chromium	22.6	18.5	43.5	113	19.6	46.5	122 *	80-120	6.66	(< 20)
Lead	4.79	46.3	54.9	108	49.1	56.9	106	80-120	3.57	(< 20)
Selenium	0.201J	46.3	46.9	101	49.1	48.3	98	80-120	3.05	(< 20)
Silver	0.0479J	4.63	4.73	101	4.91	5.02	101	80-120	5.89	(< 20)

Batch Information

Analytical Batch: MMS8356
 Analytical Method: SW6020
 Instrument: Perkin Elmer Sciex ICP-MS P3
 Analyst: ACF
 Analytical Date/Time: 11/15/2013 2:51:25PM

Prep Batch: MXX27286
 Prep Method: Soils/Solids Digest for Metals by ICP-MS
 Prep Date/Time: 11/13/2013 10:37:00AM
 Prep Initial Wt./Vol.: 1.08g
 Prep Extract Vol: 50.00mL

Print Date: 12/03/2013 12:52:21PM

Bench Spike Summary

Original Sample ID: 1191527
 MS Sample ID: 1191048 BND
 MSD Sample ID:

Analysis Date: 11/15/2013 14:46
 Analysis Date: 11/15/2013 14:56
 Analysis Date:
 Matrix: Soil/Solid (dry weight)

QC for Samples: 1135553001, 1135553002, 1135553003

Results by SW6020

Parameter	Sample	Matrix Spike (mg/Kg)			Spike Duplicate (mg/Kg)			CL	RPD (%)	RPD CL
		Spike	Result	Rec (%)	Spike	Result	Rec (%)			
Chromium	22.6	115	138	101				75-125		

Batch Information

Analytical Batch: MMS8356
 Analytical Method: SW6020
 Instrument: Perkin Elmer Sciex ICP-MS P3
 Analyst: ACF
 Analytical Date/Time: 11/15/2013 2:56:47PM

Prep Batch: MXX27286
 Prep Method: Soils/Solids Digest for Metals by ICP-MS
 Prep Date/Time: 11/13/2013 10:37:00AM
 Prep Initial Wt./Vol.: 1.09g
 Prep Extract Vol: 50.00mL

Print Date: 12/03/2013 12:52:21PM



Method Blank

Blank ID: MB for HBN 1492065 [SPT/9205]
Blank Lab ID: 1190622
QC for Samples:
1135553001, 1135553002, 1135553003

Matrix: Soil/Solid (dry weight)

Results by SM21 2540G

<u>Parameter</u>	<u>Results</u>	<u>LOQ/CL</u>	<u>DL</u>	<u>Units</u>
Total Solids	100			%

Batch Information

Analytical Batch: SPT9205
Analytical Method: SM21 2540G
Instrument:
Analyst: KRL
Analytical Date/Time: 11/11/2013 5:00:00PM

Print Date: 12/03/2013 12:52:22PM

Duplicate Sample Summary

Original Sample ID: 1135551001

Duplicate Sample ID: 1190623

QC for Samples:

1135553001, 1135553002, 1135553003

Analysis Date: 11/11/2013 17:00

Matrix: Soil/Solid (dry weight)

Results by SM21 2540G

<u>NAME</u>	<u>Original ()</u>	<u>Duplicate ()</u>	<u>RPD (%)</u>	<u>RPD CL</u>
Total Solids	88.1	89.4	1.40	15.00

Batch Information

Analytical Batch: SPT9205

Analytical Method: SM21 2540G

Instrument:

Analyst: KRL

Print Date: 12/03/2013 12:52:22PM

Method Blank

Blank ID: MB for HBN 1492086 [VXX/25450]
Blank Lab ID: 1190724

Matrix: Soil/Solid (dry weight)

QC for Samples:
1135553001, 1135553002, 1135553003, 1135553020

Results by AK101

<u>Parameter</u>	<u>Results</u>	<u>LOQ/CL</u>	<u>DL</u>	<u>Units</u>
Gasoline Range Organics	0.913J	2.50	0.750	mg/Kg
Surrogates				
4-Bromofluorobenzene	82.8	50-150		%

Batch Information

Analytical Batch: VFC11728
Analytical Method: AK101
Instrument: Agilent 7890A PID/FID
Analyst: ST
Analytical Date/Time: 11/11/2013 11:44:00AM

Prep Batch: VXX25450
Prep Method: SW5035A
Prep Date/Time: 11/11/2013 8:00:00AM
Prep Initial Wt./Vol.: 50 g
Prep Extract Vol: 25 mL

Blank Spike Summary

Blank Spike ID: LCS for HBN 1135553 [VXX25450]
 Blank Spike Lab ID: 1190727
 Date Analyzed: 11/11/2013 12:38

Spike Duplicate ID: LCSD for HBN 1135553 [VXX25450]
 Spike Duplicate Lab ID: 1190728
 Matrix: Soil/Solid (dry weight)

QC for Samples: 1135553001, 1135553002, 1135553003, 1135553020

Results by AK101

Parameter	Blank Spike (mg/Kg)			Spike Duplicate (mg/Kg)			CL	RPD (%)	RPD CL
	Spike	Result	Rec (%)	Spike	Result	Rec (%)			
Gasoline Range Organics	10.0	9.58	96	10.0	9.20	92	(60-120)	4.10	(< 20)
Surrogates									
4-Bromofluorobenzene	1.25	85.5	86	1.25	83.9	84	(50-150)	1.90	

Batch Information

Analytical Batch: **VFC11728**
 Analytical Method: **AK101**
 Instrument: **Agilent 7890A PID/FID**
 Analyst: **ST**

Prep Batch: **VXX25450**
 Prep Method: **SW5035A**
 Prep Date/Time: **11/11/2013 08:00**
 Spike Init Wt./Vol.: 10.0 mg/Kg Extract Vol: 25 mL
 Dupe Init Wt./Vol.: 10.0 mg/Kg Extract Vol: 25 mL



Method Blank

Blank ID: MB for HBN 1492086 [VXX/25450]
Blank Lab ID: 1190724

Matrix: Soil/Solid (dry weight)

QC for Samples:
1135553001, 1135553002, 1135553003, 1135553020

Results by SW8021B

<u>Parameter</u>	<u>Results</u>	<u>LOQ/CL</u>	<u>DL</u>	<u>Units</u>
Benzene	6.25U	12.5	4.00	ug/Kg
Ethylbenzene	12.5U	25.0	7.80	ug/Kg
o-Xylene	12.5U	25.0	7.80	ug/Kg
P & M -Xylene	25.0U	50.0	15.0	ug/Kg
Toluene	12.5U	25.0	7.80	ug/Kg
Surrogates				
1,4-Difluorobenzene	97.4	72-119		%

Batch Information

Analytical Batch: VFC11728
Analytical Method: SW8021B
Instrument: Agilent 7890A PID/FID
Analyst: ST
Analytical Date/Time: 11/11/2013 11:44:00AM

Prep Batch: VXX25450
Prep Method: SW5035A
Prep Date/Time: 11/11/2013 8:00:00AM
Prep Initial Wt./Vol.: 50 g
Prep Extract Vol: 25 mL

Print Date: 12/03/2013 12:52:24PM



Blank Spike Summary

Blank Spike ID: LCS for HBN 1135553 [VXX25450]
 Blank Spike Lab ID: 1190725
 Date Analyzed: 11/11/2013 12:02

Spike Duplicate ID: LCSD for HBN 1135553 [VXX25450]
 Spike Duplicate Lab ID: 1190726
 Matrix: Soil/Solid (dry weight)

QC for Samples: 1135553001, 1135553002, 1135553003, 1135553020

Results by SW8021B

Parameter	Blank Spike (ug/Kg)			Spike Duplicate (ug/Kg)					
	Spike	Result	Rec (%)	Spike	Result	Rec (%)	CL	RPD (%)	RPD CL
Benzene	1250	1230	99	1250	1190	95	(75-125)	3.60	(< 20)
Ethylbenzene	1250	1280	102	1250	1230	98	(75-125)	3.90	(< 20)
o-Xylene	1250	1250	100	1250	1210	97	(75-125)	3.70	(< 20)
P & M -Xylene	2500	2550	102	2500	2450	98	(80-125)	3.90	(< 20)
Toluene	1250	1270	101	1250	1220	98	(70-125)	3.70	(< 20)

Surrogates

1,4-Difluorobenzene	1250	98.7	99	1250	98.5	99	(72-119)	0.26	
---------------------	------	------	----	------	------	----	------------	------	--

Batch Information

Analytical Batch: VFC11728
 Analytical Method: SW8021B
 Instrument: Agilent 7890A PID/FID
 Analyst: ST

Prep Batch: VXX25450
 Prep Method: SW5035A
 Prep Date/Time: 11/11/2013 08:00
 Spike Init Wt./Vol.: 1250 ug/Kg Extract Vol: 25 mL
 Dupe Init Wt./Vol.: 1250 ug/Kg Extract Vol: 25 mL

Print Date: 12/03/2013 12:52:25PM



Matrix Spike Summary

Original Sample ID: 1135499001
MS Sample ID: 1190729 MS
MSD Sample ID: 1190730 MSD

Analysis Date: 11/11/2013 13:15
Analysis Date: 11/11/2013 13:33
Analysis Date: 11/11/2013 13:51
Matrix: Soil/Solid (dry weight)

QC for Samples: 1135553001, 1135553002, 1135553003, 1135553020

Results by SW8021B

Parameter	Sample	Matrix Spike (ug/Kg)			Spike Duplicate (ug/Kg)			CL	RPD (%)	RPD CL
		Spike	Result	Rec (%)	Spike	Result	Rec (%)			
Benzene	7070	237770	238908	97	237770	233220	95	75-125	2.00	(< 20)
Ethylbenzene	6900	237770	248009	101	237770	243458	99	75-125	1.80	(< 20)
o-Xylene	15200	237770	249147	98	237770	245734	97	75-125	1.50	(< 20)
P & M -Xylene	5450U	476678	489192	103	476678	481229	101	80-125	1.50	(< 20)
Toluene	6630	237770	244596	100	237770	238908	98	70-125	2.00	(< 20)
Surrogates										
1,4-Difluorobenzene		237770	240046	101	237770	241183	101	72-119	0.10	

Batch Information

Analytical Batch: VFC11728
Analytical Method: SW8021B
Instrument: Agilent 7890A PID/FID
Analyst: ST
Analytical Date/Time: 11/11/2013 1:33:00PM

Prep Batch: VXX25450
Prep Method: AK101 Extraction (S)
Prep Date/Time: 11/11/2013 8:00:00AM
Prep Initial Wt./Vol.: 29.84g
Prep Extract Vol: 25.00mL

Print Date: 12/03/2013 12:52:26PM



Method Blank

Blank ID: MB for HBN 1491921 [XXX/30354]
Blank Lab ID: 1190350

Matrix: Soil/Solid (dry weight)

QC for Samples:
1135553001, 1135553002, 1135553003

Results by AK102

<u>Parameter</u>	<u>Results</u>	<u>LOQ/CL</u>	<u>DL</u>	<u>Units</u>
Diesel Range Organics	10.0U	20.0	6.20	mg/Kg
Surrogates				
5a Androstane	80.7	60-120		%

Batch Information

Analytical Batch: XFC11169
Analytical Method: AK102
Instrument: HP 6890 Series II FID SV D R
Analyst: EAB
Analytical Date/Time: 11/14/2013 2:27:00PM

Prep Batch: XXX30354
Prep Method: SW3550C
Prep Date/Time: 11/11/2013 8:45:00AM
Prep Initial Wt./Vol.: 30 g
Prep Extract Vol: 1 mL

Print Date: 12/03/2013 12:52:26PM

Blank Spike Summary

Blank Spike ID: LCS for HBN 1135553 [XXX30354]
 Blank Spike Lab ID: 1190351
 Date Analyzed: 11/14/2013 14:36

Spike Duplicate ID: LCSD for HBN 1135553
 [XXX30354]
 Spike Duplicate Lab ID: 1190352
 Matrix: Soil/Solid (dry weight)

QC for Samples: 1135553001, 1135553002, 1135553003

Results by AK102

Parameter	Blank Spike (mg/Kg)			Spike Duplicate (mg/Kg)			CL	RPD (%)	RPD CL
	Spike	Result	Rec (%)	Spike	Result	Rec (%)			
Diesel Range Organics	167	157	94	167	165	99	(75-125)	5.30	(< 20)
Surrogates									
5a Androstane	3.33	93.3	93	3.33	95	95	(60-120)	1.70	

Batch Information

Analytical Batch: **XFC11169**
 Analytical Method: **AK102**
 Instrument: **HP 6890 Series II FID SV D R**
 Analyst: **EAB**

Prep Batch: **XXX30354**
 Prep Method: **SW3550C**
 Prep Date/Time: **11/11/2013 08:45**
 Spike Init Wt./Vol.: 167 mg/Kg Extract Vol: 1 mL
 Dupe Init Wt./Vol.: 167 mg/Kg Extract Vol: 1 mL

Print Date: 12/03/2013 12:52:27PM



Method Blank

Blank ID: MB for HBN 1491921 [XXX/30354]
Blank Lab ID: 1190350

Matrix: Soil/Solid (dry weight)

QC for Samples:
1135553001, 1135553002, 1135553003

Results by AK103

<u>Parameter</u>	<u>Results</u>	<u>LOQ/CL</u>	<u>DL</u>	<u>Units</u>
Residual Range Organics	10.0U	20.0	6.20	mg/Kg
Surrogates				
n-Triacontane-d62	90.2	60-120		%

Batch Information

Analytical Batch: XFC11169
Analytical Method: AK103
Instrument: HP 6890 Series II FID SV D R
Analyst: EAB
Analytical Date/Time: 11/14/2013 2:27:00PM

Prep Batch: XXX30354
Prep Method: SW3550C
Prep Date/Time: 11/11/2013 8:45:00AM
Prep Initial Wt./Vol.: 30 g
Prep Extract Vol: 1 mL

Print Date: 12/03/2013 12:52:28PM



Blank Spike Summary

Blank Spike ID: LCS for HBN 1135553 [XXX30354]
Blank Spike Lab ID: 1190351
Date Analyzed: 11/14/2013 14:36

Spike Duplicate ID: LCSD for HBN 1135553 [XXX30354]
Spike Duplicate Lab ID: 1190352
Matrix: Soil/Solid (dry weight)

QC for Samples: 1135553001, 1135553002, 1135553003

Results by AK103

Parameter	Blank Spike (mg/Kg)			Spike Duplicate (mg/Kg)			CL	RPD (%)	RPD CL
	Spike	Result	Rec (%)	Spike	Result	Rec (%)			
Residual Range Organics	167	162	98	167	167	100	(60-120)	2.80	(< 20)
Surrogates									
n-Triacontane-d62	3.33	89.6	90	3.33	91.3	91	(60-120)	1.80	

Batch Information

Analytical Batch: **XFC11169**
Analytical Method: **AK103**
Instrument: **HP 6890 Series II FID SV D R**
Analyst: **EAB**

Prep Batch: **XXX30354**
Prep Method: **SW3550C**
Prep Date/Time: **11/11/2013 08:45**
Spike Init Wt./Vol.: 167 mg/Kg Extract Vol: 1 mL
Dupe Init Wt./Vol.: 167 mg/Kg Extract Vol: 1 mL

Print Date: 12/03/2013 12:52:29PM

Method Blank

Blank ID: MB for HBN 1491963 [XXX/30357]
 Blank Lab ID: 1190500

Matrix: Soil/Solid (dry weight)

QC for Samples:
 1135553001, 1135553002, 1135553003

Results by 8270D SIMS (PAH)

<u>Parameter</u>	<u>Results</u>	<u>LOQ/CL</u>	<u>DL</u>	<u>Units</u>
1-Methylnaphthalene	2.50U	5.00	1.50	ug/Kg
2-Methylnaphthalene	2.50U	5.00	1.50	ug/Kg
Acenaphthene	2.50U	5.00	1.50	ug/Kg
Acenaphthylene	2.50U	5.00	1.50	ug/Kg
Anthracene	2.50U	5.00	1.50	ug/Kg
Benzo(a)Anthracene	2.50U	5.00	1.50	ug/Kg
Benzo[b]Fluoranthene	2.50U	5.00	1.50	ug/Kg
Benzo[g,h,i]perylene	2.50U	5.00	1.50	ug/Kg
Benzo[k]fluoranthene	2.50U	5.00	1.50	ug/Kg
Chrysene	2.50U	5.00	1.50	ug/Kg
Dibenzo[a,h]anthracene	2.50U	5.00	1.50	ug/Kg
Fluoranthene	2.50U	5.00	1.50	ug/Kg
Fluorene	2.50U	5.00	1.50	ug/Kg
Indeno[1,2,3-c,d] pyrene	2.50U	5.00	1.50	ug/Kg
Naphthalene	2.50U	5.00	1.50	ug/Kg
Phenanthrene	2.50U	5.00	1.50	ug/Kg
Pyrene	2.50U	5.00	1.50	ug/Kg
Surrogates				
2-Fluorobiphenyl	86.5	45-105		%
Terphenyl-d14	99.5	30-125		%

Batch Information

Analytical Batch: XMS7764
 Analytical Method: 8270D SIMS (PAH)
 Instrument: HP 6890/5973 MS SVQA
 Analyst: RTS
 Analytical Date/Time: 11/12/2013 11:50:00AM

Prep Batch: XXX30357
 Prep Method: SW3550C
 Prep Date/Time: 11/11/2013 3:50:00PM
 Prep Initial Wt./Vol.: 22.5 g
 Prep Extract Vol: 1 mL

Print Date: 12/03/2013 12:52:30PM

Blank Spike Summary

Blank Spike ID: LCS for HBN 1135553 [XXX30357]
 Blank Spike Lab ID: 1190501
 Date Analyzed: 11/12/2013 12:04

Matrix: Soil/Solid (dry weight)

QC for Samples: 1135553001, 1135553002, 1135553003

Results by 8270D SIMS (PAH)

Parameter	Blank Spike (ug/Kg)			CL
	Spike	Result	Rec (%)	
1-Methylnaphthalene	22.2	19.2	87	(44-107)
2-Methylnaphthalene	22.2	18.2	82	(45-105)
Acenaphthene	22.2	18.4	83	(45-110)
Acenaphthylene	22.2	18.3	82	(45-105)
Anthracene	22.2	15.0	67	(55-105)
Benzo(a)Anthracene	22.2	20.8	94	(50-110)
Benzo[b]Fluoranthene	22.2	21.0	95	(45-115)
Benzo[g,h,i]perylene	22.2	19.4	87	(40-125)
Benzo[k]fluoranthene	22.2	22.2	100	(45-125)
Chrysene	22.2	22.5	101	(55-110)
Dibenzo[a,h]anthracene	22.2	19.9	89	(40-125)
Fluoranthene	22.2	22.8	102	(55-115)
Fluorene	22.2	20.5	93	(50-110)
Indeno[1,2,3-c,d] pyrene	22.2	20.0	90	(40-120)
Naphthalene	22.2	18.3	82	(40-105)
Phenanthrene	22.2	20.1	91	(50-110)
Pyrene	22.2	21.7	98	(45-125)
Surrogates				
2-Fluorobiphenyl	22.2	89.2	89	(45-105)
Terphenyl-d14	22.2	104	104	(30-125)

Batch Information

Analytical Batch: **XMS7764**
 Analytical Method: **8270D SIMS (PAH)**
 Instrument: **HP 6890/5973 MS SVQA**
 Analyst: **RTS**

Prep Batch: **XXX30357**
 Prep Method: **SW3550C**
 Prep Date/Time: **11/11/2013 15:50**
 Spike Init Wt./Vol.: 22.2 ug/Kg Extract Vol: 1 mL
 Dupe Init Wt./Vol.: Extract Vol:



Matrix Spike Summary

Original Sample ID: 1135553001
 MS Sample ID: 1190502 MS
 MSD Sample ID: 1190503 MSD

Analysis Date: 11/12/2013 12:45
 Analysis Date: 11/12/2013 12:59
 Analysis Date: 11/12/2013 13:13
 Matrix: Soil/Solid (dry weight)

QC for Samples: 1135553001, 1135553002, 1135553003

Results by 8270D SIMS (PAH)

Parameter	Sample	Matrix Spike (ug/Kg)			Spike Duplicate (ug/Kg)			CL	RPD (%)	RPD CL
		Spike	Result	Rec (%)	Spike	Result	Rec (%)			
1-Methylnaphthalene	2.71U	24.1	20.5	85	23.9	20.5	86	44-107	0.03	(< 30)
2-Methylnaphthalene	2.71U	24.1	20.4	85	23.9	19.3	81	45-105	5.90	(< 30)
Acenaphthene	2.71U	24.1	20.6	86	23.9	19.7	83	45-110	4.40	(< 30)
Acenaphthylene	2.71U	24.1	21.4	88	23.9	19.8	83	45-105	7.00	(< 30)
Anthracene	2.71U	24.1	21.0	87	23.9	18.4	77	55-105	13.60	(< 30)
Benzo(a)Anthracene	2.71U	24.1	22.5	93	23.9	21.6	90	50-110	3.90	(< 30)
Benzo[b]Fluoranthene	2.71U	24.1	21.2	88	23.9	21.6	90	45-115	1.60	(< 30)
Benzo[g,h,i]perylene	2.71U	24.1	18.3	76	23.9	17.3	73	40-125	5.50	(< 30)
Benzo[k]fluoranthene	2.71U	24.1	20.7	86	23.9	19.8	83	45-125	4.10	(< 30)
Chrysene	2.71U	24.1	23.2	96	23.9	22.1	93	55-110	4.60	(< 30)
Dibenzo[a,h]anthracene	2.71U	24.1	17.1	71	23.9	15.8	66	40-125	8.00	(< 30)
Fluoranthene	2.71U	24.1	23.8	99	23.9	23.1	97	55-115	2.90	(< 30)
Fluorene	2.71U	24.1	22.2	92	23.9	20.6	86	50-110	7.90	(< 30)
Indeno[1,2,3-c,d] pyrene	2.71U	24.1	18.0	75	23.9	16.8	70	40-120	7.40	(< 30)
Naphthalene	2.71U	24.1	21.0	87	23.9	19.6	82	40-105	7.30	(< 30)
Phenanthrene	2.71U	24.1	21.6	90	23.9	20.7	87	50-110	4.30	(< 30)
Pyrene	2.71U	24.1	23.7	98	23.9	23.3	98	45-125	1.40	(< 30)

Surrogates

2-Fluorobiphenyl		24.1	22.5	93	23.9	20.5	86	45-105	9.30
Terphenyl-d14		24.1	25.3	105	23.9	24.6	103	30-125	2.50

Batch Information

Analytical Batch: XMS7764
 Analytical Method: 8270D SIMS (PAH)
 Instrument: HP 6890/5973 MS SVQA
 Analyst: RTS
 Analytical Date/Time: 11/12/2013 12:59:00PM

Prep Batch: XXX30357
 Prep Method: Sonication Extraction Soil 8270 PAH SIM
 Prep Date/Time: 11/11/2013 3:50:00PM
 Prep Initial Wt./Vol.: 22.71g
 Prep Extract Vol: 1.00mL

Print Date: 12/03/2013 12:52:31PM



Method Blank

Blank ID: MB for HBN 1493301 [XXX/30421]
Blank Lab ID: 1192668

Matrix: Soil/Solid (dry weight)

QC for Samples:
1135553001, 1135553002, 1135553003

Results by 8270D SIMS (PAH)

<u>Parameter</u>	<u>Results</u>	<u>LOQ/CL</u>	<u>DL</u>	<u>Units</u>
Benzo[a]pyrene	2.50U	5.00	1.50	ug/Kg
Surrogates				
2-Fluorobiphenyl	79.9	45-105		%
Terphenyl-d14	92.8	30-125		%

Batch Information

Analytical Batch: XMS7791
Analytical Method: 8270D SIMS (PAH)
Instrument: HP 6890/5973 MS SVQA
Analyst: RTS
Analytical Date/Time: 11/26/2013 5:48:00PM

Prep Batch: XXX30421
Prep Method: SW3550C
Prep Date/Time: 11/26/2013 1:00:00PM
Prep Initial Wt./Vol.: 22.5 g
Prep Extract Vol: 1 mL

Print Date: 12/03/2013 12:52:32PM

Blank Spike Summary

Blank Spike ID: LCS for HBN 1135553 [XXX30421]
Blank Spike Lab ID: 1192669
Date Analyzed: 11/26/2013 18:01

Matrix: Soil/Solid (dry weight)

QC for Samples: 1135553001, 1135553002, 1135553003

Results by 8270D SIMS (PAH)

<u>Parameter</u>	Blank Spike (ug/Kg)			<u>CL</u>
	<u>Spike</u>	<u>Result</u>	<u>Rec (%)</u>	
Benzo[a]pyrene	22.2	15.7	71	(50-110)
Surrogates				
2-Fluorobiphenyl	22.2	78.5	79	(45-105)
Terphenyl-d14	22.2	97.7	98	(30-125)

Batch Information

Analytical Batch: **XMS7791**
Analytical Method: **8270D SIMS (PAH)**
Instrument: **HP 6890/5973 MS SVQA**
Analyst: **RTS**

Prep Batch: **XXX30421**
Prep Method: **SW3550C**
Prep Date/Time: **11/26/2013 13:00**
Spike Init Wt./Vol.: 22.2 ug/Kg Extract Vol: 1 mL
Dupe Init Wt./Vol.: Extract Vol:

Print Date: 12/03/2013 12:52:32PM



Matrix Spike Summary

Original Sample ID: 1135644005
MS Sample ID: 1192670 MS
MSD Sample ID: 1192671 MSD

Analysis Date: 11/26/2013 20:29
Analysis Date: 11/26/2013 20:43
Analysis Date: 11/26/2013 20:57
Matrix: Soil/Solid (dry weight)

QC for Samples: 1135553001, 1135553002, 1135553003

Results by 8270D SIMS (PAH)

Parameter	Sample	Matrix Spike (ug/Kg)			Spike Duplicate (ug/Kg)			CL	RPD (%)	RPD CL
		Spike	Result	Rec (%)	Spike	Result	Rec (%)			
Benzo[a]pyrene	53.4U	23.5	26.7U	0 *	23.4	26.7U	0 *	50-110	0.00	(< 30)
Surrogates										
2-Fluorobiphenyl		23.5	22.3	95	23.4	25.2	108 *	45-105	12.20	
Terphenyl-d14		23.5	24.2	103	23.4	24.2	104	30-125	0.25	

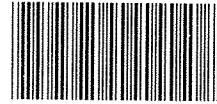
Batch Information

Analytical Batch: XMS7791
Analytical Method: 8270D SIMS (PAH)
Instrument: HP 6890/5973 MS SVQA
Analyst: RTS
Analytical Date/Time: 11/26/2013 8:43:00PM

Prep Batch: XXX30421
Prep Method: Sonication Extraction Soil 8270 PAH SIM
Prep Date/Time: 11/26/2013 1:00:00PM
Prep Initial Wt./Vol.: 22.82g
Prep Extract Vol: 1.00mL

Print Date: 12/03/2013 12:52:33PM

1135553



SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

CHAIN-OF-CUSTODY RECORD

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

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

303 Wellsian Way
Richland, WA 99352
(509) 946-6309

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

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

2255 S.W. Canyon Road
Portland, OR 97201-2498
(503) 223-6147

1200 17th Street, Suite 1024
Denver, Co 80202
(303) 825-3800

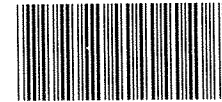
Laboratory SGS
Attn: Steve Crupi

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

Sample Identity	Lab No.	Time	Date Sampled	Comp.	Grab	GPO/BTEX	AK 101/EPA 8021B	DPO 12/EO	AK 102/110B	RUCRA Metals	EPA 6020	PAH SIMJ	EPA 827D	Total Number of Containers	Remarks/Matrix
02348-BISS1	① A-B	6:42p	11/5/13	X	X	X	X	X	X	X				2	Soil
02348-BISS21	② A-B	6:44p	11/5/13	X	X	X	X	X	X	X				2	Soil
02348-B05S3	③ A-B	12:22p	11/5/13	X	X	X	X	X	X	X				2	Soil
02348-B08S2	④ A-B	11:37	11/4/13	X										2	HOLD
02348-B08S3	⑤ A-B	11:49	11/4/13	X										2	↓
02348-B08S4	⑥ A-B	12:05p	11/4/13	X										2	
02348-B08S5	⑦ A-B	12:20p	11/4/13	X										2	
02348-B08S6	⑧ A-B	12:32p	11/4/13	X										2	
02348-B08S7	⑨ ^{ES} _{11/9}			X										2	
02348-BISS2	⑨ A-B	6:48p	11/5/13	X										2	↓

Project Information		Sample Receipt		Relinquished By: 1.		Relinquished By: 2.		Relinquished By: 3.	
Project Number: <u>32-1-02348</u>		Total Number of Containers		Signature: <u>[Signature]</u> Time: <u>0900</u>		Signature: <u>[Signature]</u> Time: <u>10:34</u>		Signature: <u>[Signature]</u> Time: <u></u>	
Project Name: <u>Whittier Nav</u>		COC Seals/Intact? Y/N/NA		Printed Name: <u>Ryan Collins</u> Date: <u>11/8/13</u>		Printed Name: <u>Thomas Keatts</u> Date: <u>11/9/13</u>		Printed Name: <u>[Signature]</u> Date: <u></u>	
Contact: <u>Ryan Collins / SARGENT & Lundy</u>		Received Good Cond./Cold		Company: <u>S&W</u>		Company: <u>S&W</u>		Company: <u>[Signature]</u>	
Ongoing Project? Yes <input checked="" type="checkbox"/> No <input type="checkbox"/>		Delivery Method:		Received By: 1.		Received By: 2.		Received By: 3.	
Sampler: <u>ROL/TMK</u>		(attach shipping bill, if any)		Signature: <u>[Signature]</u> Time: <u>0900</u>		Signature: <u>[Signature]</u> Time: <u></u>		Signature: <u>[Signature]</u> Time: <u>10:34</u>	
Instructions				Printed Name: <u>Thomas Keatts</u> Date: <u>11/8/13</u>		Printed Name: <u>[Signature]</u> Date: <u></u>		Printed Name: <u>Marie De Zetter</u> Date: <u>11/09/13</u>	
Requested Turnaround Time: <u>STANDARD 10-DAY</u>				Company: <u>S&W</u>		Company: <u>[Signature]</u>		Company: <u>SGS</u>	
Special Instructions: <u>LEVEL II DELIVERABLES</u>				Distribution: White - w/shipment - returned to Shannon & Wilson w/ laboratory report Yellow - w/shipment - for consignee files Pink - Shannon & Wilson - Job File					

1135553



SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

CHAIN-OF-CUSTODY RECORD

Laboratory SGS Page 2 of 3
Attn: Steve Crupl

400 N. 34th Street, Suite 100 Seattle, WA 98103 (206) 632-8020
2355 Hill Road Fairbanks, AK 99709 (907) 479-0600
2255 S.W. Canyon Road Portland, OR 97201-2498 (503) 223-6147
2043 Westport Center Drive St. Louis, MO 63146-3564 (314) 699-9660
303 Wellsian Way Richland, WA 99352 (509) 946-6309
5430 Fairbanks Street, Suite 3 Anchorage, AK 99518 (907) 561-2120
1200 17th Street, Suite 1024 Denver, Co 80202 (303) 825-3800

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

Sample Identity	Lab No.	Time	Date Sampled	Comp.	Grab						Total Number of Containers	Remarks/Matrix	
02348-B05S1	(10) A-B	1158	11/5/13		X							2	HOLD
02348-B05S2	(11) A-B	12:10p	11/5/13		X							2	↓
02348-B05S4	(12) A-B	12:42p	11/5/13		X							2	
02348-B05S5	(13) A-B	1:08p	11/5/13		X							2	
02348-B13S1	(14) A-B	7:43	11/2/13		X							2	
02348-B13S3	(15) A-B	8:15	11/2/13		X							2	
02348-B15S6	(16) A-B	7:35p	11/5/13		X							2	
02348-B16S1	(17) A-B	10:05p	11/6/13		X							2	
02348-B16S2	(18) A-B	10:18p	11/6/13		X							2	
02348-B16S3	(19) A-B	10:30p	11/6/13		X							2	

Project Information	Sample Receipt
Project Number: <u>32-1-02348</u>	Total Number of Containers
Project Name: <u>Whittier Nar</u>	COC Seals/Intact? Y/N/NA
Contact: <u>Ryan C. Hines / Stafford G. Hines</u>	Received Good Cond./Cold
Ongoing Project? Yes <input checked="" type="checkbox"/> No <input type="checkbox"/>	Delivery Method:
Sampler: <u>RDL/HMK</u>	(attach shipping bill, if any)

Instructions	
Requested Turnaround Time:	<u>Standard 10-Day</u>
Special Instructions:	<u>Level II deliverables</u>

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

Relinquished By: 1.	Relinquished By: 2.	Relinquished By: 3.
Signature: <u>[Signature]</u> Time: <u>10:54</u>	Signature: _____ Time: _____	Signature: _____ Time: _____
Printed Name: <u>Thomas Keatts</u> Date: <u>11/9/13</u>	Printed Name: _____ Date: _____	Printed Name: _____ Date: _____
Company: <u>STW</u>	Company: _____	Company: _____
Received By: 1.	Received By: 2.	Received By: 3.
Signature: _____ Time: _____	Signature: _____ Time: _____	Signature: <u>[Signature]</u> Time: <u>10:34</u>
Printed Name: _____ Date: _____	Printed Name: _____ Date: _____	Printed Name: <u>MARIE DE ZETTER</u> Date: <u>11/04/13</u>
Company: _____	Company: _____	Company: <u>SGS</u>

1135553



SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

CHAIN-OF-CUSTODY RECORD

Laboratory: SGS
Attn: Steve Crupi

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

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

303 Wellsian Way
Richland, WA 99352
(509) 946-6309

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

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

2255 S.W. Canyon Road
Portland, OR 97201-2498
(503) 223-6147

1200 17th Street, Suite 1024
Denver, Co 80202
(303) 825-3800

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

Sample Identity	Lab No.	Time	Date Sampled	Comp.	Grab	Analysis Parameters/Sample Container Description					Total Number of Containers	Remarks/Matrix				
-TB	(20) A-B	NA	NA	X	X	GPO/ASTEX AN/DI/ENR-20218					1	SOIL HOLD				
02348-1319S1	(21) A-B	1145	11/7	X											2	
02348-1319S2	(22) A-B	1155	11/7	X											2	
02348-1319S3	(23) A-B	425	11/7	X											2	
02348-B16SS	(24) A-B	10:52 p	11/6	X											2	

Project Information		Sample Receipt	
Project Number: <u>W32-1-02348</u>	Total Number of Containers		
Project Name: <u>Whittier New</u>	COC Seals/Intact? Y/N/NA		
Contact: <u>Peter Collins / Staff / G/Slon</u>	Received Good Cond./Cold		
Ongoing Project? Yes <input checked="" type="checkbox"/> No <input type="checkbox"/>	Delivery Method:		
Sampler: <u>KDC</u>	(attach shipping bill, if any)		

Relinquished By: 1.		Relinquished By: 2.		Relinquished By: 3.	
Signature: <u>[Signature]</u>	Time: <u>10:34</u>	Signature: _____	Time: _____	Signature: _____	Time: _____
Printed Name: <u>Thomas Katts</u>	Date: <u>11-9-13</u>	Printed Name: _____	Date: _____	Printed Name: _____	Date: _____
Company: <u>STW</u>		Company: _____		Company: _____	
Received By: 1.		Received By: 2.		Received By: 3.	
Signature: _____	Time: _____	Signature: _____	Time: _____	Signature: <u>[Signature]</u>	Time: <u>10:34</u>
Printed Name: _____	Date: _____	Printed Name: _____	Date: _____	Printed Name: <u>MARIE DE ZETTER</u>	Date: <u>11/9/13</u>
Company: _____		Company: _____		Company: <u>SGS</u>	

Instructions	
Requested Turnaround Time: <u>Standard 10-Day</u>	
Special Instructions: <u>Level II Relinquished</u>	

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

LABORATORY DATA REVIEW CHECKLIST

CS Report Name: Navigational Improvements, Whittier, Alaska,

Date: December 2013

Laboratory Report Date: December 3, 2013

Consultant Firm: Shannon & Wilson, Inc.

Completed by: Jessa H. Tibbetts

Title: Environmental Scientist

Laboratory Name: SGS North America, Inc.

Work Order Number: 1135553

ADEC File Number: NA

ADEC RecKey Number: NA

(NOTE: NA = not applicable; Text in *italics* added by Shannon & Wilson, Inc.)

1. Laboratory

- a. Did an ADEC CS approved laboratory receive and perform all of the submitted sample analyses? **Yes** / No / NA (Please explain.)

Comments:

- b. If the samples were transferred to another "network" laboratory or sub-contracted to an alternate laboratory, was the laboratory performing the analyses ADEC CS-approved? **Yes** / No / **NA**

Comments: *Samples were not transferred.*

2. Chain of Custody (COC)

- a. COC information completed, signed, and dated (including released/received by)? **Yes** / No / NA (Please explain.)

Comments:

- b. Correct analyses requested? **Yes** / No / NA (Please explain.)

Comments:

3. Laboratory Sample Receipt Documentation

- a. Sample/cooler temperature documented and within range at receipt ($4^{\circ} \pm 2^{\circ}$ C)? **Yes** / No / NA (Please explain.)

Comments: *The temperature of the cooler was documented at 5.4° C.*

- b. Sample preservation acceptable - acidified waters, Methanol-preserved VOC soil (GRO, BTEX, VOCs, etc.)? **Yes** / No / NA (Please explain.)

Comments:

- c. Sample condition documented - broken, leaking (soil MeOH), zero headspace (VOC vials)? **Yes** / No / NA (Please explain.)

Comments: *No undesirable sample conditions noted.*

- d. If there were any discrepancies, were they documented (e.g., incorrect sample containers/preservation, sample temperatures outside range, insufficient sample size, missing samples)? **Yes** / No / NA (Please explain.)

Comments: *The COC indicated one jar for the trip blank, but two jars were received by the laboratory. One jar was analyzed and the other jar was placed on hold and not analyzed.*

- e. Data quality or usability affected? (Please Explain.)

Comments: *The incorrectly labeled sample and the extra sample were put on hold and not submitted for analysis. In our opinion, this does not affect the data quality or usability.*

4. Case Narrative

- a. Present and understandable? **Yes** / No / NA (Please explain.)

Comments:

- b. Discrepancies, errors, or QC failures noted by the lab? **Yes** / No / NA (Please explain.)

Comments: *The following discrepancies, errors, or QC failures are listed in the case narrative:*

- *The LCS recovery for benzo(a)pyrene was outside QC criteria (biased low), affecting Samples B05S3, B15S1, and B15S21.*
- *The MSD recovery for chromium did not meet the QC criteria.*
- *The MS/MSD recovery of benzo(a)pyrene was outside the QC criteria.*
- *The MS/MSD samples were analyzed at dilution due to matrix interference with laboratory standards.*
- *Surrogate 2-fluorobiphenyl recovery in the MSD was outside QC criteria due to sample dilution.*

- c. Were corrective actions documented? **Yes** / No / NA (Please explain.)

Comments:

- *Samples B05S3, B15S1, and B15S21 were re-extracted. The LCS recovery for benzo(a)pyrene met QC criteria.*
- *The post digestion spike was successful for the failed chromium MSD recovery.*

- d. What is the effect on data quality/usability, according to the case narrative?

Comments:

- *Although the MS/MSD for benzo(a)pyrene did not meet QC criteria, after re-extraction the LCS recoveries were within acceptable QC criteria. Therefore data quality/usability should not be affected.*
- *The LOQs for PAHs analysis are elevated in the MS/MSD due to sample dilution. The sample was diluted due to matrix interference with laboratory internal standards. Even though the LOQs are elevated, they are still less than the applicable ADEC cleanup levels. Therefore data quality/usability should not be affected.*

Other QC discrepancies are discussed in other sections of the laboratory data review checklist.

5. Sample Results

- a. Correct analyses performed/reported as requested on COC? **Yes** / **No** / **NA** (Please explain.)

Comments:

- b. All applicable holding times met? **Yes** / **No** / **NA** (Please explain.)

Comments: *Sample B15S1 was re-extracted and reported outside of hold time for benzo(a)pyrene.*

- c. All soils reported on a dry-weight basis? **Yes** / **No** / **NA** (Please explain.)

Comments:

- d. Are the reported LOQs less than the Cleanup Level or the minimum required detection level for the project? **Yes** / **No** / **NA** (Please explain.)

Comments:

- e. Data quality or usability affected? (Please explain.) **NA**

Comments: *Therefore, it is our opinion the data quality or usability are unaffected.*

6. QC Samples

a. Method Blank

- i. One method blank reported per matrix, analysis, and 20 samples?

Yes / **No** / **NA** (Please explain.)

Comments:

- ii. All method blank results less than LOQ? **Yes** / **No** / **NA** (Please explain.)

Comments:

- *Chromium was detected at an estimated concentration of 0.123 mg/Kg, which is less than the LOQ (0.400 mg/Kg).*

- *GRO was detected at an estimated concentration of 0.913 mg/Kg, which is less than the LOQ (2.50 mg/Kg).*

iii. If above LOQ, what samples are affected? **NA**

Comments: *Although the estimated concentrations of chromium and GRO detected in the method blank were less than the LOQ, each project sample may be affected.*

iv. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes / No / NA

Comments:

v. Data quality or usability affected?

Comments: *The estimated GRO concentrations detected in Samples B05S3, B15S1, and B15S21 are within 5 times the concentration measured in the method blank., therefore it is considered non-detect at the LOQ value and flagged "B" in Table 1, Summary of Analytical Results.*

The chromium concentrations detected in Samples B05S3, B15S1, and B15S21 are not within 5 times the concentration measured in the method blank and considered valid results and not flagged.

b. Laboratory Control Sample/Duplicate (LCS/LCSD)

i. Organics - One LCS/LCSD reported per matrix, analysis, and 20 samples?

(LCS/LCSD required per AK methods, LCS required per SW846) **Yes** / No / NA
(Please explain.)

Comments:

ii. Metals/Inorganics - One LCS and one sample duplicate reported per matrix, analysis and 20 samples? **Yes** / No / NA **(Please explain.)**

Comments:

iii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits? And project specified DQOs, if applicable. (AK petroleum methods: AK101 60%-120%, AK102 75%-125%, AK103 60%-120%; all other analyses see the laboratory QC pages) **Yes** / No / NA **(Please explain.)**

Comments: *The LCS recovery for benzo(a)pyrene was outside QC criteria (biased low).*

iv. Precision – All relative percent differences (RPDs) reported and less than method or laboratory limits? And project specified DQOs, if applicable. RPD reported from LCS/LCSD, MS/MSD, and or sample/sample duplicate. (AK Petroleum methods 20%; all other analyses see the laboratory QC pages) **Yes** / No / NA **(Please explain.)**

Comments:

- v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments: *Samples B05S3, B15S1, and B15S21 may be affected.*

- vi. Do the affected samples(s) have data flags? If so, are the data flags clearly defined?

Yes / **No** / NA

Comments:

- vii. Data quality or usability affected? **(Please explain.)**

Comments: *While each project sample may be affected, benzo(a)pyrene was not detected above the LOQ in any of associated samples. Therefore, it is our opinion the data quality or usability are unaffected.*

c. Surrogates - Organics Only

- i. Are surrogate recoveries reported for organic analyses, field, QC and laboratory samples? **Yes** / No / NA **(Please explain.)**

Comments:

- ii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits? And project specified DQOs if applicable. (AK Petroleum methods 50-150 %R; all other analyses see the laboratory report pages) **Yes** / No / NA **(Please explain.)**

Comments: *The 2-fluorobiphenyl (PAH surrogate) percent recovery in the MSD was outside the QC criteria due to sample dilution.*

- iii. Do the sample results with failed surrogate recoveries have data flags? If so, are the data flags clearly defined? **Yes** / **No** / NA **(Please explain.)**

Comments:

- iv. Data quality or usability affected? **Yes** / No / **NA** **(Please explain.)**

Comments: *The LOQ for benzo(a)pyrene in the MSD was elevated, but less than the applicable ADEC cleanup levels. Benzo(a)pyrene was not detected in the associated samples. Therefore data quality/usability should not be affected.*

d. Trip Blank - Volatile analyses only (GRO, BTEX, VOCs, etc.) Water and Soil

- i. One trip blank reported per matrix, analysis and cooler? **Yes** / No / NA **(Please explain.)**

Comments:

- ii. Is the cooler used to transport the trip blank and volatile samples clearly indicated on the COC? **Yes** / **No** / NA **(Please explain if NA or no.)**

Comments: *Only one cooler submitted for this work order.*

- iii. All results less than LOQ? **Yes** / No / NA (Please explain.)

Comments: *Although less than the LOQ, toluene and xylenes were reported at estimated concentrations in the trip blank.*

- iv. If above LOQ, what samples are affected?

Comments: *Although the trip blank detections were less than the LOQs, each project sample may be potentially affected.*

- v. Data quality or usability affected? Explain.

Comments: *While each project sample may be affected, toluene and xylenes were not detected above the LOQ in any of associated samples. Therefore, it is our opinion the data quality or usability are unaffected.*

e. Field Duplicate

- i. One field duplicate submitted per matrix, analysis and 10 project samples?

Yes / **No** / NA (Please explain.)

Comments: *Sample B15S21 is the field duplicate for Sample B15S1.*

- ii. Were the field duplicates submitted blind to the lab? **Yes** / No / **NA** (Please explain.)

Comments:

- iii. Precision – All relative percent differences (RPDs) less than specified DQOs?

(Recommended: 30% for water, 50% for soil) **Yes** / No / NA (Please explain.)

Comments:

- iv. Data quality or usability affected? Explain. **NA**

Comments:

- f. Decontamination or Equipment Blank** (if not applicable, a comment stating why must be entered below)

Yes / No / **NA** (Please explain.) *A decontamination/equipment blank was not included as part of the project scope.*

- i. All results less than LOQ? **Yes** / No / **NA** (Please explain.)

Comments:

- ii. If results are above LOQ, what samples are affected? **NA**

Comments:

- iii. Data quality or usability affected? Explain. **NA**

Comments:

7. Other Data Flags/Qualifiers (ACOE, AFCEE, Lab-specific, etc.)

Are they defined and appropriate? **Yes** / No / NA

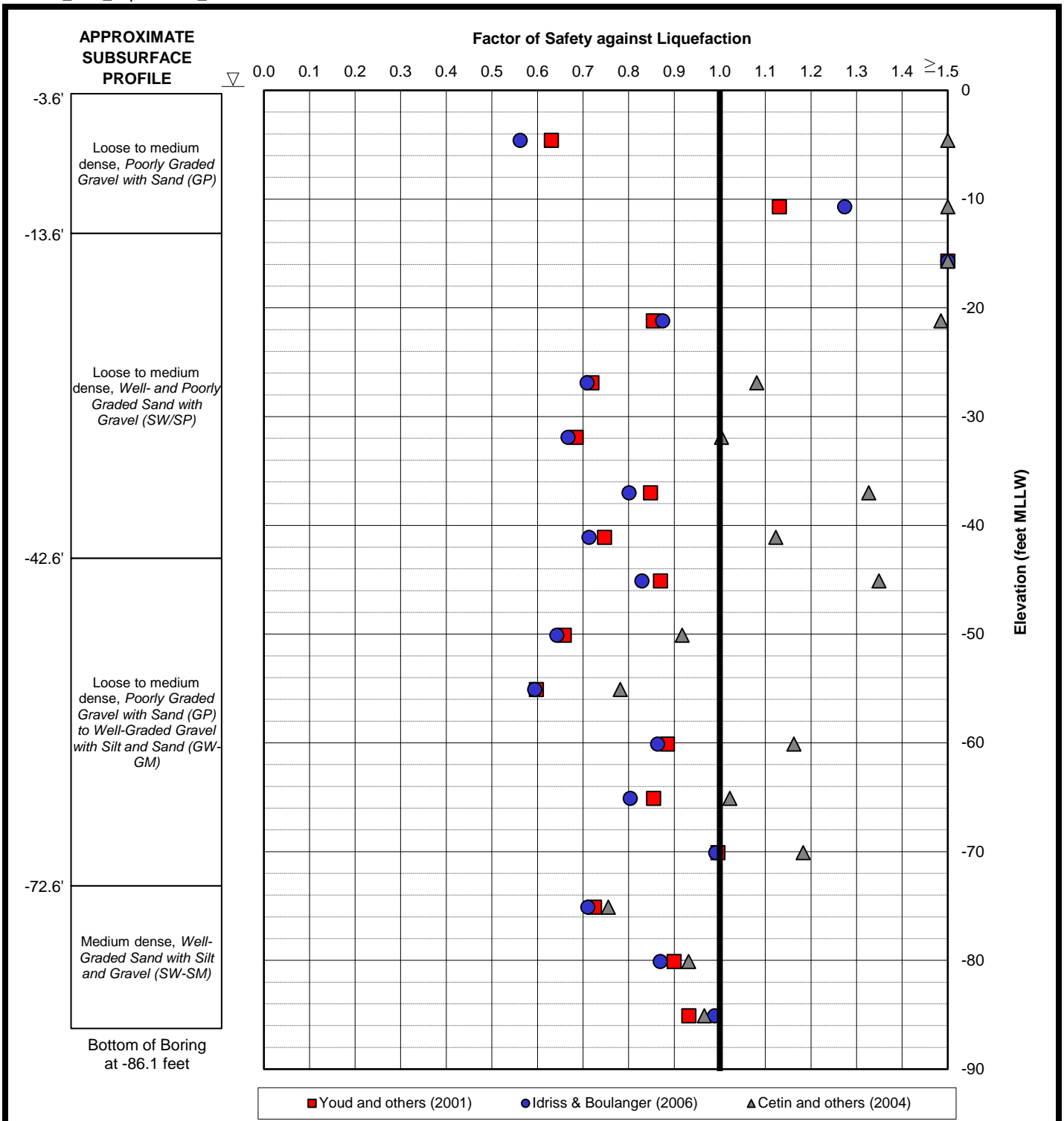
Comments: *A key is provided on page 4 of the laboratory results.*

APPENDIX C

RESULTS OF LIQUEFACTION ANALYSES

FIGURES

C-1	Results of Liquefaction Analyses Boring B-06 (3 Sheets)
C-2	Results of Liquefaction Analyses Boring B-12 (3 Sheets)
C-3	Results of Liquefaction Analyses Boring B-17 (3 Sheets)



NOTES

1. See main text for references.
2. The liquefaction resistance of a soil is based on its density and fines content. We used the results of the standard penetration testing to estimate the density, and the results of selected laboratory tests to estimate the fines content.

Navigational Improvements Study
Head of Passage Canal, Whittier, Alaska

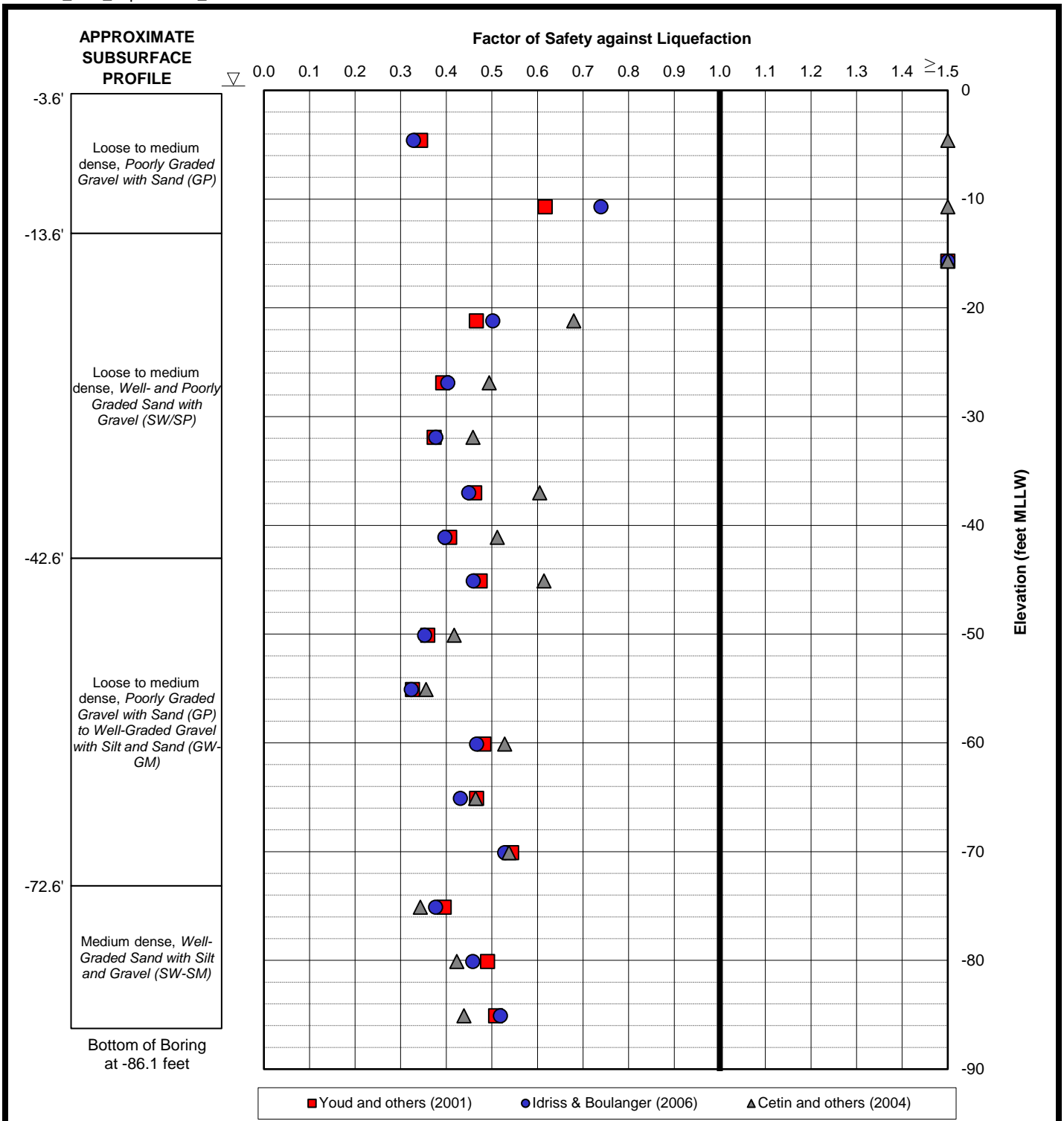
RESULTS OF LIQUEFACTION ANALYSES
BORING B-06
M = 6.3, PGA = 0.30

August 2017

32-1-02348-001

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. C-1
(Sheet 1 of 3)



NOTES

1. See main text for references.
2. The liquefaction resistance of a soil is based on its density and fines content. We used the results of the standard penetration testing to estimate the density, and the results of selected laboratory tests to estimate the fines content.

Navigational Improvements Study
Head of Passage Canal, Whittier, Alaska

RESULTS OF LIQUEFACTION ANALYSES
BORING B-06
M = 6.8, PGA = 0.45

August 2017

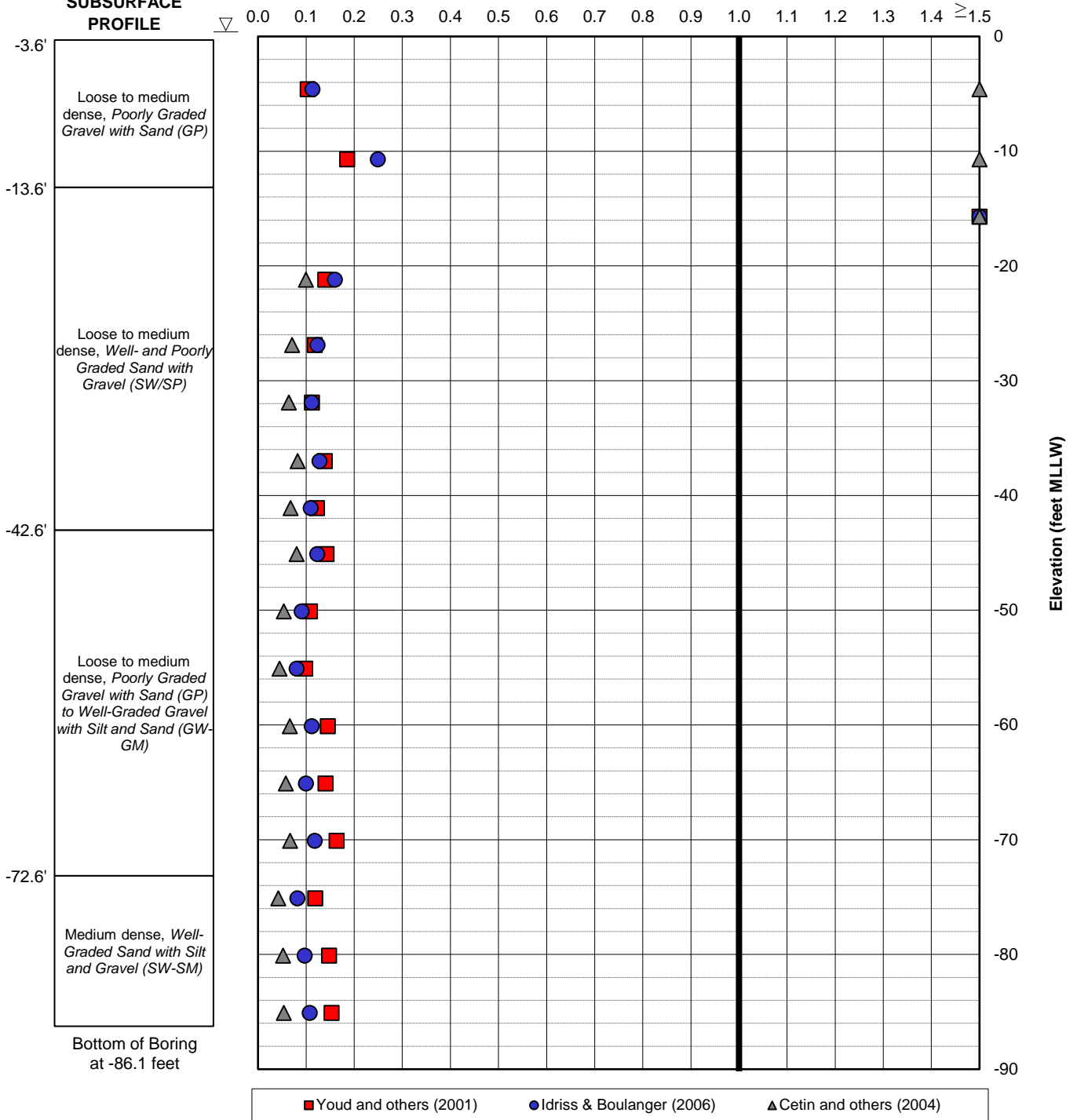
32-1-02348-001

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. C-1
(Sheet 2 of 3)

**APPROXIMATE
SUBSURFACE
PROFILE**

Factor of Safety against Liquefaction



NOTES

1. See main text for references.
2. The liquefaction resistance of a soil is based on its density and fines content. We used the results of the standard penetration testing to estimate the density, and the results of selected laboratory tests to estimate the fines content.

Navigational Improvements Study
Head of Passage Canal, Whittier, Alaska

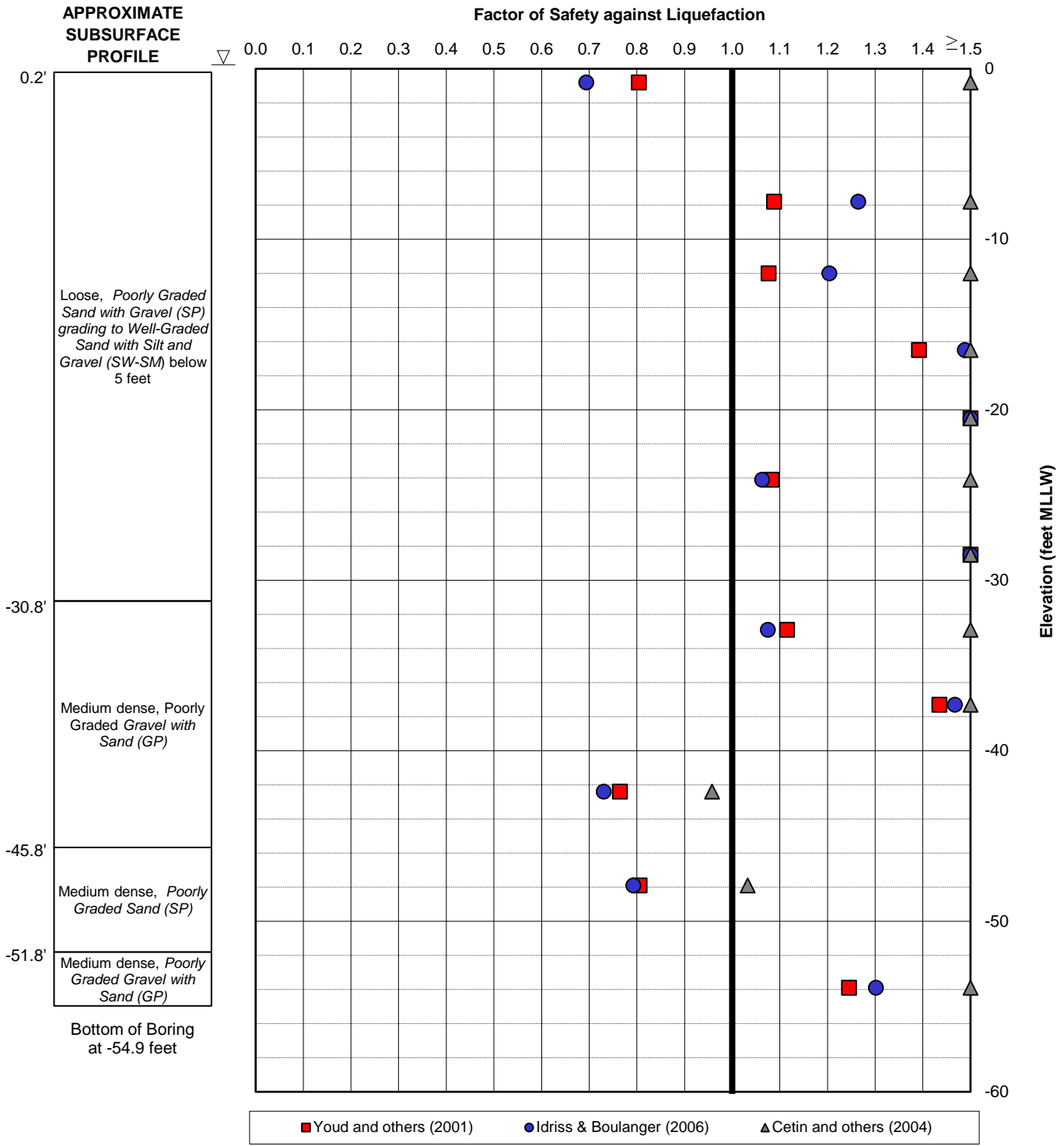
**RESULTS OF LIQUEFACTION ANALYSES
BORING B-06
M = 9.2, PGA = 0.68**

August 2017

32-1-02348-001

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. C-1
(Sheet 3 of 3)



NOTES

1. See main text for references.
2. The liquefaction resistance of a soil is based on its density and fines content. We used the results of the standard penetration testing to estimate the density, and the results of selected laboratory tests to estimate the fines content.

Navigational Improvements Study
Head of Passage Canal, Whittier, Alaska

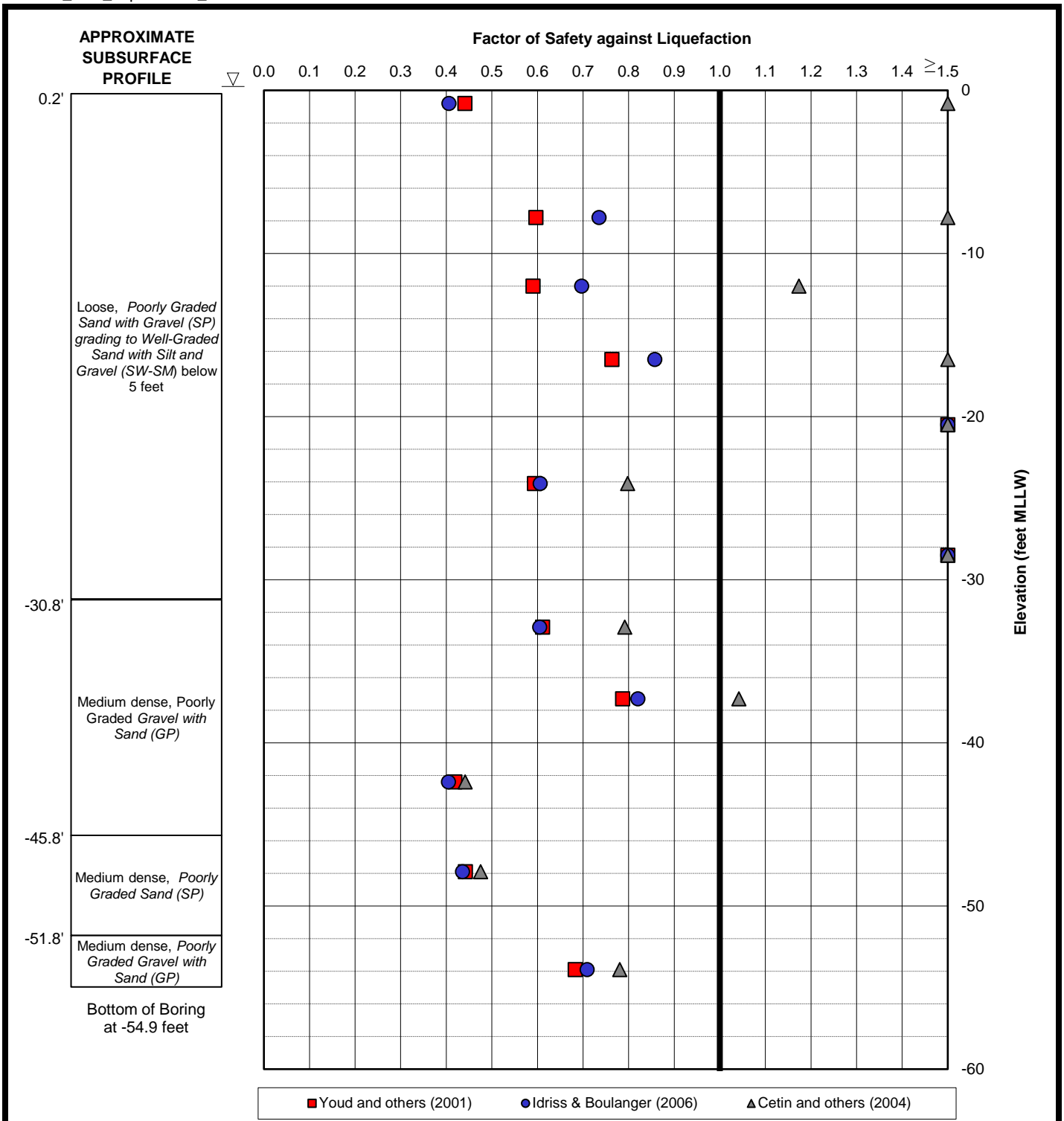
RESULTS OF LIQUEFACTION ANALYSES
BORING B-12
M = 6.3, PGA = 0.30

August 2017

32-1-02348-001

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. C-2
(Sheet 1 of 3)



NOTES

1. See main text for references.
2. The liquefaction resistance of a soil is based on its density and fines content. We used the results of the standard penetration testing to estimate the density, and the results of selected laboratory tests to estimate the fines content.

Navigational Improvements Study
Head of Passage Canal, Whittier, Alaska

RESULTS OF LIQUEFACTION ANALYSES
BORING B-12
M = 6.8, PGA = 0.45

August 2017

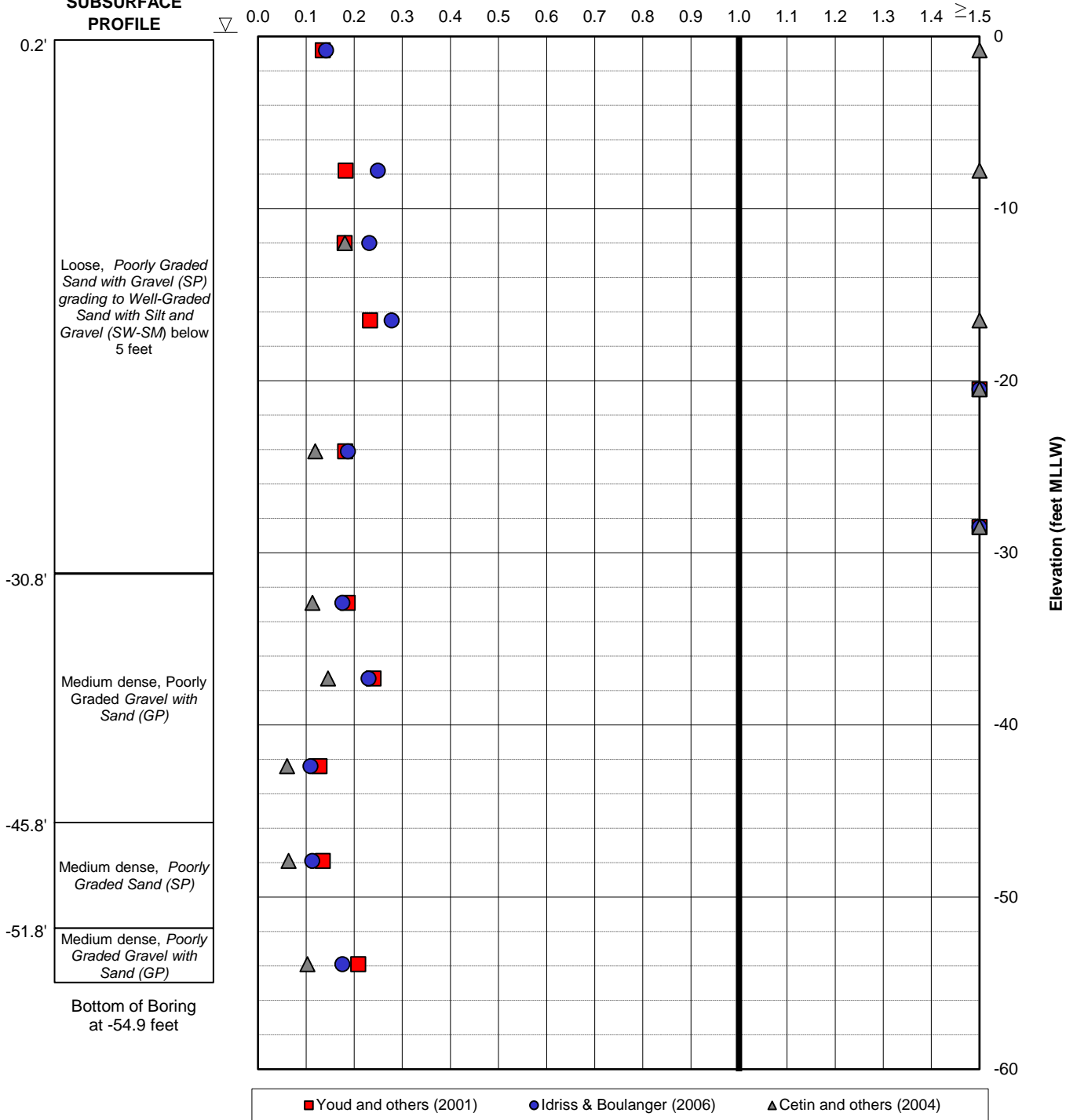
32-1-02348-001

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. C-2
(Sheet 2 of 3)

**APPROXIMATE
SUBSURFACE
PROFILE**

Factor of Safety against Liquefaction



NOTES

1. See main text for references.
2. The liquefaction resistance of a soil is based on its density and fines content. We used the results of the standard penetration testing to estimate the density, and the results of selected laboratory tests to estimate the fines content.

Navigational Improvements Study
Head of Passage Canal, Whittier, Alaska

**RESULTS OF LIQUEFACTION ANALYSES
BORING B-12
M = 9.2, PGA = 0.68**

August 2017

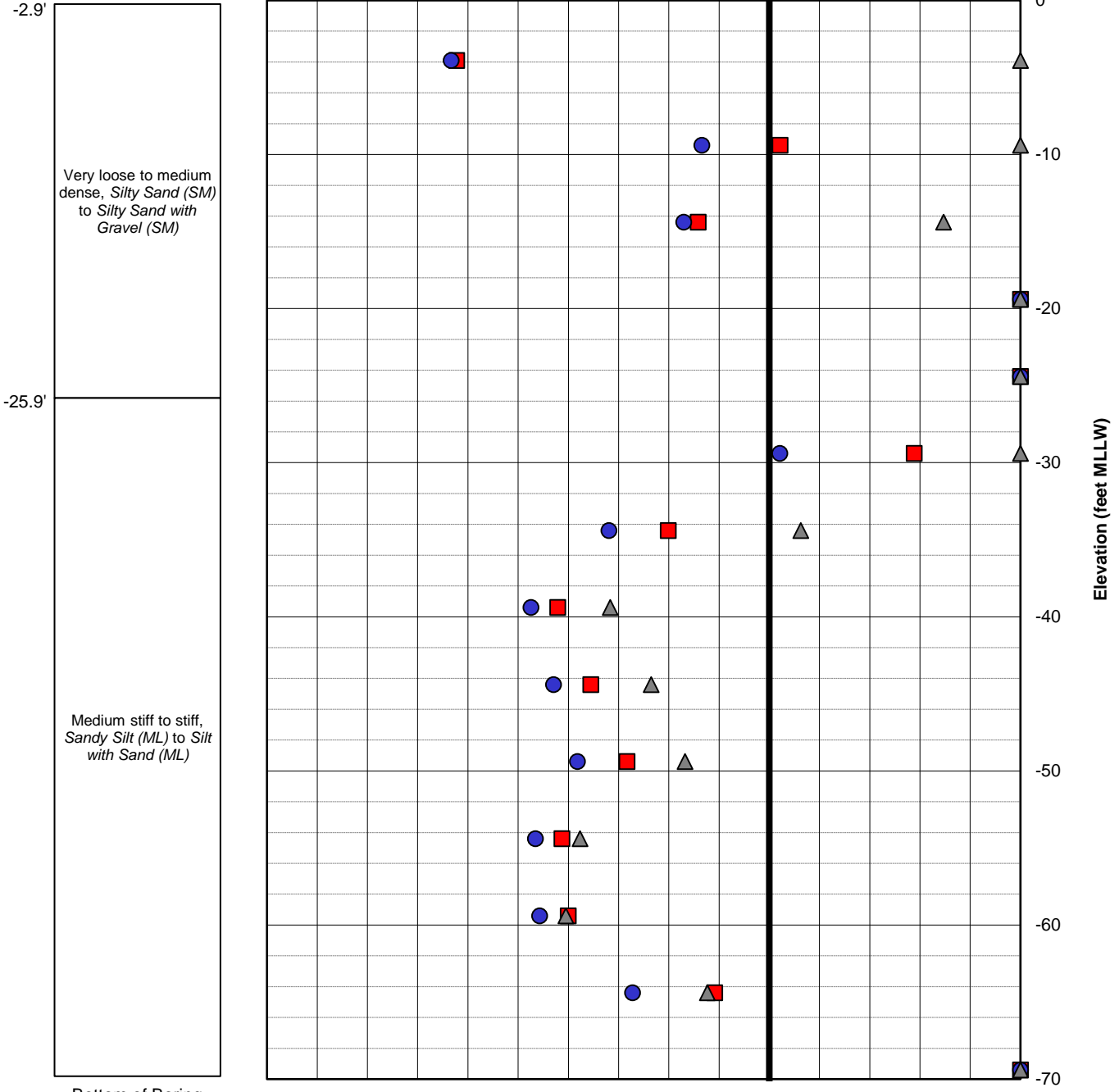
32-1-02348-001

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. C-2
(Sheet 3 of 3)

**APPROXIMATE
SUBSURFACE
PROFILE**

Factor of Safety against Liquefaction



NOTES

1. See main text for references.
2. The liquefaction resistance of a soil is based on its density and fines content. We used the results of the standard penetration testing to estimate the density, and the results of selected laboratory tests to estimate the fines content.

Navigational Improvements Study
Head of Passage Canal, Whittier, Alaska

**RESULTS OF LIQUEFACTION ANALYSES
BORING B-17
M = 6.3, PGA = 0.35**

August 2017

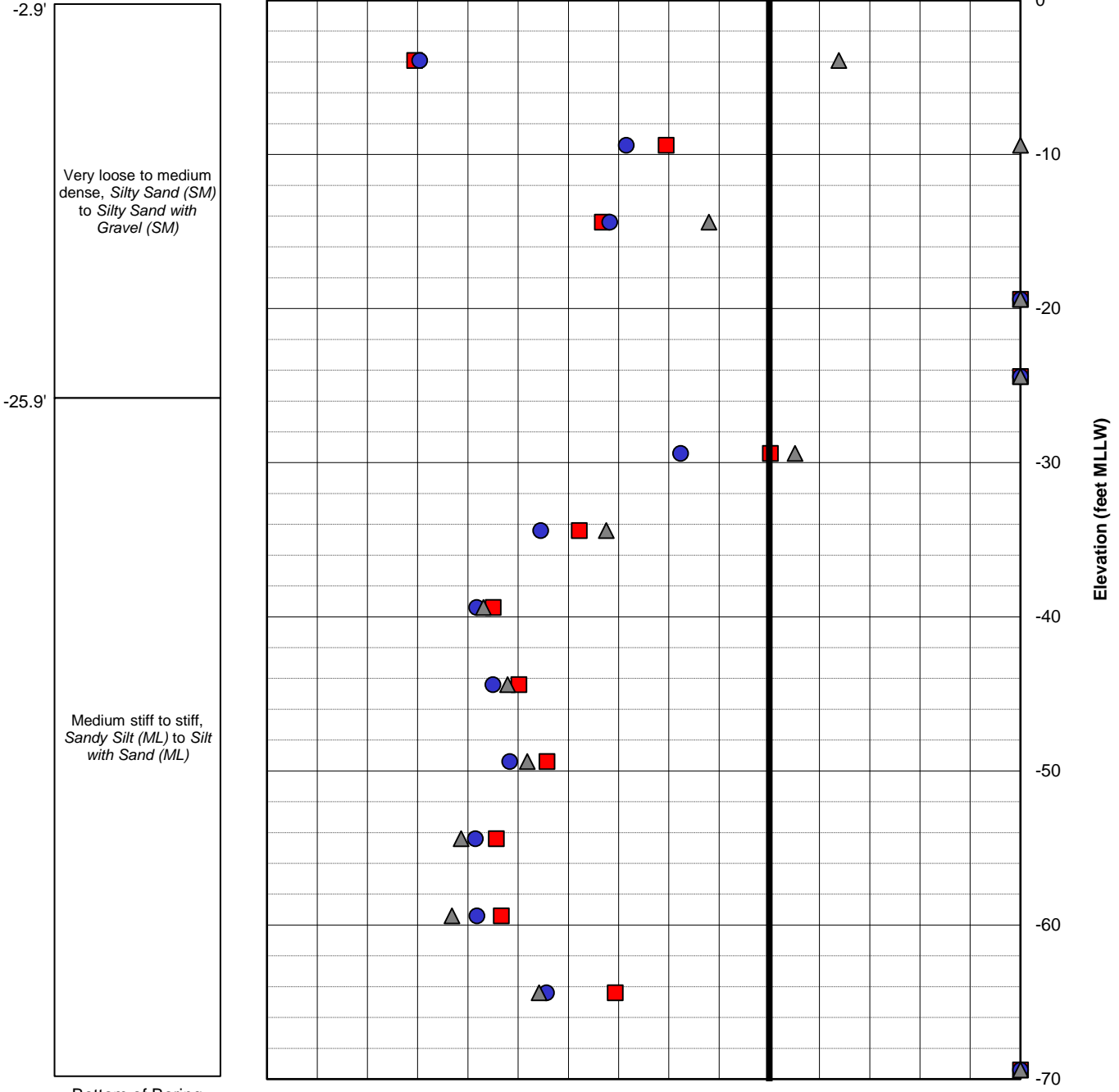
32-1-02348-001

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. C-3
(Sheet 1 of 3)

**APPROXIMATE
SUBSURFACE
PROFILE**

Factor of Safety against Liquefaction



■ Youd and others (2001) ● Idriss & Boulanger (2006) ▲ Cetin and others (2004)

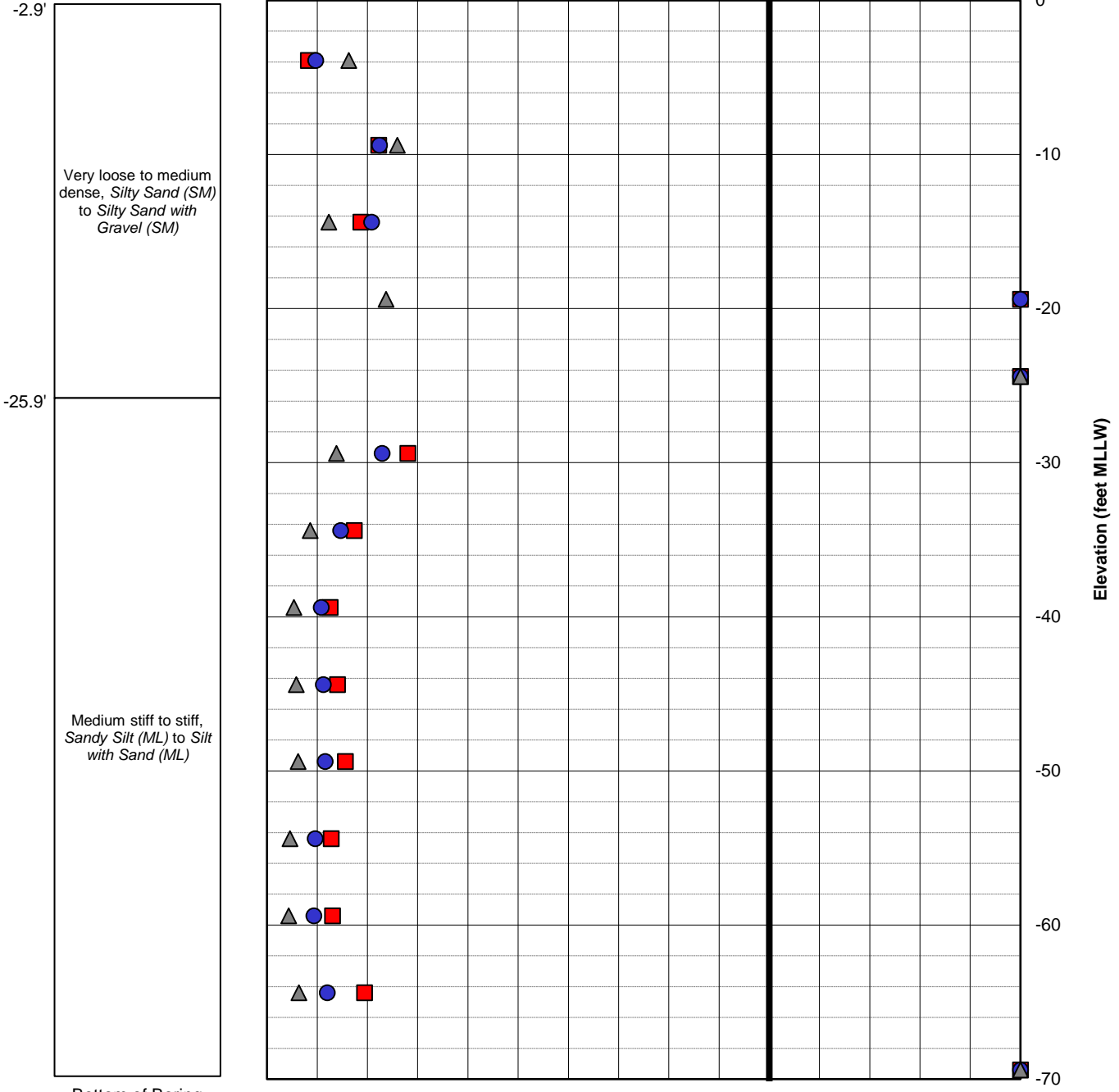
NOTES

1. See main text for references.
2. The liquefaction resistance of a soil is based on its density and fines content. We used the results of the standard penetration testing to estimate the density, and the results of selected laboratory tests to estimate the fines content.

Navigational Improvements Study
 Head of Passage Canal, Whittier, Alaska
RESULTS OF LIQUEFACTION ANALYSES
BORING B-17
M = 6.8, PGA = 0.37
 August 2017 32-1-02348-001
SHANNON & WILSON, INC. **FIG. C-3**
 Geotechnical and Environmental Consultants **(Sheet 2 of 3)**

**APPROXIMATE
SUBSURFACE
PROFILE**

Factor of Safety against Liquefaction



Bottom of Boring at -69.9 feet

■ Youd and others (2001) ● Idriss & Boulanger (2006) ▲ Cetin and others (2004)

NOTES

1. See main text for references.
2. The liquefaction resistance of a soil is based on its density and fines content. We used the results of the standard penetration testing to estimate the density, and the results of selected laboratory tests to estimate the fines content.

Navigational Improvements Study
 Head of Passage Canal, Whittier, Alaska
RESULTS OF LIQUEFACTION ANALYSES
BORING B-17
M = 9.2, PGA = 0.61
 August 2017 32-1-02348-001
SHANNON & WILSON, INC. **FIG. C-3**
 Geotechnical and Environmental Consultants **(Sheet 3 of 3)**

APPENDIX D

**IMPORTANT INFORMATION ABOUT YOUR
GEOTECHNICAL/ENVIRONMENTAL REPORT**



Date: August 2017
To: City of Whittier
Navigation Improvements Study, Head of
Passage Canal, Whittier, 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