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HYDROGEOLOGIC REPORT

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FUGRO CONSULTANTS, INC.

HYDROGEOLOGIC REPORT
ALASKA LNG PRE-FEED INVESTIGATION
NEAR NIKISKI, KENAI PENINSULA, ALASKA

April 2015

Report No. 04.10140094-10
EXXONMOBIL ALASKA LNG LLC (EMALL)
HOUSTON, TEXAS

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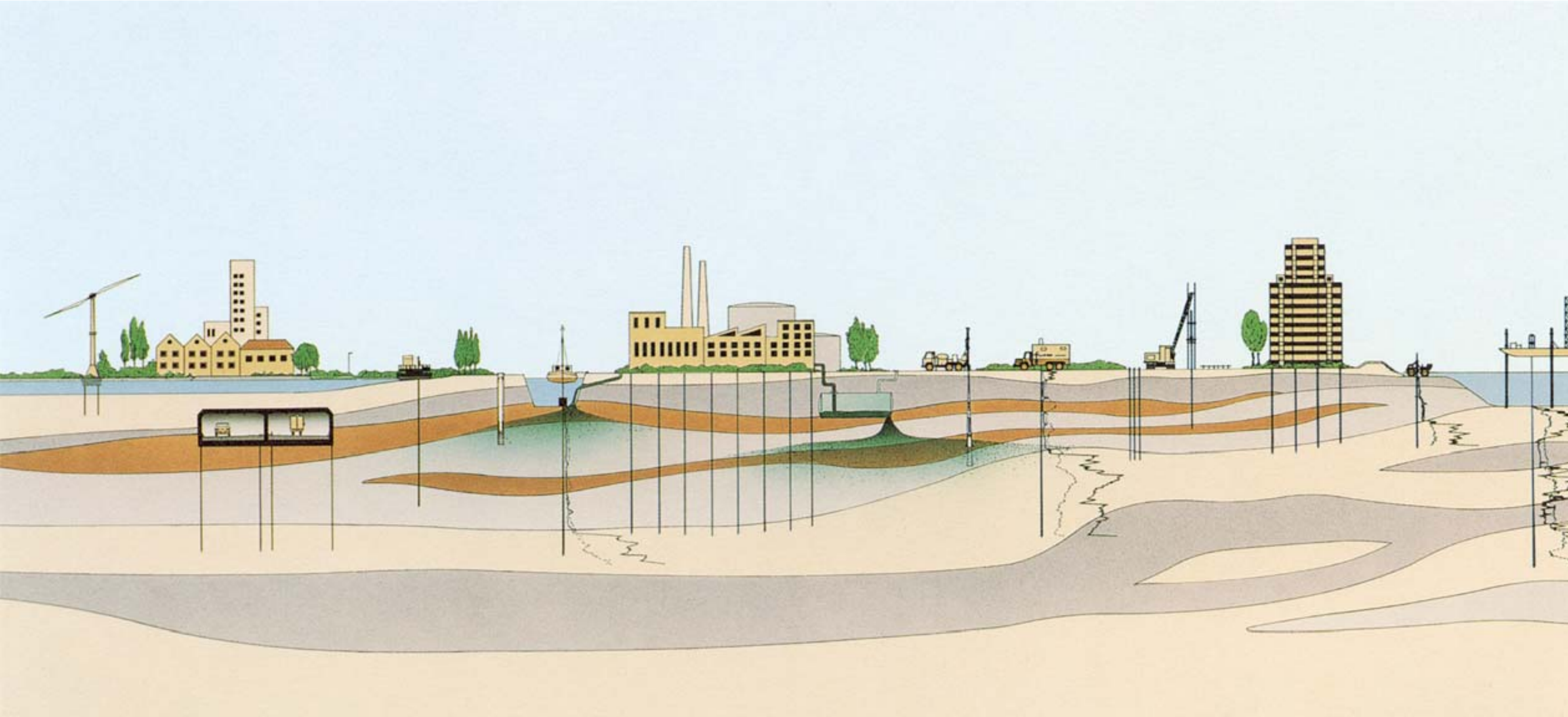

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April 29, 2015

ExxonMobil Alaska LNG LLC (EMALL)
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Attention: Richard Raines
Geotechnical Engineer/Technical POC

Pre-FEED
Hydrogeologic Report
Onshore LNG Facilities
Alaska LNG Project
Nikiski, Alaska

Fugro Consultants, Inc. (Fugro) is pleased to present this hydrogeologic report for the onshore facilities of the Alaska LNG Project (AKLNG) located in Nikiski, Alaska. Our services were authorized under Service Work Order No. AKLNG-FUG-US-002 Rev 0, dated August 8, 2014 in accordance with the Service Agreement No. A2275592 between Fugro and ExxonMobil Global Services Company, dated October 29, 2012. Fugro has been contracted by ExxonMobil Alaska LNG LLC (EMALL) under the service order to provide pre front-end engineering and design (Pre-FEED) level site investigation services for the proposed AKLNG Project.

Current plans are to complete the site investigation for Pre-FEED level study in two phases. Field services for Phase 1 were completed in fall of 2014, whereas the Phase 2 field services are planned for summer of 2015. This report is based on the results of Phase 1 geotechnical field investigation and laboratory testing conducted between August, 2014 and December, 2014.

We appreciate the opportunity to be of service to EMALL. Please call Mr. Abhishek Shethji, P.E. Fugro's Project Manager, at (713) 369-5431 if you have any questions or comments concerning this report, or when we may be of further assistance.

Sincerely,

FUGRO CONSULTANTS, INC.
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1.0 INTRODUCTION

1.1 PROJECT DESCRIPTION

The Alaska Gasline Development Corporation, BP Alaska LNG LLC, ConocoPhillips Alaska LNG Company, ExxonMobil Alaska LNG LLC, and TransCanada Alaska Midstream LP (Applicants) plan to construct one integrated LNG Project (AKLNG Project) with interdependent facilities for the purpose of liquefying supplies of natural gas from Alaska, in particular the Point Thomson Unit (PTU) and Prudhoe Bay Unit (PBU) production fields on the Alaska North Slope (North Slope), for export in foreign commerce and opportunity for in-state deliveries of natural gas.

The Natural Gas Act (NGA), 15 U.S.C. § 717a(11) (2006), and FERC regulations, 18 C.F.R. § 153.2(d) (2014), define “LNG terminal” to include “all natural gas facilities located onshore or in State waters that are used to receive, unload, load, store, transport, gasify, liquefy, or process natural gas that is exported to a foreign country from the United States.” With respect to this Project, the “LNG terminal” includes the following: a liquefaction facility (Liquefaction Facility) in Southcentral Alaska; an approximately 800-mile, large diameter gas pipeline (Mainline); a gas treatment plant (GTP) on the North Slope; a gas transmission line connecting the GTP to the PTU gas production facility (PTU Gas Transmission Line or PTTL); and a gas transmission line connecting the GTP to the PBU gas production facility (PBU Gas Transmission Line or PBTL). All of these facilities are essential to export natural gas in foreign commerce.

The new Liquefaction Facility will be constructed on the eastern shore of Cook Inlet in the Nikiski area of the Kenai Peninsula. The Liquefaction Facility will include the structures, equipment, underlying access rights and all other associated systems for pre-processing (other than that performed by the GTP) and liquefaction of natural gas, as well as storage and loading of LNG, including terminal facilities (dock) and auxiliary marine vessels used to support marine terminal operations (excluding LNG carriers). The Liquefaction Facility will include three liquefaction trains combining to process up to approximately 20 million metric tons per annum (MMTPA) of LNG. Three (3) tanks, each with a storage capacity of 160,000 cubic meter (m^3) will be constructed to store the LNG. The Liquefaction Facility will be capable of accommodating two LNG carriers. The size range of LNG carriers that the Liquefaction Facility will accommodate will be determined through further engineering study and consultation with the United States Coast Guard (USCG) as part of the Waterway Suitability Assessment (WSA) process.

AKLNG contracted Fugro to investigate existing the site conditions in the following proposed development areas: onshore LNG facilities, marine LNG Terminal, and marine pipeline corridors. Plates 1 and 2 show the general vicinity of the project. More details regarding the project can be found in document USAKE-PT-SRREG-00-0001 released by AKLNG.

1.2 GENERAL SCOPE OF WORK

Fugro Consultants, Inc. prepared this report to document the hydrogeologic conditions at the Alaska LNG site (Site) near Nikiski, Kenai (see Plate 1 – Vicinity Map). These conditions are evaluated based on the previously completed geologic field mapping, borings, groundwater monitoring well installations, and groundwater data collected during Fugro's site investigations at the end of 2014. In addition, we have reviewed selected area geologic and hydrogeologic data as listed in the Reference Section of this report to complement the field work and aid in data interpretation. The Groundwater Monitoring Well Installation Report, including well construction details, boring logs, well development records, and baseline groundwater level measurements is included as Appendix A.

The hydrogeological study components of Fugro's site investigation included the installation, development, and sampling of selected groundwater monitoring wells. The wells were installed to collect baseline groundwater quality data, delineate aquifers and aquitards across the project Site, and provide means to develop an understanding of aquifer characteristics including variations in permeability, depth, fluctuation, tidal impacts, gradient, and flow direction.

Well installations and subsequent associated activities were completed in general conformance with the approved Project Execution Plan (PEP) dated September 14, 2014. Well locations were selected to provide preliminary geospatial coverage of the Site, and ease of access for later sampling and monitoring activities. The locations of the six (6) installed wells (designated MW-14, MW-27, MW-39a, MW-39b, MW-50a and MW-50b) are depicted on Plate 2 – Investigation Plan. Wells were completed between November 12th and November 21st, 2014.

1.3 DEVIATIONS FROM SCOPE OF WORK

Due to difficult drilling conditions, changing weather conditions, and scheduling conflicts, several planned well installation and characterization activities were not completed during the 2014 field campaign. Deviations were discussed with the Client prior to reducing the scope of the planned investigation tasks. Specific deviations from the PEP included the following:

- Twenty groundwater monitoring wells (twelve shallow; eight deep) were originally contemplated. Six wells (four shallow; two deep; targeting the first and second aquifers, respectively) were installed during the 2014 field campaign.
- The groundwater quality assessment program was not initiated at the Site due to site access agreement issues and winterization requirements.
- Video logging of completed wells, to document well screen locations, was not completed.

2.0 EVALUATION OF SITE DATA

2.1 REGIONAL DATA REVIEW

Stratigraphy observed in the project Site area is dominated by glacial and glaciofluvial deposits laid down during the late Pleistocene Naptowne glaciation. Relatively thin Holocene deposits form a discontinuous mantle over the Pleistocene deposits, occurring in mapped thicknesses primarily in depressions and stream valleys.

The two main formations encountered during the field investigation at the Site include the stratigraphically higher Killey unit and the stratigraphically lower Moosehorn unit. The contact between the Killey unit outwash deposits (Pko) and the late Moosehorn unit subestuarine deposits (Pme) are generally marked by orange discoloration of the underlying late Moosehorn deposits. The finer-grained and more compact (i.e., lower permeability) Moosehorn deposits act as an aquitard for iron-rich groundwater descending through the Killey sands. The water flows laterally along the contact and emerges at the bluff face just west of the current project Site extent, as a seep, where the iron oxidizes and stains the face of the exposure. Based on field observations, the contact between the two deposits represents a prominent surface present throughout the Kenai-Nikiski area observed at elevations ranging from sea level to 100 feet, NAVD88.

2.2 SITE LITHOLOGY

2.2.1 General

Lithologic observations from selected borings and groundwater monitoring wells are presented in generalized cross sections presented as Plates 3 through 7. These sections show surface topography and lithologic units encountered during Fugro’s studies, including the inferred subsurface contact between the Killey unit and the Moosehorn unit. Based on the as-built boring elevations, the existing site grade varies from about El. +94 to about El. +135 ft. In general, the surface topography dips slightly to the west and south.

The Killey unit contains coarser grained Killey age glacial outwash deposits consisting of sands; laminated sands and silts; coarse sands and rounded gravels. The Moosehorn unit contains mainly clayey sands with gravel, silty sands, sandy silts, silts, lean clays and silty clays extending below the Killey unit, to a maximum depth of about 150 feet. General geologic descriptions of selected cross sections are presented in the following subsections. Cross sections present well schematics and groundwater measurements obtained in 2014. Interpretation of groundwater flow and trends for the site are described in Section 4.0 Groundwater, of this report, with further graphic depiction on Plates 16 and 17 (Apparent Upper and Lower Aquifer Potentiometric Surfaces), and Plate 18, Coastal Erosional Features including bluff seeps as observed by Fugro in 2014. Additional cross sections are presented in the Fugro Geotechnical Data Report, Onshore LNG Facilities, Alaska LNG Project, Report No. 04.10140094-8.

2.2.2 Section A-A’

The A-A’ section (Plate 3) (the northernmost east-west section in the current project Site extent), shows the surface topography sloping gradually to the west, and the contact between the Killey unit and Moosehorn unit sloping gradually upward approximately 10 feet in the westerly direction.

2.2.3 Section D-D’

The D-D’ section (Plate 4) trends east-west, approximately half-way between the northern and southern boundaries of the current Site extent. Except for a depression in the eastern edge of this section, surface topography slope is relatively flat until sharply declining in the bluff area west of boring B-23. The contact between the Killey unit and the Moosehorn unit undulates slightly in the eastern portion of the section, then gradually declines approximately 25 feet in a westerly direction.

2.2.4 Section F-F’

The F-F’ section (Plate 5) is the most southerly east-west trending section in the current project Site extent. The surface topography gradually slopes downward toward the west, briefly rises at the well MW-39 location, then sharply dips westward at the western extent of the section. The contact between the Killey unit and the Moosehorn unit is relatively flat trending westward, except for a slight dip in the vicinity of borings B-39 and B-45.

2.2.5 Section H-H’

The H-H’ section (Plate 6) is a north-south trending section which shows surface topography undulating, with a general downward slope to the south. The contact between the Killey unit and the Moosehorn unit generally dips to the south, with undulations in the contact in the southern part of the Site.

2.2.6 Section I-I’

The I-I’ section (Plate 7) is a north-south trending section located approximately 1,000 feet to the east of section H-H’. The general topographic surface slope is slightly downward to the south. The contact between the Killey unit and the Moosehorn unit is shown to slope slightly downward to the south.

3.0 HYDROLOGIC SETTING

3.1 GENERAL

For the purposes of this report, the Killey unit comprises the Upper Aquifer and wells with a “b” suffix in their designation were designed and installed for screening within the Upper Aquifer. Similarly, the Moosehead unit, comprises the Lower Aquifer and wells with an “a” suffix in their designation were designed and installed for screening within the Lower Aquifer. The Upper Aquifer is unconfined, and the Lower Aquifer is confined or semi-confined. An aquitard separates the two units.

Water falling to the land surface as rain or snow percolates into underlying soils down to the water table, where it recharges the Upper Aquifer. Groundwater in the unconfined Upper Aquifer flows toward springs on the coastal bluffs where it was observed to be discharging during the 2014 field investigation. Groundwater in the Upper Aquifer also leaks through the clay units to recharge deeper aquifers. Groundwater in the Lower Aquifer flows toward the coast and discharges under, and likely, into Cook Inlet (as discussed in Section 4.1 and shown on Plate 17).

Lakes in the area are recharged by precipitation, snowmelt, and by groundwater inflow. Studies at the Site have not been detailed enough to assess hydrologic connection between the aquifers and the lakes. It is anticipated that groundwater water levels adjacent to lakes would correlate to lake water levels and fluctuations based on hydrologic processes. Similarly, as distance away from lakes increases, groundwater levels would rise or fall to meet stabilized groundwater levels in an area.

3.2 PRECIPITATION

The mean annual precipitation for Nikiski between 1980 and 2010 was 19.01 inches per year according to Nikiski data compiled by NOAA and the National Weather Service. Much of the precipitation that falls during the winter season is stored as snow and ice, and is not available to recharge lakes, streams, and aquifer units until it melts.

4.0 GROUNDWATER

4.1 OCCURRENCE, FLOW DIRECTION, AND GRADIENT

During borehole installation, groundwater was first observed across the site between depths of 17.5 feet (at B-28) and 64.5 feet (at B-23) below ground surface. The shallowest depth to groundwater observed (boring B-28) potentially may represent a locally perched water condition. Collection of additional data during the 2015 field data collection campaign may provide additional information regarding potentially perched conditions.

The summary of observed depth-to-water observations from selected boreholes drilled in 2014 are presented in Table 4:1-1 below. It should be noted that the boreholes were drilled during the dry season, and depth to water should be expected to be encountered at shallower depths at the end of the spring season following a normal snow accumulation and snow melt cycle. Fugro understands, based on discussions with local geologists, that it is common to observe a late spring/early summer groundwater elevation peak and a subsequent peak in the fall.

Table 4:1-1 Summary of Depth-to-Water Observations

Boring ID	Initial Water Depth (ft)	Final Water Depth before Backfill Placement (ft)
B-23	64.5	Not measured
B-24	55.0	Not measured
B-28	17.5	Not measured
B-38	31.5	Not measured
B-39	21.5	Not measured
B-40	39.7	31.8
B-42	40.0	36.7
B-43	31.2	37.6
B-49	46.8	Not measured

Micro Diver devices were installed within each well between November 20 and 21, 2014. Groundwater elevations in the wells are calculated by converting the measured pressure readings. The initial groundwater surface elevations measured in these wells are presented in Table 4:1-2. The wells cover a large spatial area, and top of well casing elevations vary from 97.75 feet NAVD88 at well MW-39a in the southern portion of the site to 136.24 feet NAVD88 at well MW-14 about 5000 feet to the north.

Table 4:1-2 Observed Groundwater Elevations

	MW-14 Upper Aquifer	MW-27 Upper Aquifer	MW-39a Lower Aquifer	MW-39b Upper Aquifer	MW-50a Lower Aquifer	MW-50b Upper Aquifer
Static Groundwater Measured	11/22/2014	11/21/2014	11/22/2014	11/20/2014	11/22/2014	11/20/2014
Groundwater Elevation, NAVD88	95.9	96.1	33.9	75.3	69.0	93.8

Graphical depictions of the variation in groundwater surface elevations within the wells, as recorded by the Micro Divers are presented as Plates 8 through 17. A summary of each of these plates is provided below.

- Plate 8 shows groundwater elevations in each of the six (6) wells recorded between November 22 and December 31, 2014.
- Plates 9, 10, and 11 display the groundwater elevations of the Upper Aquifer wells MW-14 and MW-27, MW-39b, and MW-50b, respectively, between November 22 and December 31, 2014. The general elevation trend suggests a steady declining groundwater elevation, consistent with the late dry season timing and prior to spring snow melt and aquifer recharge.
- Plate 12 shows the groundwater elevations for the Lower Aquifer wells MW-39a and MW-50a, with Nikiski tides superimposed over the period of November 22 through December 31, 2014. A review of this plate shows the Lower Aquifer groundwater elevations mimic the variations of the Nikiski tides, implying hydrologic connectivity between the two.
- Plates 13 and 14 exhibit groundwater elevations for wells MW-39a and MW-50a, respectively, recorded between December 3 and 10, 2014, but on a larger scale.
- Plate 15 shows the groundwater elevations of the Upper Aquifer wells MW-14 and MW-27, with Nikiski tides superimposed over the period of December 3 through December 10, 2014. A review of this plate suggests that the well elevations had little to no response due to tidal fluctuations. The disparity in response to tidal fluctuations between the Upper Aquifer wells and the Lower Aquifer wells suggest that there is no significant connection or groundwater communication between the Upper and Lower Aquifers as evidenced in the limited study area.
- Graphical depictions of the apparent groundwater contours of the Upper and Lower aquifers using the November 2014 data presented in Table 4.1-2 are presented as Plates 16 and 17. It should be noted that due to the extremely limited dataset, major

assumptions have been incorporated in the review and interpretation of the data, and in the development of the contours shown, including that groundwater generally flows to the shoreline. In general, groundwater within the Upper aquifer flows in a westerly/southwesterly direction toward Cook Inlet at an approximate gradient of 0.009 ft/ft; and the groundwater within the Lower aquifer flows in a westerly/southwesterly direction at an approximate gradient of 0.015 ft/ft. It should further be noted that the gradient and flow direction in the Lower aquifer is based solely on the data obtained from newly installed deep wells MW-39a and MW-50a, and our interpretation that the contours would be similar to those presented by the Upper aquifer data.

Based on a review of the 2014 data collected through December 31, 2014, it appears that the groundwater surface elevation is still declining, which is expected nearing the end of the dry season. We were not able to identify any regional studies covering the expected change in water levels between dry and wet seasons, and would assume that topography, proximity to water features including shoreline areas, as well as mass of accumulated snowfall and snow melt would greatly affect this seasonal change in water levels.

4.2 SLUG TESTING

Slug testing was conducted within wells MW-14, MW-27, MW-39b, MW-50a and MW-50b on November 20 and 21, 2014. For a brief description of the slug testing process, including data plots, and an excel table of inputs used to create the data plots, see the Groundwater Monitoring Well Installation Report, Appendix A.

Based upon the collected data, the K values (hydraulic conductivity) derived from the slug tests, using the Bouwer and Rice method (ASTM Standard D5912-96), varied from 190 to 1,550 feet/day. These K values are very high, and the wells all recovered from initial displacement to the static level within a few seconds. Slug tests are considered most reliable and accurate (assuming wells are properly constructed and developed, and all else being equal) for aquifers of low to moderate K values (i.e., K of less than 50 feet/day). Given the very quick recovery and associated high slug-test derived K values for these wells, these data should be used with caution (recognizing the inherent degree of uncertainty).

Pumping tests are needed to confirm K values for use in analyses related to construction dewatering and other applications. During the slug tests, it was observed that the wells produced more water than could be reasonably evaluated using standard slug test methodologies. More robust pumping tests are needed to stress the selected source water aquifer over a longer period of time to effect an adequate drawdown in the pumped well and to allow observation of water level changes in observation wells installed radially away from a pumped well. The goal of a robust pumping test is ultimately to determine the stabilized flow capacity, stabilized water level during pumping, depth of pumping, and number of wells needed to achieve the volume of water needed for production or potentially generated as in the case of construction dewatering. Pump tests should be properly designed to address both a construction dewatering condition which could result in flows of at least 10,000 gallons per minute (gpm), or 1,000 gpm, such as may be required for a production well. According to anecdotal information provided in several referenced sources sustained pumping rates at various Nikiski area facilities have reported achieving pumping rates varying between these possible flow rates, and further suggest that flow rates are heavily dependent on stratigraphy and hydrogeologic conditions. It has also been reported that some productions wells near Cook Inlet have experienced salt water intrusion. As such, selecting the pump test location is just as critical as designing the pumping tests (length of run time and rate of pumping) to match the proposed use of the well or dewatering system, is just as important as. Pump test programs should therefore involve instrumenting multi-wells, located in specific areas of proposed water use, and include both step-drawdown and constant-discharge phases of the tests to maximize the collection of relevant data.

4.3 WATER QUALITY

Although groundwater quality sampling and analyses were not conducted as a part of the 2014 field investigation campaign, some observations can be made from observations made in the field by Fugro staff (see previously completed Fugro Geologic Mapping Program Report No.04.10140094-2, DRAFT: October 3, 2014), review of published reports by others, and from the State of Alaska Department of Environmental Conservation (ADEC) records. During the field mapping program conducted September 8 to 12, 2014, Fugro staff observed iron oxide rich seeps emerging in the side of beach bluffs at the Killey/Moosehorn unit contact. The presence of the iron oxide may indicate elevated levels of iron and Total Dissolved Solids (TDS), especially in the Upper Aquifer groundwater. The locations of observed bluff seeps are shown on Plate 18.

A review of selected published reports shows that groundwater samples collected from wells in the region typically have high levels of iron and manganese, a direct result of adsorption from the various compositions of rock types through which groundwater travels. In addition, water quality of groundwater samples collected in near-shore wells is generally of poorer condition than groundwater samples collected further inland, potentially a result of saline intrusion or industrial activities.

According to the ADEC division of Spill Prevention and Response Contaminated Sites Program Web Page, several contaminated sites are present within the current project Site extent. None of these contaminated sites are, however, in proximity to the six (6) completed groundwater monitoring wells. Petroleum hydrocarbons and industry-specific compounds have been detected locally in groundwater at some of these ADEC sites.

5.0 CONCLUSIONS AND RECOMMENDATIONS

Studies completed during the 2014 field investigation campaign have provided general coverage and data collection for the Site. Wells installed to date are separated by a distance of approximately 4,000 feet in the northeast/southwest direction, and by approximately 7,250 feet in the northwest/southeast direction. Only one well is located in proximity to the Cook Inlet shoreline and it is located more than 1,000 feet away.

Based on the limited data collected to date, we conclude the following:

- The hydraulic connection between the Upper and Lower Aquifers appears limited or restricted by the existing aquitard. The degree of restriction and competence of the aquitard has not been studied to date.
- The Lower Aquifer unit is observed to be tidally impacted. Insufficient data exists to fully describe the impacts of tidal action in the Upper Aquifer, but the preliminary data suggest that groundwater levels in the Upper Aquifer are not influenced by tidal fluctuations.
- Groundwater depths are known to be seasonally affected due to precipitation, snow accumulation and snow melt. Variations in depth to groundwater should be monitored through at least one hydrologic cycle to provide additional data.
- The Upper and Lower aquifers are highly permeable. Slug-test derived K values from monitoring wells ranged from 190 to 1,550 feet/day.

Additional studies are required to further characterize the aquifers underlying the Site. To better evaluate chemical and physical groundwater characteristics of the project Site, additional wells should be added to the well network. In addition, a robust water quality program including sampling and monitoring should be implemented. To provide assistance with developing construction dewatering system and production well designs, robust, multi-well pumping tests should be conducted to develop site-specific aquifer parameters and to verify K values.

6.0 REFERENCES

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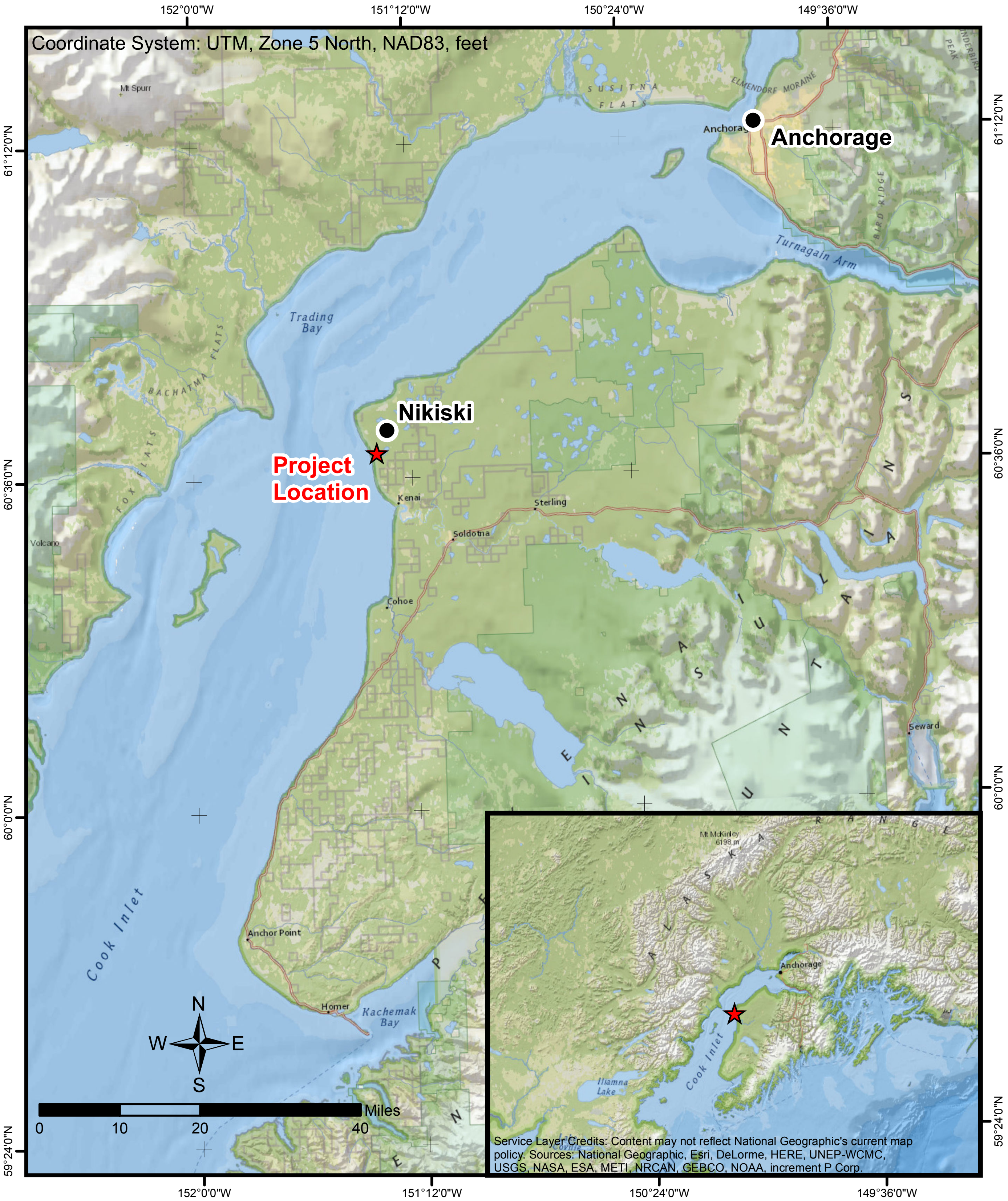
PLATES



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VICINITY MAP
ONSHORE FACILITIES
ALASKA LNG PROJECT
NIKISKI, ALASKA

PLATE 1

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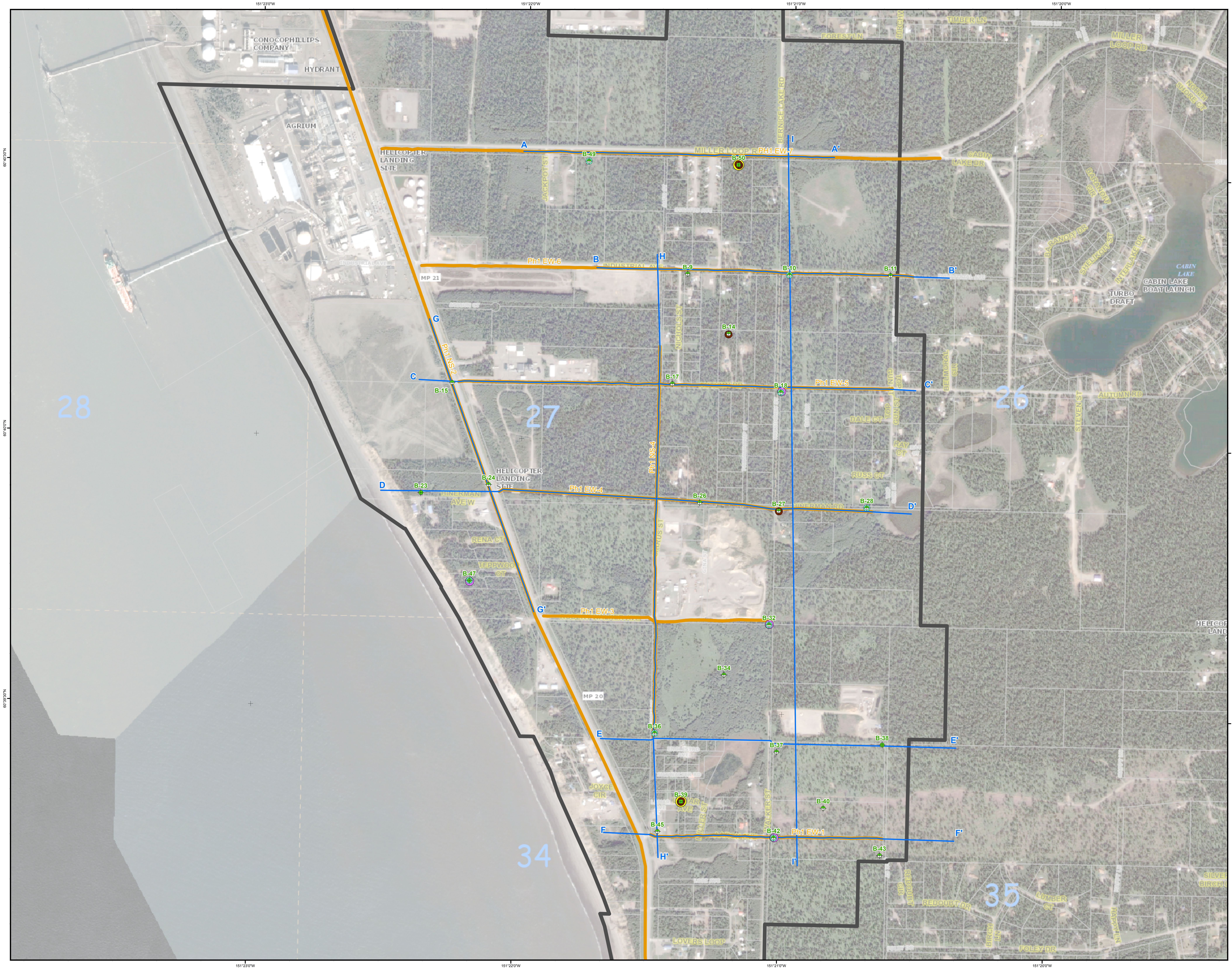


LEGEND

PHASE 1 2014 GEOTECHNICAL EXPLORATIONS

- ⊕ Boring - 100ft
- ⊕ Boring - 150ft
- ● Downhole Geophysics
- ● Monitoring Well
- ● Permanent Survey Monument
- ● E-LOGGING

PROJECT SITE LAYERS

- ▭ Onshore LNG Facilities

GEOPHYSICAL SURVEY LINES

- ━ Onshore Geophysical Lines

CROSS SECTION LINES

- ━ Cross-Sections

Borings	Depth, ft	As-Built Elevation, ft (NAVD88)	As-Built Coordinates (NAD83 – NSRS2007)		DH(1)	EL(2)	MW(3)	PSM(4)
			Latitude, deg	Longitude, deg				
B-9	100.50	132.25	60.67185419	-151.35640928				
B-10	103.00	132.80	60.67188199	-151.35002128	1			
B-11	101.25	136.36	60.67192943	-151.34366487				
B-14	110.70	133.40	60.67003682	-151.35375743			1	
B-15	101.00	122.96	60.66836028	-151.37105711				
B-17	101.50	131.21	60.66845974	-151.35723247				
B-18	101.50	131.25	60.66826252	-151.35041257	1			1
B-23	186.50	124.63	60.66494561	-151.37288538				
B-24	101.00	120.40	60.66523854	-151.36864010				
B-26	100.50	125.54	60.66481307	-151.35535978				
B-27	101.50	124.35	60.66461107	-151.35039124			1	
B-28	103.00	118.89	60.66475620	-151.34486218	1			
B-32	101.50	122.99	60.66109265	-151.35084727	1			1
B-34	101.00	111.83	60.65951893	-151.35361467				
B-36	103.00	111.70	60.65768300	-151.35789052	1			
B-37	26.50	106.27	60.65717918	-151.35022180				
B-38	151.30	123.47	60.65746298	-151.34359639				
B-39	151.50	95.51	60.65559414	-151.35615280		1	2	
B-40	101.50	120.84	60.65547709	-151.34721579				
B-42	101.50	118.85	60.65453131	-151.35029923	1			
B-43	102.75	121.14	60.65405368	-151.34362451				1
B-45	101.50	109.09	60.65465742	-151.35759481				
B-47	151.00	119.73	60.66227016	-151.36972091	1			1
B-49	101.50	127.76	60.67526763	-151.36274607	1			
B-50	151.50	131.66	60.67524580	-151.35335931		1	2	

Notes:

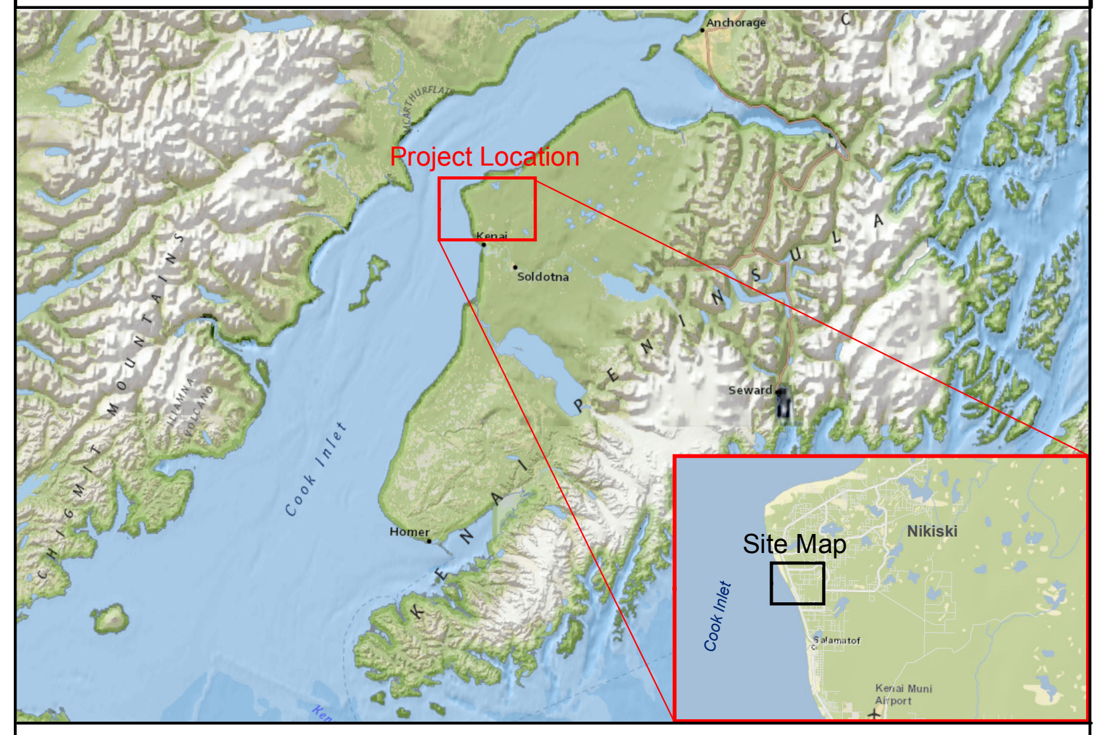
(1)DH= Downhole Seismic Test
(2)EL= Wireline E-Logging Data
(3)MW= Monitoring Well
(4)PSM= Permanent Survey Monument

Monitoring Wells	Depth, ft	As-Built Elevation, ft (NAVD88)	As-Built Coordinates (NAD83 – NSRS2007)	
			Latitude, deg	Longitude, deg
MW-14	55	136.24	60.67001489	-151.35376440
MW-27	56	126.79	60.66459539	-151.35037410
MW-39A	146	97.99	60.65557926	-151.35615710
MW-39B	39	97.75	60.65560508	-151.35613450
MW-50A	145	135.12	60.67523060	-151.35331470
MW-50B	56	134.67	60.67526072	-151.35336650

Permanent Survey Monuments	Corresponding Boring	As-Built Elevation, ft (NAVD88)	As-Built Coordinates (NAD83 – NSRS2007)	
			Latitude, deg	Longitude, deg
PSM-1	B-18	131.29	60.66827846	-151.35036057
PSM-2	B-47	119.87	60.66224113	-151.36969412
PSM-3	B-32	123.16	60.66110421	-151.35082797
PSM-4	B-42	118.47	60.65453570	-151.35025144

Notes:

1. Base imagery provided by Kenai Peninsula Borough (KPB).
2. Onshore LNG Facility boundary provided by EMALL.
3. As-built coordinates of exploration locations provided by JOA Surveying Services, Inc. (JOA).



GEODETIC INFORMATION

PROJECTION:	Transverse_Mercator
FALSE EASTING:	1640416.666666666
FALSE NORTHING:	0.0
CENTRAL MERIDIAN:	-150.0
SCALE FACTOR:	0.9999
LATITUDE OF ORIGIN:	54.0
LINEAR UNIT:	US Foot
SPHEROID:	GRS 1980
SEMI-MAJOR AXIS:	6,378,137.000
SEMI-MINOR AXIS:	6,356,752.314140356
INVERSE FLATTENING:	298.257222101

N
W E
S

Coordinate Grid: NAD 1983 (NSRS 2007), Degrees Minutes Seconds

FUGRO CONSULTANTS, INC.
6100 Hillcroft Ave.
Houston, Texas 77081
Tel: 713.369.5400
Fax: 713.369.5518
www.fugroconsultants.com

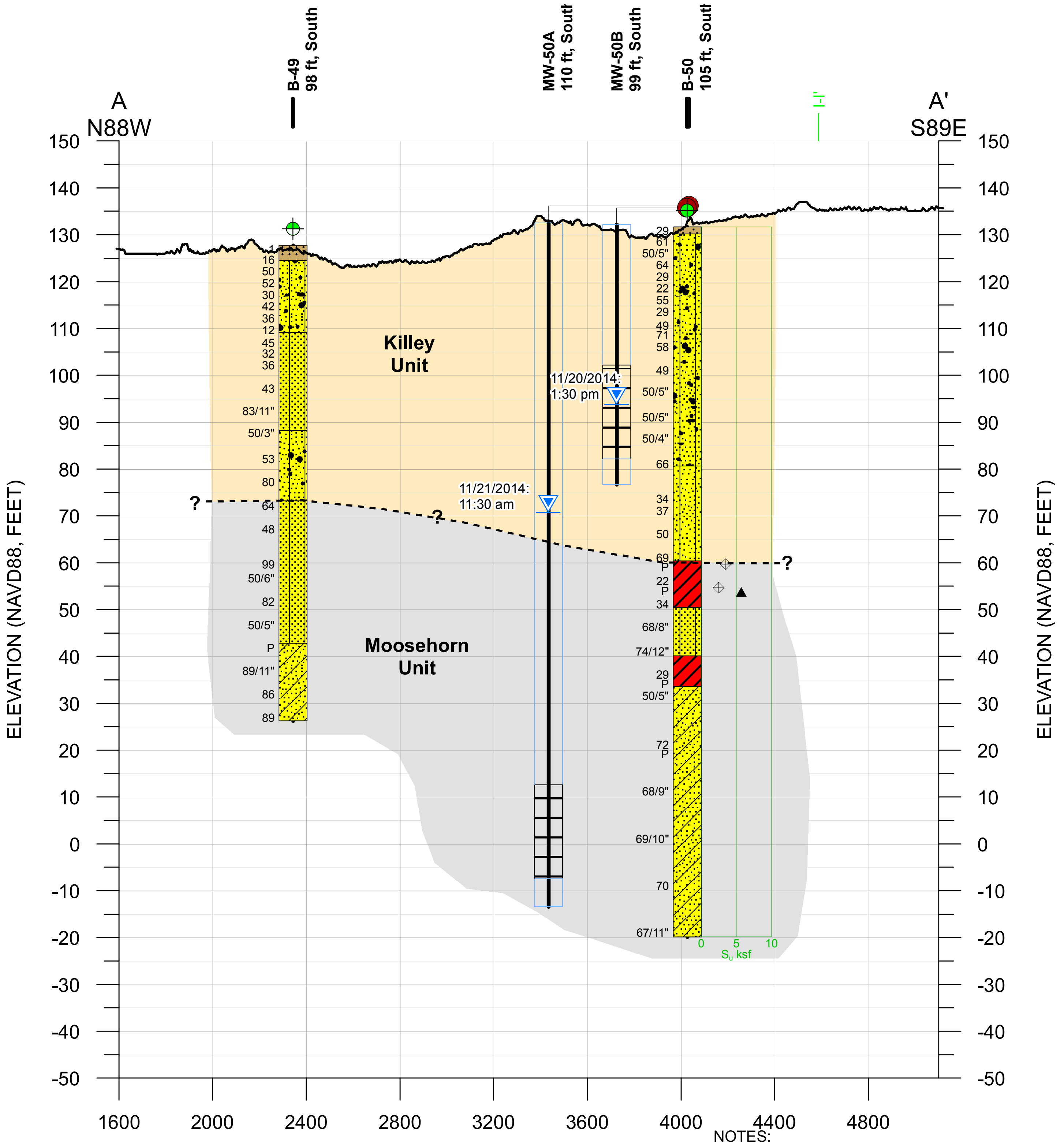
INVESTIGATION PLAN
ONSHORE FACILITIES
ALASKA LNG PROJECT
NIKISKI, ALASKA

0 500 1,000
Feet

REV NO:	DATE:	DESCRIPTION:	DRAWN:	CHKD:	APPR:
0	01/15/2015	Monitoring Well Draft Report	TNS	KS	JA
1	04/15/2015	Final Report	TNS	YSC	JA

JOB NUMBER: 04.10140094-10

DRAWING NO.: PLATE 2



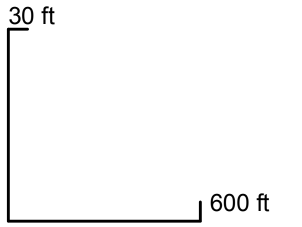
LEGEND

PHASE 1 2014 GEOTECHNICAL EXPLORATIONS

⊕ Boring - 100ft
⊕ Boring - 150ft
● Monitoring Well
▼ Water Level Reading During Drilling
▽ Water Level Reading from Monitoring Well on date shown
— Topographic Elevation, NAVD88, Feet
- ? - Interpreted Subsurface Contact
☰ Slotted Screen Section of Monitoring Well

SOIL DESCRIPTIONS

▨ Topsoil
▨ Lean CLAY (CL)
▨ Poorly-Graded SAND with Silt (SP-SM)
▨ Well-Graded SAND with Silt (SW-SM)
▨ Well-Graded SAND with Silt and Gravel (SW-SM)
▨ Clayey SAND (SC)



Horizontal and Vertical Scales
Vertical exaggeration is 20x.

UNDRAINED SHEAR STRENGTH (S_u)

▲ Unconsolidated Undrained Triaxial
◇ Torvane
⊗ Pocket Penetrometer
+ Soil Strength Exceeds Instrument's Maximum Measurable Strength.

TUBE AND SPT SAMPLES

P	Push thin-walled 3" tube.
20	Number of blows to produce 12" of penetration after the initial 6" of seating.
86/11"	Number of blows required to produce the indicated penetration after an initial 6" seating.
Ref/3"	50 blows produced the indicated penetration during the initial 6" interval.

NOTES:
1) Topographic source data is from Kenai Peninsula Borough LiDAR, collected in 2008 and processed using 4 foot bin interval. Topographic elevation is referenced to NAVD88. Data provided by EXP Geomatics (EXP).
2) As-Built coordinates and elevations of the exploration locations provided by JOA Surveying Services, Inc. (JOA).
3) Stratigraphic contacts are approximate, and interpreted from borings. Conditions vary both along and perpendicular to the section line. The lateral extent of the top soil is not known based on the limited borings.
4) Boring data are projected onto the cross section line, therefore, stratigraphic contacts may not correspond to the descriptions (lithology, shear strength, etc.) on the logs.
5) Material descriptions are generalized. Materials may vary within the stratigraphic unit and include layers of material that differ from the general description. Refer to boring logs for detailed descriptions of the materials encountered at the exploration location.
6) See Plate 2 for location of explorations and cross section lines.
7) See Plate 8 for piezometric elevation readings.

GENERALIZED SUBSURFACE CROSS SECTION A-A' ALONG GEOPHYSICAL LINE PH1 EW-7 WITH WELL SCREEN INTERVALS AND STATIC GROUNDWATER LEVELS

ONSHORE LNG FACILITIES
ALASKA LNG PROJECT
NIKISKI, ALASKA

PLATE 3

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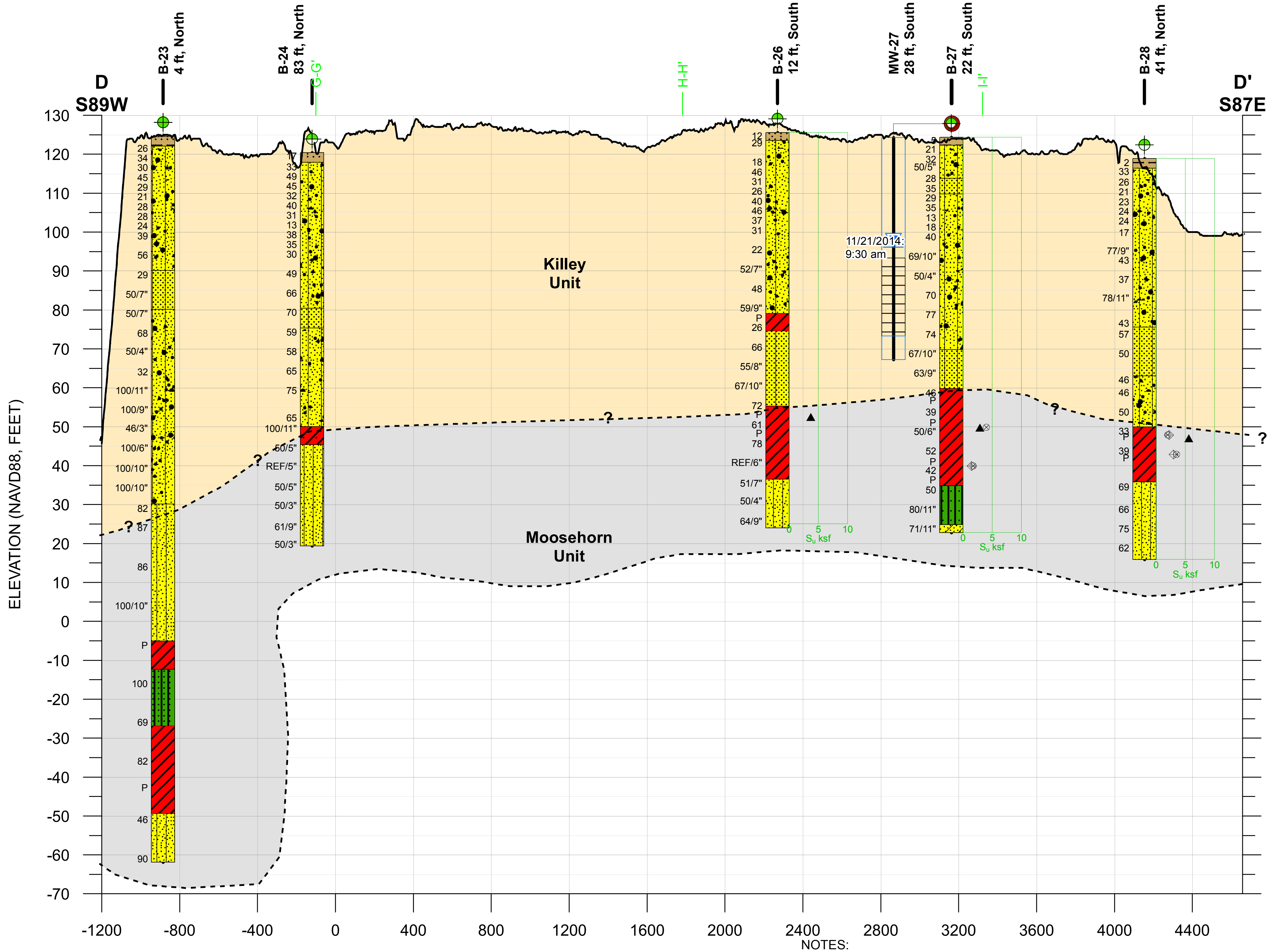

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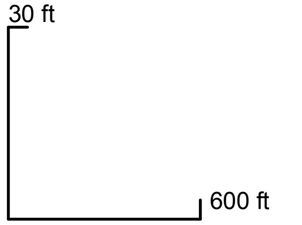
LEGEND

PHASE 1 2014 GEOTECHNICAL EXPLORATIONS

- ⊕ Boring - 100ft
- ⊕ Boring - 150ft
- ● Monitoring Well
- ▼ Water Level Reading During Drilling
- ▽ Water Level Reading from Monitoring Well on date shown
- — Topographic Elevation, NAVD88, Feet
- - ?- - Interpreted Subsurface Contact
- ☰ Slotted Screen Section of Monitoring Well

SOIL DESCRIPTIONS

- ▨ Topsoil
- 🟥 Lean CLAY (CL)
- 🟥 Lean CLAY with Sand (CL)
- 🟩 SILT with Sand (ML)
- 🟩 Sandy SILT (ML)
- 🟨 Poorly-Graded SAND with Silt (SP-SM)
- 🟨 Well-Graded SAND with Silt and Gravel (SW-SM)
- 🟨 Clayey SAND (SC)
- 🟨 Silty SAND (SM)



Horizontal and Vertical Scales
Vertical exaggeration is 20x.

UNDRAINED SHEAR STRENGTH (S_u)

- ▲ Unconsolidated Undrained Triaxial
- ⌖ Torvane
- ⊗ Pocket Penetrometer
- + Soil Strength Exceeds Instrument's Maximum Measurable Strength.

TUBE AND SPT SAMPLES

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20	Number of blows to produce 12" of penetration after the initial 6" of seating.
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Ref/3"	50 blows produced the indicated penetration during the initial 6" interval.

NOTES:

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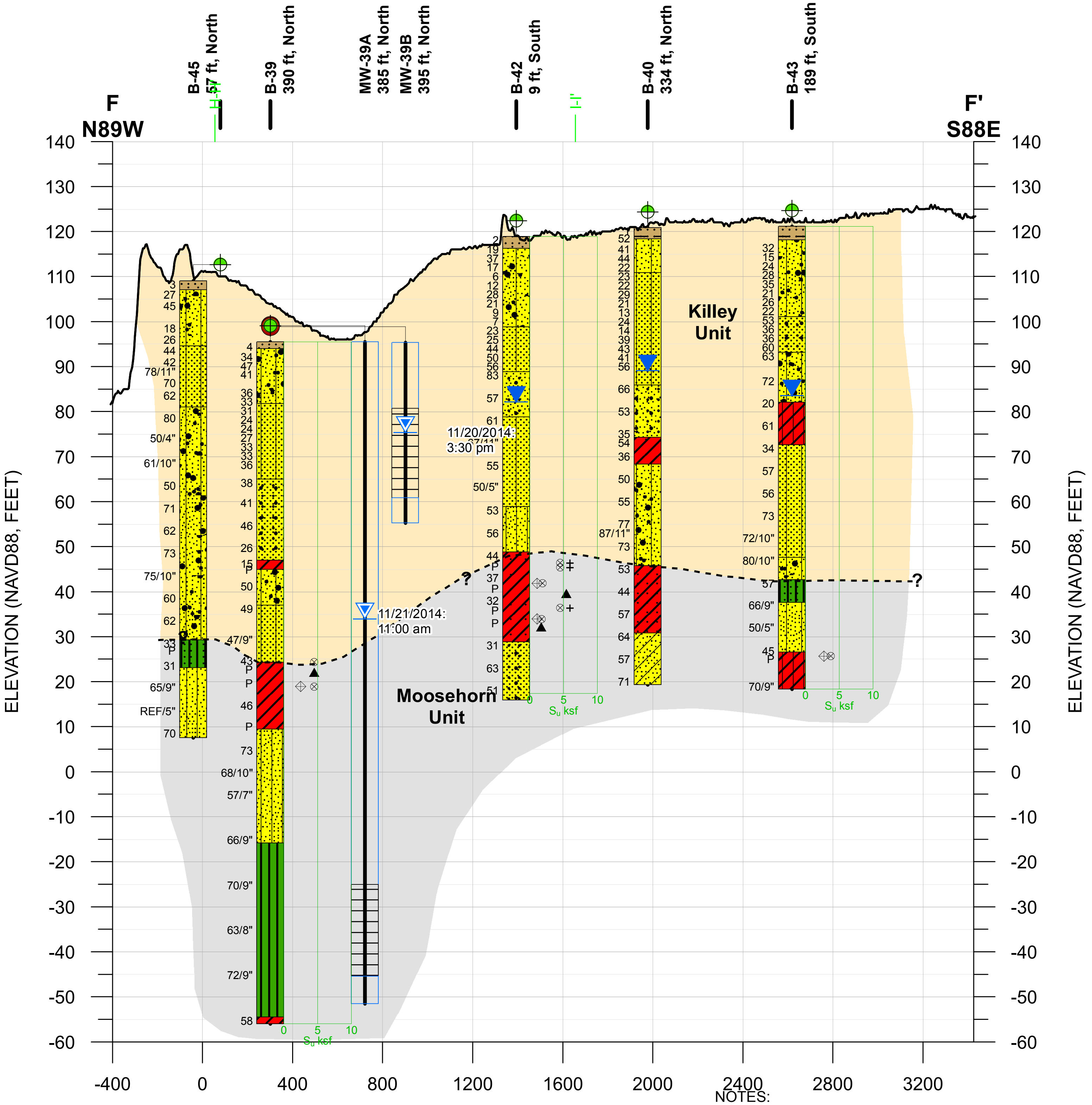
5) Material descriptions are generalized. Materials may vary within the stratigraphic unit and include layers of material that differ from the general description. Refer to boring logs for detailed descriptions of the materials encountered at the exploration location.
6) See Plate 2 for location of explorations and cross section lines.
7) See Plate 8 for piezometric elevation readings.

GENERALIZED SUBSURFACE CROSS SECTION D-D' ALONG GEOPHYSICAL LINE PH1 EW-4 WITH WELL SCREEN INTERVALS AND STATIC GROUNDWATER LEVELS

ONSHORE LNG FACILITIES
ALASKA LNG PROJECT
NIKISKI, ALASKA

PLATE 4



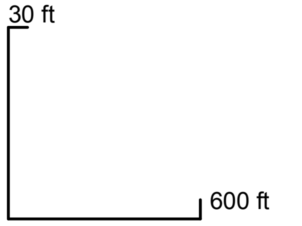
LEGEND

PHASE 1 2014 GEOTECHNICAL EXPLORATIONS

- ⊕ Boring - 100ft
- ⊕ Boring - 150ft
- ● Monitoring Well
- ▼ Water Level Reading During Drilling
- ▽ Water Level Reading from Monitoring Well on date shown
- — Topographic Elevation, NAVD88, Feet
- -?- Interpreted Subsurface Contact
- ▤ Slotted Screen Section of Monitoring Well

SOIL DESCRIPTIONS

- ▨ Topsoil
- 🟥 Lean CLAY (CL)
- 🟥 Lean CLAY with Sand (CL)
- 🟥 Sandy Lean Clay (CL)
- 🟥 Silty CLAY (CL-ML)
- 🟥 Silty CLAY with Sand (CL-ML)
- 🟩 Silt (ML)
- 🟩 Sandy SILT (ML)
- 🟨 Poorly-Graded SAND with Silt (SP-SM)
- 🟨 Poorly-Graded SAND with Gravel (SP)
- 🟨 Well-Graded SAND with Silt (SW-SM)
- 🟨 Well-Graded SAND with Gravel (SW)
- 🟨 Well-Graded SAND with Silt and Gravel (SW-SM)
- 🟨 Clayey SAND (SC)
- 🟨 Silty SAND (SM)



Horizontal and Vertical Scales
Vertical exaggeration is 20x.

UNDRAINED SHEAR STRENGTH (S_u)

- ▲ Unconsolidated Undrained Triaxial
- ⊕ Torvane
- ⊗ Pocket Penetrometer
- + Soil Strength Exceeds Instrument's Maximum Measurable Strength.

TUBE AND SPT SAMPLES

P	Push thin-walled 3" tube.
20	Number of blows to produce 12" of penetration after the initial 6" of seating.
86/11"	Number of blows required to produce the indicated penetration after an initial 6" seating.
Ref/3"	50 blows produced the indicated penetration during the initial 6" interval.

NOTES:
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2) As-Built coordinates and elevations of the exploration locations provided by JOA Surveying Services, Inc. (JOA).
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5) Material descriptions are generalized. Materials may vary within the stratigraphic unit and include layers of material that differ from the general description. Refer to boring logs for detailed descriptions of the materials encountered at the exploration location.
6) See Plate 2 for location of explorations and cross section lines.
7) See Plate 8 for piezomteric elevation readings.

GENERALIZED SUBSURFACE CROSS SECTION F-F' ALONG GEOPHYSICAL LINE PH1 EW-1 WITH WELL SCREEN INTERVALS AND STATIC GROUNDWATER LEVELS

ONSHORE LNG FACILITIES
ALASKA LNG PROJECT
NIKISKI, ALASKA

PLATE 5

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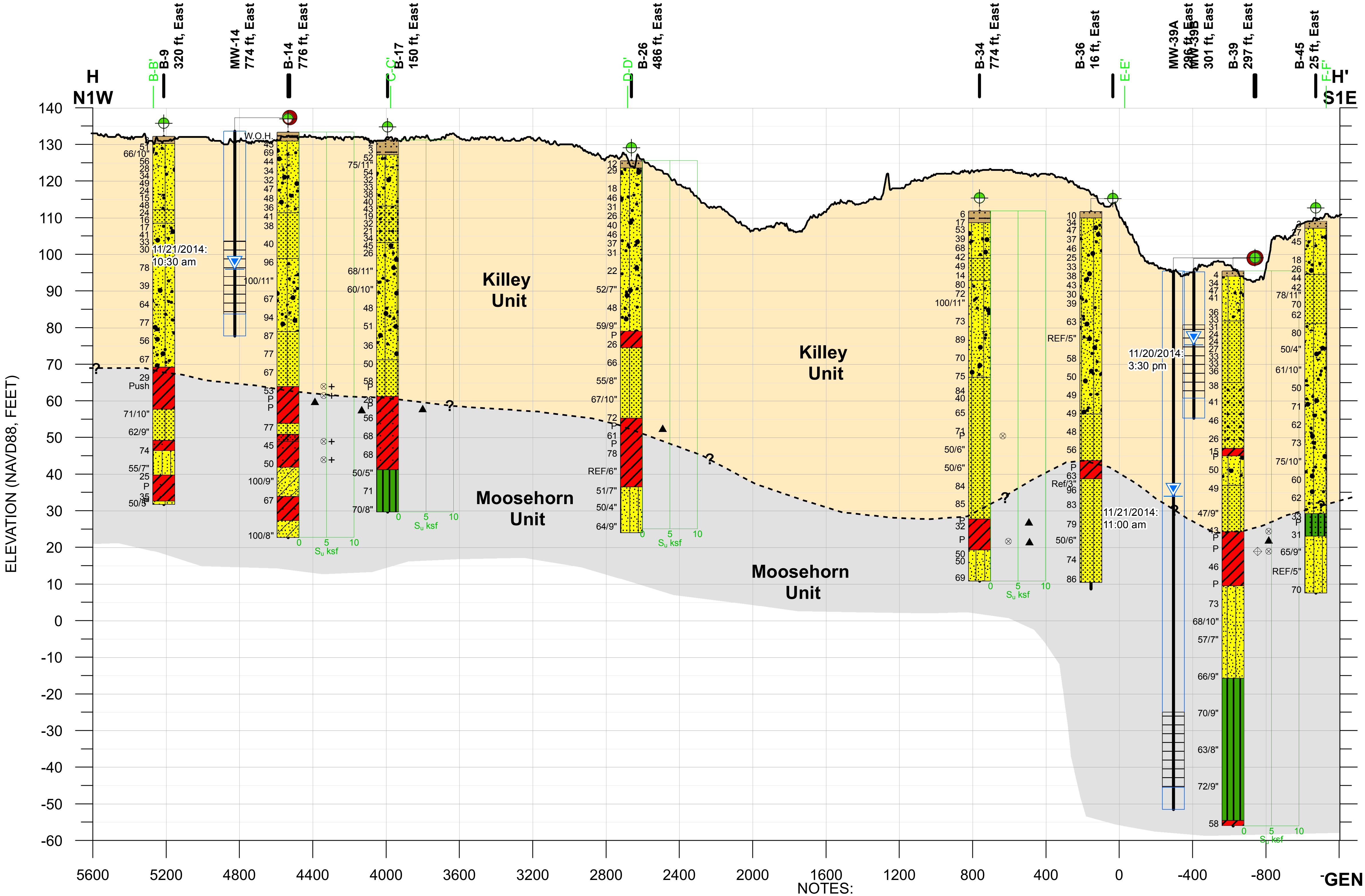

LEGEND

PHASE 1 2014 GEOTECHNICAL EXPLORATIONS

- ⊕ Boring - 100ft
- ⊕ Boring - 150ft
- ● Monitoring Well
- ▼ Water Level Reading During Drilling
- ▽ Water Level Reading from Monitoring Well on date shown
- — Topographic Elevation, NAVD88, Feet
- - ?- Interpreted Subsurface Contact
- ☰ Slotted Screen Section of Monitoring Well

SOIL DESCRIPTIONS

- ▨ Topsoil
- ▨ Lean CLAY (CL)
- ▨ Lean CLAY with Sand (CL)
- ▨ Sandy Lean Clay (CL)
- ▨ Silt (ML)
- ▨ Sandy SILT (ML)
- ▨ Poorly-Graded SAND with Silt (SP-SM)
- ▨ Poorly-Graded SAND with Silt and Gravel (SP-SM)
- ▨ Poorly-Graded SAND with Gravel (SP)
- ▨ Clayey SAND (SC)
- ▨ Silty SAND (SM)

30 ft

600 ft

Horizontal and Vertical Scales
Vertical exaggeration is 20x.

UNDRAINED SHEAR STRENGTH (S_u)

- ▲ Unconsolidated Undrained Triaxial
- ⌖ Torvane
- ⊗ Pocket Penetrometer
- \+ Soil Strength Exceeds Instrument's Maximum Measurable Strength.

TUBE AND SPT SAMPLES

P	Push thin-walled 3" tube.
20	Number of blows to produce 12" of penetration after the initial 6" of seating.
86/11"	Number of blows required to produce the indicated penetration after an initial 6" seating.
Ref/3"	50 blows produced the indicated penetration during the initial 6" interval.

NOTES:
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6) See Plate 2 for location of explorations and cross section lines.
7) See Plate 8 for piezometric elevation readings.

GENERALIZED SUBSURFACE CROSS SECTION H-H' WITH WELL SCREEN INTERVALS AND STATIC GROUNDWATER LEVELS

ONSHORE LNG FACILITIES
ALASKA LNG PROJECT
NIKISKI, ALASKA

PLATE 6

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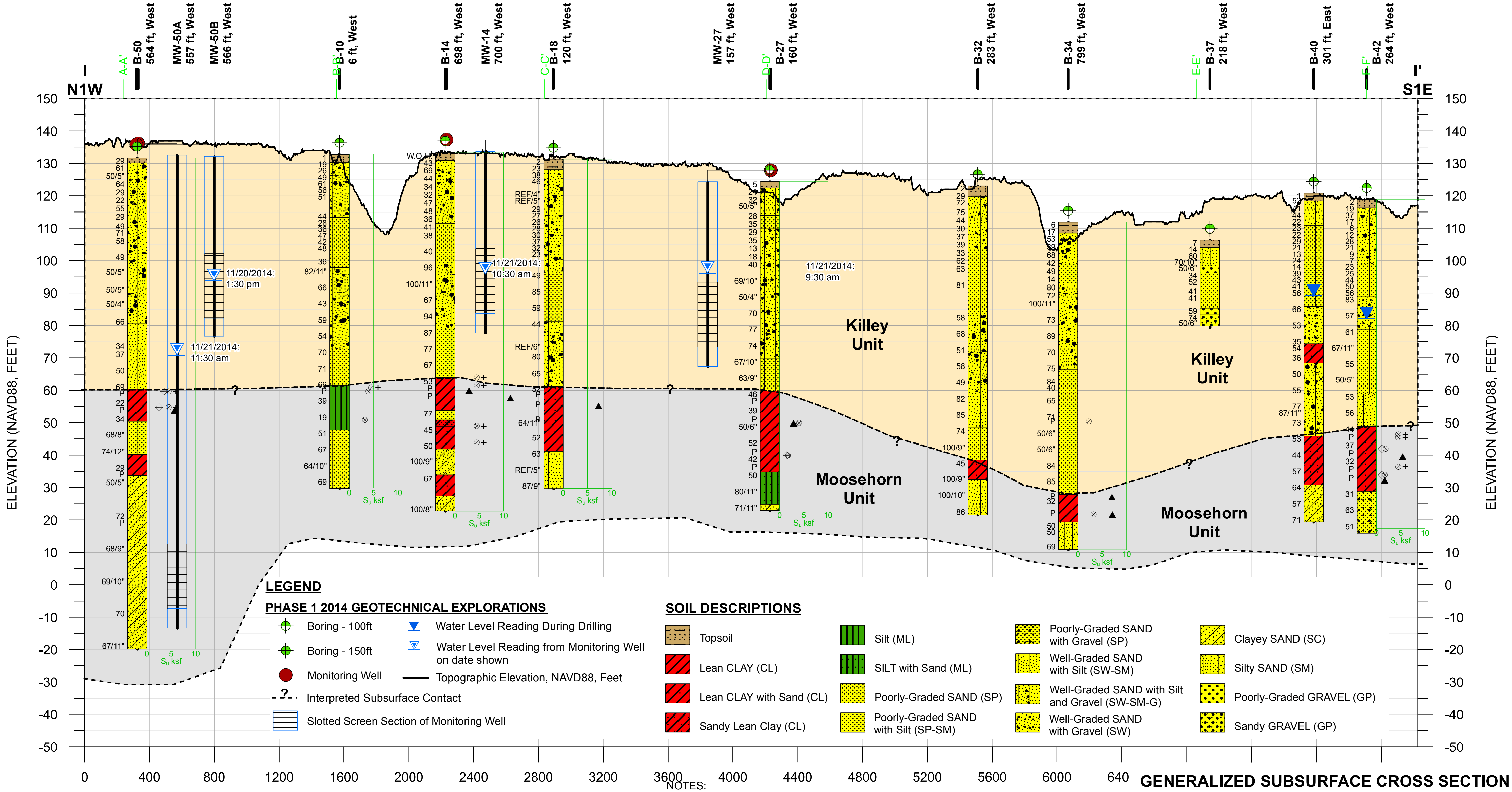

LEGEND

PHASE 1 2014 GEOTECHNICAL EXPLORATIONS

- Boring - 100ft
- Boring - 150ft
- Monitoring Well
- Interpreted Subsurface Contact
- Slotted Screen Section of Monitoring Well
- Water Level Reading During Drilling
- Water Level Reading from Monitoring Well on date shown
- Topographic Elevation, NAVD88, Feet

SOIL DESCRIPTIONS

- Topsoil
- Lean CLAY (CL)
- Lean CLAY with Sand (CL)
- Sandy Lean Clay (CL)
- Silt (ML)
- SILT with Sand (ML)
- Poorly-Graded SAND (SP)
- Poorly-Graded SAND with Silt (SP-SM)
- Poorly-Graded SAND with Gravel (SP)
- Well-Graded SAND with Silt (SW-SM)
- Well-Graded SAND with Silt and Gravel (SW-SM-G)
- Well-Graded SAND with Gravel (SW)
- Clayey SAND (SC)
- Silty SAND (SM)
- Poorly-Graded GRAVEL (GP)
- Sandy GRAVEL (GP)

30 ft

600 ft

Horizontal and Vertical Scales
Vertical exaggeration is 20x.

UNDRAINED SHEAR STRENGTH (S_u)

- ▲ Unconsolidated Undrained Triaxial
- ◈ Torvane
- ⊗ Pocket Penetrometer
- + Soil Strength Exceeds Instrument's Maximum Measurable Strength.

TUBE AND SPT SAMPLES

P	Push thin-walled 3" tube.
20	Number of blows to produce 12" of penetration after the initial 6" of seating.
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Ref/3"	50 blows produced the indicated penetration during the initial 6" interval.

NOTES:

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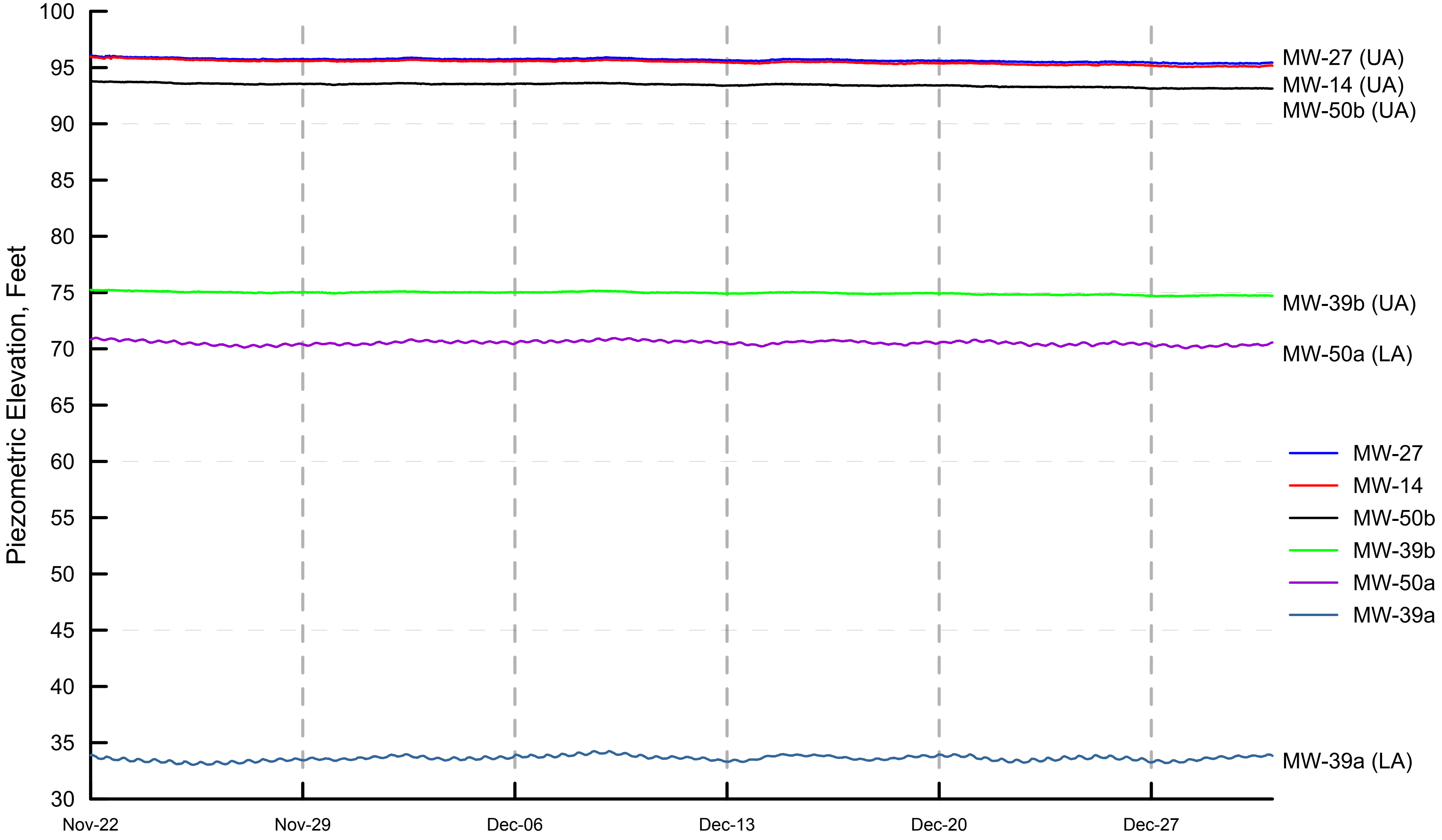
6) See Plate 2 for location of explorations and cross section lines.
7) See Plate 8 for piezometric elevation readings.

GENERALIZED SUBSURFACE CROSS SECTION I-I' WITH WELL SCREEN INTERVALS AND STATIC GROUNDWATER LEVELS

ONSHORE LNG FACILITIES
ALASKA LNG PROJECT
NIKISKI, ALASKA

PLATE 7

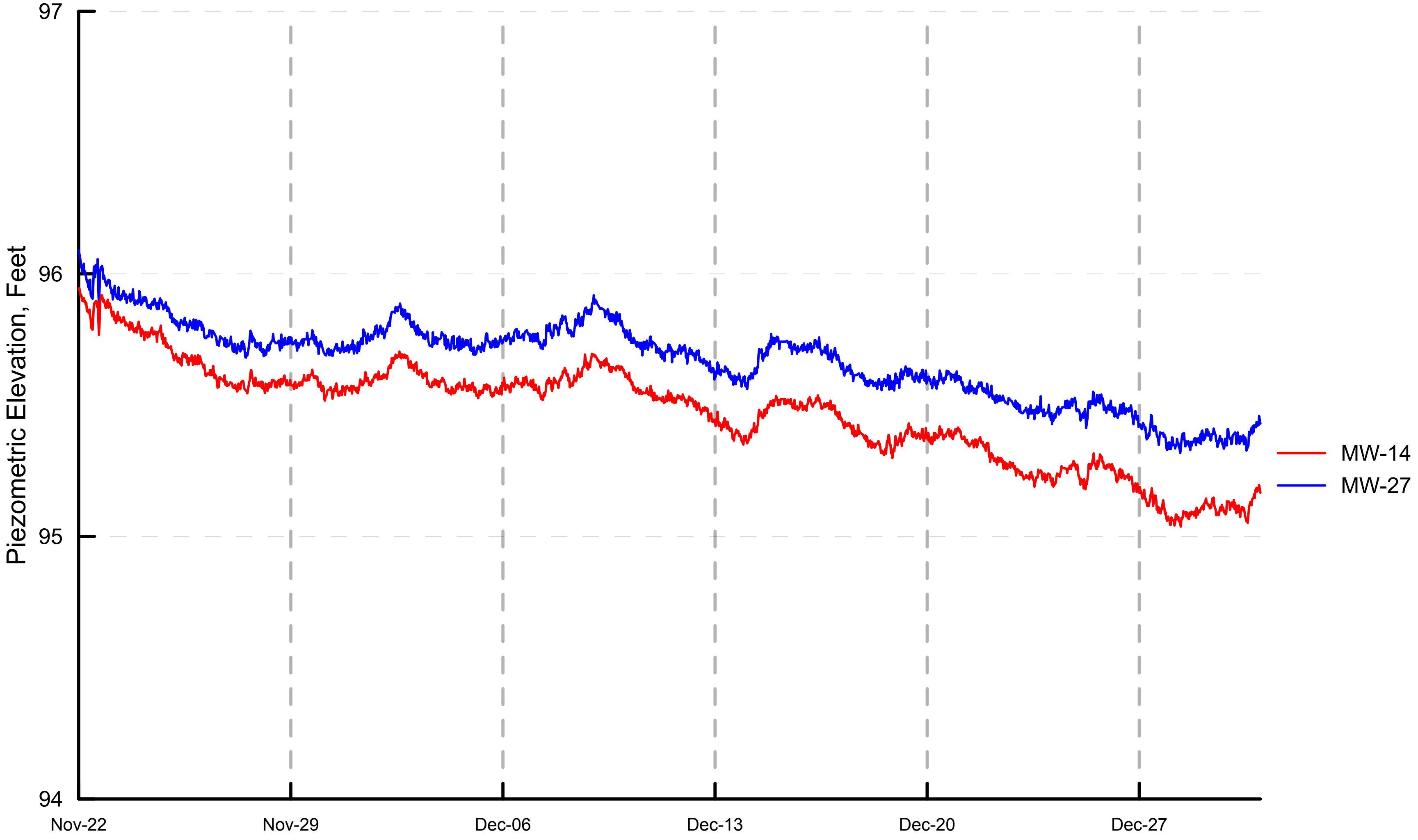
R:\04100\2014 Projects\04.10140094 - AKLNG\05_GIS\Outputs\01_REPORTS\2015_04_15_Final_Hydrologic_Report\MXD\Plate-07_Xsect_I.mxd, 4/20/2015, serranot



NOTES:
UA = UPPER AQUIFER
LA = LOWER AQUIFER

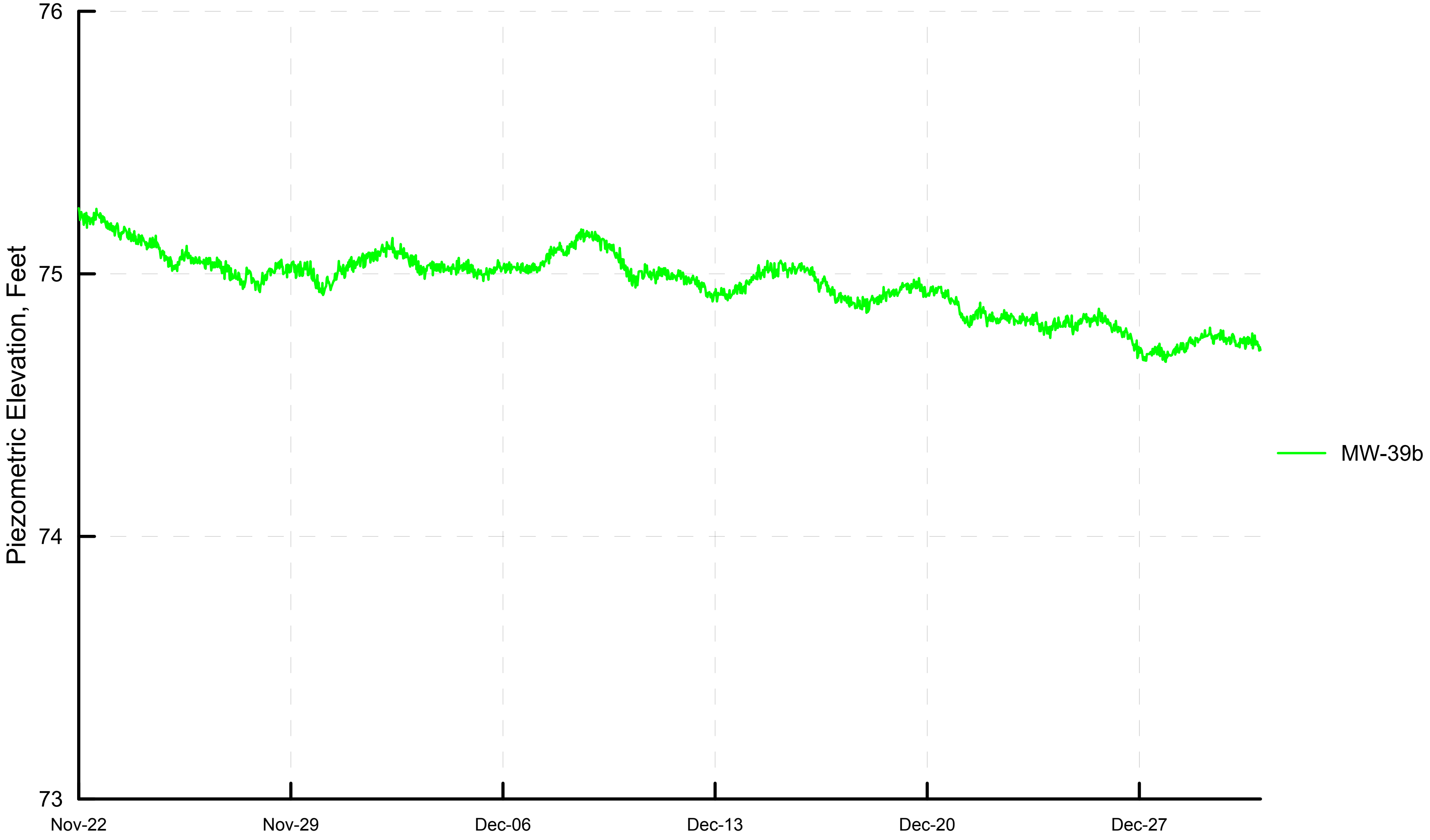
PIEZOMETRIC ELEVATIONS
ONSHORE LNG FACILITIES
ALASKA LNG PROJECT
NIKISKI, ALASKA

PLATE 8



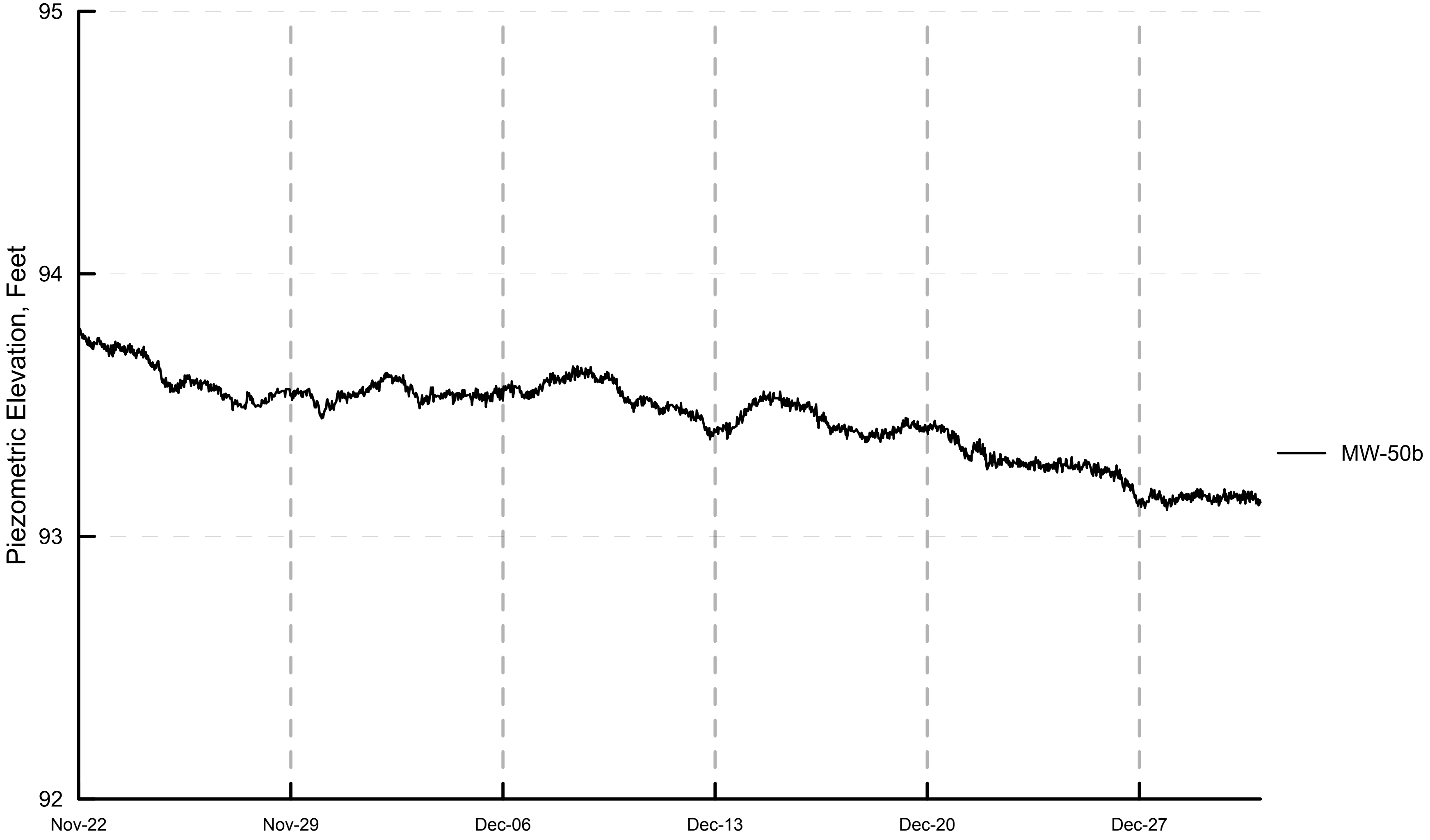
PIEZOMETRIC ELEVATIONS
ONSHORE LNG FACILITIES
ALASKA LNG PROJECT
NIKISKI, ALASKA

PLATE 9



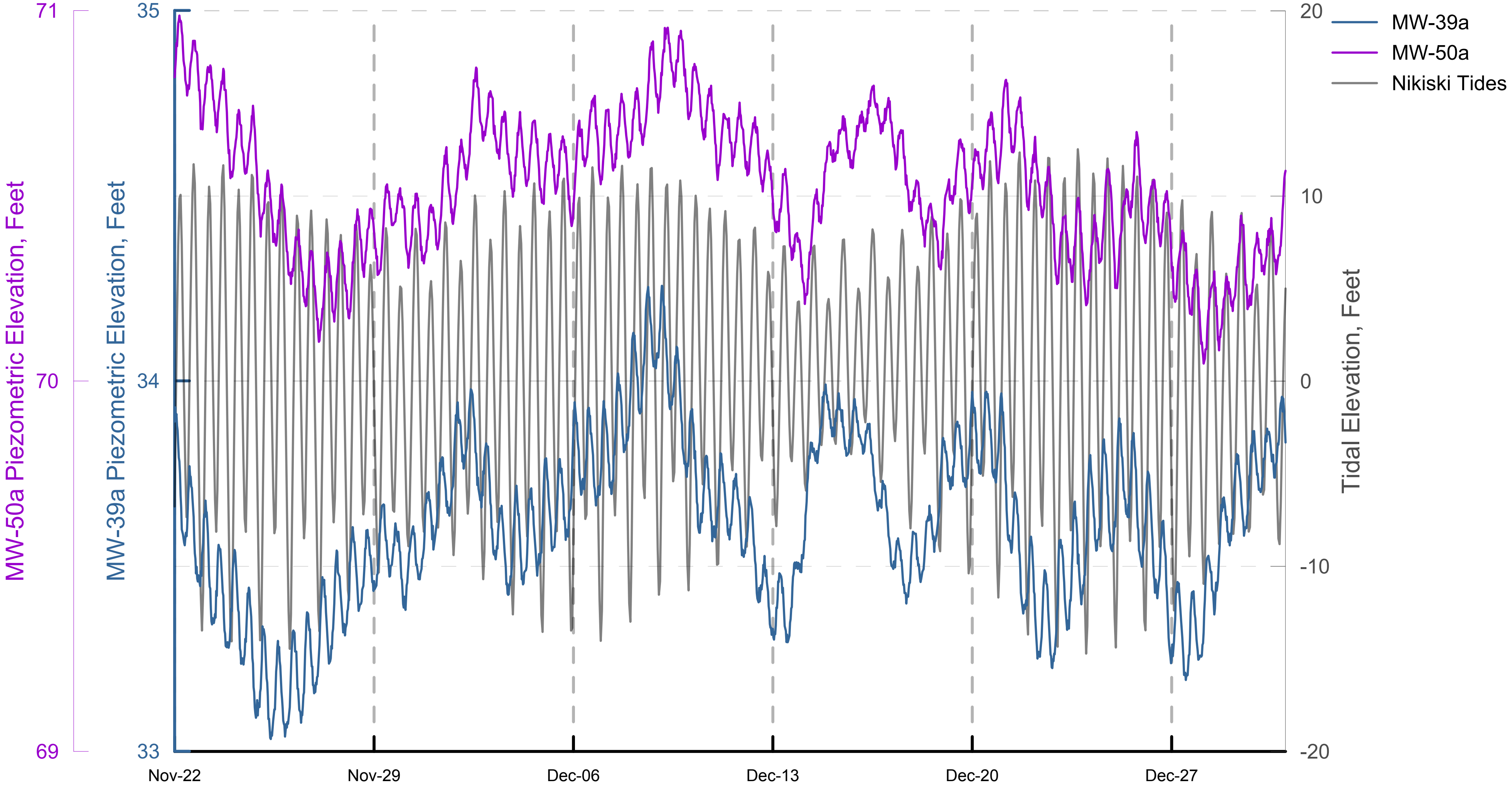
PIEZOMETRIC ELEVATIONS
ONSHORE LNG FACILITIES
ALASKA LNG PROJECT
NIKISKI, ALASKA

PLATE 10

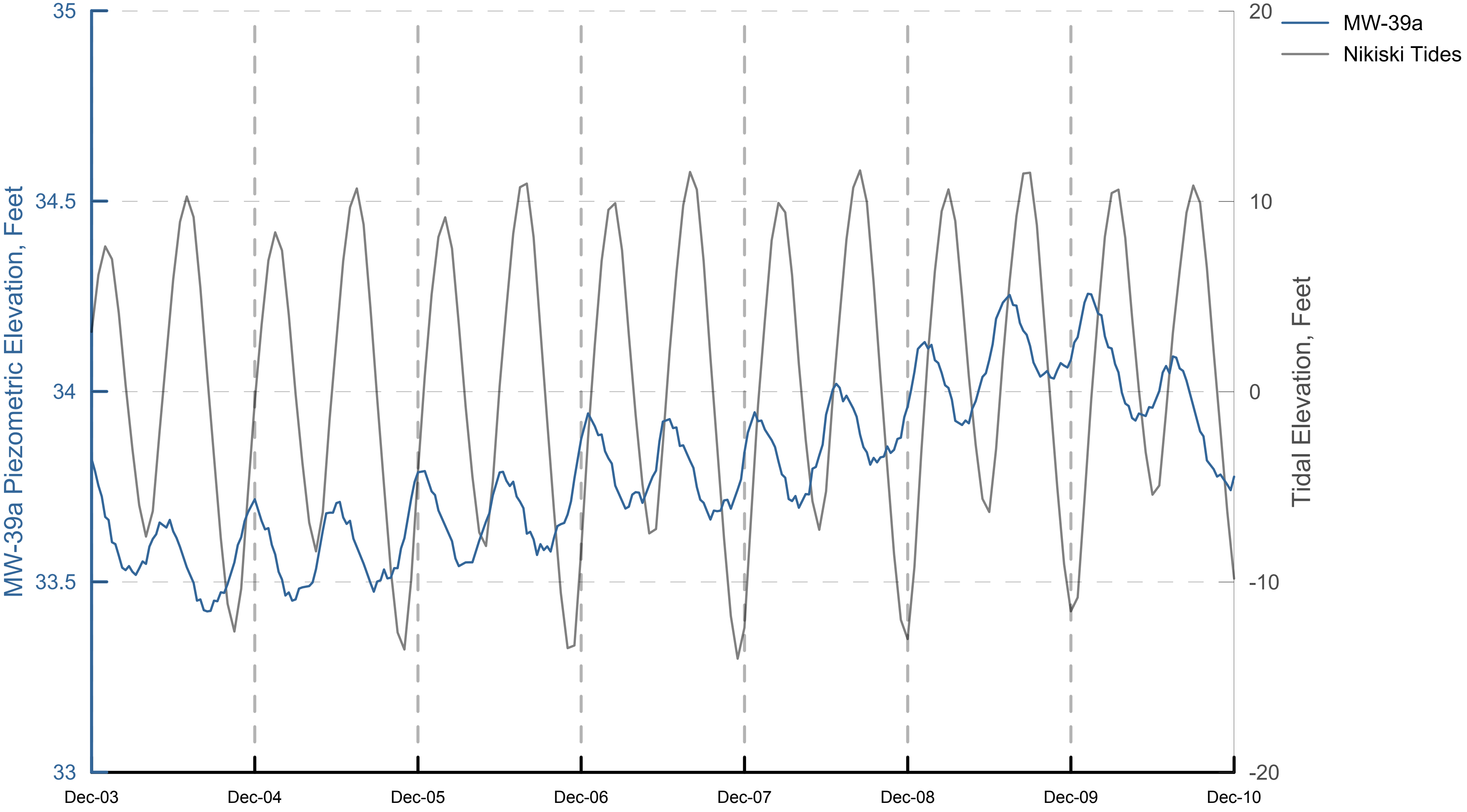


PIEZOMETRIC ELEVATIONS
ONSHORE LNG FACILITIES
ALASKA LNG PROJECT
NIKISKI, ALASKA

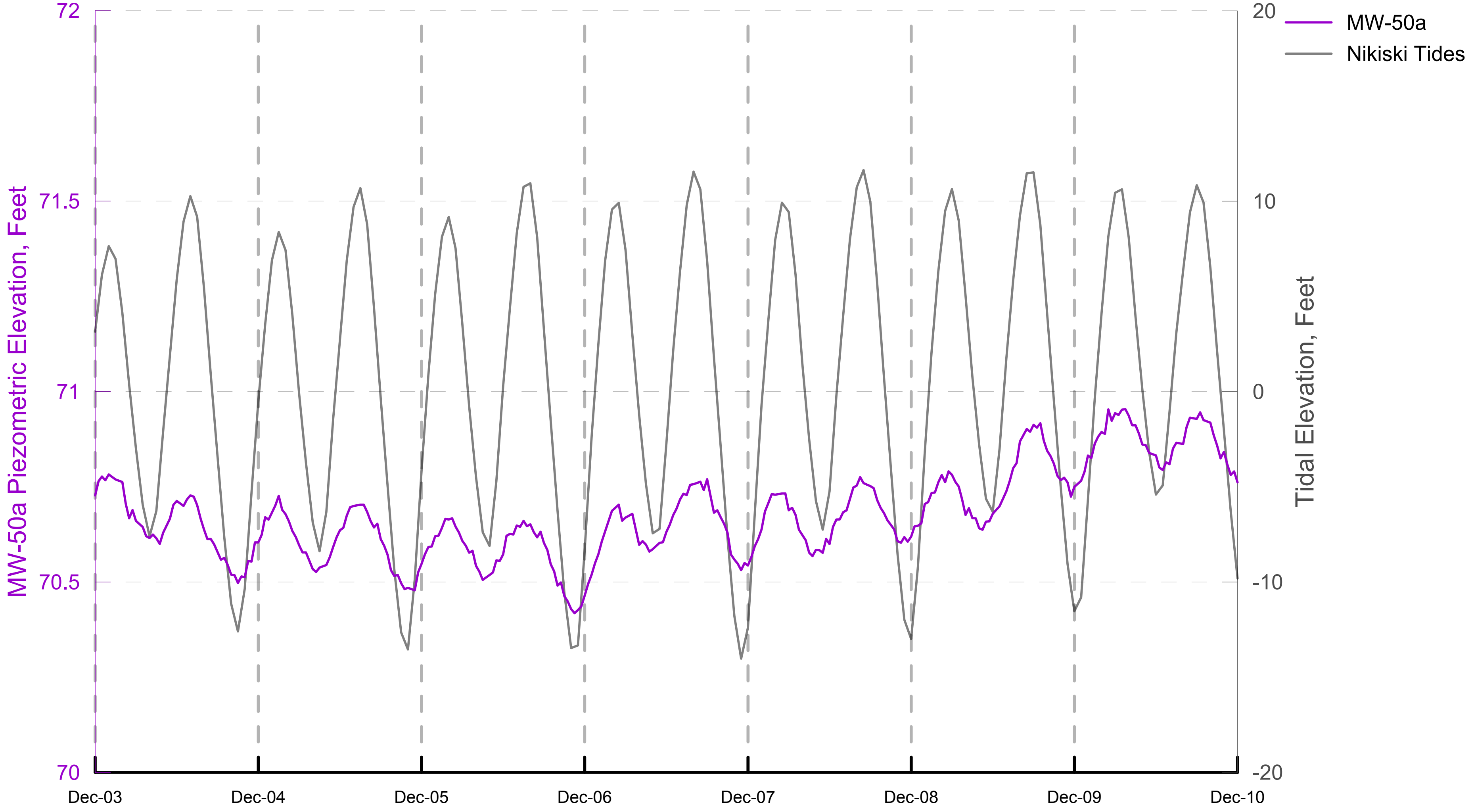
PLATE 11



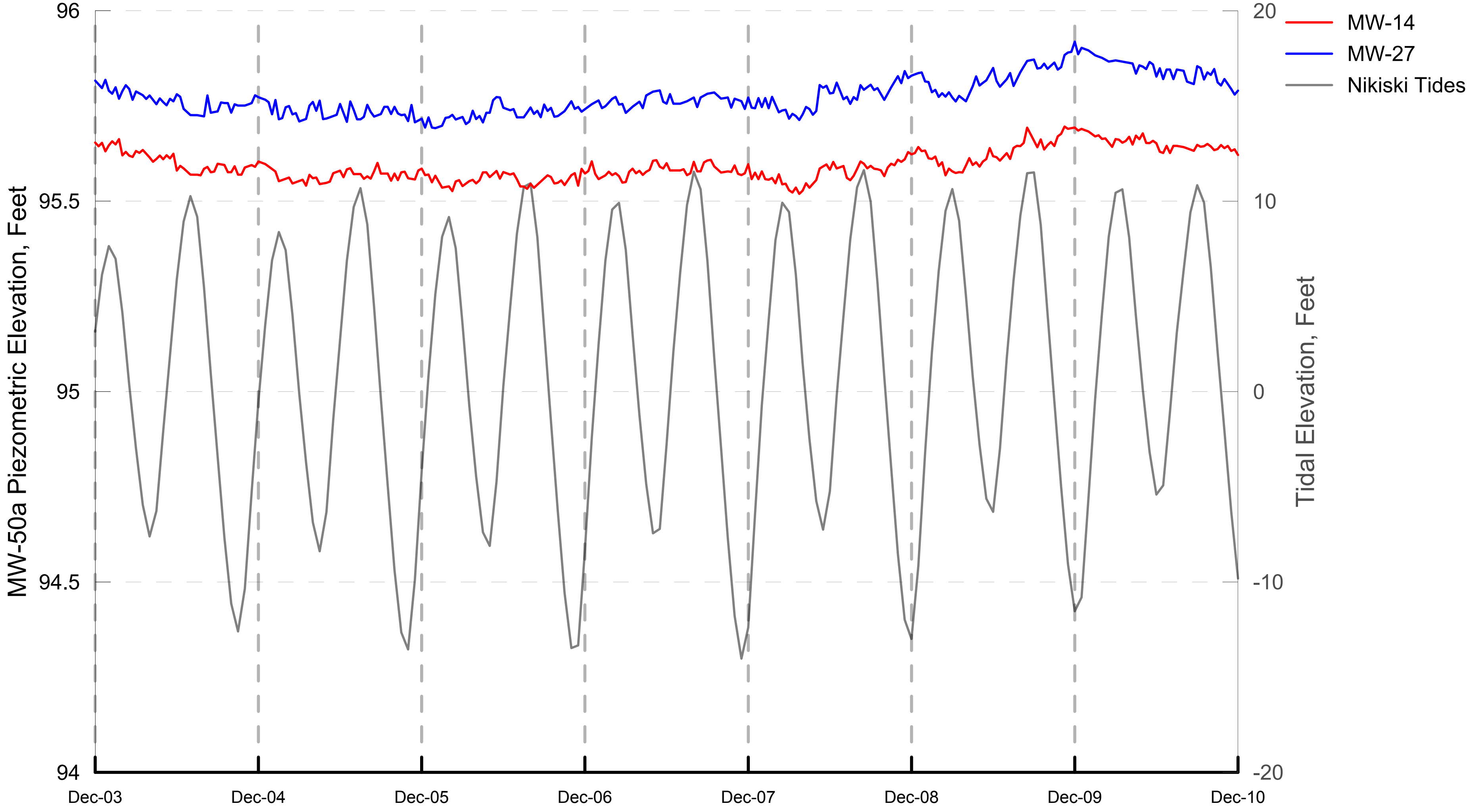
PIEZOMETRIC ELEVATIONS
WITH TIDAL ELEVATIONS
ONSHORE LNG FACILITIES
ALASKA LNG PROJECT
NIKISKI, ALASKA
PLATE 12



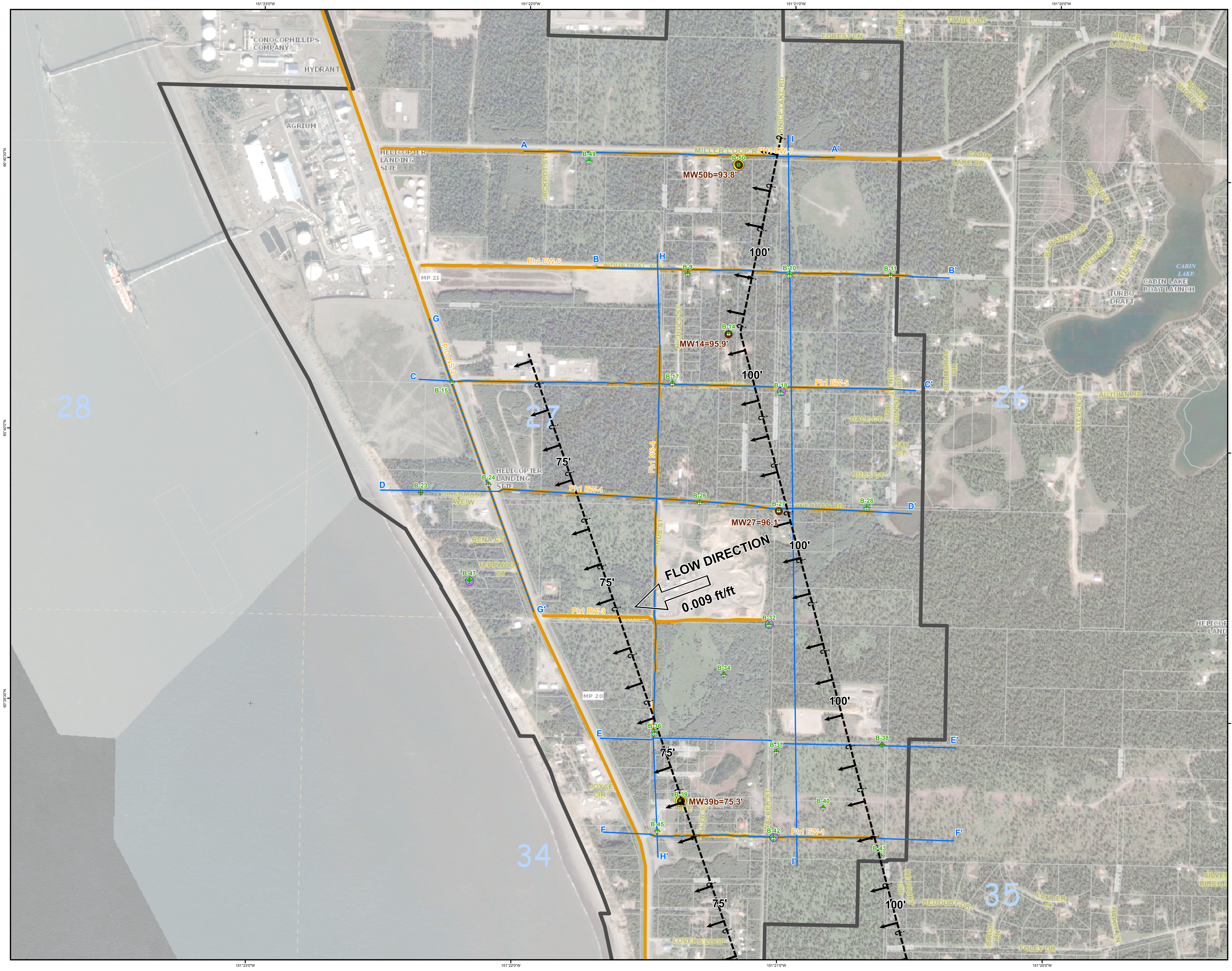
PIEZOMETRIC ELEVATIONS
WITH TIDAL ELEVATIONS
ONSHORE LNG FACILITIES
ALASKA LNG PROJECT
NIKISKI, ALASKA
PLATE 13



PIEZOMETRIC ELEVATIONS WITH TIDAL ELEVATIONS
ONSHORE LNG FACILITIES
ALASKA LNG PROJECT
NIKISKI, ALASKA
PLATE 14



PIEZOMETRIC ELEVATIONS
WITH TIDAL ELEVATIONS
ONSHORE LNG FACILITIES
ALASKA LNG PROJECT
NIKISKI, ALASKA
PLATE 15



LEGEND

PHASE 1 2014 GEOTECHNICAL EXPLORATIONS

- Boring - 100ft
- Boring - 150ft
- Downhole Geophysics
- Monitoring Well
- Permanent Survey Monument
- E-LOGGING

PROJECT SITE LAYERS

- Onshore LNG Facilities

GEOPHYSICAL SURVEY LINES

- Onshore Geophysical Lines

CROSS SECTION LINES

- Cross-Sections

Borings	Depth, ft	As-Built Elevation, ft (NAVD88)	As-Built Coordinates (NAD83 – NSRS2007)		DH[1]	EL[2]	MW[3]	PSM[4]
			Latitude, deg	Longitude, deg				
B-9	100.50	132.25	60.67185419	-151.35640928				
B-10	103.00	132.80	60.67188199	-151.35002128	1			
B-11	101.25	136.36	60.67192943	-151.34366487				
B-14	110.70	133.40	60.67003682	-151.35375743			1	
B-15	101.00	122.96	60.66836028	-151.37105711				
B-17	101.50	131.21	60.66845974	-151.35723247				
B-18	101.50	131.25	60.66826252	-151.35041257	1			1
B-23	186.50	124.63	60.66494561	-151.37288538				
B-24	101.00	120.40	60.66523854	-151.36864010				
B-26	100.50	125.54	60.66481307	-151.35535978				
B-27	101.50	124.35	60.66461107	-151.35039124			1	
B-28	103.00	118.89	60.66475620	-151.34486218	1			
B-32	101.50	122.99	60.66109265	-151.35084727	1			1
B-34	101.00	111.83	60.65951893	-151.35361467				
B-36	103.00	111.70	60.65768300	-151.35789052	1			
B-37	26.50	106.27	60.65717918	-151.35022180				
B-38	151.30	123.47	60.65746298	-151.34359639				
B-39	151.50	95.51	60.65559414	-151.35615280		1	2	
B-40	101.50	120.84	60.65547709	-151.34721579				
B-42	101.50	118.85	60.65453131	-151.35029923	1			
B-43	102.75	121.14	60.65405368	-151.34362451				1
B-45	101.50	109.09	60.65465742	-151.35759481				
B-47	151.00	119.73	60.66227016	-151.36972091	1			1
B-49	101.50	127.76	60.67526763	-151.36274607	1			
B-50	151.50	131.66	60.67524580	-151.35335931		1	2	

Notes:

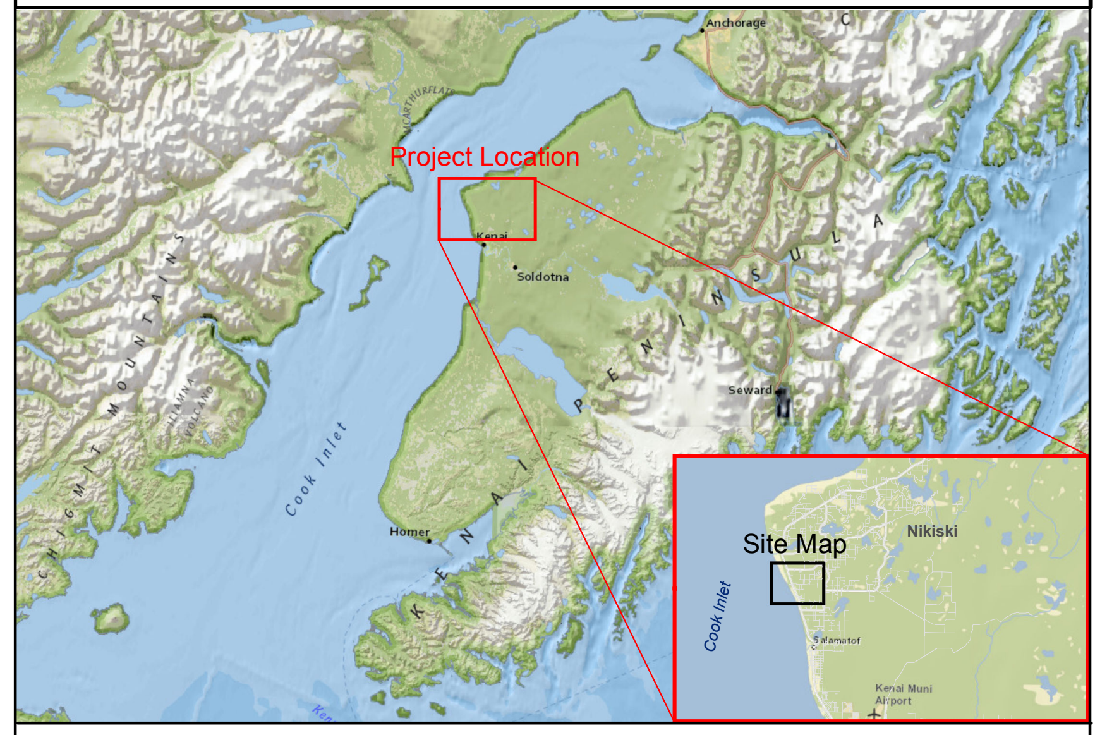
[1] DH= Downhole Seismic Test
[2] EL= Wireline E-Logging Data
[3] MW= Monitoring Well
[4] PSM= Permanent Survey Monument

Monitoring Wells	Depth, ft	As-Built Elevation, ft (NAVD88)	As-Built Coordinates (NAD83 – NSRS2007)	
			Latitude, deg	Longitude, deg
MW-14	55	136.24	60.67001489	-151.35376440
MW-27	56	126.79	60.66459539	-151.35037410
MW-39A	146	97.99	60.65557926	-151.35615710
MW-39B	39	97.75	60.65560508	-151.35613450
MW-50A	145	135.12	60.67523060	-151.35331470
MW-50B	56	134.67	60.67526072	-151.35336650

Permanent Survey Monuments	Corresponding Boring	As-Built Elevation, ft (NAVD88)	As-Built Coordinates (NAD83 – NSRS2007)	
			Latitude, deg	Longitude, deg
PSM-1	B-18	131.29	60.66827846	-151.35036057
PSM-2	B-47	119.87	60.66224113	-151.36969412
PSM-3	B-32	123.16	60.66110421	-151.35082797
PSM-4	B-42	118.47	60.65453570	-151.35025144

Notes:

1. Base imagery provided by Kenai Peninsula Borough (KPB).
2. Onshore LNG Facility boundary provided by EMALL.
3. As-built coordinates of exploration locations provided by JOA Surveying Services, Inc. (JOA).
4. Groundwater elevations measured 11/20/2014 and 11/21/2014.



GEODETIC INFORMATION

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FALSE NORTHING:	0.0
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SCALE FACTOR:	0.9999
LATITUDE OF ORIGIN:	54.0
LINEAR UNIT:	US Foot
SPHEROID:	GRS 1980
SEMI-MAJOR AXIS:	6,378,137.000
SEMI-MINOR AXIS:	6,356,752.314140356
INVERSE FLATTENING:	298.257222101

N
W E
S

Coordinate Grid: NAD 1983 (NSRS 2007), Degrees Minutes Seconds

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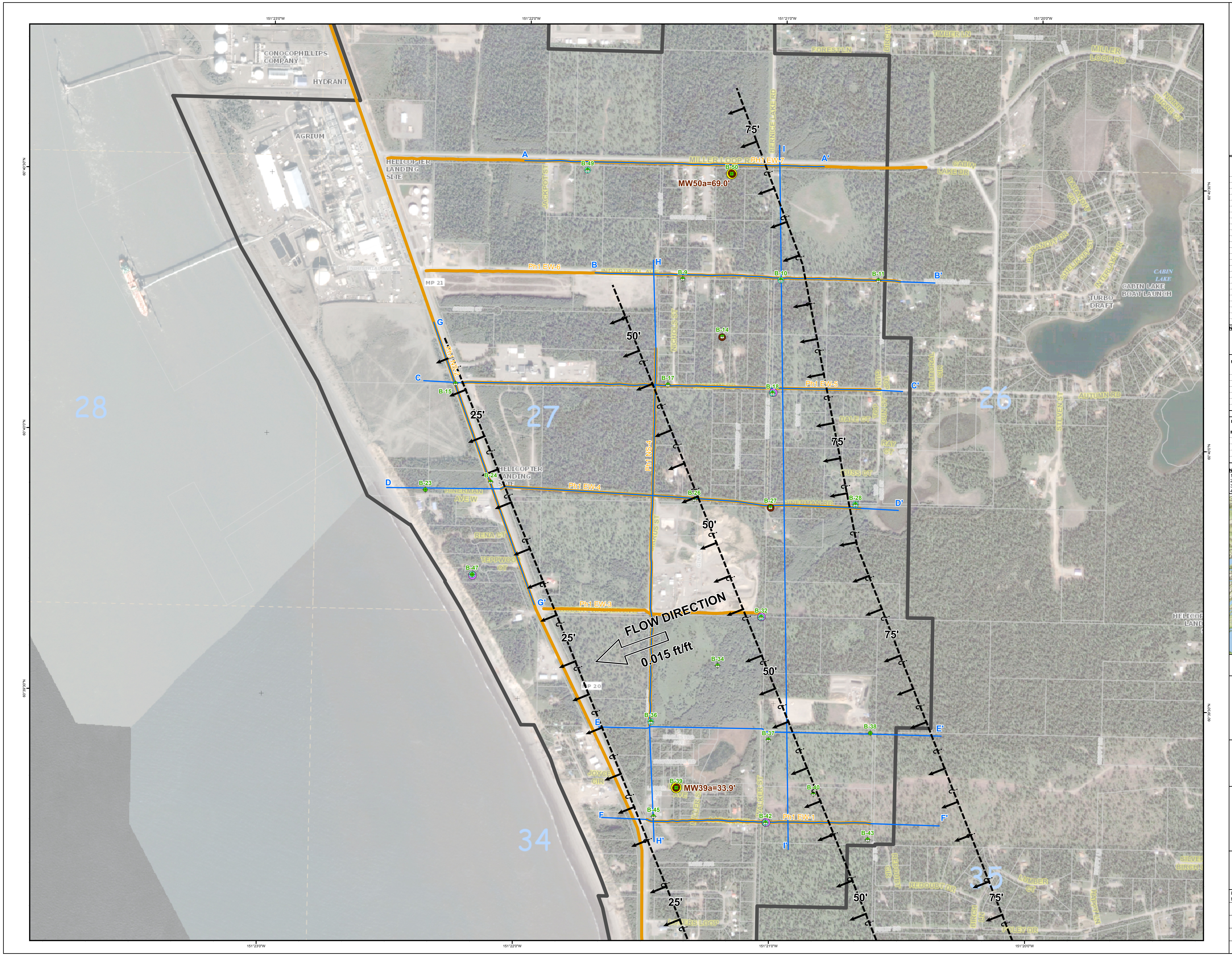
APPARENT UPPER AQUIFER GROUNDWATER CONTOURS
ONSHORE FACILITIES
ALASKA LNG PROJECT
NIKISKI, ALASKA

0 500 1,000
Feet

REV NO:	DATE:	DESCRIPTION:	DRAWN:	CHKD:	APPR:
0	01/15/2015	Monitoring Well Draft Report	TNS	KS	JA
1	04/15/2015	Final Report	TNS	YSC	JA

JOB NUMBER: 04.10140094-10

DRAWING NO.: PLATE 16



LEGEND

PHASE 1 2014 GEOTECHNICAL EXPLORATIONS

- ⊕ Boring - 100ft
- ⊕ Boring - 150ft
- ● Downhole Geophysics
- ● Monitoring Well
- ● Permanent Survey Monument
- ● E-LOGGING

PROJECT SITE LAYERS

- ▭ Onshore LNG Facilities

GEOPHYSICAL SURVEY LINES

- ▬ Onshore Geophysical Lines

CROSS SECTION LINES

- ▬ Cross-Sections

Borings	Depth, ft	As-Built Elevation, ft (NAVD88)	As-Built Coordinates (NAD83 – NSRS2007)		DH[(1)]	EL[(2)]	MW[(3)]	PSM[(4)]
			Latitude, deg	Longitude, deg				
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B-39	151.50	95.51	60.65559414	-151.35615280		1	2	
B-40	101.50	120.84	60.65547709	-151.34721579				
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B-43	102.75	121.14	60.65405368	-151.34362451				1
B-45	101.50	109.09	60.65465742	-151.35759481				
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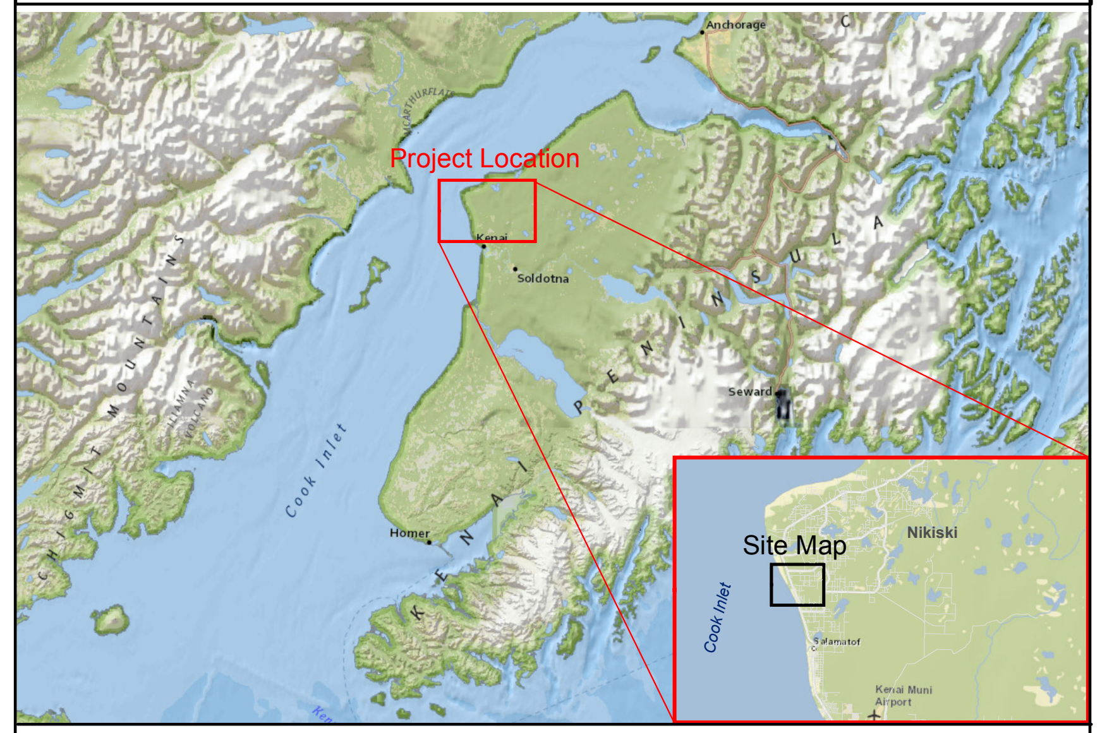
PSM-3	B-32	123.16	60.66110421	-151.35082797
PSM-4	B-42	118.47	60.65453570	-151.35025144

Notes:

1. Base imagery provided by Kenai Peninsula Borough (KPB).
2. Onshore LNG Facility boundary provided by EMALL.
3. As-built coordinates of exploration locations provided by JOA Surveying Services, Inc. (JOA).
4. Groundwater elevations measured 11/22/2014.



GEODETIC INFORMATION

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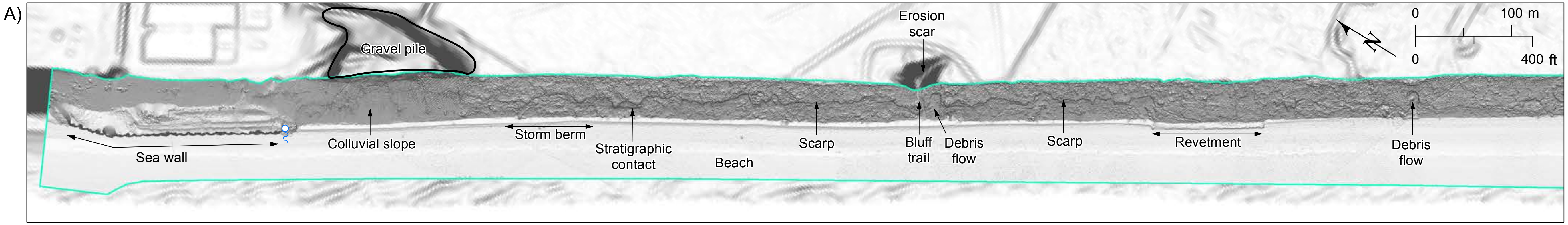
NIKISKI, ALASKA

0 500 1,000
Feet

REV NO:	DATE:	DESCRIPTION:	DRAWN:	CHKD:	APPR:
0	01/15/2015	Monitoring Well Draft Report	TNS	KS	JA
1	04/15/2015	Final Report	TNS	YSC	JA

JOB NUMBER: 04.10140094-10
DRAWING NO.: PLATE 17

A)



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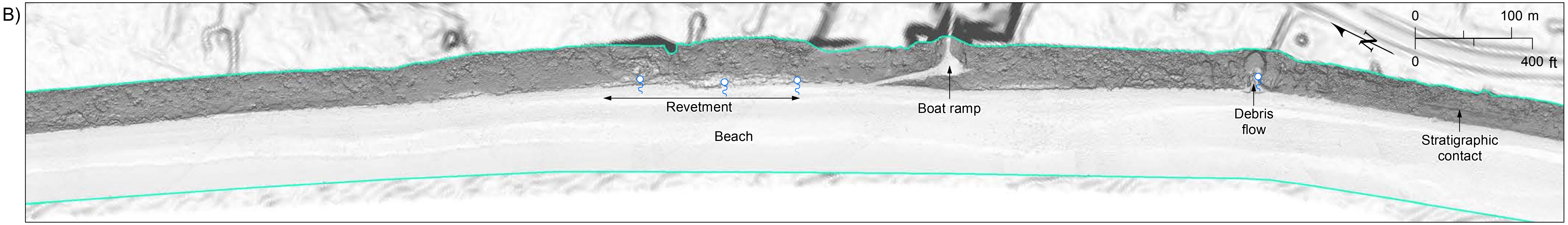

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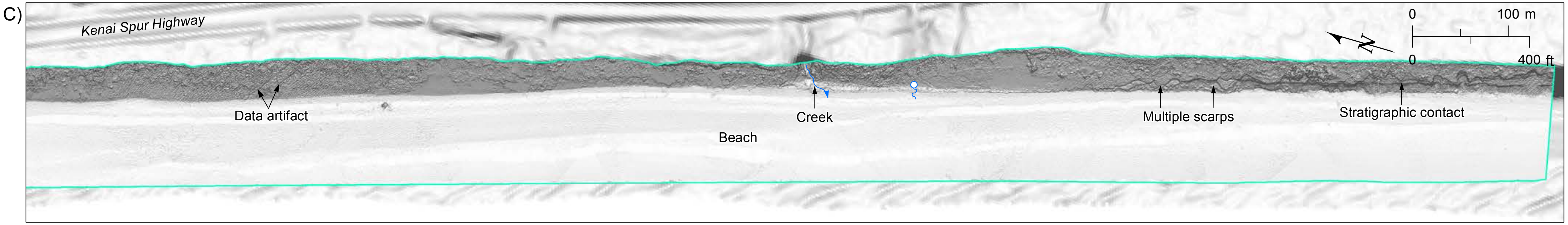
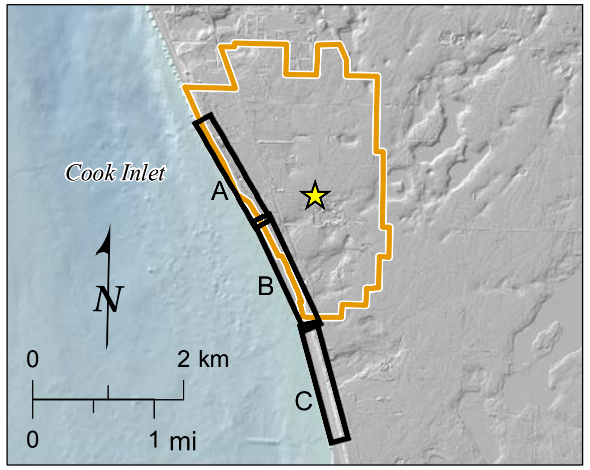




Explanation

▭ Sea cliff LiDAR data extent

⚲ Spring or seep

▭ Project boundary

☆ Site center

REV NO.	DATE	DESCRIPTION:	DRAWN	CHKD.	APPR.
0	01/15/2015	DRAFT REPORT	TNS	KS	JA
1	04/15/2015	FINAL REPORT	JA	DS	JA
JOB NUMBER		04.10140094-10	DRAWING NO.		

COASTAL EROSION FEATURES OBSERVED IN 2014 LIDAR DATA

ONSHORE LNG FACILITIES
ALASKA LNG PROJECT
NIKISKI, ALASKA

PLATE 18

Document Path: \\psf\Host\Volumes\project\Projects\10_0000\10_140094_AKLNG_EM_PreFEED\05_Graphics\10_140094 D Figures\Plate 18 _Jeriann Alexander\Plate 18 D-106_Coastal_Erosion.mxd

APPENDIX A
WELL INSTALLATION COMPLETION REPORT

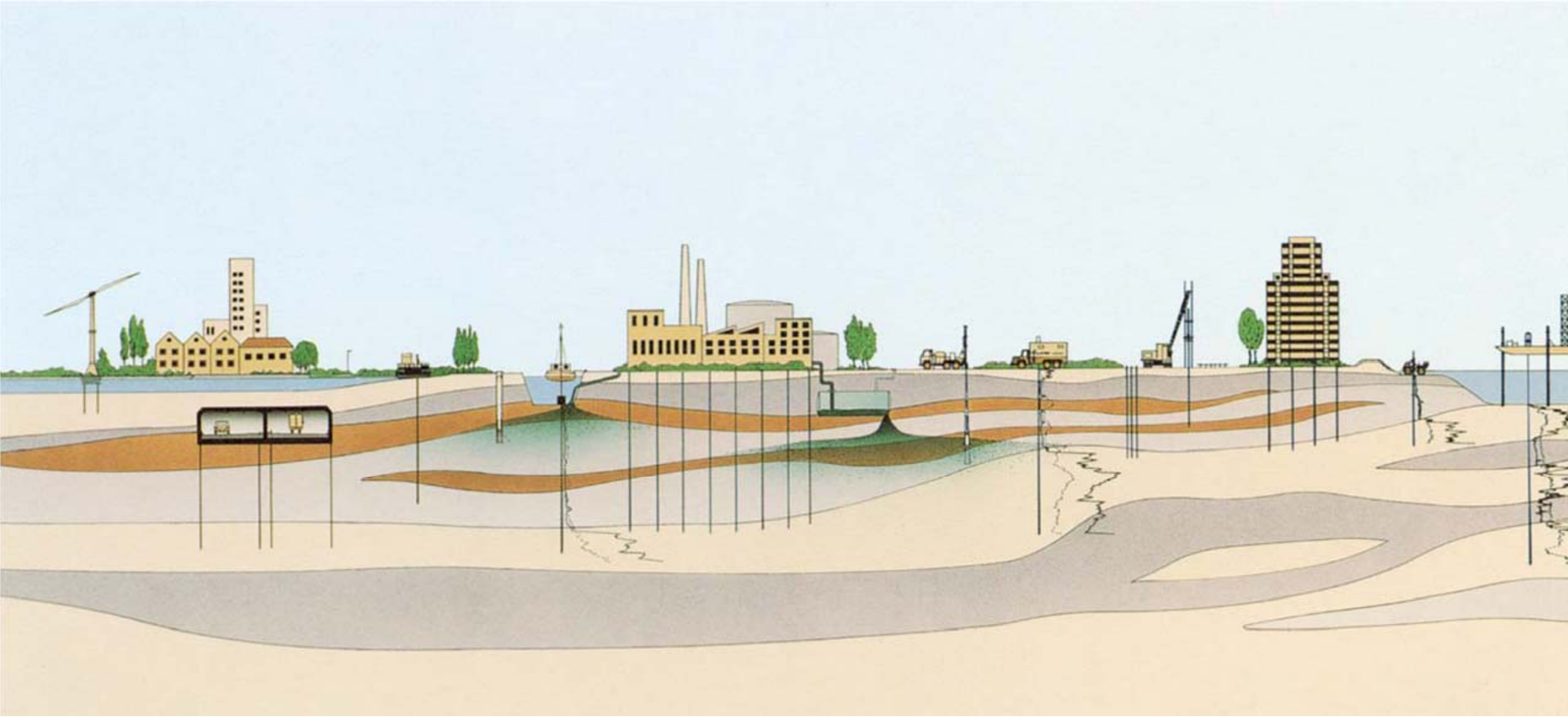
FUGRO CONSULTANTS, INC.

WELL INSTALLATION COMPLETION REPORT
ALASKA LNG PRE-FEED INVESTIGATION
NEAR NIKISKI, KENAI PENINSULA, ALASKA

April 2015

Report No. 04.10140094-10
EXXONMOBIL ALASKA LNG LLC (EMALL)
HOUSTON, TEXAS

Rev	Date	Revision Description	Originator	Reviewer	Approver
A	15-Jan-15	Draft Issue	DS	JA	PS
0	29-April-15	Final Issue	JA/BB	DS	JA



FUGRO CONSULTANTS, INC.

1000 Broadway, Suite 440
Oakland, California 94607
Tel: (510) 267-4429
Fax: (510) 268-0545

Report No. 04.10140094-10
April 29, 2015

ExxonMobil Alaska LNG LLC (EMALL)
10613 W. Sam Houston Pkwy N, Suite 500
Houston, TX, 77064

Attention: Richard Raines
Geotechnical Engineer/Technical POC

Pre-FEED
DRAFT - Well Installation Completion Report
Onshore LNG Facilities
Alaska LNG Project
Nikiski, Alaska

Fugro Consultants, Inc. (Fugro) is pleased to present this well installation completion report for the onshore facilities of the Alaska LNG Project (AKLNG) located in Nikiski, Alaska. Our services were authorized under Service Work Order No. AKLNG-FUG-US-002 Rev 0, dated August 8, 2014 in accordance with the Service Agreement No. A2275592 between Fugro and ExxonMobil Global Services Company, dated October 29, 2012. Fugro has been contracted by ExxonMobil Alaska LNG LLC (EMALL) under the service order to provide pre front-end engineering and design (Pre-FEED) level site investigation services for the proposed AKLNG Project.

Current plans are to complete the site investigation for Pre-FEED level study in two phases. Field services for Phase 1 were completed in fall of 2014, whereas the Phase 2 field services are planned for summer of 2015. This report is based on Phase 1 field investigation activities conducted between August, 2014 and December, 2014.

We appreciate the opportunity to be of service to EMALL. Please call Mr. Abhishek Shethji, P.E., Fugro's Project Manager at (713) 369-5431, if you have any questions or comments concerning this report, or when we may be of further assistance.

Sincerely,

FUGRO CONSULTANTS, INC.
TBPE Firm Registration No. 299

Jeriann Alexander

Jeriann Alexander, P.E. R.E.P.A
Principal Engineer

Paul A. Sorensen

Abhishek S. Shethji, P.E.
Project Manager

Paul Sorensen, P.G., CHg
Principal Hydrogeologist

Copies Submitted: E-mail

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PLATES

Plate

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1.0 INTRODUCTION

Fugro Consultants, Inc. prepared this report to document the installation of groundwater monitoring wells at the Alaska LNG site (Site) near Nikiski, Kenai (see Plate A-13 – Vicinity Map). The wells were installed to collect baseline groundwater quality data and provide means to collect water level data and to conduct aquifer testing to further evaluate groundwater conditions at the Site.

Well installations and subsequent development and aquifer testing activities were conducted in general conformance with the approved Project Execution Plan (PEP) dated September 14, 2014. However, due to difficult drilling conditions, changing weather conditions, and scheduling conflicts, several planned well activities were not completed during the 2014 field campaign. Deviations were discussed with the Client prior to dropping the planned events from the schedule. Specific deviations from the PEP included the following:

- Twenty groundwater monitoring wells (twelve shallow; eight deeper) were originally contemplated. Six wells (four shallow; two deeper, targeting the Upper and Lower aquifers, respectively) were installed during the 2014 field campaign.
- The laboratory testing portion of the groundwater quality assessment was not initiated at the Site since the wells were installed to close to the onset of winter.
- Video logging of completed wells to document well screen locations was not completed.

2.0 MONITORING WELL INSTALLATION AND DATA COLLECTION

Six monitoring wells, designated MW-14, MW-27, MW-39a, MW-39b, MW-50a, and MW-50b, were installed at the locations shown on Plate A-14 (Investigation Plan) between November 12th and November 21st, 2014. The wells were installed to enable the future collection of data to evaluate groundwater parameters and quality, as well as to facilitate collection of continuous water level data. Well locations were selected to provide preliminary geospatial coverage of the site and ease of access for future sampling and monitoring activities.

This section of the report documents the completion of monitoring well installation and development of six groundwater monitoring wells at the site. Subsequent activities, including slug testing and micro diver installation, commenced following well installation and are also discussed in this section.

2.1 WELL INSTALLATION

Well locations were co-located within a few feet of previously drilled borings at the Site. Geophysical logging records and visual classifications, available from Borings B-39 and B-50, were initially reviewed to develop a general understanding of the Upper and Lower Aquifer unit deposits and to identify the presence and location of aquitard materials. General well installation details were then developed. During well borehole drilling, visual classification of encountered materials were compared to completed boring logs specific to each well location. The wells were identified by labeling them with the same boring number as their co-located boring, and were further designated with an “a” to indicate completion as a Lower Aquifer or deeper screened well, or a “b” to indicate completion as an Upper Aquifer or shallower screened well. Monitoring wells MW-14, MW-27, MW-39b and MW-50b were screened in the shallow groundwater horizon comprising the Upper Aquifer; wells MW-39a and MW-50a were screened in a deeper groundwater horizon.

The monitoring well boreholes were drilled using truck-mounted drill rigs. Monitoring wells MW-14, MW-27, and MW-50b were drilled to their completion depths using hollow-stem, dry-auger drilling techniques, whereas monitoring wells MW-39a, MW-39b, and MW-50a were drilled using a combination of hollow-stem, dry-auger and wet-rotary drilling techniques. General monitoring well installation included the following activities:

- Placing a 1-foot thick layer of 8-12 gradation filter sand at the bottom of the borehole.
- Installing a 5-foot long, 2-inch diameter siltation basin with an end cap approximately 1-foot above the bottom of the borehole.
- Installing a 20-foot long, slotted screen with 0.020-inch slots on top of the siltation basin and extending a 2-inch riser pipe from the top of the screen section to the ground surface.
    - A 2-inch diameter slotted screen was installed at monitoring wells MW-14, MW-27, MW-39b, MW-50a, and MW-50b.

  - A 2-inch inner diameter, 3.4-inch outer diameter, prepacked slotted screen was installed at monitoring well MW-39a.
- Backfilling around the riser pipe with 8-12 gradation filter sand to above the top of the screen.
- Placing and hydrating a 2-foot thick bentonite seal on top of the filter sand in monitoring wells MW-14, MW-27, and MW-50b.
- Placing cement-bentonite grout from the top of the bentonite seal/filter sand to the ground surface to 3- to 5-feet below the ground surface.
- Placing gravel from the top of the cement-bentonite grout to the ground surface.
- Installing the surface completion around the monitoring well riser pipe which consisted of a 5-foot long, 6-inch diameter iron stovepipe casing.

All monitoring well materials consisted of Schedule 40, flush threaded PVC which was contained in the original plastic wrapping until installation. Monitoring well installation details are presented on Plates A-15 through A-20. The boring logs of the previously drilled borings at each monitoring well location are presented on Plates A-21 through A-24b. Monitoring well construction details for each groundwater monitoring well are presented in Table 2.1.1.

Table 2.1.1: Monitoring Well Construction Details

Well ID	MW-14	MW-27	MW-39a	MW-39b	MW-50a	MW-50b
Completion Date (1)	11/20/2014	11/17/2014	11/16/2014	11/17/2014	11/17/2014	11/20/2014
Borehole Diameter (inches)	8.25	8.25	4.00	8.25	4.00	8.25
Borehole Termination Depth (feet)	56.0	57.0	147.0	40.0	146.0	55.5
PVC Casing Termination Depth (feet)	55.0	56.0	146.0	39.0	145.0	55.0
PVC Casing Diameter (inches)	2	2	2	2	2	2
Depth of Screen Interval (feet)	30-50	31-51	120.5-141	14.5-34.5	120-140	30-50
Groundwater Depth (feet)	41.50	37.50	42.20	25.20	61.50	38.20
Groundwater Elevation (feet) (2)	95.9	96.1	33.9	75.3	70.8	93.8

Notes: (1) Completion Date refers to date of well development. (2) Elevations are referenced to NAVD88 Datum.

The monitoring well locations were surveyed by JOA Surveying Services, Inc. (JOA), a qualified and licensed State of Alaska surveyor, between November 18 and November 20, 2014. The elevations are referenced to Permanent Survey Monuments surveyed to the NAVD88 datum and the horizontal location information is reference to NAD83 – NSRS2007. Data points were acquired in general accordance with USAKE-EX-GSZZZ-00-0001 Geodetic Parameters document provided by EMALL.

Monitoring well elevations (referenced from top of the PVC casing riser) are summarized in Table 2.1.1. Additional information related to surveying and Permanent Survey Monuments is presented in the Fugro Geotechnical Data Report, Onshore LNG Facilities, Alaska LNG Project, Report No. 04.10140094-8.

Table 2.1.2: As-Built Coordinates for Monitoring Wells

Monitoring Well ID	Depth Below Existing Ground Surface, ft	As-Built Elevation, Top of Casing, ft (NAVD88)	As-Built Coordinates (NAD83 – NSRS2007)	
			Latitude, deg	Longitude, deg
MW-14	55	136.24	60.67001489	-151.35376440
MW-27	56	126.79	60.66459539	-151.35037410
MW-39a	146	97.99	60.65557926	-151.35615710
MW-39b	39	97.75	60.65560508	-151.35613450
MW-50a	145	135.12	60.67523060	-151.35331470
MW-50b	55	134.67	60.67526072	-151.35336650

2.2 WELL DEVELOPMENT

The groundwater monitoring wells were developed by agitating and purging the groundwater within the wells using a ¾-inch surge block, a disposable bailer, and a peristaltic pump. Purged groundwater was temporarily contained at the surface, inspected for sheen prior to release, and subsequently discharged onto the ground surface in a manner which mitigated surficial erosion and performed in accordance with Alaska Department of Environmental Conservation Permit No. AKG003000. No odors or discoloration of purged groundwater was observed during well development.

A summary of the monitoring well development program records and details are presented in Table 2.2.1.

Table 2.2.1: Monitoring Well Development Records

Monitoring Well ID	Date of Well Development	Water Removed During Development, gallons	Casing Volume, gallons	Approximate Number of Casing Volumes Removed (1)
MW-14	November 20, 2014	108.8	2.4	45.3
MW-27	November 17, 2014	60.0	4.0	15.0
MW-39a	November 16, 2014	100.0	21.4	4.7
MW-39b	November 17, 2014	34.1	2.7	12.6
MW-50a	November 17, 2014	77.7	13.2	5.9
MW-50b	November 20, 2014	27.4	2.3	11.9

Notes: (1) Estimates of the volume of water removed from the monitoring well in units of the PVC casing volume.

2.3 SLUG TESTING

Slug testing was performed on five of the six monitoring wells (MW-14, MW-27, MW-39b, MW-50a, and MW-50b) on November 20 and 21, 2014 to estimate the permeability of the identified Upper and Lower Aquifer units. Slug testing was completed by Fugro's field personnel. A slug test was not performed on Monitoring Well MW-39a due to a slight bend at the top of the monitoring well riser, preventing the slug from being lowered into the riser.

A spare *Micro-Diver* (the same as the instrumentation equipped in the monitoring wells) was set within the monitoring well screen and programmed to obtain water level readings at 0.5 second intervals during the slug tests. A 10-ft long slug, with 1.5-in outer diameter (total volume = 212 in^3), was used to perform the slug test. Using the known depth of the water below the top of the monitoring well riser, the needed depth was marked on the rope holding the slug and the slug was lowered into the monitoring well riser until the slug was completely submerged. After submerging the slug, the water level was measured to check if the water level had returned to its original stage. In each slug test, the water level seemed to stabilize instantaneously. The slug was then quickly removed, immediately dropping the surface of the water column. The water column then began to rise back to stabilization and pressure change readings in the water column were obtained at 0.5 second intervals by the Micro-Diver until the water level reached its pretest level. Slug testing data plots, edited raw data excel files, and an excel table of inputs used to create the data plots are included as Appendix A to this report (Plates A-29 through A-33).

Based upon the collected data, Fugro used the Bouwer and Rice method (ASTM Standard D5912-96) to process the data to obtain aquifer hydraulic conductivity (K values). The derived K values varied from 190 to 1,550 feet/day. These K values are very high, and the wells all recovered from initial displacement to the static level within a few seconds. Slug tests are considered most reliable and accurate (assuming wells are properly constructed and developed) for aquifers of low to moderate K values (i.e., K of less than 50 feet/day). Given the very quick recovery and associated high slug-test derived K values for these wells, these data should be used with caution (recognizing the inherent degree of uncertainty). Pumping tests are needed to confirm K values for use in analyses related to construction dewatering and other applications, as described in the Fugro Hydrogeologic Report, Report No. 04.10140094-10.

2.4 PRESSURE TRANSDUCER INSTALLATION

Fugro installed Micro-Diver instrumentation systems to measure piezometric levels and to set up a wireless retrieval system at each well location. The instrumentation system, acquired from Schlumberger Water Services, is referred to as the Diver-NETZ system, and consists of the following components:

- ***Micro-Diver*** – absolute (non-vented) pressure transducer used to measure water pressure (which is converted to a pressure head by the data logger) and temperature, and to store the data.
- ***Diver-DXT*** – short range radio transmitter with built in barometer that connects to the diver unit via a coaxial cable and wirelessly connects to a Diver-Gate unit for data transmission.
- ***DXT Cable*** – coaxial cable for suspending the Micro-Diver unit in the riser pipe, and transmitting data from the Micro-Diver to the Diver-DXT transmitter.
- ***Diver-Gate*** – portable modem device used to connect the Diver-DXT transmitter to a mobile handheld device or laptop computer via Bluetooth connection for data transmission.

The piezometer data is collected wirelessly utilizing the handheld Diver-Gate, along with periodic data downloads using a portable laptop at the well locations. A list of the equipment obtained for the wireless system is identified in Table 2.4.1.

Table 2.4.1: Diver-NETZ System Components for Monitoring Well Locations

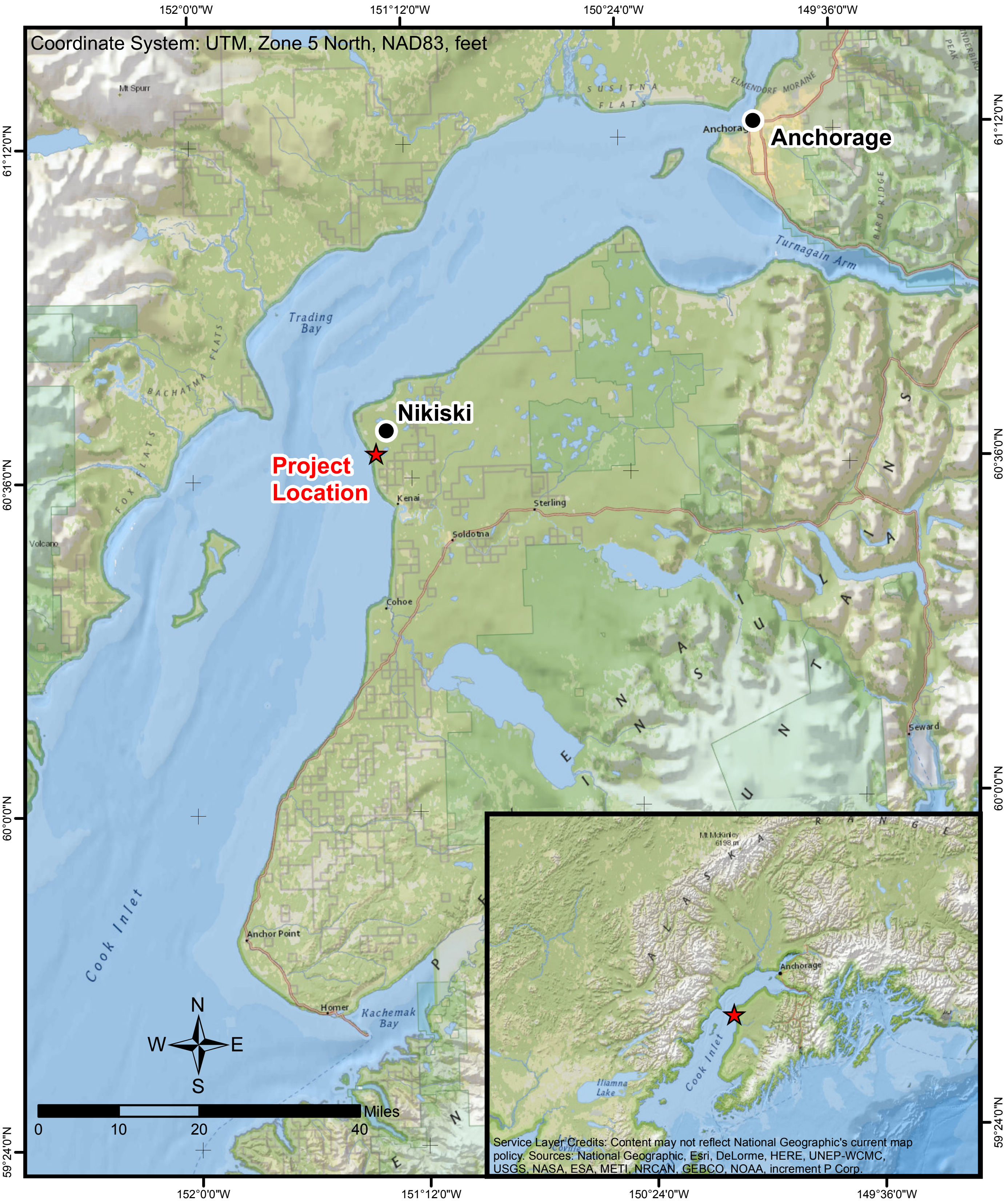
Monitoring Well ID	Final DXT Cable Length, ft	Elevation of Micro-Diver, ft (NAVD88)	Micro-Diver Serial No.	Diver-DXT Serial No.
MW-14	49.7	85.1	S3097	E2164
MW-27	49.7	75.7	R2357	E2489
MW-39a	140.9	-44.3	R2351	E2311
MW-39b	34.7	61.6	R2352	E2285
MW-50a	139.6	-5.9	R2349	E2274
MW-50b	50.4	82.8	R2354	E2153
Diver-Gate				141403B00199

Water level measurements were continuously recorded over the period between November 22 and December 31, 2014. This data obtained from the Micro-Diver download is presented on Plates A-25 to A-28.

3.0 CONCLUSIONS

A total of six groundwater wells were installed to evaluate groundwater and aquifer characteristics at the Site. Based on lithologic data collected during previous subsurface explorations of companion boreholes, four of the wells were targeted for screening within the Upper Aquifer unit; the other two were targeted for screening within the Lower Aquifer unit. Based on the data collected to date, the wells appear to be properly designed and constructed for these purposes.

PLATES

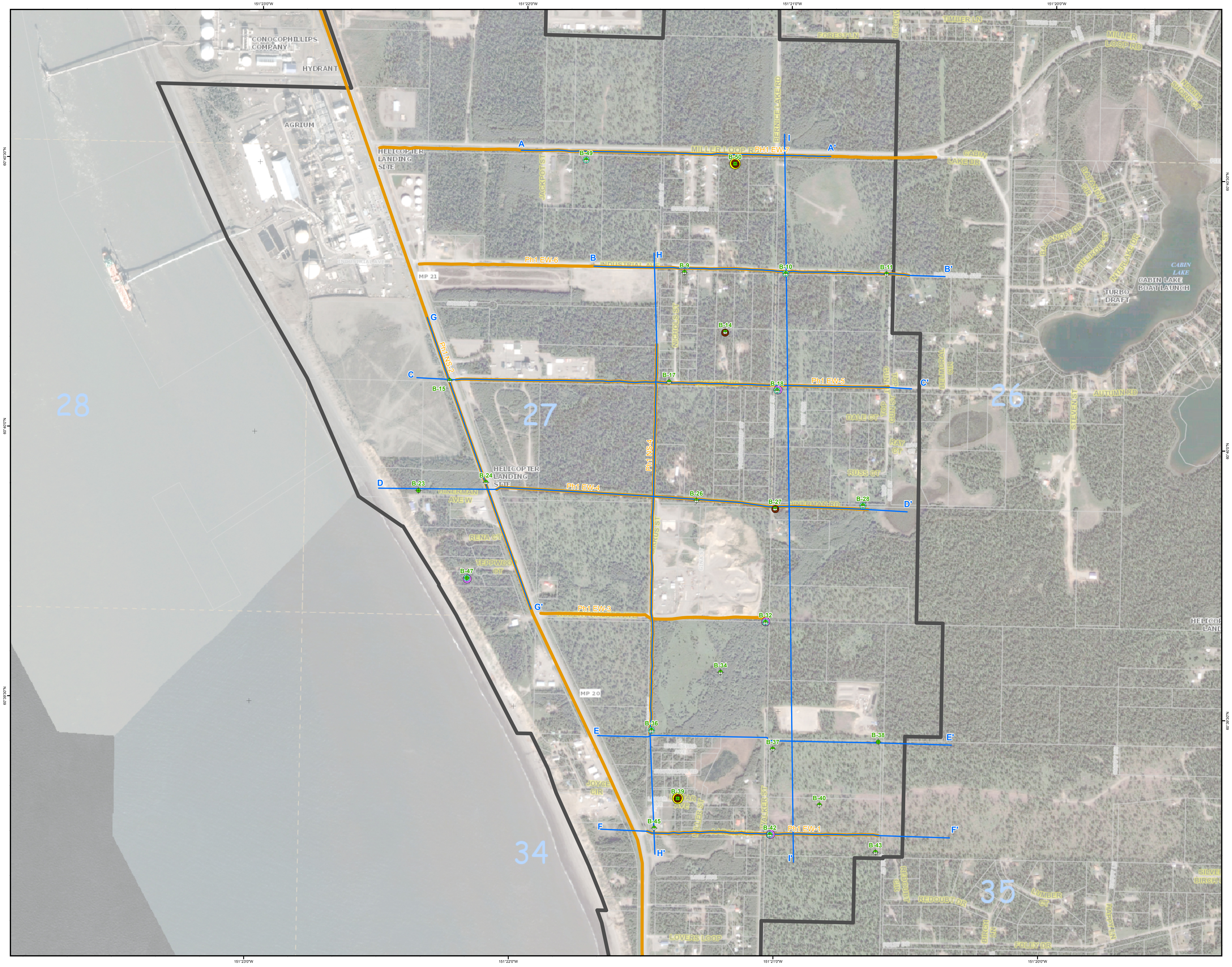


Service Layer Credits: Content may not reflect National Geographic's current map policy. Sources: National Geographic, Esri, DeLorme, HERE, UNEP-WCMC, USGS, NASA, ESA, METI, NRCAN, GEBCO, NOAA, increment P Corp.

R:\04100\2014 Projects\04.10140094 - AKLNG\05_GIS\Outputs\01_REPORTS\2015_04_15_Final_Hydrologic_Report\Appendix A\MXD\Plate_A-13_VicinityMap.mxd, 4/15/2015, serranot

VICINITY MAP
ONSHORE FACILITIES
ALASKA LNG PROJECT
NIKISKI, ALASKA

PLATE A-13



LEGEND

PHASE 1 2014 GEOTECHNICAL EXPLORATIONS

- ⊕ Boring - 100ft
- ⊕ Boring - 150ft
- ● Downhole Geophysics
- ● Monitoring Well
- ● Permanent Survey Monument
- ● E-LOGGING

PROJECT SITE LAYERS

- ▭ Onshore LNG Facilities

GEOPHYSICAL SURVEY LINES

- ▬ Onshore Geophysical Lines

CROSS SECTION LINES

- ▬ Cross-Sections

Borings	Depth, ft	As-Built Elevation, ft (NAVD88)	As-Built Coordinates (NAD83 – NSRS2007)		DH[(1)]	EL[(2)]	MW[(3)]	PSM[(4)]
			Latitude, deg	Longitude, deg				
B-9	100.50	132.25	60.67185419	-151.35640928				
B-10	103.00	132.80	60.67188199	-151.35002128	1			
B-11	101.25	136.36	60.67192943	-151.34366487				
B-14	110.70	133.40	60.67003682	-151.35375743			1	
B-15	101.00	122.96	60.66836028	-151.37105711				
B-17	101.50	131.21	60.66845974	-151.35723247				
B-18	101.50	131.25	60.66826252	-151.35041257	1			1
B-23	186.50	124.63	60.66494561	-151.37288538				
B-24	101.00	120.40	60.66523854	-151.36864010				
B-26	100.50	125.54	60.66481307	-151.35535978				
B-27	101.50	124.35	60.66461107	-151.35039124			1	
B-28	103.00	118.89	60.66475620	-151.34486218	1			
B-32	101.50	122.99	60.66109265	-151.35084727	1			1
B-34	101.00	111.83	60.65951893	-151.35361467				
B-36	103.00	111.70	60.65768300	-151.35789052	1			
B-37	26.50	106.27	60.65717918	-151.35022180				
B-38	151.30	123.47	60.65746298	-151.34359639				
B-39	151.50	95.51	60.65559414	-151.35615280		1	2	
B-40	101.50	120.84	60.65547709	-151.34721579				
B-42	101.50	118.85	60.65453131	-151.35029923	1			
B-43	102.75	121.14	60.65405368	-151.34362451				1
B-45	101.50	109.09	60.65465742	-151.35759481				
B-47	151.00	119.73	60.66227016	-151.36972091	1			1
B-49	101.50	127.76	60.67526763	-151.36274607	1			
B-50	151.50	131.66	60.67524580	-151.35335931		1	2	

Notes:

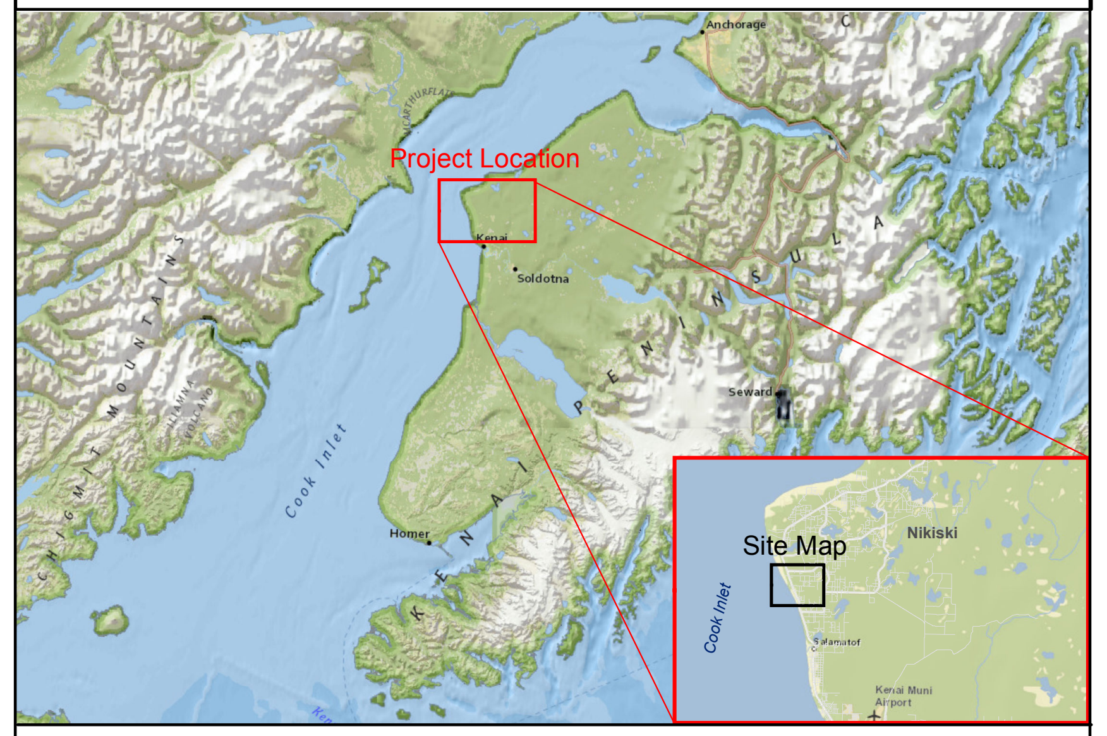
(1)DH= Downhole Seismic Test
(2)EL= Wireline E-Logging Data
(3)MW= Monitoring Well
(4)PSM= Permanent Survey Monument

Monitoring Wells	Depth, ft	As-Built Elevation, ft (NAVD88)	As-Built Coordinates (NAD83 – NSRS2007)	
			Latitude, deg	Longitude, deg
MW-14	55	136.24	60.67001489	-151.35376440
MW-27	56	126.79	60.66459539	-151.35037410
MW-39A	146	97.99	60.65557926	-151.35615710
MW-39B	39	97.75	60.65560508	-151.35613450
MW-50A	145	135.12	60.67523060	-151.35331470
MW-50B	56	134.67	60.67526072	-151.35336650

Permanent Survey Monuments	Corresponding Boring	As-Built Elevation, ft (NAVD88)	As-Built Coordinates (NAD83 – NSRS2007)	
			Latitude, deg	Longitude, deg
PSM-1	B-18	131.29	60.66827846	-151.35036057
PSM-2	B-47	119.87	60.66224113	-151.36969412
PSM-3	B-32	123.16	60.66110421	-151.35082797
PSM-4	B-42	118.47	60.65453570	-151.35025144

Notes:

1. Base imagery provided by Kenai Peninsula Borough (KPB).
2. Onshore LNG Facility boundary provided by EMALL.
3. As-built coordinates of exploration locations provided by JOA Surveying Services, Inc. (JOA).



GEODETIC INFORMATION

PROJECTION:	Transverse_Mercator
FALSE EASTING:	1640416.666666666
FALSE NORTHING:	0.0
CENTRAL MERIDIAN:	-150.0
SCALE FACTOR:	0.9999
LATITUDE OF ORIGIN:	54.0
LINEAR UNIT:	US Foot
SPHEROID:	GRS 1980
SEMI-MAJOR AXIS:	6,378,137.000
SEMI-MINOR AXIS:	6,356,752.314140356
INVERSE FLATTENING:	298.257222101

N
W E
S

Coordinate Grid: NAD 1983 (NSRS 2007), Degrees Minutes Seconds

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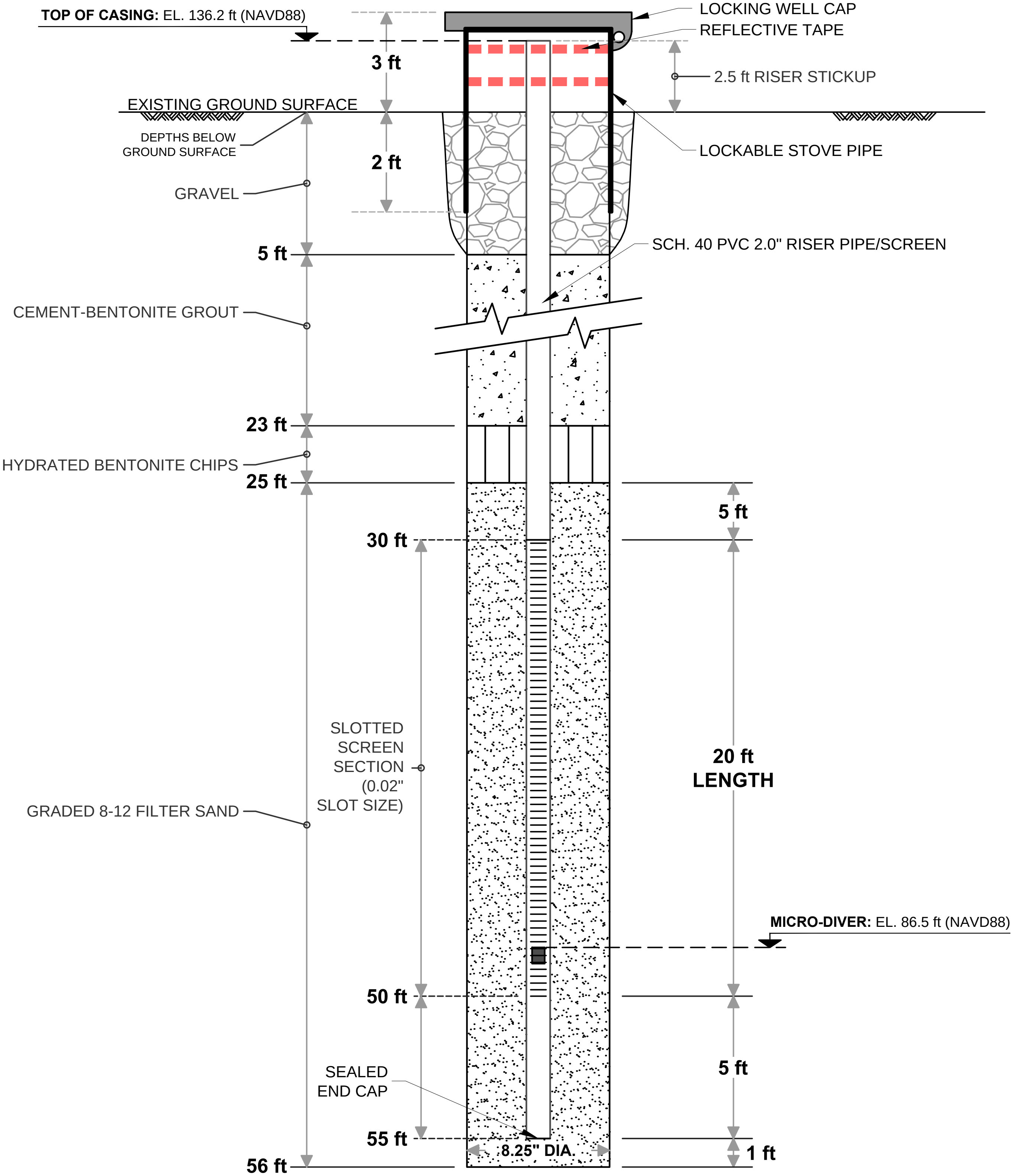
www.fugroconsultants.com

INVESTIGATION PLAN
ONSHORE FACILITIES
ALASKA LNG PROJECT
NIKISKI, ALASKA

0 500 1,000
Feet

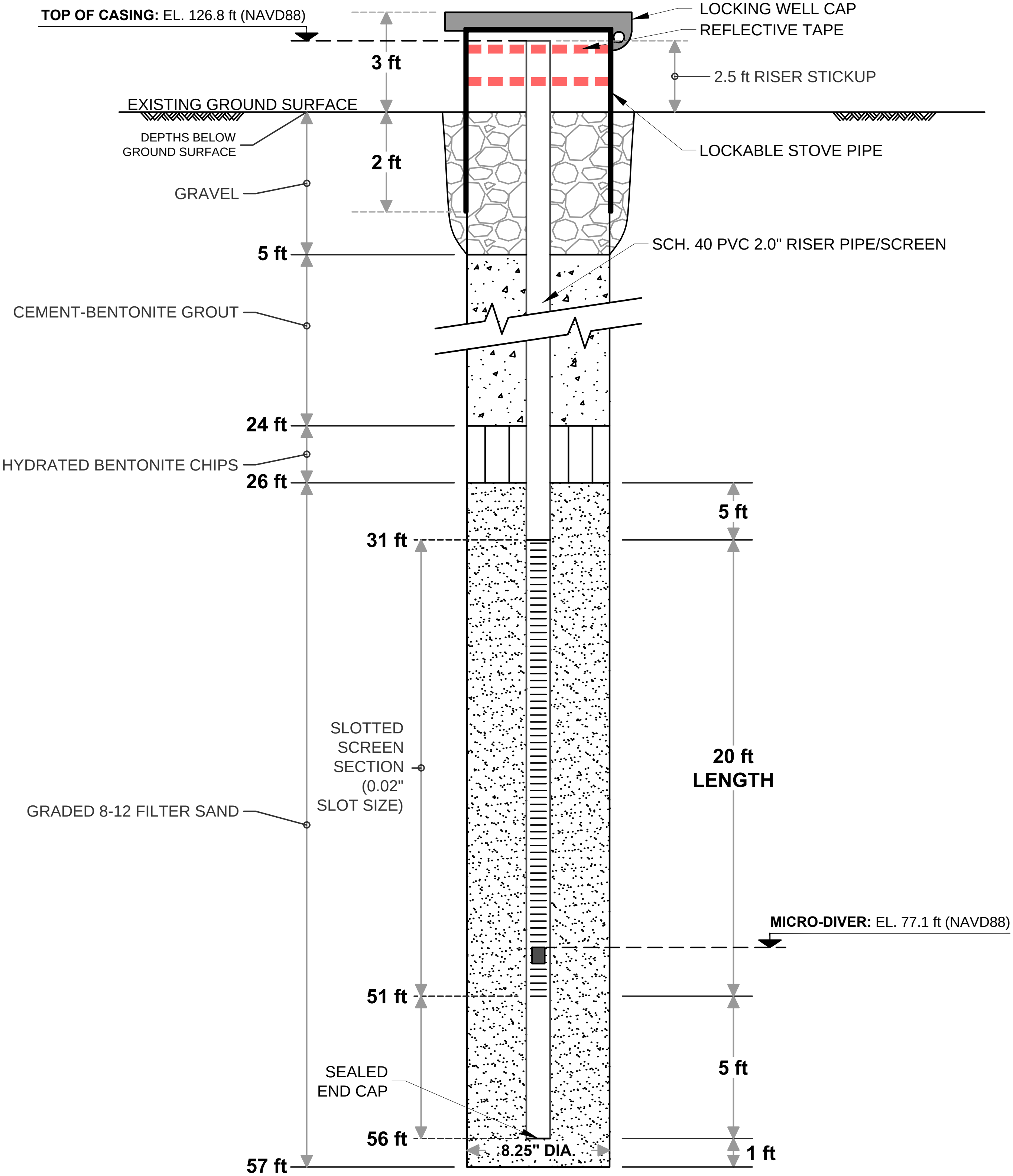
REV NO:	DATE:	DESCRIPTION:	DRAWN:	CHKD:	APPR:
0	01/15/2015	Monitoring Well Draft Report	TNS	KS	JA
1	04/15/2015	Final Report	TNS	YSC	JA

JOB NUMBER: 04.10140094-10
DRAWING NO.: PLATE A-14



MONITORING WELL MW-14
INSTALLATION DETAILS

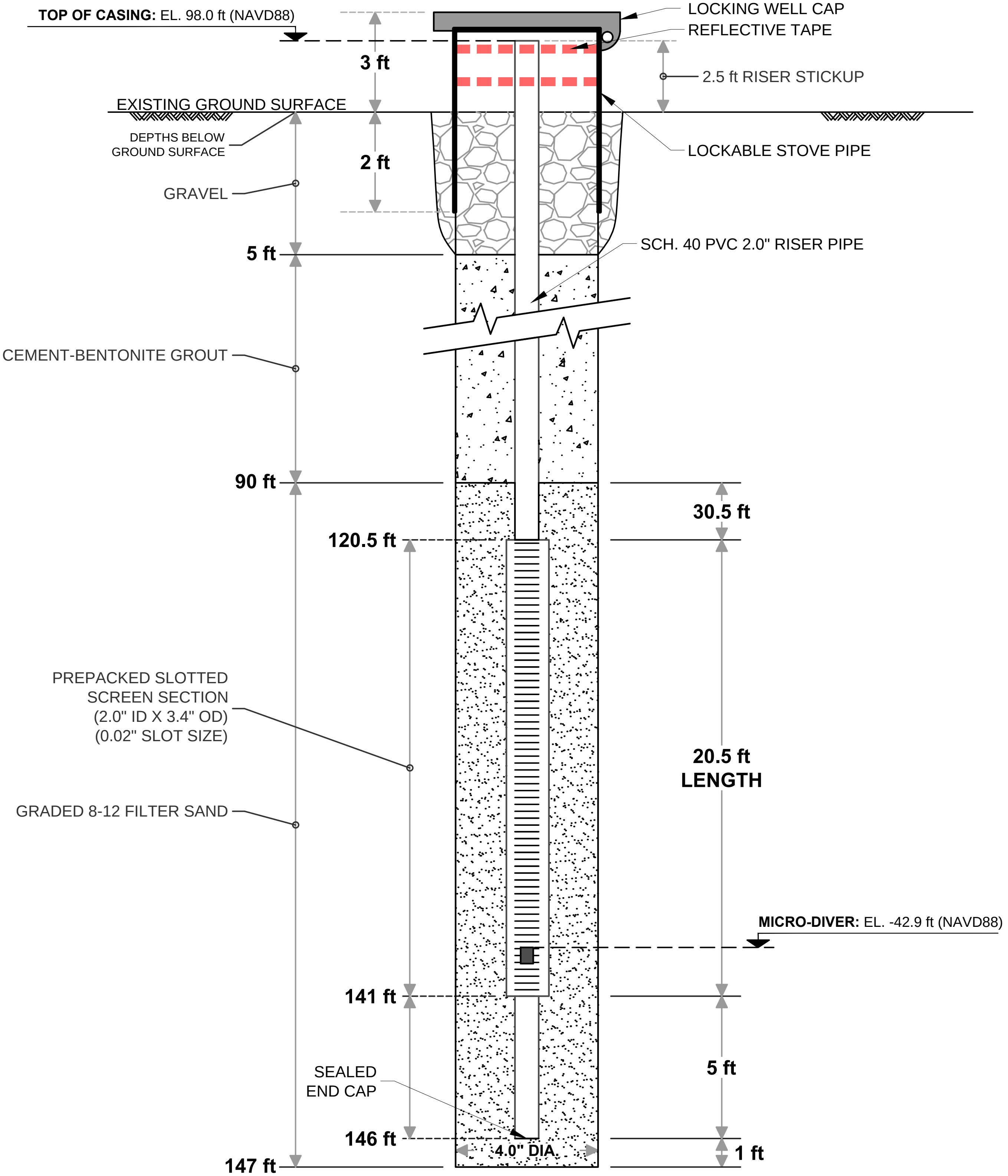
ONSHORE FACILITIES
ALASKA LNG PROJECT
NIKISKI, ALASKA
(NOT TO SCALE)



MONITORING WELL MW-27 INSTALLATION DETAILS

ONSHORE FACILITIES
ALASKA LNG PROJECT
NIKISKI, ALASKA
(NOT TO SCALE)

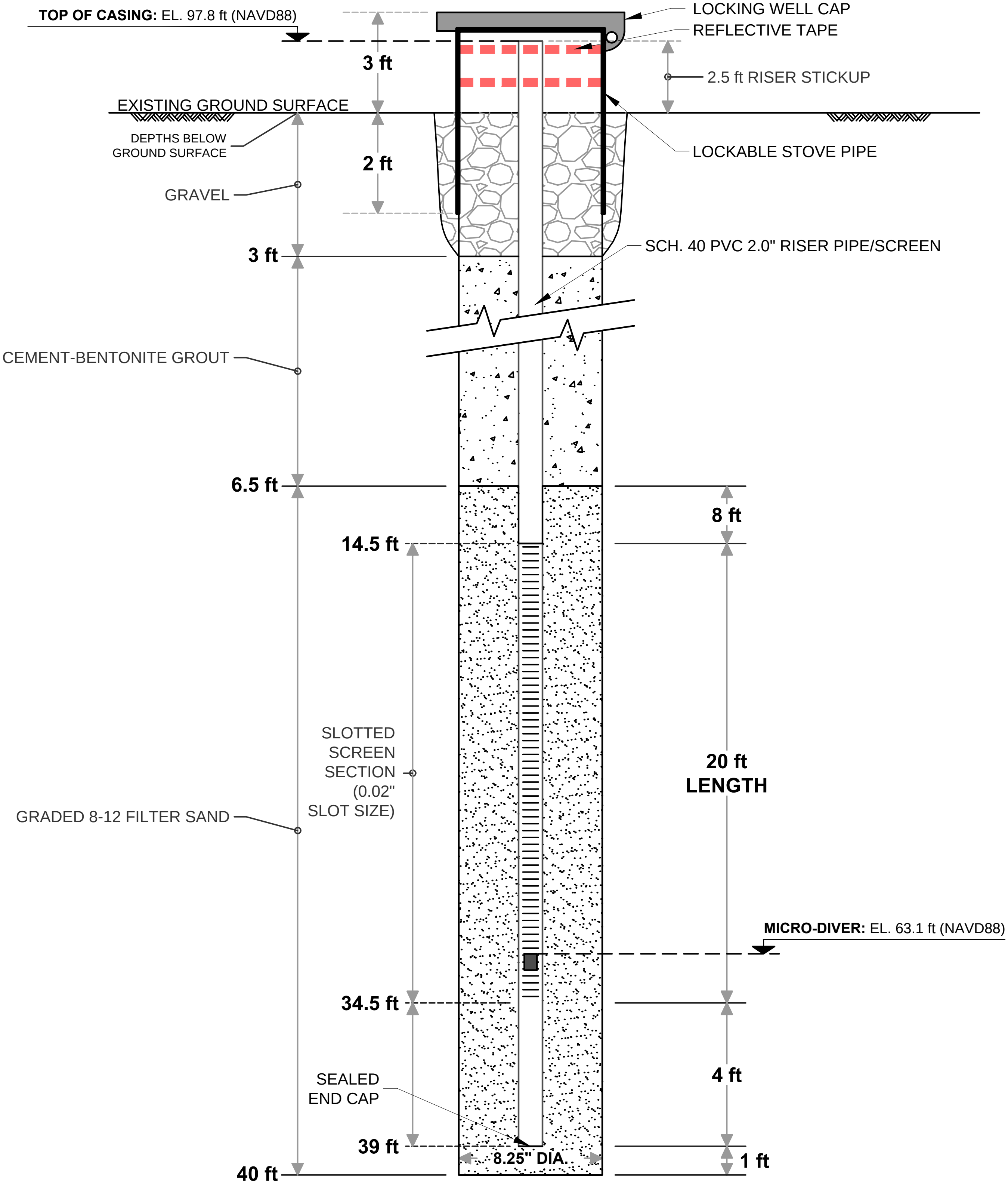
PLATE A-16



MONITORING WELL MW-39A INSTALLATION DETAILS

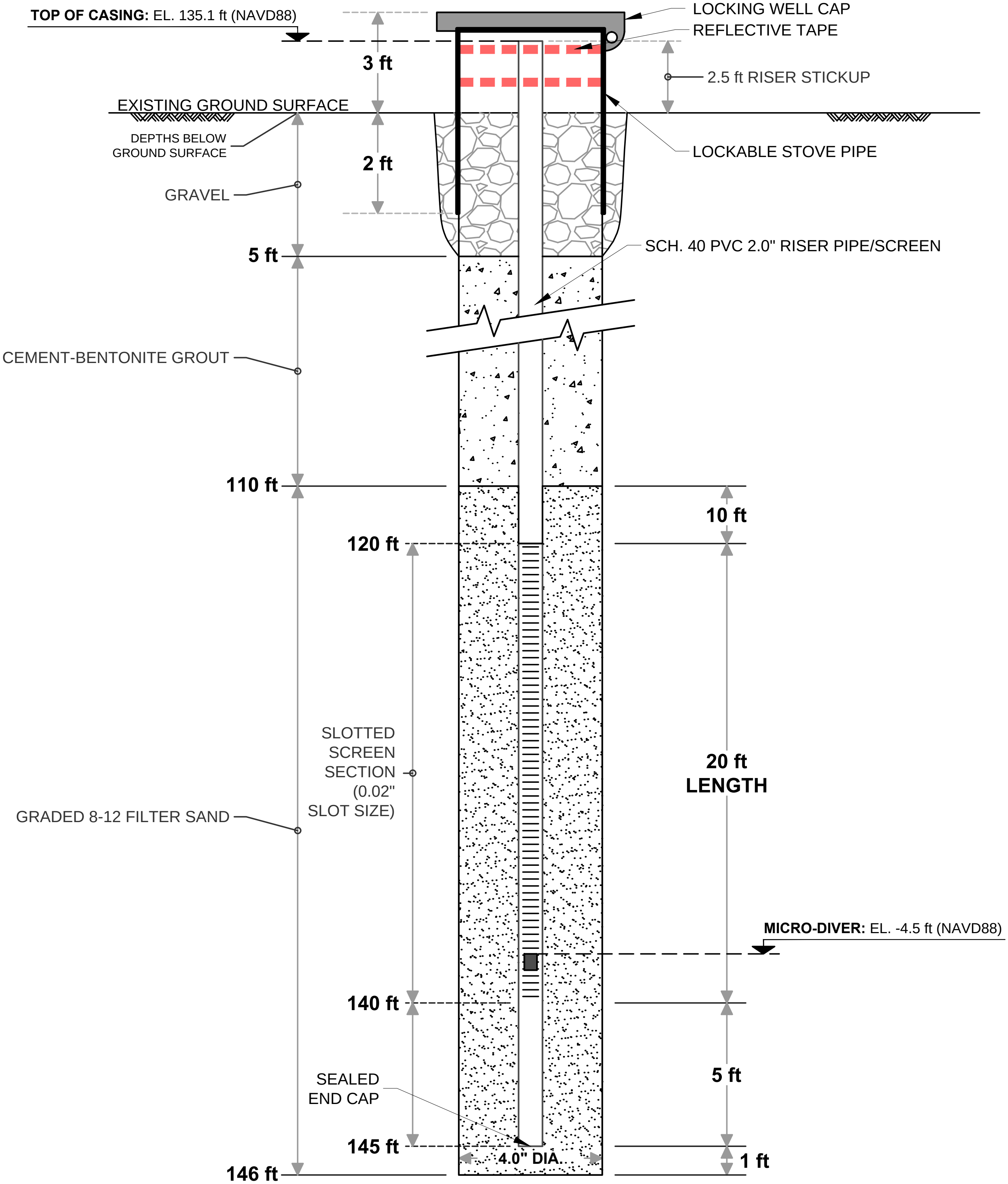
ONSHORE FACILITIES
ALASKA LNG PROJECT
NIKISKI, ALASKA
(NOT TO SCALE)

PLATE A-17



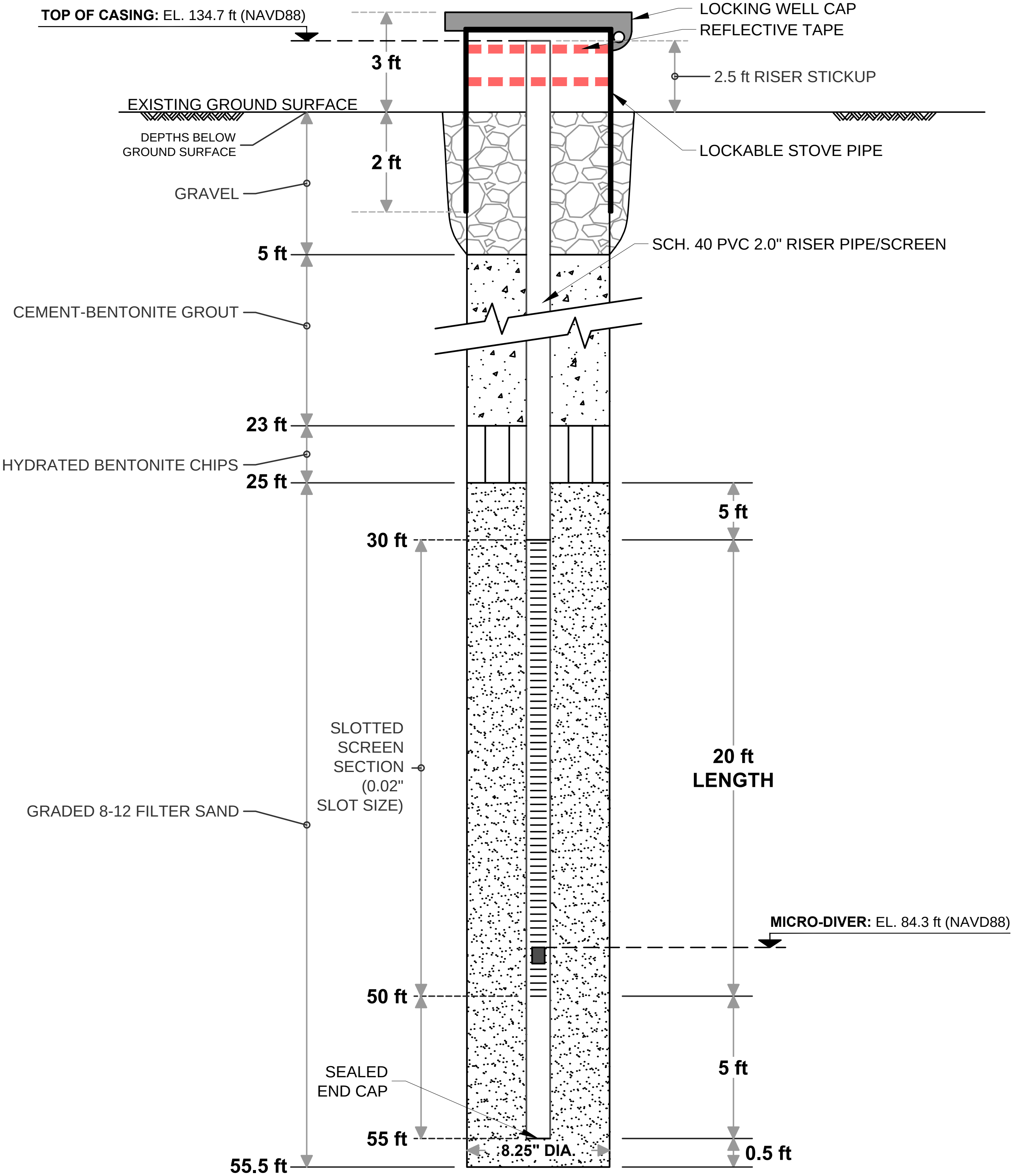
MONITORING WELL MW-39B INSTALLATION DETAILS

ONSHORE FACILITIES
ALASKA LNG PROJECT
NIKISKI, ALASKA
(NOT TO SCALE)



MONITORING WELL MW-50A
INSTALLATION DETAILS

ONSHORE FACILITIES
ALASKA LNG PROJECT
NIKISKI, ALASKA
(NOT TO SCALE)

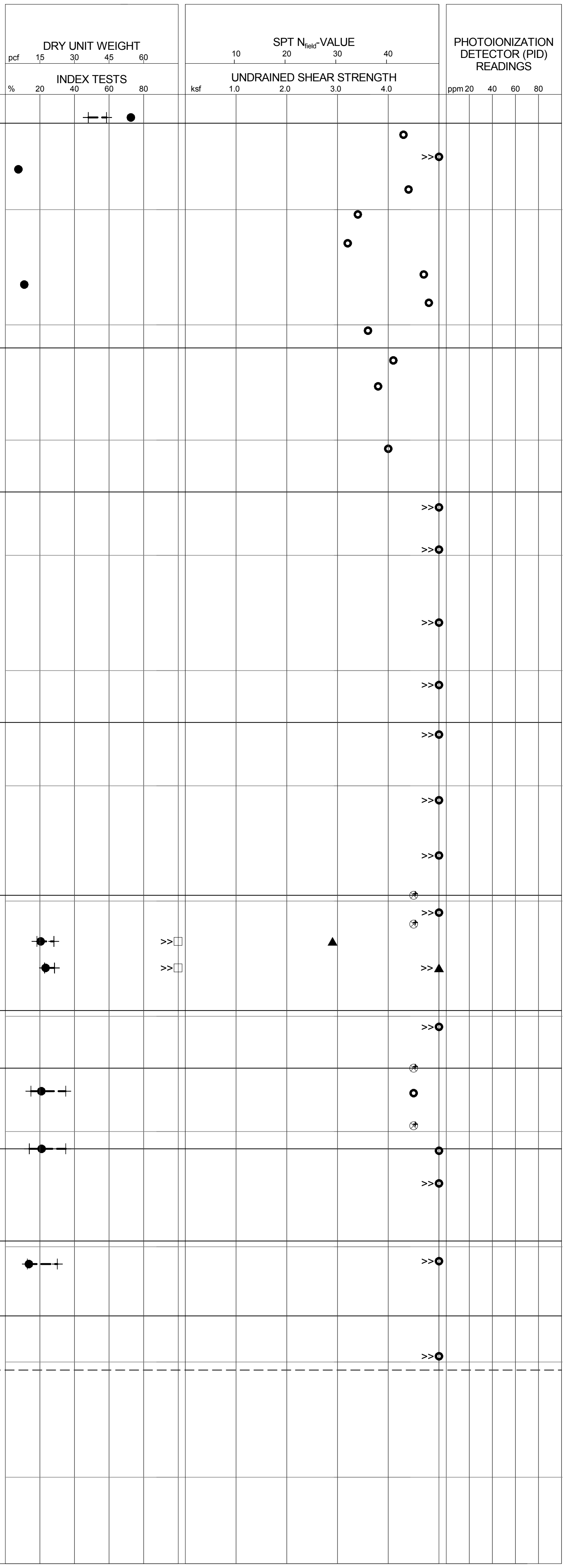


MONITORING WELL MW-50B INSTALLATION DETAILS

ONSHORE FACILITIES
ALASKA LNG PROJECT
NIKISKI, ALASKA
(NOT TO SCALE)

PLATE A-20

SAMPLE NO.	BLOWS/FT	MATERIAL DESCRIPTION	STRATUM DEPTH, FT	% PASSING #200 SIEVE
S-1	W.O.H.	TOPSOIL: very loose, brown, SANDY SILT (ML), with grass, roots and organic material	2.5	75
S-2	43	SAND WITH SILT AND GRAVEL (SW-SM): dense to very dense, dark gray, fine to medium grained, with gravel		
S-3	69			7
S-4	44			6
S-5	34			
S-6	32			
S-7	47			8
S-8	48			
S-9a S-9b	36		22.0	
S-10	41	SAND WITH SILT (SP-SM): dense, dark gray, fine to coarse grained, with gravel		
S-11	38			
S-12	40		34.5	9
S-13	96	SAND WITH SILT AND GRAVEL (SW-SM): very dense, dark brown, fine to medium grained, with calcareous fragments		
S-14	100|11"			7
S-15	67	- with silt seams and organic pockets at 46.5 ft		
S-16	94	- olive gray, fine to coarse grained, with silt seams and organic pockets below 50.0 ft	54.5	6
S-17a S-17b	87	SAND WITH SILT (SP-SM): very dense, dark gray, fine to medium, with gravel - very dense, dark gray, fine, with gravel		
S-18	77			12
		- with clay seams and gravel at 62.0 ft		
S-19	67			
		- with silt, organic seams and trace of gravel at 68.0 ft	69.5	
S-20a S-20b	53	LEAN CLAY (CL): hard, olive gray to dark gray, with sand and silt pockets		
S-21	Push			97
S-22	Push		79.5	99
S-23	77	SAND WITH SILT (SP-SM): very dense, dark gray, fine to medium grained, with clay pockets, seams and gravel		
		LEAN CLAY WITH SAND (CL): hard, dark gray, with trace of gravel (DN: CLAY at 82.5 ft)	84.5	
S-24	45 Push			86
		- with sand pockets, seams and trace of gravel, below 89.5 ft		
S-25	50		91.5	76
		CLAYEY SAND (SC): very dense, dark gray, fine grained (DN: SAND beow 91.5 ft)		
S-26a S-26b	100|9"	- very dense, dark gray, fine to medium grained, at 97.0 ft	99.5	
S-27	67	LEAN CLAY WITH SAND (CL): hard, dark gray, with trace of gravel	106.0	81
		CLAYEY SAND (SC): very dense, dark gray, fine grained		
S-28	100|8"		110.7	19



NOTES:
1) The log and data presented are a simplification of actual conditions encountered at the time of sampling at the exploration location. Subsurface conditions may differ at other locations and with the passage of time.
2) For additional symbol identification, refer to Key to Terms & Symbols Used on Logs.
3) DN = Driller's Note

CLASSIFICATION TESTS
- ● Water Content
- ☐ Dry Unit Weight
- ○ Submerged Unit Weight
- ■ Non-Plastic
- Plastic Limit +– – – – – – – – –+ Liquid Limit

STRENGTH TESTS
- ⊗ Pocket Penetrometer
- ⊕ Torvane
- ◇ Remote Vane
- ◆ Miniature Vane
- ▲ Unconsolidated Undrained Triaxial
- ▣ Unconfined Compression
- ◇ Residual Vane
- ◇ △ Open symbols indicate remolded tests

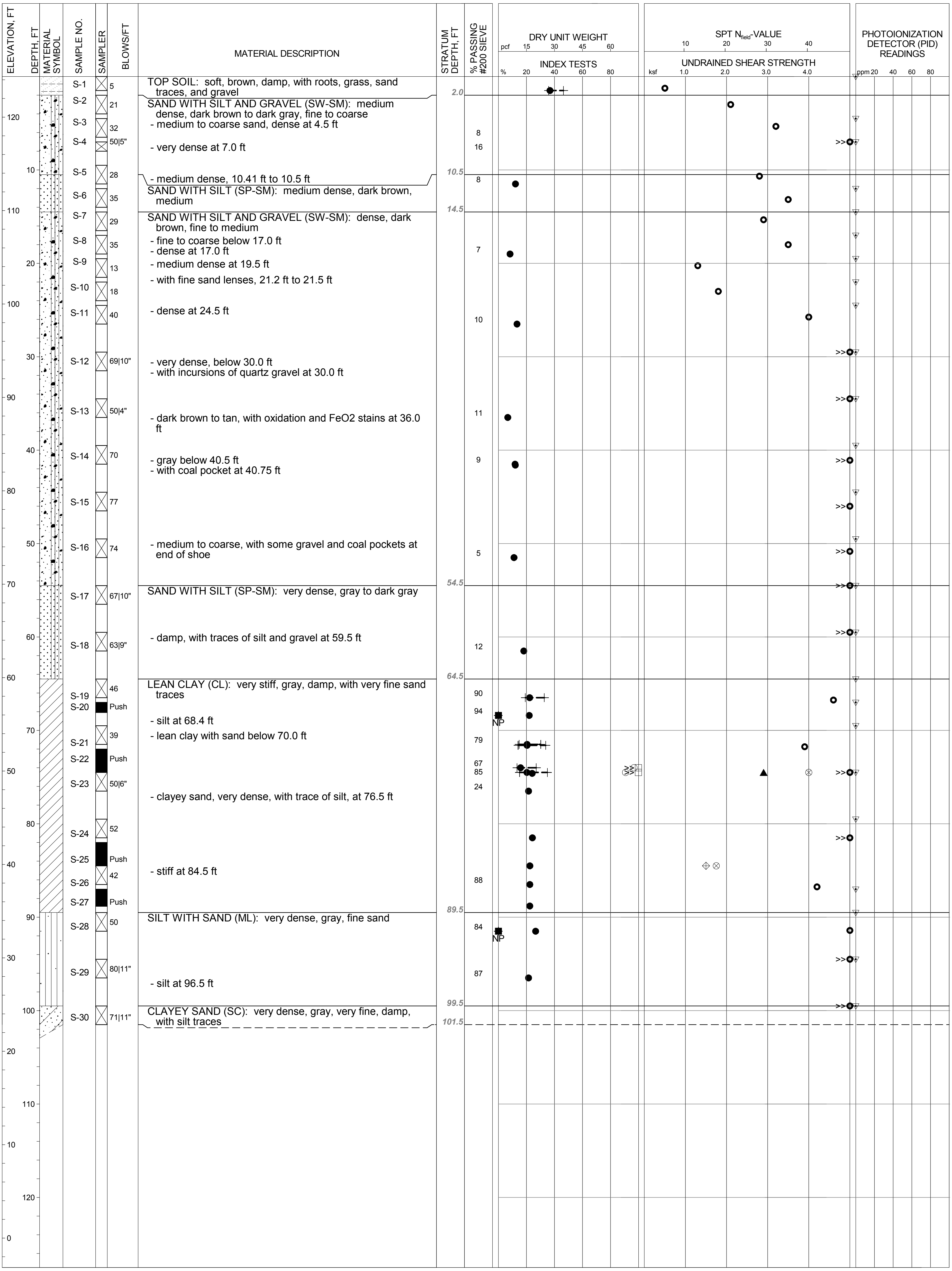
- ○ SPT N_{Field}-Value
- >> Exceeds Data Scale
- WOR - Weight of Rod
- WOH - Weight of Hammer
- ▽ PID

COMPLETION DEPTH: 110.7 ft
COORDINATES: W151.353757 N60.670037 (GCS, NAD 1983, NSRS2007, degrees)
SURFACE ELEVATION: 133.40 ft (rel. NAVD88 datum)
EXPLORATION START DATE: 10/24/2014
COMPLETION DATE: 10/27/2014
LOGGED BY: O. Boscan

PHASE-1 BORING LOG B-14
ALASKA LNG PROJECT
ONSHORE LNG FACILITIES
NIKISKI, ALASKA

DRILLING COMPANY: Denali
DRILLER: F. Chase
DRILLING RIG: RIG D - Truck (CME-85)
BACKFILL: Cement Bentonite-Grout
DRILLING METHOD
HOLLOW STEM AUGER: N/A
WET ROTARY: 0 to 110.7 ft
CASING: 0 to 64.5 ft

PLATE A-21



SAMPLE NO.	BLOWS/FT	MATERIAL DESCRIPTION	STRATUM DEPTH, FT	% PASSING #200 SIEVE
S-1	5	TOP SOIL: soft, brown, damp, with roots, grass, sand traces, and gravel	2.0	
S-2	21	SAND WITH SILT AND GRAVEL (SW-SM): medium dense, dark brown to dark gray, fine to coarse		
S-3	32	- medium to coarse sand, dense at 4.5 ft		8
S-4	50|5"	- very dense at 7.0 ft		16
S-5	28	- medium dense, 10.41 ft to 10.5 ft	10.5	8
S-6	35	SAND WITH SILT (SP-SM): medium dense, dark brown, medium	14.5	
S-7	29	SAND WITH SILT AND GRAVEL (SW-SM): dense, dark brown, fine to medium		
S-8	35	- fine to coarse below 17.0 ft - dense at 17.0 ft		7
S-9	13	- medium dense at 19.5 ft		
		- with fine sand lenses, 21.2 ft to 21.5 ft		
S-10	18			
S-11	40	- dense at 24.5 ft		10
S-12	69|10"	- very dense, below 30.0 ft - with incursions of quartz gravel at 30.0 ft		
S-13	50|4"	- dark brown to tan, with oxidation and FeO2 stains at 36.0 ft		11
S-14	70	- gray below 40.5 ft - with coal pocket at 40.75 ft		9
S-15	77			
S-16	74	- medium to coarse, with some gravel and coal pockets at end of shoe	54.5	5
S-17	67|10"	SAND WITH SILT (SP-SM): very dense, gray to dark gray		
S-18	63|9"	- damp, with traces of silt and gravel at 59.5 ft	64.5	12
S-19	46	LEAN CLAY (CL): very stiff, gray, damp, with very fine sand traces		90
S-20	Push	- silt at 68.4 ft		94
S-21	39	- lean clay with sand below 70.0 ft		79
S-22	Push			67 85
S-23	50|6"	- clayey sand, very dense, with trace of silt, at 76.5 ft		24
S-24	52			
S-25	Push	- stiff at 84.5 ft		
S-26	42			88
S-27	Push		89.5	
S-28	50	SILT WITH SAND (ML): very dense, gray, fine sand		84
S-29	80|11"	- silt at 96.5 ft	99.5	87
S-30	71|11"	CLAYEY SAND (SC): very dense, gray, very fine, damp, with silt traces	101.5	

NOTES:
1) The log and data presented are a simplification of actual conditions encountered at the time of sampling at the exploration location. Subsurface conditions may differ at other locations and with the passage of time.
2) For additional symbol identification, refer to Key to Terms & Symbols Used on Logs.
3) DN = Driller's Note

CLASSIFICATION TESTS
- ● Water Content
- □ Dry Unit Weight
- ○ Submerged Unit Weight
- ■ Non-Plastic
- Plastic Limit + – – – – – – + Liquid Limit

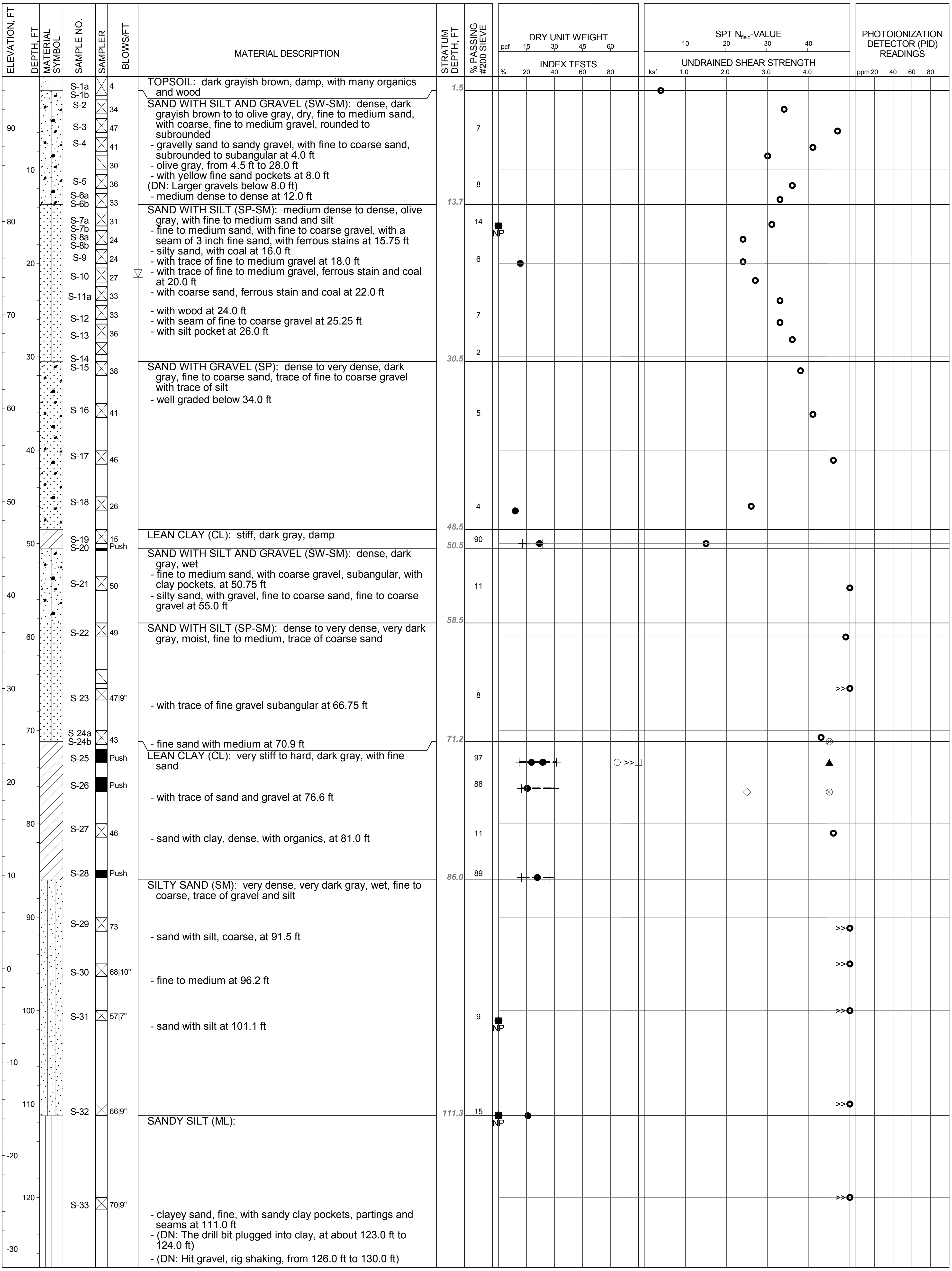
STRENGTH TESTS
- ⊗ Pocket Penetrometer
- ⊕ Torvane
- ◇ Remote Vane
- ◆ Miniature Vane
- ▲ Unconsolidated Undrained Triaxial
- ▣ Unconfined Compression
- ◇ Residual Vane
- ◇ △ Open symbols indicate remolded tests

- ○ SPT N_{Field}-Value
- \>> Exceeds Data Scale
- WOR - Weight of Rod
- WOH - Weight of Hammer
- ▽ PID

COMPLETION DEPTH: 101.5 ft
COORDINATES: W151.350391 N60.664611 (GCS, NAD 1983, NSRS2007, degrees)
SURFACE ELEVATION: 124.35 ft (rel. NAVD88 datum)
EXPLORATION START DATE: 10/21/2014
COMPLETION DATE: 10/23/2014
LOGGED BY: L. Ferreira

PHASE-1 BORING LOG B-27
ALASKA LNG PROJECT
ONSHORE LNG FACILITIES
NIKISKI, ALASKA

DRILLING COMPANY: Denali
DRILLER: S. Greer
DRILLING RIG: RIG B - Truck (CME-75)
BACKFILL: Cement Bentonite-Grout
DRILLING METHOD
HOLLOW STEM AUGER: N/A
WET ROTARY: 0 to 99.5 ft
CASING: 0 to 59.5 ft



SAMPLE NO.	BLOWS/FT	% PASSING #200 SIEVE
S-1a S-1b	4	
S-2	34	
S-3	47	7
S-4	41	
	30	
S-5	36	8
S-6a S-6b	33	
S-7a S-7b	31	14
S-8a S-8b	24	
S-9	24	6
S-10	27	
S-11a	33	
S-12	33	7
S-13	36	
S-14		2
S-15	38	
S-16	41	5
S-17	46	
S-18	26	4
S-19	15	90
S-20	Push	
S-21	50	11
S-22	49	
S-23	47|9"	8
S-24a S-24b	43	
S-25	Push	97
S-26	Push	88
S-27	46	11
S-28	Push	89
S-29	73	
S-30	68|10"	
S-31	57|7"	9
S-32	66|9"	15
S-33	70|9"	

MATERIAL DESCRIPTION

TOPSOIL: dark grayish brown, damp, with many organics and wood

1.5

SAND WITH SILT AND GRAVEL (SW-SM): dense, dark grayish brown to to olive gray, dry, fine to medium sand, with coarse, fine to medium gravel, rounded to subrounded
- gravelly sand to sandy gravel, with fine to coarse sand, subrounded to subangular at 4.0 ft
- olive gray, from 4.5 ft to 28.0 ft
- with yellow fine sand pockets at 8.0 ft

(DN: Larger gravels below 8.0 ft)
- medium dense to dense at 12.0 ft

13.7

SAND WITH SILT (SP-SM): medium dense to dense, olive gray, with fine to medium sand and silt
- fine to medium sand, with fine to coarse gravel, with a seam of 3 inch fine sand, with ferrous stains at 15.75 ft
- silty sand, with coal at 16.0 ft
- with trace of fine to medium gravel at 18.0 ft
- with trace of fine to medium gravel, ferrous stain and coal at 20.0 ft
- with coarse sand, ferrous stain and coal at 22.0 ft
- with wood at 24.0 ft
- with seam of fine to coarse gravel at 25.25 ft
- with silt pocket at 26.0 ft

30.5

SAND WITH GRAVEL (SP): dense to very dense, dark gray, fine to coarse sand, trace of fine to coarse gravel with trace of silt
- well graded below 34.0 ft

48.5

LEAN CLAY (CL): stiff, dark gray, damp

50.5

SAND WITH SILT AND GRAVEL (SW-SM): dense, dark gray, wet
- fine to medium sand, with coarse gravel, subangular, with clay pockets, at 50.75 ft
- silty sand, with gravel, fine to coarse sand, fine to coarse gravel at 55.0 ft

58.5

SAND WITH SILT (SP-SM): dense to very dense, very dark gray, moist, fine to medium, trace of coarse sand
- with trace of fine gravel subangular at 66.75 ft
- fine sand with medium at 70.9 ft

71.2

LEAN CLAY (CL): very stiff to hard, dark gray, with fine sand
- with trace of sand and gravel at 76.6 ft
- sand with clay, dense, with organics, at 81.0 ft

86.0

SILTY SAND (SM): very dense, very dark gray, wet, fine to coarse, trace of gravel and silt
- sand with silt, coarse, at 91.5 ft
- fine to medium at 96.2 ft
- sand with silt at 101.1 ft

111.3

SANDY SILT (ML):
- clayey sand, fine, with sandy clay pockets, partings and seams at 111.0 ft
- (DN: The drill bit plugged into clay, at about 123.0 ft to 124.0 ft)
- (DN: Hit gravel, rig shaking, from 126.0 ft to 130.0 ft)

NOTES:
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2) For additional symbol identification, refer to Key to Terms & Symbols Used on Logs.
3) DN = Driller's Note

CLASSIFICATION TESTS
- ● Water Content
- ☐ Dry Unit Weight
- ○ Submerged Unit Weight
- ■ Non-Plastic

Plastic Limit +– – – – – – – – –+ Liquid Limit

STRENGTH TESTS
- ⊗ Pocket Penetrometer
- ⊕ Torvane
- ◇ Remote Vane
- ◆ Miniature Vane
- ▲ Unconsolidated Undrained Triaxial
- ▣ Unconfined Compression
- ◇ Residual Vane
- ◇ △ Open symbols indicate remolded tests

- ● SPT N_{Field}-Value
- >> Exceeds Data Scale

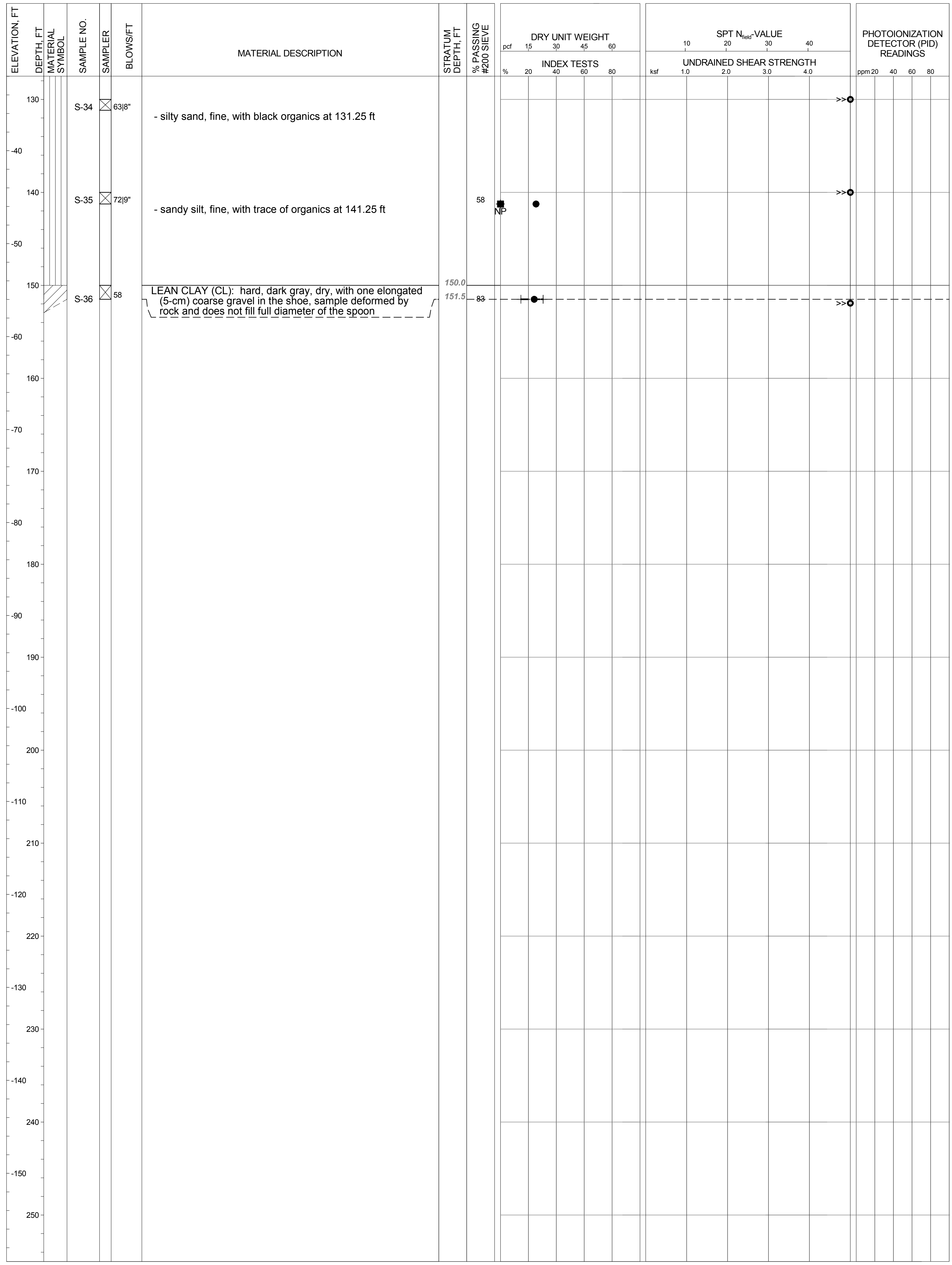
WOR - Weight of Rod
WOH - Weight of Hammer
▽ PID

COMPLETION DEPTH: 151.5 ft
COORDINATES: W151.356153 N60.655594 (GCS, NAD 1983, NSRS2007, degrees)
SURFACE ELEVATION: 95.51 ft (rel. NAVD88 datum)
EXPLORATION START DATE: 9/27/2014
COMPLETION DATE: 10/1/2014
LOGGED BY: B. Binatli / J. Soto

PHASE-1 BORING LOG B-39
ALASKA LNG PROJECT
ONSHORE LNG FACILITIES
NIKISKI, ALASKA

DRILLING COMPANY: Denali
DRILLER: J. Love / C. Garcia
DRILLING RIG: RIG B - Truck (CME-75)
BACKFILL: Cement Bentonite-Grout
DRILLING METHOD
HOLLOW STEM AUGER: 0 to 28.5 ft
WET ROTARY: 28.5 to 150.0 ft
CASING: 0 to 60.0 ft

SAMPLE NO.	SAMPLER	BLOWS/FT	MATERIAL DESCRIPTION	STRATUM DEPTH, FT	% PASSING #200 SIEVE
S-34	☒	63|8"	- silty sand, fine, with black organics at 131.25 ft		
S-35	☒	72|9"	- sandy silt, fine, with trace of organics at 141.25 ft		58
S-36	☒	58	LEAN CLAY (CL): hard, dark gray, dry, with one elongated (5-cm) coarse gravel in the shoe, sample deformed by rock and does not fill full diameter of the spoon	150.0 151.5	83



NOTES:
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2) For additional symbol identification, refer to Key to Terms & Symbols Used on Logs.
3) DN = Driller's Note

CLASSIFICATION TESTS
- ● Water Content
- □ Dry Unit Weight
- ○ Submerged Unit Weight
- ■ Non-Plastic
- Plastic Limit + – – – – – – – + Liquid Limit

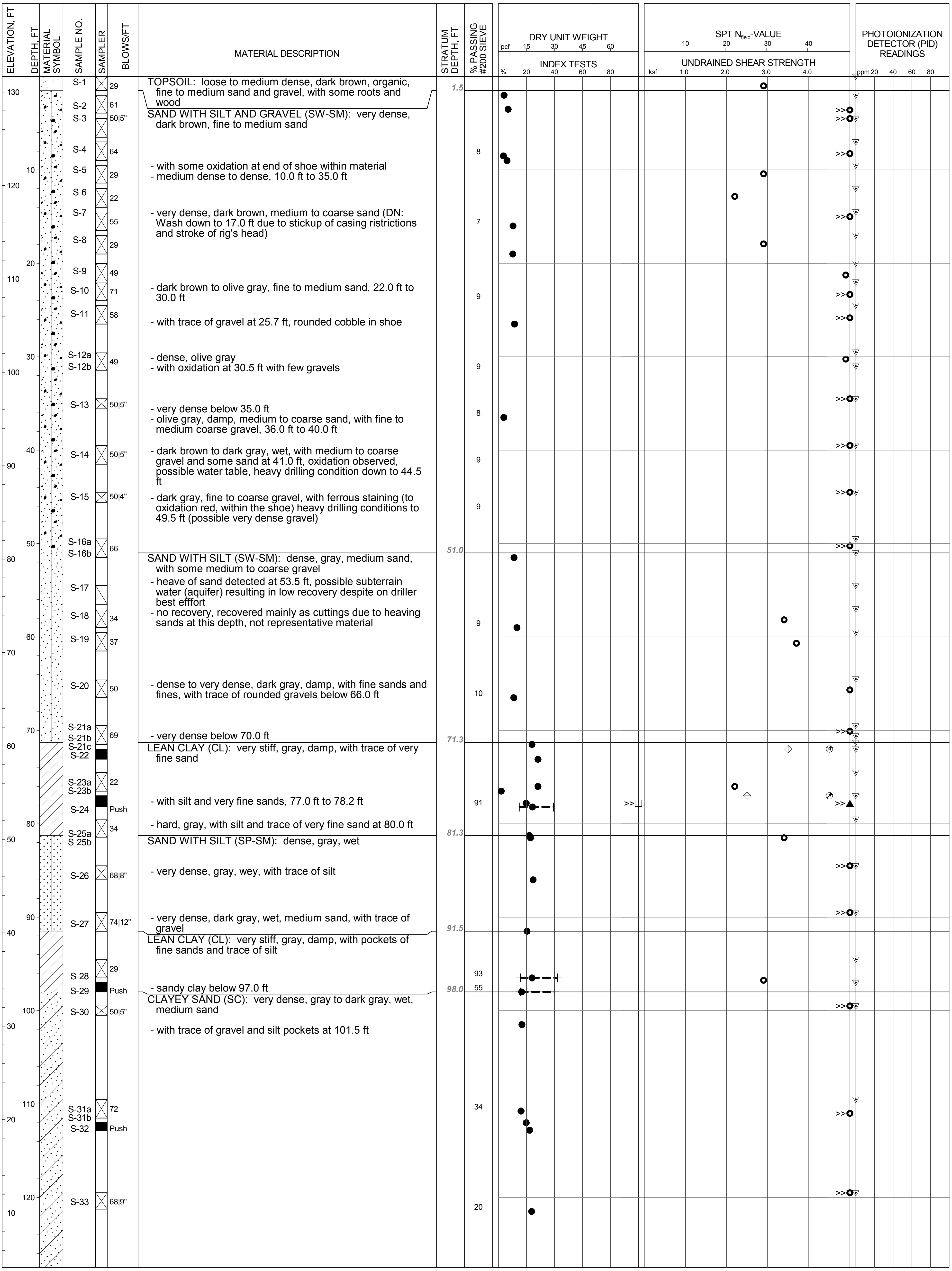
STRENGTH TESTS
- ⊗ Pocket Penetrometer
- ⊕ Torvane
- ◇ Remote Vane
- ◆ Miniature Vane
- ▲ Unconsolidated Undrained Triaxial
- ▣ Unconfined Compression
- ◇ Residual Vane
- ◇ Open symbols indicate
- △ remolded tests

- ○ SPT N_{Field}-Value
- » Exceeds Data Scale
- WOR - Weight of Rod
- WOH - Weight of Hammer
- ▿ PID

COMPLETION DEPTH: 151.5 ft
COORDINATES: W151.356153 N60.655594 (GCS, NAD 1983, NSRS2007, degrees)
SURFACE ELEVATION: 95.51 ft (rel. NAVD88 datum)
EXPLORATION START DATE: 9/27/2014
COMPLETION DATE: 10/1/2014
LOGGED BY: B. Binatli / J. Soto

PHASE-1 BORING LOG B-39
ALASKA LNG PROJECT
ONSHORE LNG FACILITIES
NIKISKI, ALASKA

DRILLING COMPANY: Denali
DRILLER: J. Love / C. Garcia
DRILLING RIG: RIG B - Truck (CME-75)
BACKFILL: Cement Bentonite-Grout
DRILLING METHOD
HOLLOW STEM AUGER: 0 to 28.5 ft
WET ROTARY: 28.5 to 150.0 ft
CASING: 0 to 60.0 ft



Sample No.	Blows/ft
S-1	29
S-2	61
S-3	50|5"
S-4	64
S-5	29
S-6	22
S-7	55
S-8	29
S-9	49
S-10	71
S-11	58
S-12a S-12b	49
S-13	50|5"
S-14	50|5"
S-15	50|4"
S-16a S-16b	66
S-17	
S-18	34
S-19	37
S-20	50
S-21a S-21b S-21c	69
S-22	
S-23a S-23b	22
S-24	Push
S-25a S-25b	34
S-26	68|8"
S-27	74|12"
S-28	29
S-29	Push
S-30	50|5"
S-31a S-31b	72
S-32	Push
S-33	68|9"

% Passing #200 Sieve: 8, 7, 9, 9, 8, 9, 9, 9, 10, 91, 93, 55, 34, 20

TOPSOIL: loose to medium dense, dark brown, organic, fine to medium sand and gravel, with some roots and wood

1.5

SAND WITH SILT AND GRAVEL (SW-SM): very dense, dark brown, fine to medium sand

- with some oxidation at end of shoe within material
- medium dense to dense, 10.0 ft to 35.0 ft
- very dense, dark brown, medium to coarse sand (DN: Wash down to 17.0 ft due to stickup of casing ristrictions and stroke of rig's head)
- dark brown to olive gray, fine to medium sand, 22.0 ft to 30.0 ft
- with trace of gravel at 25.7 ft, rounded cobble in shoe
- dense, olive gray
- with oxidation at 30.5 ft with few gravels
- very dense below 35.0 ft
- olive gray, damp, medium to coarse sand, with fine to medium coarse gravel, 36.0 ft to 40.0 ft
- dark brown to dark gray, wet, with medium to coarse gravel and some sand at 41.0 ft, oxidation observed, possible water table, heavy drilling condition down to 44.5 ft
- dark gray, fine to coarse gravel, with ferrous staining (to oxidation red, within the shoe) heavy drilling conditions to 49.5 ft (possible very dense gravel)

51.0

SAND WITH SILT (SW-SM): dense, gray, medium sand, with some medium to coarse gravel

- heave of sand detected at 53.5 ft, possible subterrain water (aquifer) resulting in low recovery despite on driller best efffort
- no recovery, recovered mainly as cuttings due to heaving sands at this depth, not representative material
- dense to very dense, dark gray, damp, with fine sands and fines, with trace of rounded gravels below 66.0 ft
- very dense below 70.0 ft

71.3

LEAN CLAY (CL): very stiff, gray, damp, with trace of very fine sand

- with silt and very fine sands, 77.0 ft to 78.2 ft
- hard, gray, with silt and trace of very fine sand at 80.0 ft

81.3

SAND WITH SILT (SP-SM): dense, gray, wet

- very dense, gray, wey, with trace of silt
- very dense, dark gray, wet, medium sand, with trace of gravel

91.5

LEAN CLAY (CL): very stiff, gray, damp, with pockets of fine sands and trace of silt

- sandy clay below 97.0 ft

98.0

CLAYEY SAND (SC): very dense, gray to dark gray, wet, medium sand

- with trace of gravel and silt pockets at 101.5 ft

NOTES:
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2) For additional symbol identification, refer to Key to Terms & Symbols Used on Logs.
3) DN = Driller's Note

CLASSIFICATION TESTS
- ● Water Content
- □ Dry Unit Weight
- ○ Submerged Unit Weight
- ■ Non-Plastic
- Plastic Limit +– – – – – – – – –+ Liquid Limit

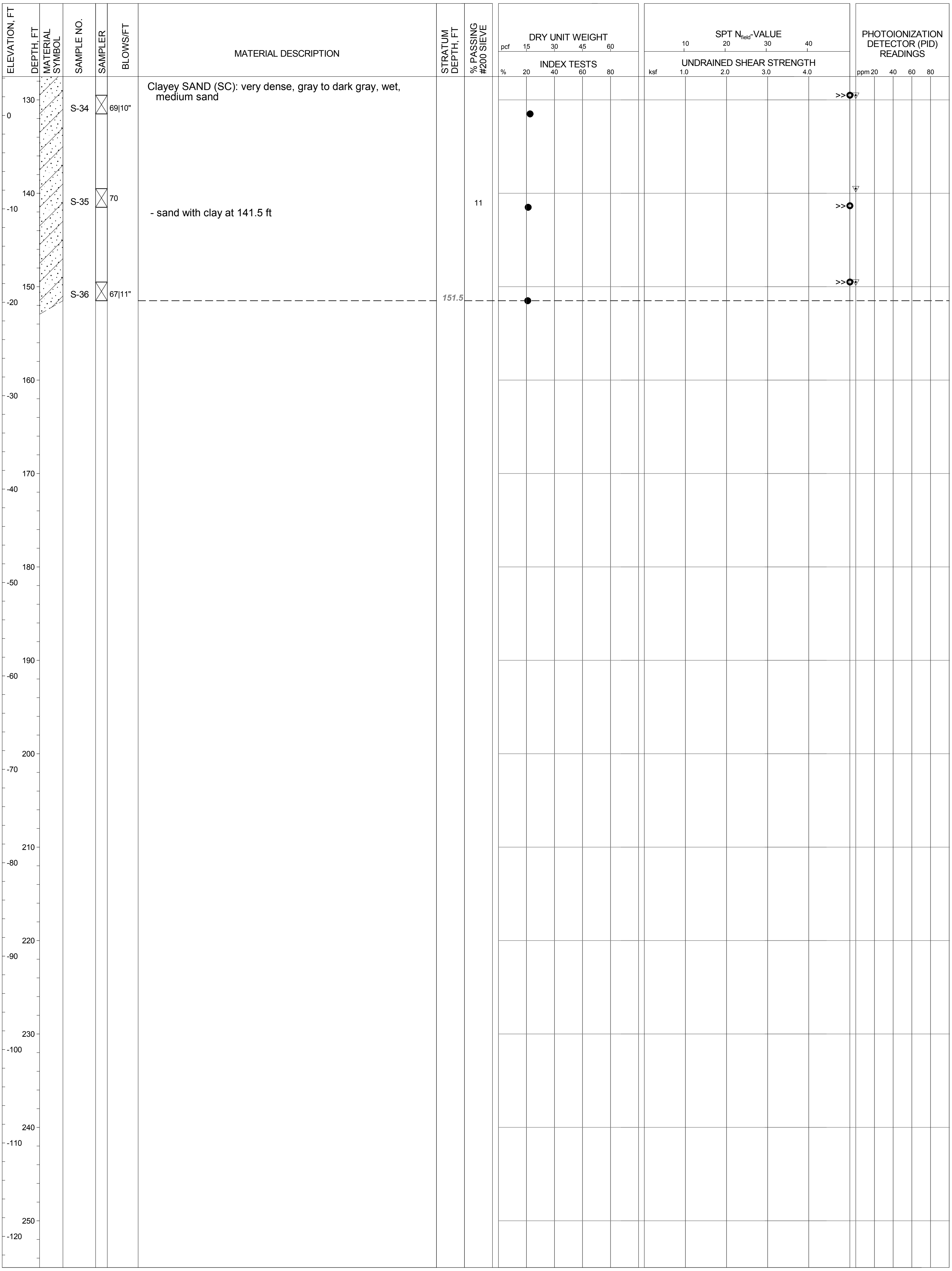
STRENGTH TESTS
- ⊗ Pocket Penetrometer
- ✧ Torvane
- ✧ Remote Vane
- ◆ Miniature Vane
- ▲ Unconsolidated Undrained Triaxial
- ▣ Unconfined Compression
- ✧ Residual Vane
- ◇ Open symbols indicate
- △ remolded tests

- ○ SPT N_Field-Value
- >> Exceeds Data Scale
- WOR - Weight of Rod
- WOH - Weight of Hammer
- ▽ PID

COMPLETION DEPTH: 151.5 ft
COORDINATES: W151.353359 N60.675246 (GCS, NAD 1983, NSRS2007, degrees)
SURFACE ELEVATION: 131.66 ft (rel. NAVD88 datum)
EXPLORATION START DATE: 10/16/2014
COMPLETION DATE: 10/19/2014
LOGGED BY: L. Ferreira

PHASE-1 BORING LOG B-50
ALASKA LNG PROJECT
ONSHORE LNG FACILITIES
NIKISKI, ALASKA

DRILLING COMPANY: Denali
DRILLER: S. Greer
DRILLING RIG: RIG B - Truck (CME-75)
BACKFILL: Cement Bentonite-Grout
DRILLING METHOD
HOLLOW STEM AUGER: N/A
WET ROTARY: 0 to 151.5 ft
CASING: 0 to 74.5 ft



SAMPLE NO.	BLOWS/FT	MATERIAL DESCRIPTION	STRATUM DEPTH, FT	% PASSING #200 SIEVE
S-34	69|10"	Clayey SAND (SC): very dense, gray to dark gray, wet, medium sand		
S-35	70	- sand with clay at 141.5 ft		11
S-36	67|11"		151.5	

NOTES:
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3) DN = Driller's Note

CLASSIFICATION TESTS
- ● Water Content
- □ Dry Unit Weight
- ○ Submerged Unit Weight
- ■ Non-Plastic
- Plastic Limit +– – – – – –+ Liquid Limit

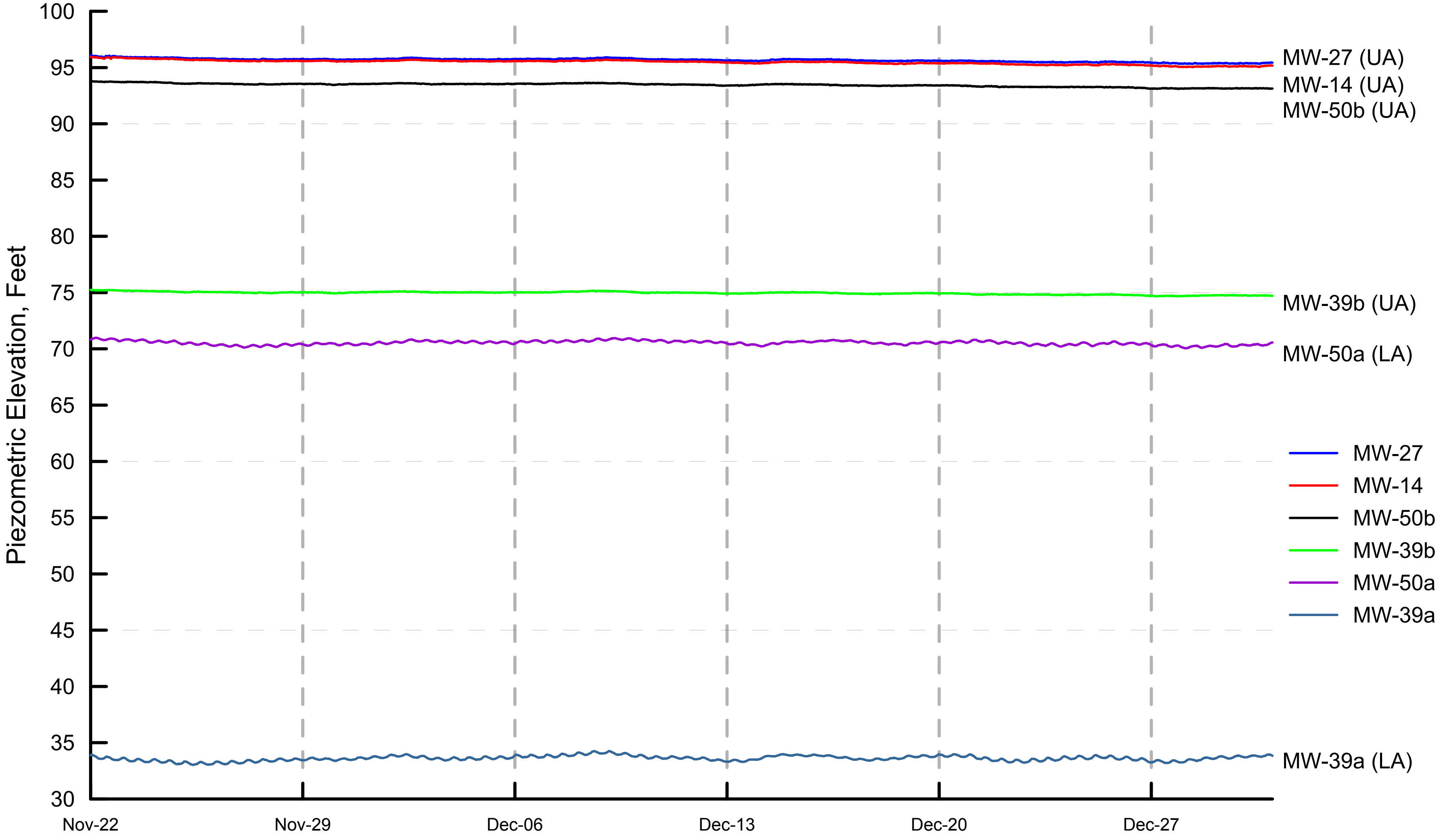
STRENGTH TESTS
- ⊗ Pocket Penetrometer
- ⊕ Torvane
- ◇ Remote Vane
- ◆ Miniature Vane
- ▲ Unconsolidated Undrained Triaxial
- ▣ Unconfined Compression
- ⊖ Residual Vane
- ◇ Open symbols indicate
- △ remolded tests

- ○ SPT N_{Field}-Value
- » Exceeds Data Scale
- WOR - Weight of Rod
- WOH - Weight of Hammer
- ▽ PID

COMPLETION DEPTH: 151.5 ft
COORDINATES: W151.353359 N60.675246 (GCS, NAD 1983, NSRS2007, degrees)
SURFACE ELEVATION: 131.66 ft (rel. NAVD88 datum)
EXPLORATION START DATE: 10/16/2014
COMPLETION DATE: 10/19/2014
LOGGED BY: L. Ferreira

PHASE-1 BORING LOG B-50
ALASKA LNG PROJECT
ONSHORE LNG FACILITIES
NIKISKI, ALASKA

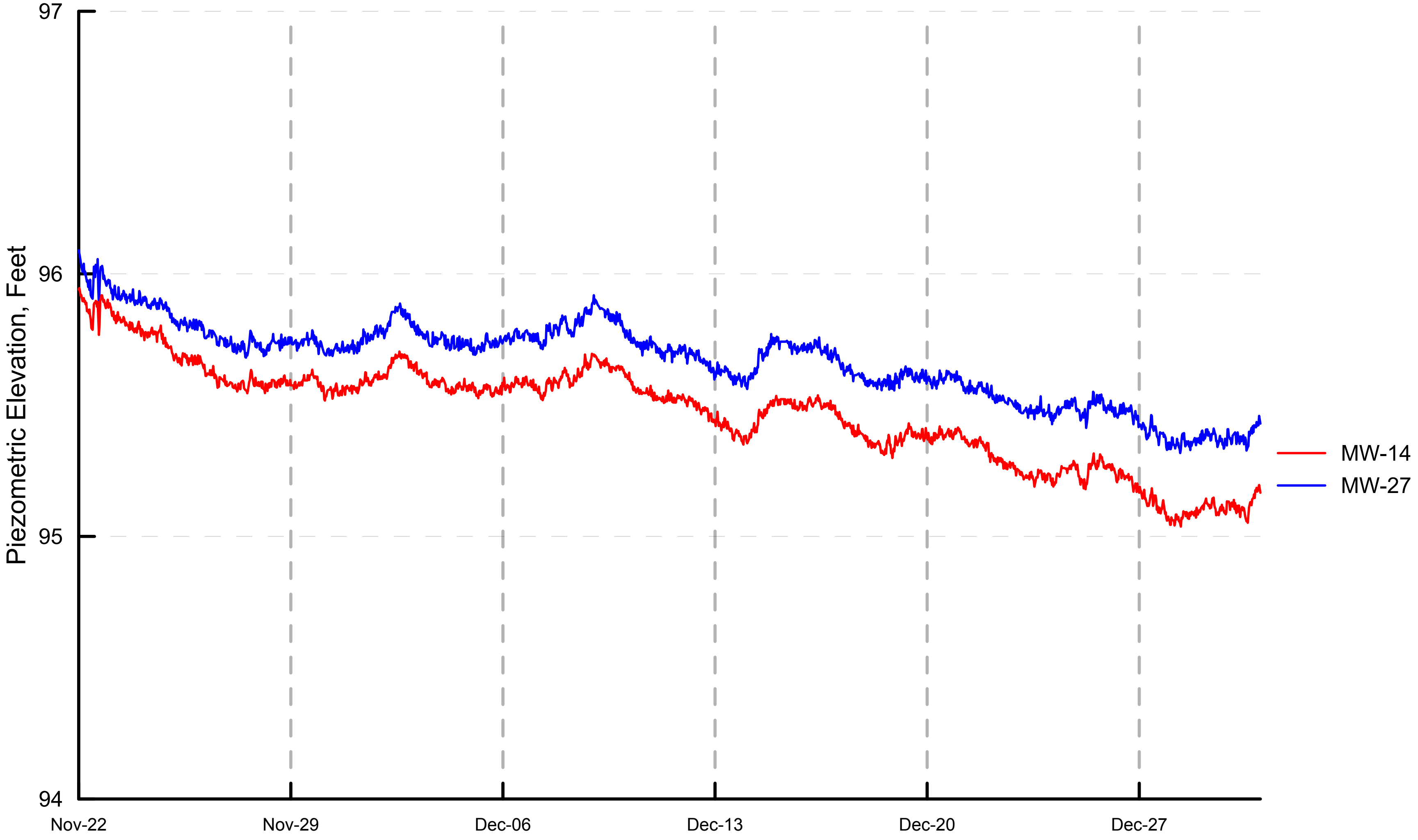
DRILLING COMPANY: Denali
DRILLER: S. Greer
DRILLING RIG: RIG B - Truck (CME-75)
BACKFILL: Cement Bentonite-Grout
DRILLING METHOD
HOLLOW STEM AUGER: N/A
WET ROTARY: 0 to 151.5 ft
CASING: 0 to 74.5 ft



NOTES:
UA = UPPER AQUIFER
LA = LOWER AQUIFER

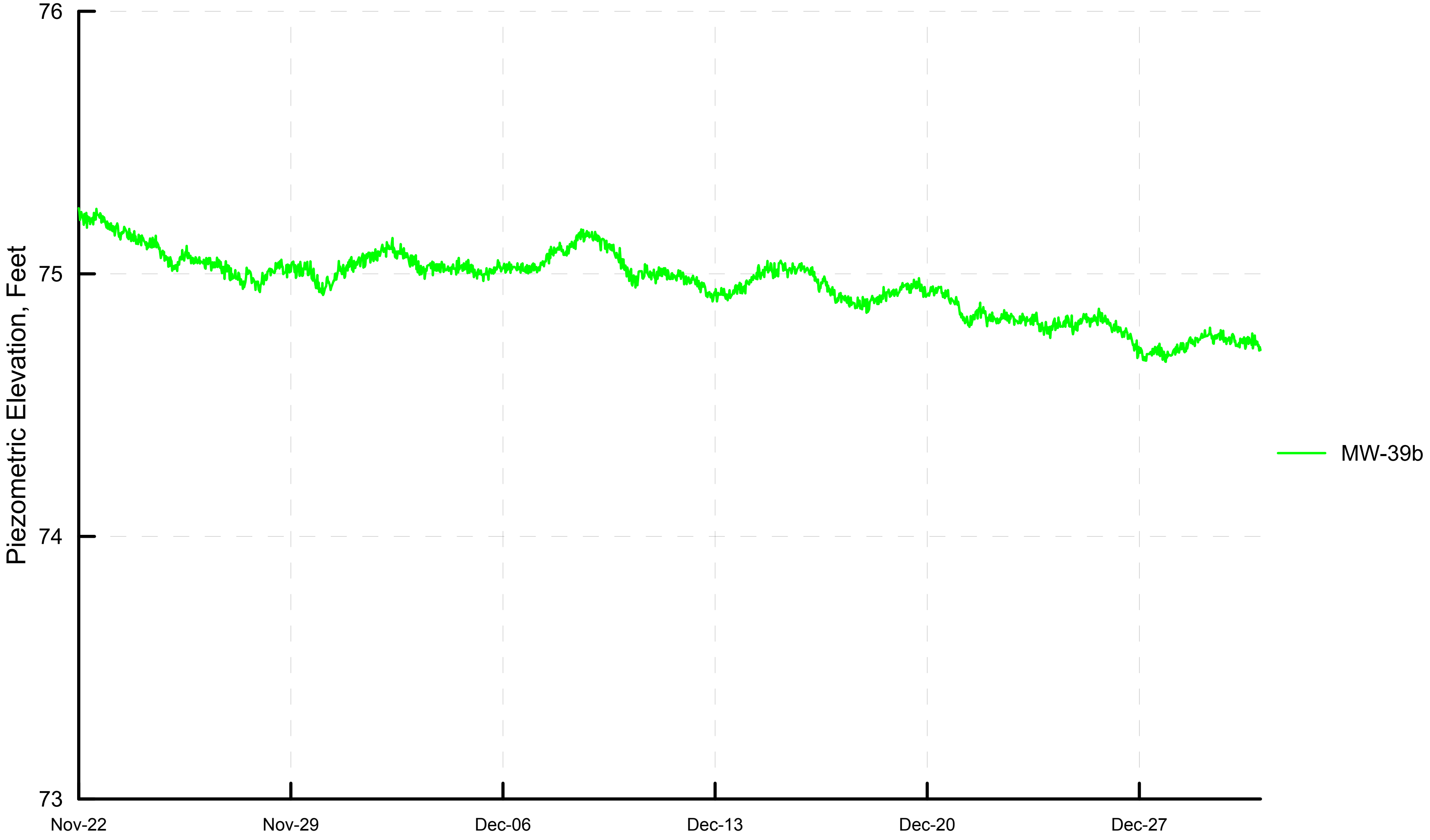
PIEZOMETRIC ELEVATIONS
ONSHORE LNG FACILITIES
ALASKA LNG PROJECT
NIKISKI, ALASKA

PLATE A-25



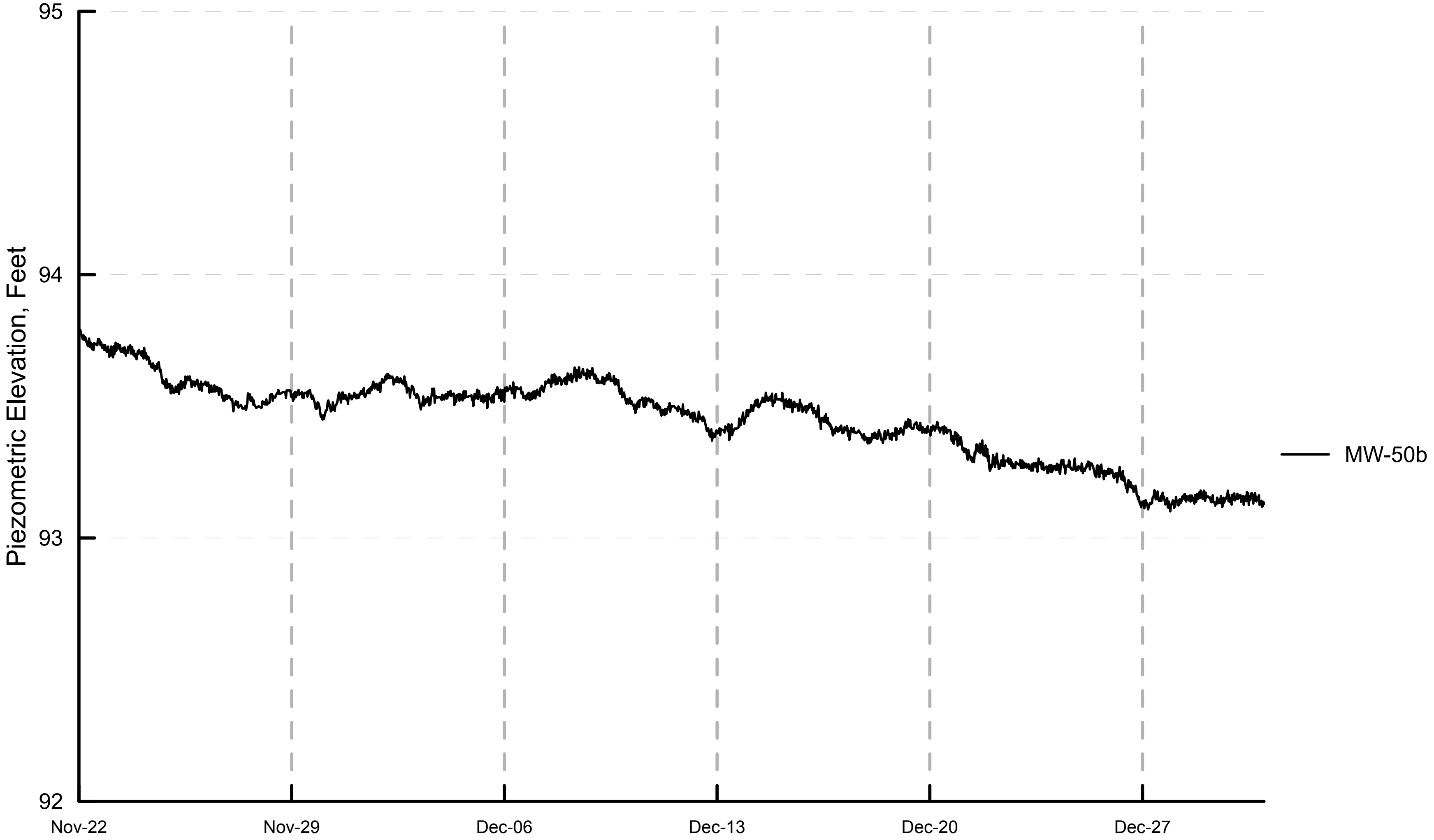
PIEZOMETRIC ELEVATIONS
ONSHORE LNG FACILITIES
ALASKA LNG PROJECT
NIKISKI, ALASKA

PLATE A-26



PIEZOMETRIC ELEVATIONS
ONSHORE LNG FACILITIES
ALASKA LNG PROJECT
NIKISKI, ALASKA

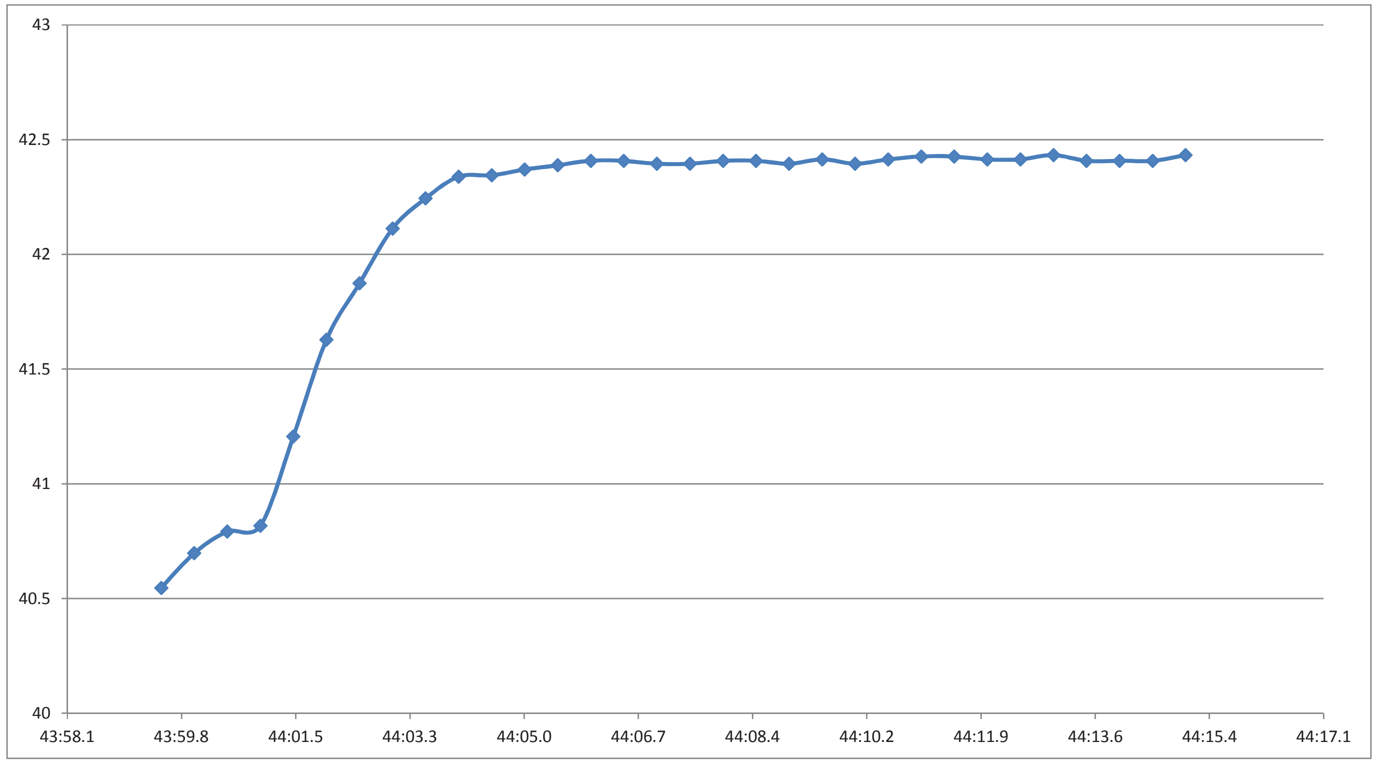
PLATE A-27

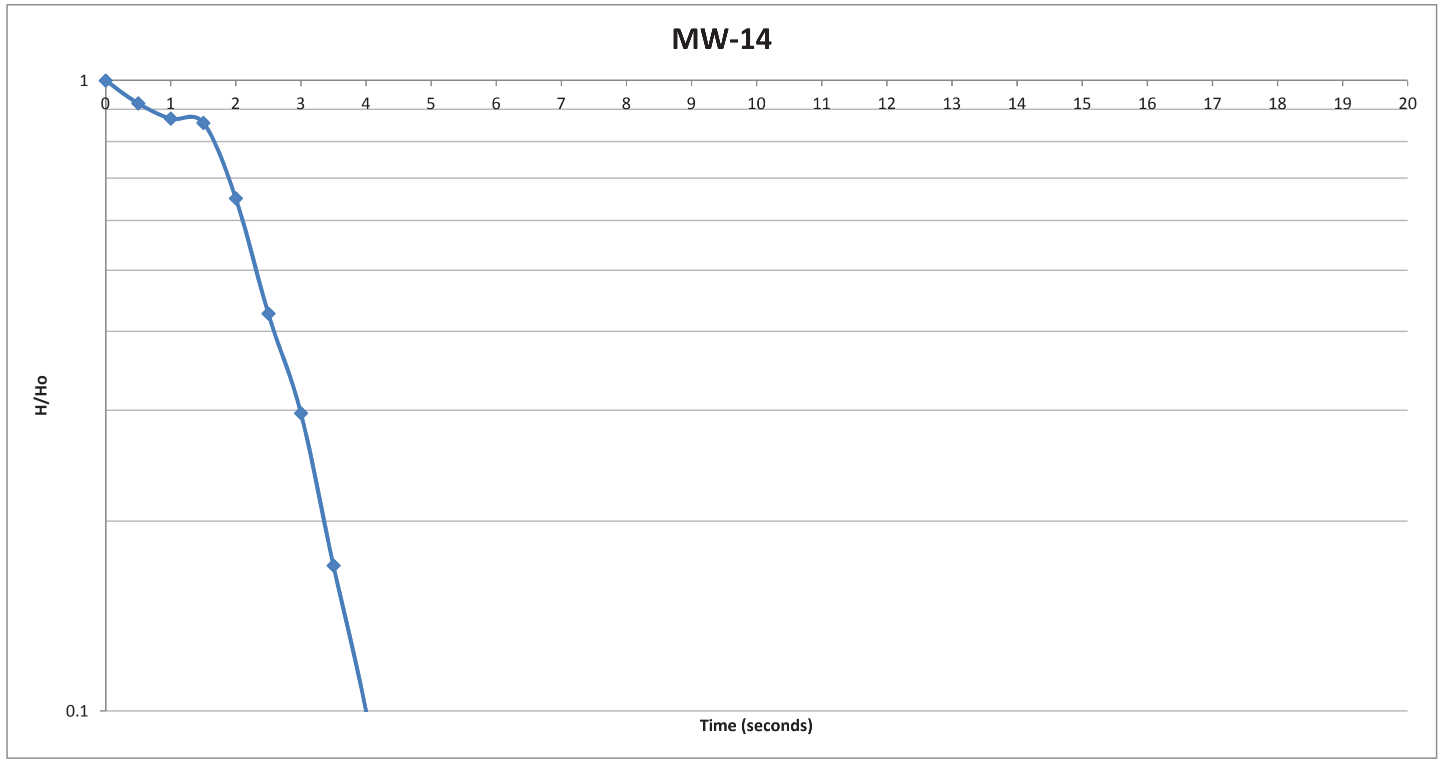


PIEZOMETRIC ELEVATIONS
ONSHORE LNG FACILITIES
ALASKA LNG PROJECT
NIKISKI, ALASKA

PLATE A-28

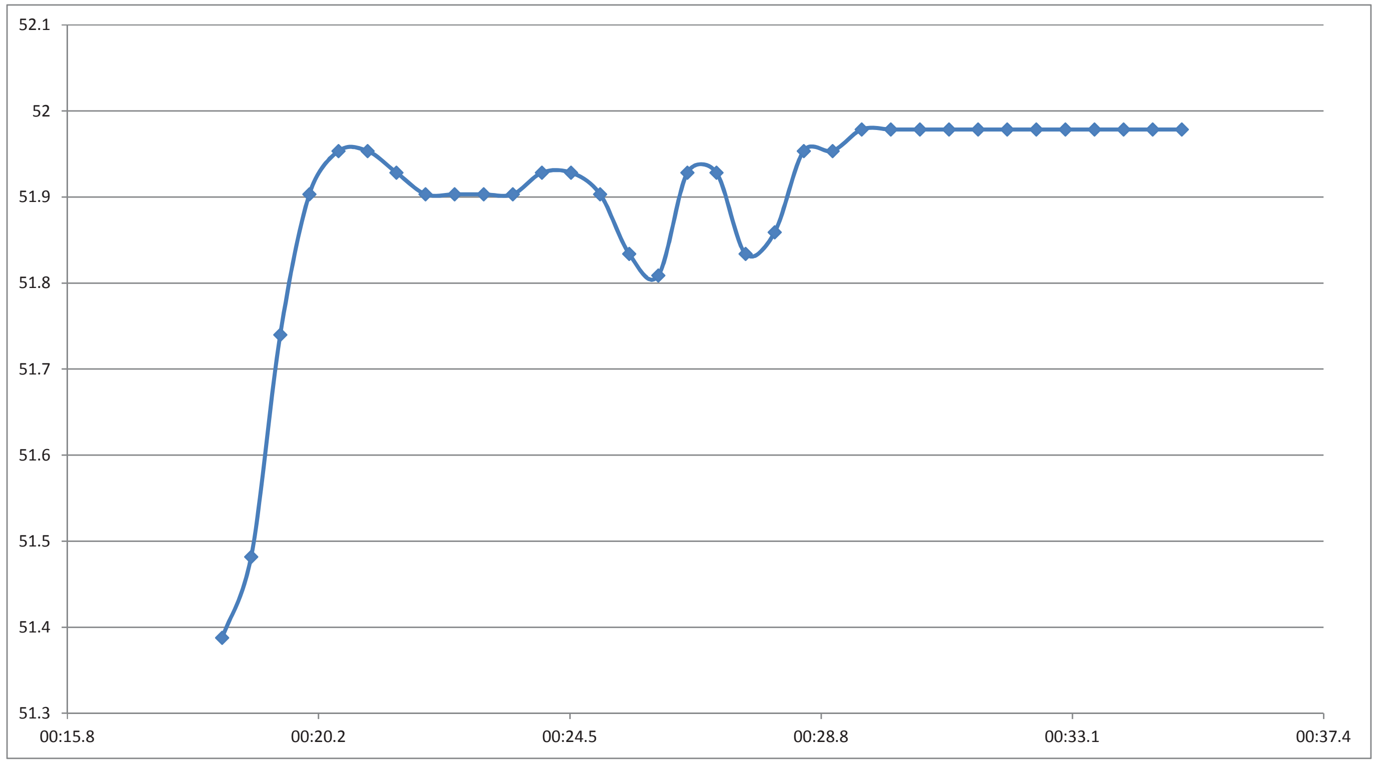
	(ft)						H/H0	Ho=	-1.8865
43:59.5	40.5465	00:00.0	Time(min)	Dis (ft)	0.00	Total Time (seconds)	1		
44:00.0	40.6975	00:00.5	0.008	1.74	0.50	15.5	0.919957593		
44:00.5	40.7918	00:01.0	0.017	1.64	1.00		0.869970845		
44:01.0	40.8169	00:01.5	0.025	1.62	1.50		0.856665783		
44:01.5	41.2068	00:02.0	0.033	1.23	2.00		0.649986748		
44:02.0	41.6281	00:02.5	0.042	0.80	2.50		0.426663133		
44:02.5	41.8734	00:03.0	0.050	0.56	3.00		0.296633978		
44:03.0	42.1123	00:03.5	0.058	0.32	3.50		0.16999735		
44:03.5	42.2444	00:04.0	0.067	0.19	4.00		0.099973496		
44:04.0	42.3387	00:04.5	0.075	0.09	4.50		0.049986748		
44:04.5	42.345	00:05.0	0.083	0.09	5.00		0.04664723		
44:05.0	42.3701	00:05.5	0.092	0.06	5.50		0.033342168		
44:05.5	42.389	00:06.0	0.100	0.04	6.00		0.023323615		
44:06.0	42.4079	00:06.5	0.108	0.03	6.50		0.013305062		
44:06.5	42.4079	00:07.0	0.117	0.03	7.00		0.013305062		
44:07.0	42.3953	00:07.5	0.125	0.04	7.50		0.019984098		
44:07.5	42.3953	00:08.0	0.133	0.04	8.00		0.019984098		
44:08.0	42.4079	00:08.5	0.142	0.03	8.50		0.013305062		
44:08.5	42.4079	00:09.0	0.150	0.03	9.00		0.013305062		
44:09.0	42.3953	00:09.5	0.158	0.04	9.50		0.019984098		
44:09.5	42.4142	00:10.0	0.167	0.02	10.00		0.009965545		
44:10.0	42.3953	00:10.5	0.175	0.04	10.50		0.019984098		
44:10.5	42.4142	00:11.0	0.183	0.02	11.00		0.009965545		
44:11.0	42.4267	00:11.5	0.192	0.01	11.50		0.003339518		
44:11.5	42.4267	00:12.0	0.200	0.01	12.00		0.003339518		
44:12.0	42.4142	00:12.5	0.208	0.02	12.50		0.009965545		
44:12.5	42.4142	00:13.0	0.217	0.02	13.00		0.009965545		
44:13.0	42.433	00:13.5	0.225	0.00	13.50		0		
44:13.5	42.4079	00:14.0	0.233	0.03	14.00		0.013305062		
44:14.0	42.4079	00:14.5	0.242	0.03	14.50		0.013305062		
44:14.5	42.4079	00:15.0	0.250	0.03	15.00		0.013305062		
44:15.0	42.433	00:15.5	0.258	0.00	15.50		0		

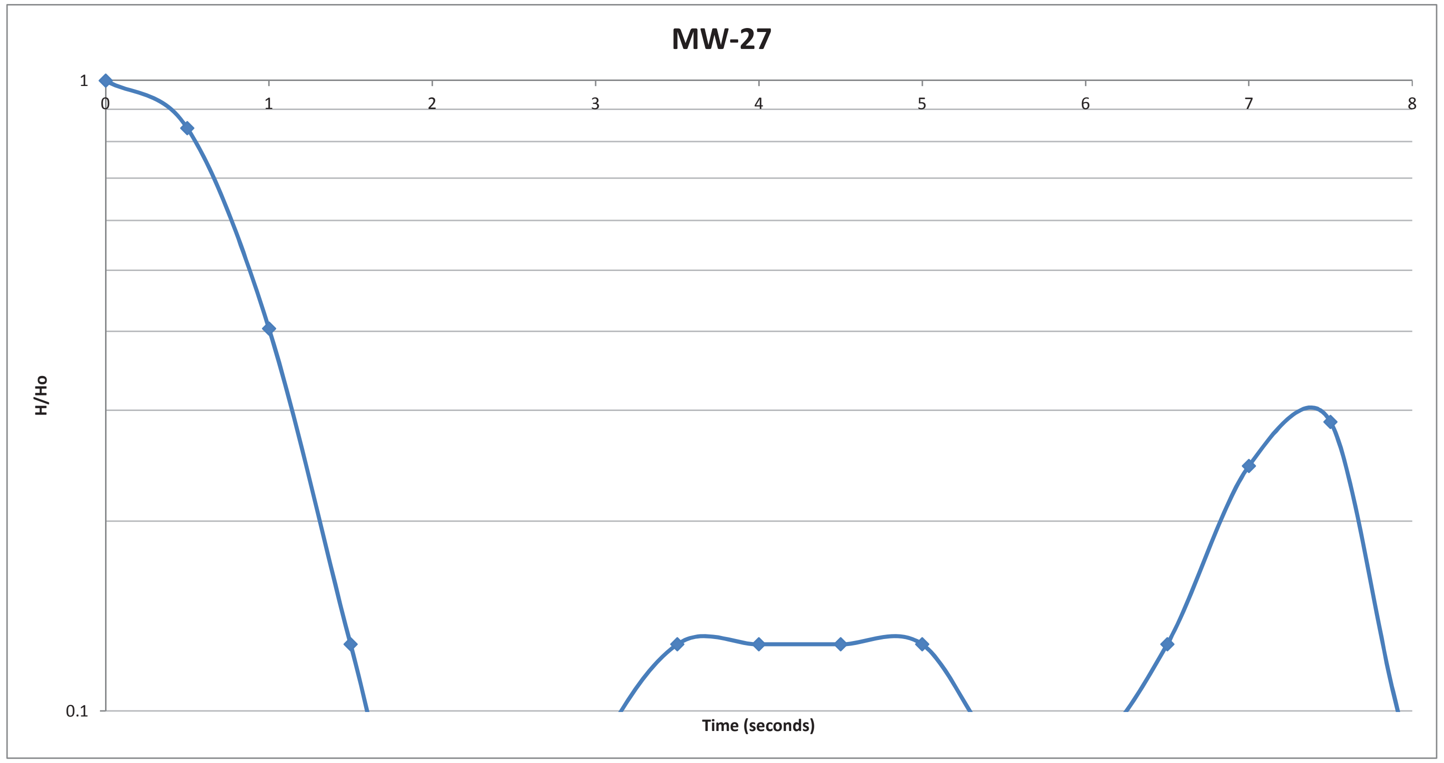




SLUG TEST DATA - MW-14
ONSHORE LNG FACILITIES
ALASKA LNG PROJECT
NIKISKI, ALASKA

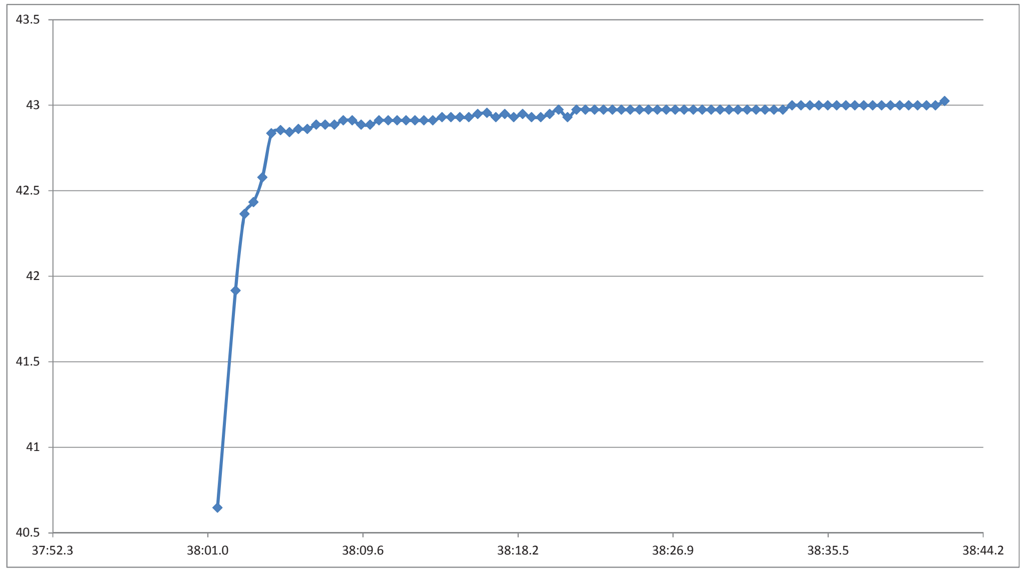
	(ft)						H/H0	Ho=	-0.5911
00:18.5	51.3875	00:00.0	Time(min)	Dis (ft)	0.00	Total Time (seconds)	1		
00:19.0	51.4818	00:00.5	0.008	0.49	0.50	16.5	0.840466926		
00:19.5	51.7397	00:01.0	0.017	0.24	1.00		0.404161732		
00:20.0	51.9032	00:01.5	0.025	0.07	1.50		0.127558789		
00:20.5	51.9535	00:02.0	0.033	0.02	2.00		0.042463204		
00:21.0	51.9535	00:02.5	0.042	0.02	2.50		0.042463204		
00:21.5	51.9283	00:03.0	0.050	0.05	3.00		0.085095585		
00:22.0	51.9032	00:03.5	0.058	0.07	3.50		0.127558789		
00:22.5	51.9032	00:04.0	0.067	0.07	4.00		0.127558789		
00:23.0	51.9032	00:04.5	0.075	0.07	4.50		0.127558789		
00:23.5	51.9032	00:05.0	0.083	0.07	5.00		0.127558789		
00:24.0	51.9283	00:05.5	0.092	0.05	5.50		0.085095585		
00:24.5	51.9283	00:06.0	0.100	0.05	6.00		0.085095585		
00:25.0	51.9032	00:06.5	0.108	0.07	6.50		0.127558789		
00:25.5	51.834	00:07.0	0.117	0.14	7.00		0.244628658		
00:26.0	51.8088	00:07.5	0.125	0.17	7.50		0.287261039		
00:26.5	51.9283	00:08.0	0.133	0.05	8.00		0.085095585		
00:27.0	51.9283	00:08.5	0.142	0.05	8.50		0.085095585		
00:27.5	51.834	00:09.0	0.150	0.14	9.00		0.244628658		
00:28.0	51.8591	00:09.5	0.158	0.12	9.50		0.202165454		
00:28.5	51.9535	00:10.0	0.167	0.02	10.00		0.042463204		
00:29.0	51.9535	00:10.5	0.175	0.02	10.50		0.042463204		
00:29.5	51.9786	00:11.0	0.183	0.00	11.00		0		
00:30.0	51.9786	00:11.5	0.192	0.00	11.50		0		
00:30.5	51.9786	00:12.0	0.200	0.00	12.00		0		
00:31.0	51.9786	00:12.5	0.208	0.00	12.50		0		
00:31.5	51.9786	00:13.0	0.217	0.00	13.00		0		
00:32.0	51.9786	00:13.5	0.225	0.00	13.50		0		
00:32.5	51.9786	00:14.0	0.233	0.00	14.00		0		
00:33.0	51.9786	00:14.5	0.242	0.00	14.50		0		
00:33.5	51.9786	00:15.0	0.250	0.00	15.00		0		
00:34.0	51.9786	00:15.5	0.258	0.00	15.50		0		
00:34.5	51.9786	00:16.0	0.267	0.00	16.00		0		
00:35.0	51.9786	00:16.5	0.275	0.00	16.50		0		

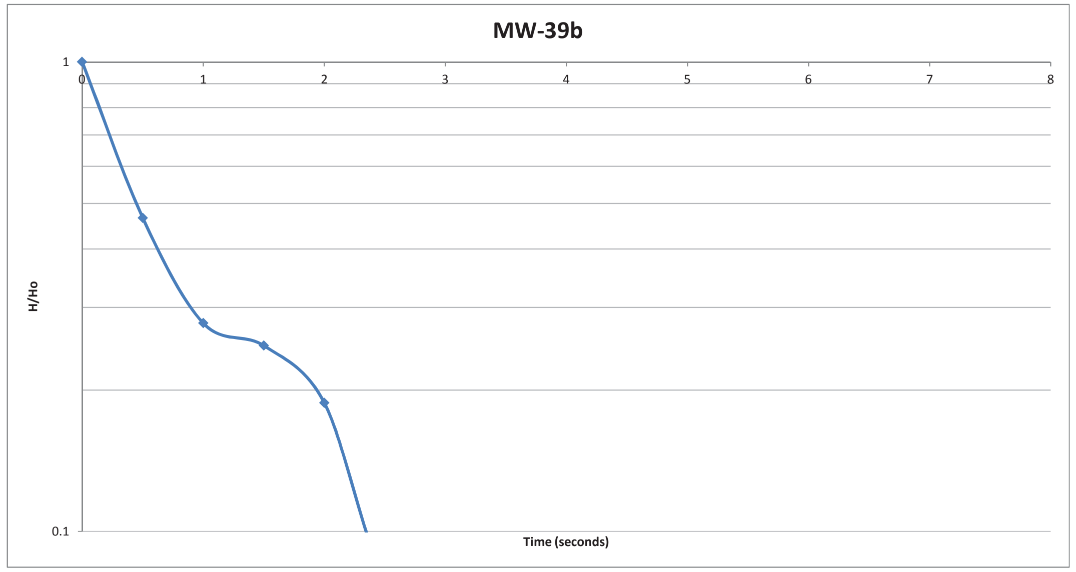




SLUG TEST DATA - MW-27
ONSHORE LNG FACILITIES
ALASKA LNG PROJECT
NIKISKI, ALASKA

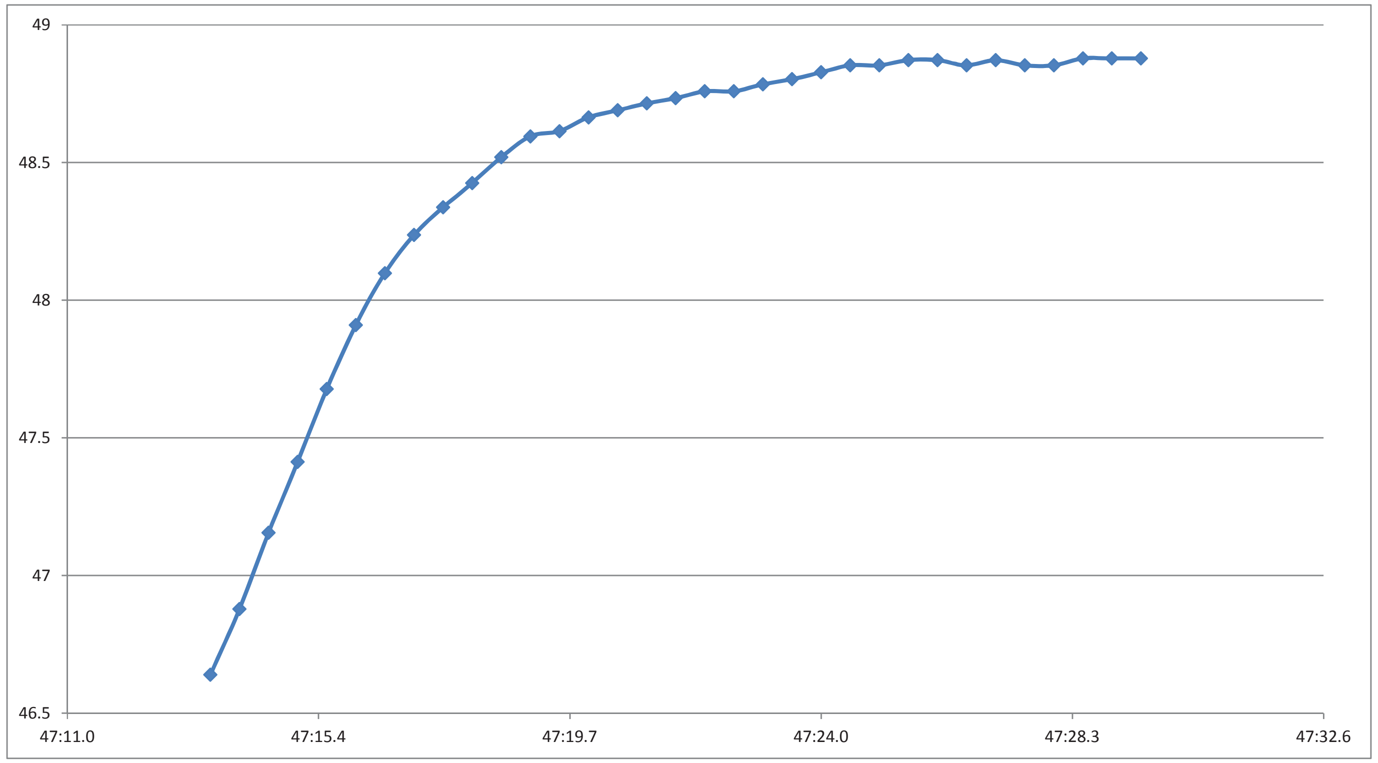
	(ft)						H/H0	Ho=	-2.377
38:01.5	40.6471	00:00.0	Time(min)	Dis (ft)	0.00	Total Time (seconds)	1		
38:02.5	41.9174	00:01.0	0.008	1.08	0.50	40.5	0.465586874		
38:03.0	42.3638	00:01.5	0.017	0.64	1.00		0.277787127		
38:03.5	42.433	00:02.0	0.025	0.57	1.50		0.2486748		
38:04.0	42.5776	00:02.5	0.033	0.42	2.00		0.187841817		
38:04.5	42.8355	00:03.0	0.042	0.16	2.50		0.079343711		
38:05.0	42.8543	00:03.5	0.050	0.14	3.00		0.071434581		
38:05.5	42.8418	00:04.0	0.058	0.16	3.50		0.076693311		
38:06.0	42.8606	00:04.5	0.067	0.14	4.00		0.068784182		
38:06.5	42.8606	00:05.0	0.075	0.14	4.50		0.068784182		
38:07.0	42.8858	00:05.5	0.083	0.11	5.00		0.058182583		
38:07.5	42.8858	00:06.0	0.092	0.11	5.50		0.058182583		
38:08.0	42.8858	00:06.5	0.100	0.11	6.00		0.058182583		
38:08.5	42.9109	00:07.0	0.108	0.09	6.50		0.047623054		
38:09.0	42.9109	00:07.5	0.117	0.09	7.00		0.047623054		
38:09.5	42.8858	00:08.0	0.125	0.11	7.50		0.058182583		
38:10.0	42.8858	00:08.5	0.133	0.11	8.00		0.058182583		
38:10.5	42.9109	00:09.0	0.142	0.09	8.50		0.047623054		
38:11.0	42.9109	00:09.5	0.150	0.09	9.00		0.047623054		
38:11.5	42.9109	00:10.0	0.158	0.09	9.50		0.047623054		
38:12.0	42.9109	00:10.5	0.167	0.09	10.00		0.047623054		
38:12.5	42.9109	00:11.0	0.175	0.09	10.50		0.047623054		
38:13.0	42.9109	00:11.5	0.183	0.09	11.00		0.047623054		
38:13.5	42.9109	00:12.0	0.192	0.09	11.50		0.047623054		
38:14.0	42.9298	00:12.5	0.200	0.07	12.00		0.039671855		
38:14.5	42.9298	00:13.0	0.208	0.07	12.50		0.039671855		
38:15.0	42.9298	00:13.5	0.217	0.07	13.00		0.039671855		
38:15.5	42.9298	00:14.0	0.225	0.07	13.50		0.039671855		
38:16.0	42.9487	00:14.5	0.233	0.05	14.00		0.031720656		
38:16.5	42.9549	00:15.0	0.242	0.04	14.50		0.029112326		
38:17.0	42.9298	00:15.5	0.250	0.07	15.00		0.039671855		
38:17.5	42.9487	00:16.0	0.258	0.05	15.50		0.031720656		
38:18.0	42.9298	00:16.5	0.267	0.07	16.00		0.039671855		
38:18.5	42.9487	00:17.0	0.275	0.05	16.50		0.031720656		
38:19.0	42.9298	00:17.5	0.283	0.07	17.00		0.039671855		
38:19.5	42.9298	00:18.0	0.292	0.07	17.50		0.039671855		
38:20.0	42.9487	00:18.5	0.300	0.05	18.00		0.031720656		
38:20.5	42.9738	00:19.0	0.308	0.03	18.50		0.021161127		
38:21.0	42.9298	00:19.5	0.317	0.07	19.00		0.039671855		
38:21.5	42.9738	00:20.0	0.325	0.03	19.50		0.021161127		
38:22.0	42.9738	00:20.5	0.333	0.03	20.00		0.021161127		
38:22.5	42.9738	00:21.0	0.342	0.03	20.50		0.021161127		
38:23.0	42.9738	00:21.5	0.350	0.03	21.00		0.021161127		
38:23.5	42.9738	00:22.0	0.358	0.03	21.50		0.021161127		
38:24.0	42.9738	00:22.5	0.367	0.03	22.00		0.021161127		
38:24.5	42.9738	00:23.0	0.375	0.03	22.50		0.021161127		
38:25.0	42.9738	00:23.5	0.383	0.03	23.00		0.021161127		
38:25.5	42.9738	00:24.0	0.392	0.03	23.50		0.021161127		
38:26.0	42.9738	00:24.5	0.400	0.03	24.00		0.021161127		
38:26.5	42.9738	00:25.0	0.408	0.03	24.50		0.021161127		
38:27.0	42.9738	00:25.5	0.417	0.03	25.00		0.021161127		
38:27.5	42.9738	00:26.0	0.425	0.03	25.50		0.021161127		
38:28.0	42.9738	00:26.5	0.433	0.03	26.00		0.021161127		
38:28.5	42.9738	00:27.0	0.442	0.03	26.50		0.021161127		
38:29.0	42.9738	00:27.5	0.450	0.03	27.00		0.021161127		
38:29.5	42.9738	00:28.0	0.458	0.03	27.50		0.021161127		
38:30.0	42.9738	00:28.5	0.467	0.03	28.00		0.021161127		
38:30.5	42.9738	00:29.0	0.475	0.03	28.50		0.021161127		
38:31.0	42.9738	00:29.5	0.483	0.03	29.00		0.021161127		
38:31.5	42.9738	00:30.0	0.492	0.03	29.50		0.021161127		
38:32.0	42.9738	00:30.5	0.500	0.03	30.00		0.021161127		
38:32.5	42.9738	00:31.0	0.508	0.03	30.50		0.021161127		
38:33.0	42.9738	00:31.5	0.517	0.03	31.00		0.021161127		
38:33.5	42.999	00:32.0	0.525	0.00	31.50		0.010559529		
38:34.0	42.999	00:32.5	0.533	0.00	32.00		0.010559529		
38:34.5	42.999	00:33.0	0.542	0.00	32.50		0.010559529		
38:35.0	42.999	00:33.5	0.550	0.00	33.00		0.010559529		
38:35.5	42.999	00:34.0	0.558	0.00	33.50		0.010559529		
38:36.0	42.999	00:34.5	0.567	0.00	34.00		0.010559529		
38:36.5	42.999	00:35.0	0.575	0.00	34.50		0.010559529		
38:37.0	42.999	00:35.5	0.583	0.00	35.00		0.010559529		
38:37.5	42.999	00:36.0	0.592	0.00	35.50		0.010559529		
38:38.0	42.999	00:36.5	0.600	0.00	36.00		0.010559529		
38:38.5	42.999	00:37.0	0.608	0.00	36.50		0.010559529		
38:39.0	42.999	00:37.5	0.617	0.00	37.00		0.010559529		
38:39.5	42.999	00:38.0	0.625	0.00	37.50		0.010559529		
38:40.0	42.999	00:38.5	0.633	0.00	38.00		0.010559529		
38:40.5	42.999	00:39.0	0.642	0.00	38.50		0.010559529		
38:41.0	42.999	00:39.5	0.650	0.00	39.00		0.010559529		
38:41.5	42.999	00:40.0	0.658	0.00	39.50		0.010559529		
38:42.0	43.0241	00:40.5	0.667	-0.03	40.00		0		

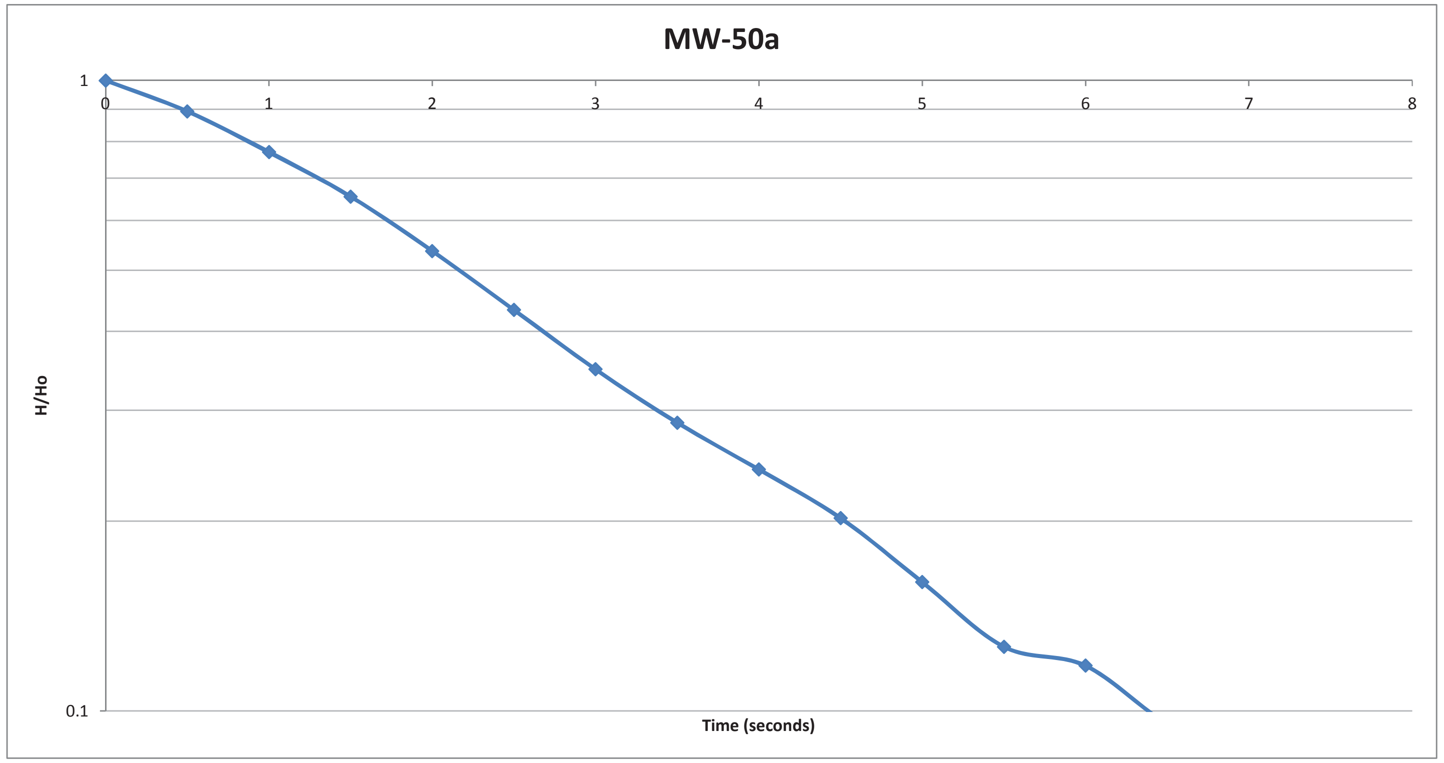




SLUG TEST DATA - MW-39B
ONSHORE LNG FACILITIES
ALASKA LNG PROJECT
NIKISKI, ALASKA

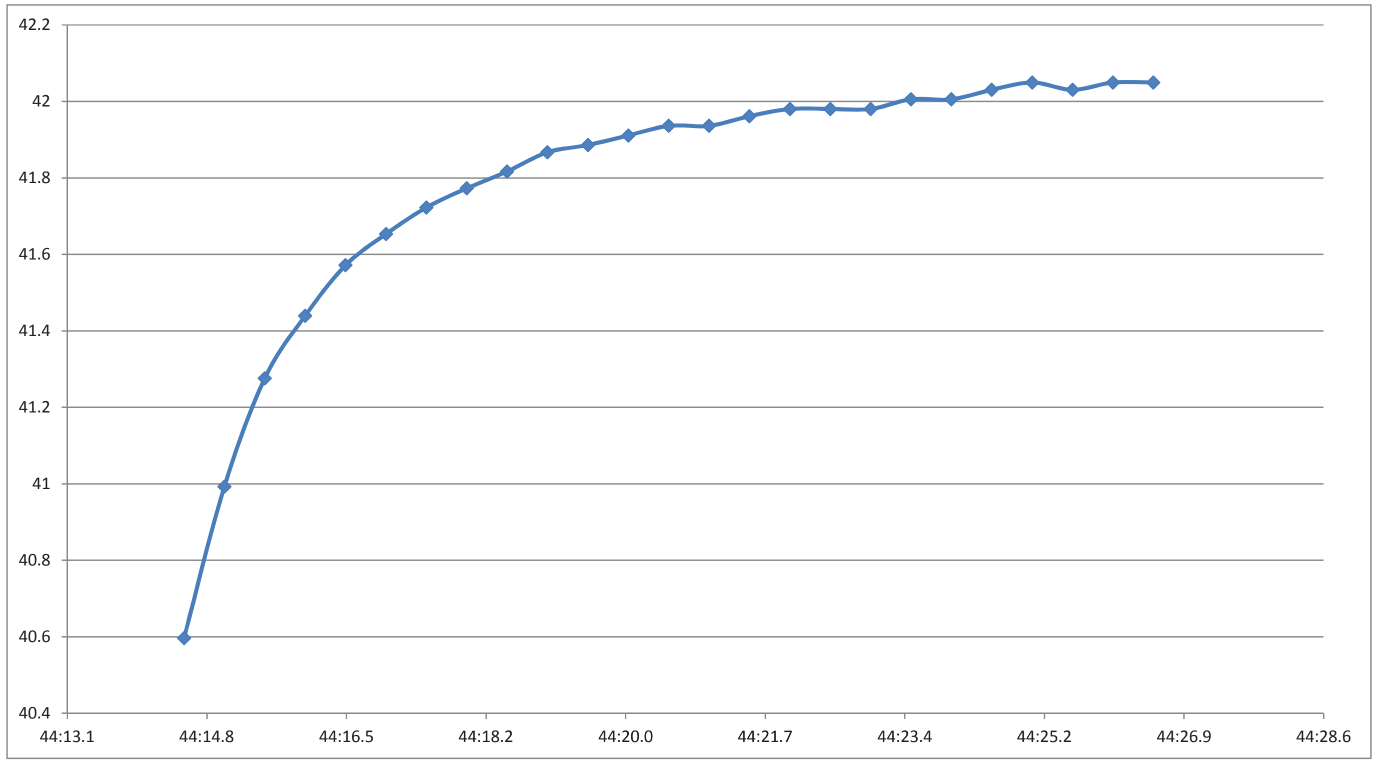
	(ft)						H/H0	Ho=	-2.2386
47:13.5	46.6399	00:00.0	Time(min)	Dis (ft)	0.00	Total Time (seconds)	1		
47:14.0	46.8788	00:00.5	0.008	2.24	0.50	16.0	0.893281515		
47:14.5	47.1555	00:01.0	0.017	2.00	1.00		0.769677477		
47:15.0	47.4133	00:01.5	0.025	1.72	1.50		0.654516215		
47:15.5	47.6774	00:02.0	0.033	1.47	2.00		0.536540695		
47:16.0	47.9101	00:02.5	0.042	1.20	2.50		0.432591798		
47:16.5	48.0988	00:03.0	0.050	0.97	3.00		0.348298043		
47:17.0	48.2371	00:03.5	0.058	0.78	3.50		0.28651836		
47:17.5	48.3377	00:04.0	0.067	0.64	4.00		0.241579559		
47:18.0	48.4257	00:04.5	0.075	0.54	4.50		0.202269275		
47:18.5	48.5201	00:05.0	0.083	0.45	5.00		0.160100063		
47:19.0	48.5955	00:05.5	0.092	0.36	5.50		0.126418297		
47:19.5	48.6144	00:06.0	0.100	0.28	6.00		0.11797552		
47:20.0	48.6647	00:06.5	0.108	0.26	6.50		0.09550612		
47:20.5	48.6899	00:07.0	0.117	0.21	7.00		0.084249084		
47:21.0	48.715	00:07.5	0.125	0.19	7.50		0.073036719		
47:21.5	48.7339	00:08.0	0.133	0.16	8.00		0.064593943		
47:22.0	48.759	00:08.5	0.142	0.14	8.50		0.053381578		
47:22.5	48.759	00:09.0	0.150	0.12	9.00		0.053381578		
47:23.0	48.7842	00:09.5	0.158	0.12	9.50		0.042124542		
47:23.5	48.803	00:10.0	0.167	0.09	10.00		0.033726436		
47:24.0	48.8282	00:10.5	0.175	0.08	10.50		0.022469401		
47:24.5	48.8533	00:11.0	0.183	0.05	11.00		0.011257036		
47:25.0	48.8533	00:11.5	0.192	0.03	11.50		0.011257036		
47:25.5	48.8722	00:12.0	0.200	0.03	12.00		0.002814259		
47:26.0	48.8722	00:12.5	0.208	0.01	12.50		0.002814259		
47:26.5	48.8533	00:13.0	0.217	0.01	13.00		0.011257036		
47:27.0	48.8722	00:13.5	0.225	0.03	13.50		0.002814259		
47:27.5	48.8533	00:14.0	0.233	0.01	14.00		0.011257036		
47:28.0	48.8533	00:14.5	0.242	0.03	14.50		0.011257036		
47:28.5	48.8785	00:15.0	0.250	0.03	15.00		0		
47:29.0	48.8785	00:15.5	0.258	0.00	15.50		0		
47:29.5	48.8785	00:16.0	0.267	0.00	16.00		0		

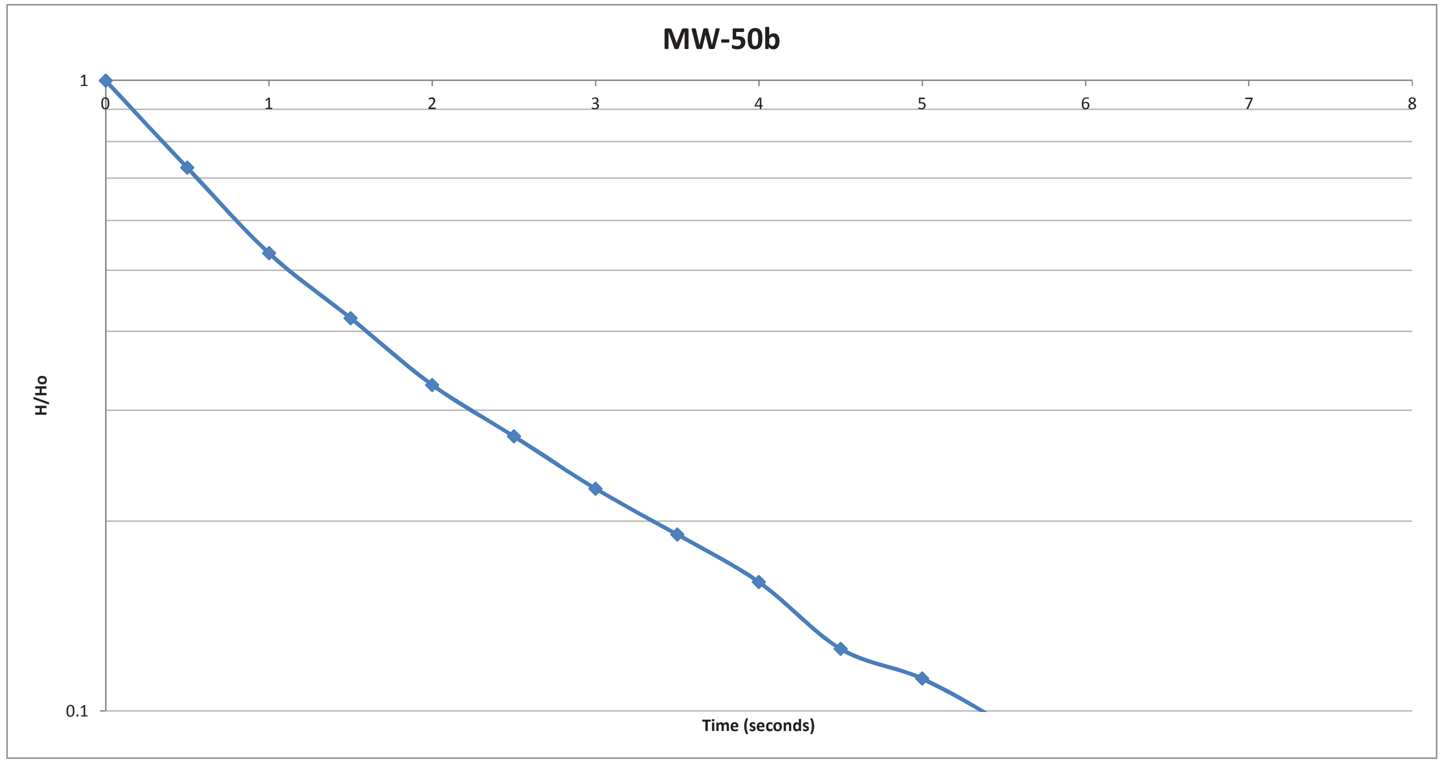




SLUG TEST DATA - MW-50A
ONSHORE LNG FACILITIES
ALASKA LNG PROJECT
NIKISKI, ALASKA

	(ft)						H/H0	Ho=	-1.4526
44:14.5	40.5968	00:00.0	Time(min)	Dis (ft)	0.00	Total Time (seconds)	1		
44:15.0	40.993	00:00.5	0.008	1.06	0.50	12.0	0.727247694		
44:15.5	41.276	00:01.0	0.017	0.77	1.00		0.532424618		
44:16.0	41.4395	00:01.5	0.025	0.61	1.50		0.419867823		
44:16.5	41.5715	00:02.0	0.033	0.48	2.00		0.328996283		
44:17.0	41.6533	00:02.5	0.042	0.40	2.50		0.272683464		
44:17.5	41.7224	00:03.0	0.050	0.33	3.00		0.225113589		
44:18.0	41.7727	00:03.5	0.058	0.28	3.50		0.190486025		
44:18.5	41.8168	00:04.0	0.067	0.23	4.00		0.160126669		
44:19.0	41.8671	00:04.5	0.075	0.18	4.50		0.125499105		
44:19.5	41.8859	00:05.0	0.083	0.16	5.00		0.112556795		
44:20.0	41.9111	00:05.5	0.092	0.14	5.50		0.095208591		
44:20.5	41.9362	00:06.0	0.100	0.11	6.00		0.07792923		
44:21.0	41.9362	00:06.5	0.108	0.11	6.50		0.07792923		
44:21.5	41.9614	00:07.0	0.117	0.09	7.00		0.060581027		
44:22.0	41.9803	00:07.5	0.125	0.07	7.50		0.047569875		
44:22.5	41.9803	00:08.0	0.133	0.07	8.00		0.047569875		
44:23.0	41.9803	00:08.5	0.142	0.07	8.50		0.047569875		
44:23.5	42.0054	00:09.0	0.150	0.04	9.00		0.030290514		
44:24.0	42.0054	00:09.5	0.158	0.04	9.50		0.030290514		
44:24.5	42.0306	00:10.0	0.167	0.02	10.00		0.01294231		
44:25.0	42.0494	00:10.5	0.175	0.00	10.50		0		
44:25.5	42.0306	00:11.0	0.183	0.02	11.00		0.01294231		
44:26.0	42.0494	00:11.5	0.192	0.00	11.50		0		
44:26.5	42.0494	00:12.0	0.200	0.00	12.00		0		





SLUG TEST DATA - MW-50B
ONSHORE LNG FACILITIES
ALASKA LNG PROJECT
NIKISKI, ALASKA