



November 21, 2013

Brice Inc.  
301 Cushman St, Suite 200  
Fairbanks, AK 99707

Attn.: Walton Crowell

Re: Totchaket Road Geotechnical and Constructability Assessment - FINAL

Mr. Crowell,

RECON LLC has completed an initial field reconnaissance and geotechnical investigation of the proposed Totchaket Highway extension currently in the planning and engineering phase. The inspection was completed by Isaac Rowland, PE, and Mick Ewing, PLS, from November 1-4, 2013.

The RECON crew mobilized to site using a river boat to cross the Nenana River on November 1, 2013. On-site transportation consisted of two ATVs. A camp was established near road mile 9.8. Upon completion of the work, demobilization across the river on November 4 was accomplished using a R44 helicopter chartered from Alaska Land Exploration.

This report summarizes the reconnaissance geotechnical investigation, makes recommendations regarding engineering and construction methods, and identifies specific locations for sand borrow.

### **Scope of Work**

The goal of this field visit was to inspect the proposed road alignment for constructability or engineering issues and complete a reconnaissance-level soils investigation.

A total of 27 bore holes were completed at quarter-mile intervals between the take-off point from the existing road at approx. MP 9.1 and the end of the proposed road extension at approx. MP 15.1. Test borings were completed using a light gas-powered soil auger utilizing a 2.5" solid flight auger.



*Photo 0097 – gas-powered auger used for geotechnical sampling*

The goal of the test bore program was to characterize and define the depth of the silt overburden layer over the length of the project as well as to sample the sand layer in areas identified as possible cut or borrow areas. A total of 30 soil samples were collected, and 9 samples were sent to the laboratory for additional analysis.

In addition to the geotechnical work completed by RECON, the route was also assessed for hazards and construction methods. Hazard assessment included noting areas subject to spring flooding, intervals appropriate for road cuts, and locations of poor soils. The best potential construction method was determined by road segment.

### **Geotechnical Assessment**

A total of 27 holes were completed along the route, starting at TB-02 and ending at TB-26. Two additional holes, TB-05A and TB-18A, were added in areas of interest. In addition, the *Totchaket Agricultural Road Soils Investigation Report* completed for the City of Nenana by Construction Test Lab Inc. in 1981 was reviewed, and its information was incorporated into RECON's assessment of project site conditions. Thirteen of the test borings completed in 1981 were determined to be within the current project area.

Soils logs and photos of each test bore location completed by RECON are included as Appendix B to this report.



RECON found that the typical soil section along the entirety of the route consists of relatively clean sand overlain by varying thicknesses of silt or silt-heavy soils. The thickness of the silt overlay varied between 1.0 and 6.0 ft, with the majority at a thickness between 2.0 and 4.0 ft. This silt soil is generally deemed to be unsuitable for road construction and typically will be either removed or left undisturbed in the sub-grade.

Permafrost was encountered in one test bore (TB-19) at a depth of 5 ft. RECON's experience in the project area is that permafrost may be encountered within the depth of road cut development at isolated locations with characteristic slope aspect and vegetative cover. However, it will be RECON's intent during design to avoid cuts in any area suspected to have shallow permafrost. Permafrost is likely pervasive at depths greater than 20 to 50 ft over much of the project area.



*Photo 0038 – Typical Nenana silt loam found throughout project area.*



*Photo 0058 – Typical clean sand found underlying the silt layer.*

The USDA Soil Conservation Service's *Soil Survey of the Totchaket Area, Alaska* identifies the surficial soils along the majority of the proposed road alignment as "Nenana Silt loam, shallow, nearly level to hilly." The USDA-mapped soil units are shown on the Test Bore Locations Map (Appendix A).

A selection of 9 sand and overburden samples were submitted for sieve analysis to EMC Engineering in Palmer, AK. The results of the tests are included in Appendix C and confirm the visual observations of clean sand overlain by silt loam in most areas.

### **Constructability Assessment**

The entire project area has been burned over in the past several years. Nearly all of the proposed road alignment is through what was previously a very dense forest of black and white spruce with stands of aspen and some birch. At the time of this field investigation, much of the burned and dead timber was still standing. However, dead and down timber is also common and makes for difficult overland travel. Regrowth of aspen and willow is common with some young spruce and birch. Very little salvageable timber was noted.



*Photo 0004 – Typical vegetation and terrain along road alignment.*

The majority of the road will require built-up (overlay) construction methods. The characteristic lack of topographic relief and presence of a pervasive silty overburden layer will not allow other types of construction for the majority of the alignment. Exceptions to this will occur where the road crosses several low northeast-trending dunes that will require cuts of various depths.

The native sand found throughout the project area generally lacks a significant percentage of silt (fines). It has been RECON's experience that when used for sub-base construction, this type of sand generally will not be amenable to significant compaction by vehicle traffic and will remain loose. This has negative implications for construction traffic, as heavy use will cause significant deterioration of the travel surface. A temporary travel way constructed on frozen native soils to the side of the road may be required.

Following is a review of the conditions and construction recommendations by road interval (mileposts are approximate):

MP 9.1–9.5

The proposed road extension departs from the existing road at MP 9.1. The departure point from the existing road will involve a small road cut that will require several thousand yards of excavation for construction of the intersection. The following half-mile is generally over relatively flat terrain overlain by silt loam of 3-4 ft depth. This road interval will require overlay construction.

MP 9.5–9.8

Over this interval the terrain rises about 30 ft before cresting a relic sand dune at MP 9.8, then drops off a relatively steep (~20%) face. This section will require a significant cut and was identified as a preferred location for a sand borrow site.



### MP 9.8–11.8

From the base of the dune at MP 9.8 to MP 11.8, the road will traverse flat terrain with minimal topographic relief. The silt overburden layer in this section is generally 3-5 ft in depth, although sections of both shallower and deeper silt were noted.

Of concern in this section are the numerous aspen “pothole” low areas that tend to fill with water in the spring. At least three such depressions will be crossed directly by the road, and it is likely that other, smaller low areas will also be crossed. One notable section at MP 10.9 (TB-09) showed high water marks on the trees of at least 4.5 ft above ground level. The use of a standard sand sub-base in these sections will result in road shoulder failure. Road re-alignment around these sections or a rock fill sub-base will be required for up to 20% of the road construction through this two-mile section.

The entirety of this section will be designed as overlay construction.

### MP 11.8–15.1

Near MP 11.8 the alignment begins to traverse more upland terrain bisected by a series of small to medium northeast-trending dune strands. The silt overburden layer over this interval varies from 4-5 ft on the flats to 1-2 ft near the crest of the dunes. Although the bulk of road construction will continue to utilize overlay construction, a number of shallow- to moderate-depth cuts will be required. RECON estimates that these cut sections will consist of 10-15% of total construction footage. It has been RECON’s observation that the moist silt layer found throughout the project is very difficult to excavate during the winter season, typically requiring a D9 class ripper dozer for best production.

Two of the larger sand ridges were specifically noted as able to provide fill material for road construction.

One section of road at least 500 ft long near MP 14.8 (TB-25) was noted as requiring geofabric or sub-excavation due to high moisture content. A 500 ft long x 10 ft deep low area was noted near MP 13.7 that will require significant rock fill or road re-alignment. Several shallower depressions were also noted.

## **Sand Borrow Locations**

Construction of the road from MP 9.1 to MP 15.1 will require a substantial quantity of borrow for the construction of the sub-base. RECON has defined several areas suitable for borrow of clean sand that may be utilized for sub-base construction. No gravel, rock, or other coarse aggregate is was found near the project area and all material required for road surfacing will need to be imported from off-site.

Based on preliminary analysis topographic data, RECON estimates that standard cut-to-fill construction will not provide sufficient material for the required road design. Given the minimal number of cuts on the alignment, RECON generally recommends the identification and permitting of two or three additional material sites or expanded cuts to ensure sufficient sand quantity is available.

Potential borrow sources identified are as follows:

MP 9.8 – A 30 ft high sand dune is located near MP 9.8. Borings in this dune include TB-05 and TB-05A. The dune has a gradual slope to the southeast and a steep face to the northwest. A large cut will be required and may provide sand for a least a mile of overlay construction. Over-excavation of this cut or permitting of a material site in this location will provide larger quantities of sand (3+ miles).



MP 13.1 – A 20 ft northeast-trending sand dune is crossed at this location. Test bore TB-18A showed shallow overburden on the dune crest. The cut at this location is not deep and would produce enough sand to allow about 0.5 miles of construction. However, this location is amenable to the development of a large borrow site to the north. It is RECON's recommendation that it be permitted as such.

MP 13.9 – A 20 ft high dune is crossed at this location. Sand was located at a depth of 3.5 ft. RECON anticipates that by utilizing a deep cut at this site, sufficient excess sand may be produced to construct the road as far as MP 15.1 (end of project).

MP 15.5 – During aerial reconnaissance of the project area after completion of the geotechnical assessment, a large sand dune complex was located just past the end of the proposed 2014 construction. If permitted as a DNR Material Site, this location may provide a large quantity of sand. Currently no survey is available for this site, and it was minimally covered by the 2013 LiDAR flight. A shallow 1981 bore hole in the general vicinity (B-19) shows sand from surface to at least 10 ft.

Other possible small-scale material site locations were identified near minor ridges or topographic highs at MP 10.5 and 11.8. However, both locations may require excavation outside the ROW to obtain appreciable volume.

### Summary

We appreciate the opportunity to provide engineering services and look forward to working with you further on this project. Please feel free to contact me at (907) 322-5545 or [isaac@reconllc.net](mailto:isaac@reconllc.net) with any questions.

Sincerely,

A handwritten signature in black ink, appearing to read "Isaac Rowland". The signature is fluid and cursive, written in a professional style.

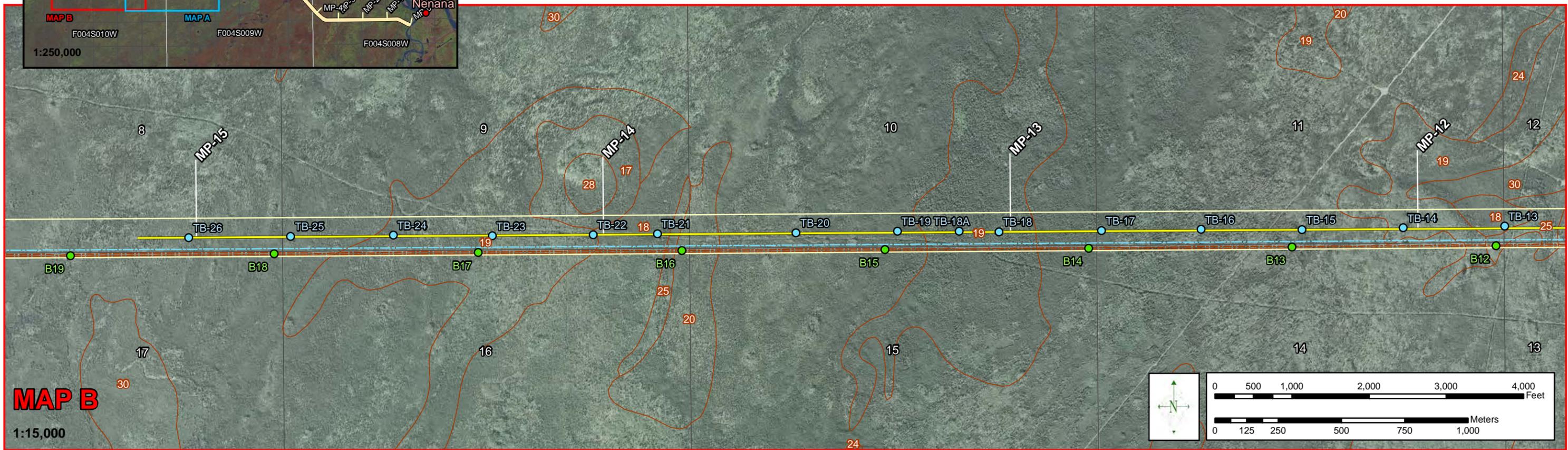
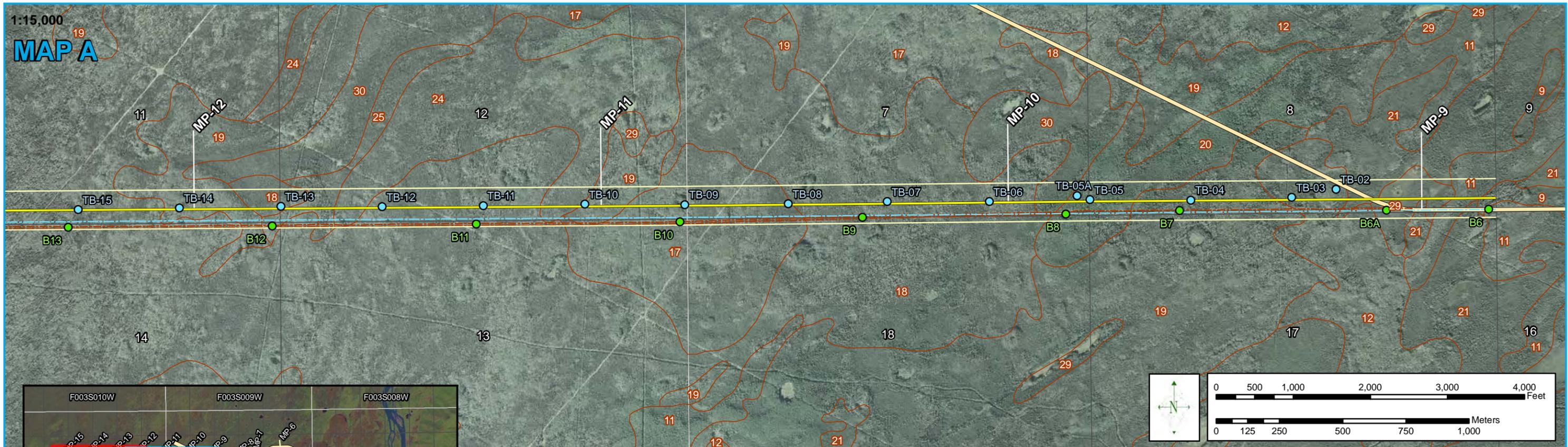
Isaac Rowland, PE  
RECON LLC

Attachments:

- Appendix A – Test Bore Location Map
- Appendix B – Soils Logs and Photos
- Appendix C – Sieve Analysis Results

# Appendix A

## Test Bore Location Map



**RECON** Totchaket Report - Appendix A  
**Test Bore Location Map**

- Legend**
- Route Extension Centerline
  - Platted Route Centerline
  - Platted Route ROW
  - Existing Trail
  - Nunivak #2 Route
  - Test Bores (Nov. 2013)
  - Historical Boreholes (1981)
  - Soil Survey Delineations
  - Townships
  - Sections

Map Produced 21 November 2013 by RECON LLC  
 481 W. Arctic Ave., Palmer, AK 99645  
 NAD 1983 Alaska SPCS Zone 4 (Feet)  
 Imagery Basemap by UAF-GINA BDL&WMS

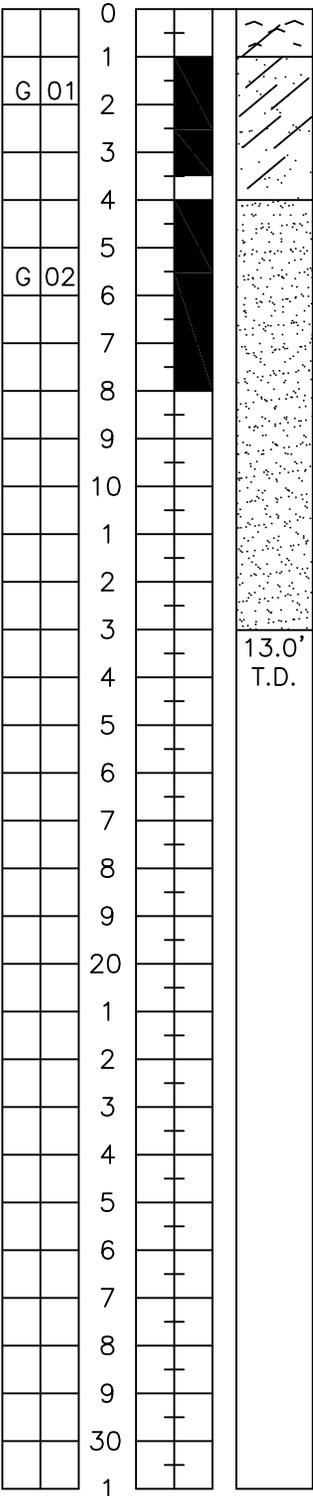
**NOTE: Mileposts shown on this map are preliminary only and may not reflect exact distance.**

# Appendix B

## Soils Logs and Photos

# GEOLOGIC LOG      TEST BORE: TB - 02

Sample Method	Sample Number	Depth In Feet	Blows per Foot	Sample Interval	Frozen Interval	Graphic Log	Ground Elev.: _____ Total Depth : _____ Bottom Elev.: _____ Collar Elev.: _____ Reference:        _____	Vegetation: _____ Burned black spruce Remarks: _____ Near crest of dune _____	Location: _____ Garmin 62 GPS N 64° 34.534 N 149° 23.933 Elev 451 ft
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0.0-1.0'      SILT loam w/ some organics, brown, slightly moist

1.0-4.0'      Sandy-SILT loam, brown, slightly moist,

4.0-13.0'      Fine - Medium SAND, tan, slightly moist, moderately dense SM

13.0' T.D.

T.D. @ 13.0'

Photos:      0029 - On road looking west  
                  0030 - TB-02 looking east  
                  0031 - Sample TB02-01  
                  0034 - Sample TB02-02

Notes:      Hole at crest of dune near preferred take off point of road  
                  at/near existing N2 spur road cut.

**RECON, LLC**  
 Rowland Engineering Consultants  
 481 W. Arctic Ave.  
 Palmer, Alaska 99645  
 Ph: (907) 746-3630

Project No.: \_\_\_\_\_ Sheet 1 of 1 Log# TB-02  
 Project Name: Totchaket Road Phase I  
 Location: Totchaket Road MP 9-15  
 Method Used: 2.5" solid flight auger Rig Type: Viper Auger  
 Engineer: Isaac Rowland, PE Contractor: RECON  
 Date Begun: 11-2-13 Date Comp.: 11-2-13

**TB-02 - Figure 1/2**



0029: On road looking west



0030: TB-02 looking east

**TB-02 - Figure 2/2**



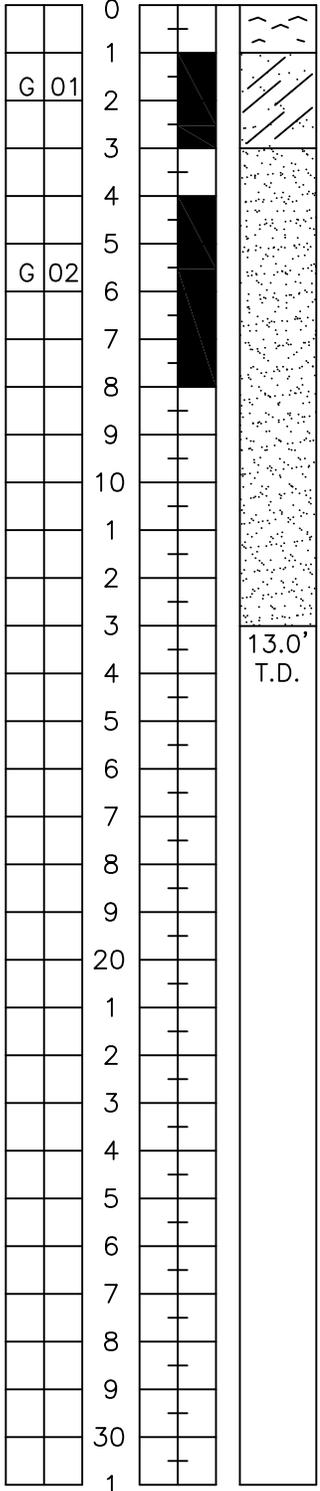
0031: Sample TB02-01



0034: Sample TB02-02

# GEOLOGIC LOG TEST BORE: TB - 03

Sample Method	Sample Number	Depth In Feet	Blows per Foot	Sample Interval	Frozen Interval	Graphic Log	Ground Elev.: _____ Total Depth : _____ Bottom Elev.: _____ Collar Elev.: _____ Reference: _____	Vegetation: _____ dense black spruce Remarks: _____ _____ _____	Location: _____ Garmin 62 GPS N 64° 34.518' N 149° 24.153' Elev 439 ft
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0.0-1.0' PEAT, black, moist

1.0-3.0' Sandy-SILT loam, brown, moist,

3.0-13.0' Fine-Medium SAND, tan-brown, slightly moist, medium density, SM

T.D. @ 13.0'

Photos: 0035 - TB-03 Site  
 0036 - Sample TB03-01  
 0037 - Sample TB03-02

Notes:

**RECON, LLC**  
 Rowland Engineering Consultants  
 481 W. Arctic Ave.  
 Palmer, Alaska 99645  
 Ph: (907) 746-3630

Project No.: \_\_\_\_\_ Sheet 1 of 1 Log# TB-03  
 Project Name: Totchaket Road Phase I  
 Location: Totchaket Road MP 9-15  
 Method Used: 2.5" solid flight auger  
 Engineer: Isaac Rowland, PE  
 Date Begun: 11-2-13  
 Rig Type: Viper Auger  
 Contractor: RECON  
 Date Comp.: 11-2-13

## TB-03 - Figure 1/2



0035: TB-03 Site



0036: Sample TB03-01

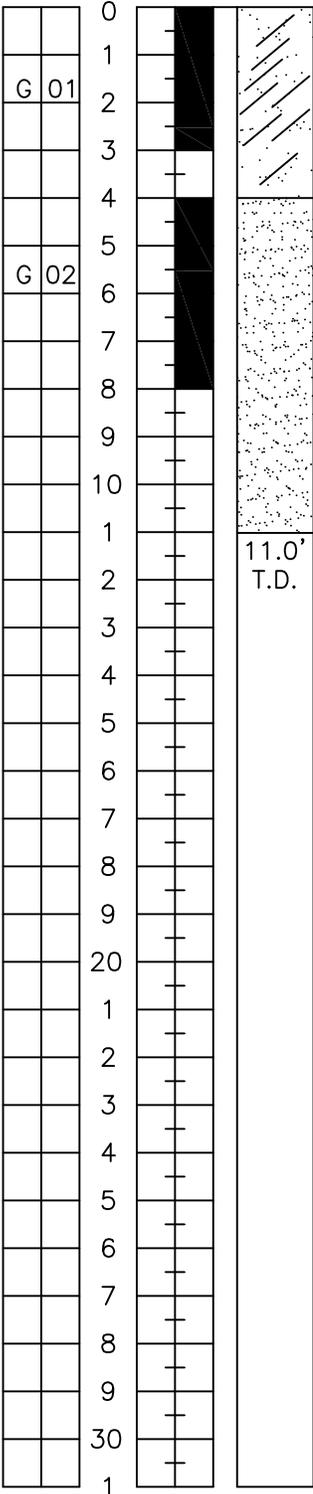
## TB-03 - Figure 2/2



0037: Sample TB03-02

# GEOLOGIC LOG TEST BORE: TB - 04

Sample Method	Sample Number	Depth In Feet	Blows per Foot	Sample Interval	Frozen Interval	Graphic Log	Ground Elev.: _____ Total Depth : _____ Bottom Elev.: _____ Collar Elev.: _____ Reference: _____	Vegetation: <u>Burned</u> aspen and spruce Remarks: _____ _____ _____	Location: Garmin 62 GPS N 64° 34.514' N 149° 24.652' Elev 463 ft
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0.0-4.0' Sandy-SILT loam, brown, slightly moist,

4.0-11.0' Fine-Medium SAND, tan-brown, slightly moist, medium density, SM

T.D. @ 11.0'

Photos: 0038 - Sample TB04-01  
 0039 - TB Location looking east  
 0040 - Sample TB04-02  
 0041 - Location

Notes: On well drained uplands

**RECON, LLC**  
 Rowland Engineering Consultants  
 481 W. Arctic Ave.  
 Palmer, Alaska 99645  
 Ph: (907) 746-3630

Project No.: \_\_\_\_\_ Sheet 1 of 1 Log# TB-04  
 Project Name: Totchaket Road Phase I  
 Location: Totchaket Road MP 9-15  
 Method Used: 2.5" solid flight auger Rig Type: Viper Auger  
 Engineer: Isaac Rowland, PE Contractor: RECON  
 Date Begun: 11-2-13 Date Comp.: 11-2-13

## TB-04 - Figure 1/2



0038: Sample TB04-01



0039: TB Location looking east

## TB-04 - Figure 2/2



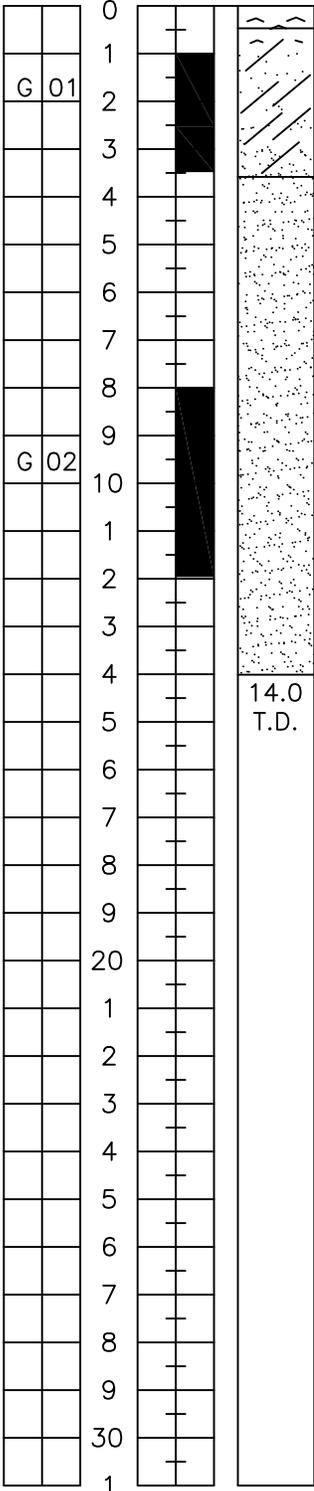
0040: Sample TB04-02



0041: Location

# GEOLOGIC LOG TEST BORE: TB - 05

Sample Method	Sample Number	Depth In Feet	Blows per Foot	Sample Interval	Frozen Interval	Graphic Log	Ground Elev.: _____ Total Depth : _____ Bottom Elev.: _____ Collar Elev.: _____ Reference: _____	Vegetation: <u>Burned</u> <u>white spruce, birch</u> Remarks: _____ <u>Approx 200' E</u> <u>of dune crest</u>	Location: _____ <u>Garmin 62 GPS</u> <u>N 64° 34.517'</u> <u>N 149° 25.151'</u> <u>Elev 492 ft</u>
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0.0-0.5' PEAT, w/ silt

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0.5-3.5' Sandy-SILT loam, brown, moist,

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3.5-14.0' Fine-Medium SAND, tan-brown, slightly moist, medium density, SM

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T.D. @ 14.0'

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Photos:      0005 - TB-05 location looking west  
                  0006 - Push sample at 1.0 ft  
                  0007 - Grab sample at 0.5-3.5 ft  
                  0008 - Grab sample at 8.0-12.0 ft  
                  0009 - Sand at 14' ft

---

Notes:        Located of first large road cut.

---

**RECON, LLC**  
 Rowland Engineering Consultants  
 481 W. Arctic Ave.  
 Palmer, Alaska 99645  
 Ph: (907) 746-3630

Project No.: \_\_\_\_\_  
 Project Name: Totchaket Road Phase I  
 Location: Totchaket Road MP 9-15  
 Method Used: 2.5" solid flight auger  
 Engineer: Isaac Rowland, PE  
 Date Begun: 11-1-13

Sheet 1 of 1 Log# TB-05  
 Rig Type: Viper Auger  
 Contractor: RECON  
 Date Comp.: 11-1-13

**TB-05 - Figure 1/3**



0005: TB-05 Location looking west



0006: Push sample at 1.0 feet

**TB-05 - Figure 2/3**



0007: Grab sample at 0.5-3.5 ft



0008: Grab sample at 8.0-12.0 ft

**TB-05 - Figure 3/3**



0009: Sand at 14 ft



TB-05A - Figure 1/1



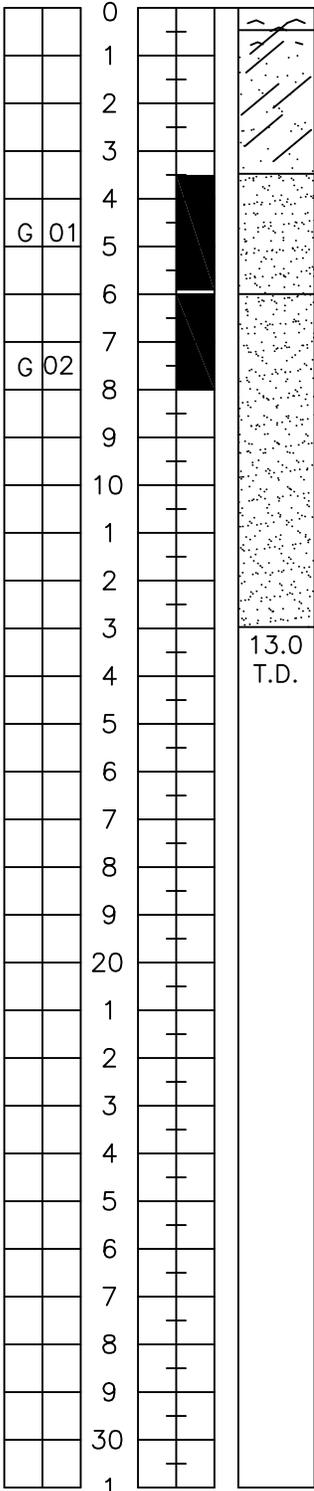
0010: TB-5A looking east



0011: Sand at 13 ft

# GEOLOGIC LOG TEST BORE: TB - 06

Sample Method	Sample Number	Depth In Feet	Blows per Foot	Sample Interval	Frozen Interval	Graphic Log	Ground Elev.: _____ Total Depth : _____ Bottom Elev.: _____ Collar Elev.: _____ Reference: _____	Vegetation: <u>Burned</u> <u>aspen</u> Remarks: _____ _____ Low area	Location: Garmin 62 GPS N 64° 34.515' N 149° 25.650' Elev 460 ft
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0.0-0.5' PEAT, w/ silt

1.0-3.5' Silty-SAND, dark gray, slightly moist

3.5-6.0' Fine-Medium SAND, red-brown, slightly moist, medium density, SM

6.0-13.0' Fine-Medium SAND, tan-gray, slightly moist, medium density, SM

13.0 T.D.

I.D. @ 13.0'

Photos: 0045 - TB-06 location looking west  
0046 - Typical sand below 6'

Notes: Located on SW edge of aspen stand. May flood in spring.

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 Rowland Engineering Consultants  
 481 W. Arctic Ave.  
 Palmer, Alaska 99645  
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Project No.: \_\_\_\_\_ Sheet 1 of 1 Log# TB-06  
 Project Name: Totchaket Road Phase I  
 Location: Totchaket Road MP 9-15  
 Method Used: 2.5" solid flight auger Rig Type: Viper Auger  
 Engineer: Isaac Rowland, PE Contractor: RECON  
 Date Begun: 11-2-13 Date Comp.: 11-2-13

**TB-06 - Figure 1/1**



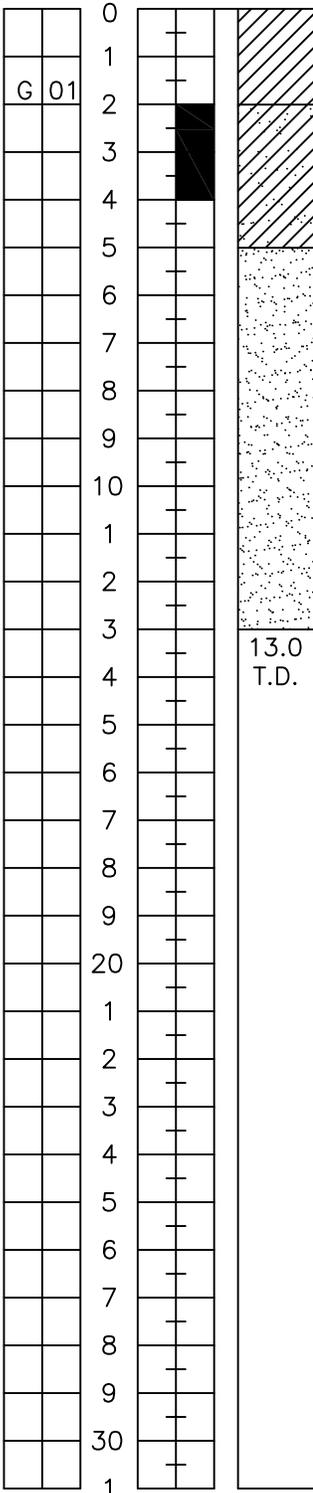
0045: TB-06 location looking west



0046: Typical sand below 6 ft

# GEOLOGIC LOG TEST BORE: TB - 07

Sample Method	Sample Number	Depth In Feet	Blows per Foot	Sample Interval	Frozen Interval	Graphic Log	Ground Elev.: _____ Total Depth : _____ Bottom Elev.: _____ Collar Elev.: _____ Reference: _____	Vegetation: <u>Burned</u> aspen _____ Remarks: _____ _____ _____	Location: _____ Garmin 62 GPS N 64° 34.517' N 149° 26.155' Elev 469 ft
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0.0–2.0' SILT loam, brown, slightly moist

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2.0–5.0' SILT loam w/ some sand, gray, moist,

---

5.0–13.0 ft Fine–Medium SAND, red–brown, slightly moist, medium density, SM

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13.0 T.D.

T.D. @ 13.0'

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Photos: 0049 – TB–07 location looking west  
 0050 – Typical Red–Brown Sand

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Notes: Located on east edge of aspen stand. May flood in spring.

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<b>RECON, LLC</b> Rowland Engineering Consultants 481 W. Arctic Ave. Palmer, Alaska 99645 Ph: (907) 746–3630	Project No.: _____ Project Name: <u>Totchaket Road Phase I</u> Location: <u>Totchaket Road MP 9–15</u> Method Used: <u>2.5" solid flight auger</u> Engineer: <u>Isaac Rowland, PE</u> Date Begun: <u>11–2–13</u>	Sheet <u>1</u> of <u>1</u> Log# <u>TB–07</u> Rig Type: <u>Viper Auger</u> Contractor: <u>RECON</u> Date Comp.: <u>11–2–13</u>
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# TB-07 – Figure 1/1



0049: TB-07 location looking west



0050: Typical Red-Brown Sand



**TB-08 - Figure 1/1**



0051: TB-08 location looking west



0052: Typical Sand



**TB-09 - Figure 1/2**



0053: TB-09 location looking west



0054: Watermark 4.5 up aspen trunk

**TB-09 - Figure 2/2**



0055: Typical Sand



## TB-10 - Figure 1/2



0056: TB-10 location looking west



0057: TB-10 location looking west

Totchaket Road - 11/2/13

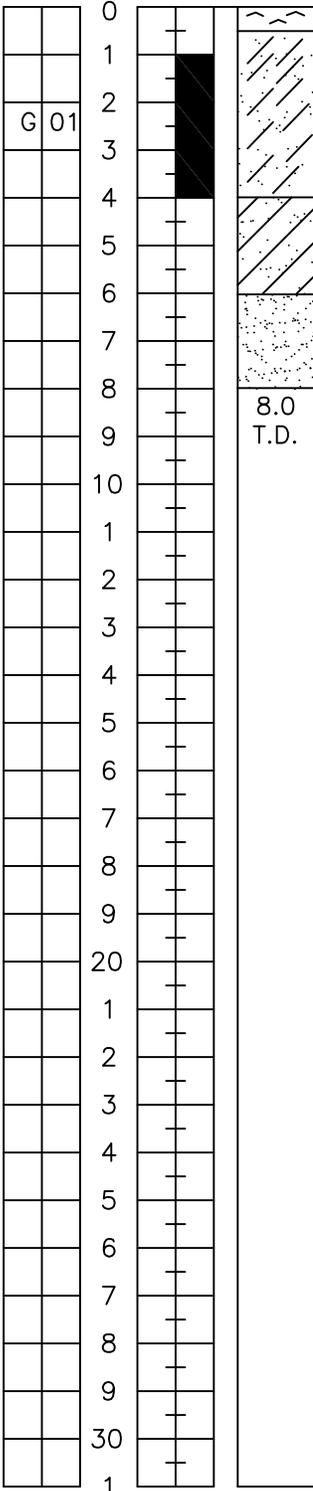
**TB-10 - Figure 2/2**



0058: Typical Sand

# GEOLOGIC LOG TEST BORE: TB - 11

Sample Method	Sample Number	Depth In Feet	Blows per Foot	Sample Interval	Frozen Interval	Graphic Log	Ground Elev.: _____ Total Depth : _____ Bottom Elev.: _____ Collar Elev.: _____ Reference: _____	Vegetation: <u>Burned</u> <u>black spruce</u> Remarks: _____ _____ _____	Location: _____ Garmin 62 GPS N 64° 34.516' N 149° 28.155' Elev 431 ft
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0.0-0.5' PEAT, black, PT

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0.5-4.0 Sandy SILT loam, gray-brown, slightly moist.

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4.0-6.0' SILT w/ sand, brown, slightly moist, somewhat plastic.  
very difficult to drill

---

6.0-8.0' Fine-Medium SAND, brown, slightly moist, medium density, SM

---

8.0  
T.D.

---

T.D. @ 8.0'

---

Photos: 0059 - TB-11 location looking north-west

---

Notes: Located on small upland flat

---

<b>RECON, LLC</b> Rowland Engineering Consultants 481 W. Arctic Ave. Palmer, Alaska 99645 Ph: (907) 746-3630	Project No.: _____ Project Name: <u>Totchaket Road Phase I</u> Location: <u>Totchaket Road MP 9-15</u> Method Used: <u>2.5" solid flight auger</u> Engineer: <u>Isaac Rowland, PE</u> Date Begun: <u>11-2-13</u>	Sheet <u>1</u> of <u>1</u> Log# <u>TB-11</u> Rig Type: <u>Viper Auger</u> Contractor: <u>RECON</u> Date Comp.: <u>11-2-13</u>
--	---	--

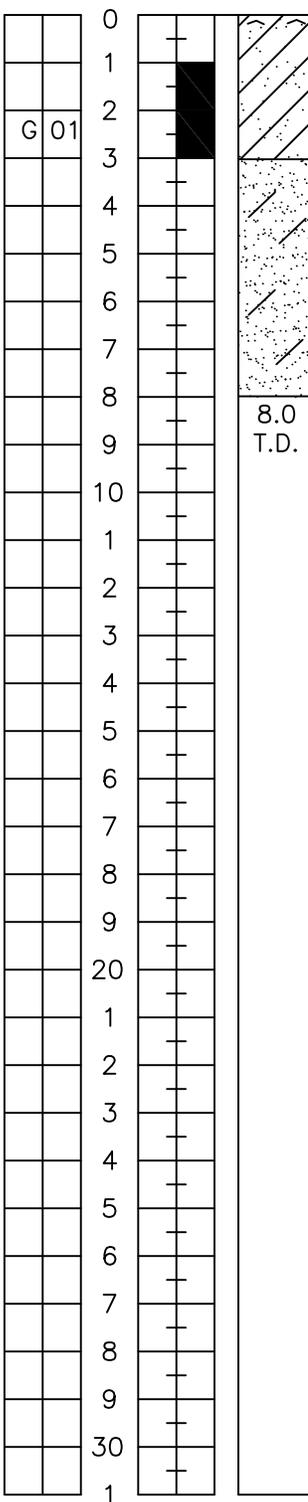
## TB-11 - Figure 1/1



0059: TB-11 location looking north-west

# GEOLOGIC LOG      TEST BORE: TB - 12

Sample Method	Sample Number	Depth In Feet	Blows per Foot	Sample Interval	Frozen Interval	Graphic Log	Ground Elev.: _____ Total Depth : _____ Bottom Elev.: _____ Collar Elev.: _____ Reference:        _____	Vegetation: <u>Burned</u> <u>aspen and spruce</u> Remarks: _____ _____ _____	Location: <u>Garmin 62 GPS</u> <u>N 64° 34.515'</u> <u>N 149° 28.655'</u> <u>Elev 457 ft</u>
---------------	---------------	---------------	----------------	-----------------	-----------------	-------------	---	--	--



0.0-3.0'      SILT w/ some sand, brown, moist, somewhat plastic.

3.0-8.0'      Fine-Medium SAND w/ trace silt, tan-gray, slightly moist,  
 medium density, SM

8.0  
T.D.      T.D. @ 8.0'

Photos:      0060 - TB-12 location  
                  0061 - Typical Sand

Notes:

<b>RECON, LLC</b> Rowland Engineering Consultants 481 W. Arctic Ave. Palmer, Alaska 99645 Ph: (907) 746-3630	Project No.: _____ Project Name: <u>Totchaket Road Phase I</u> Location: <u>Totchaket Road MP 9-15</u> Method Used: <u>2.5" solid flight auger</u> Engineer: <u>Isaac Rowland, PE</u> Date Begun: <u>11-2-13</u>	Sheet <u>1</u> of <u>1</u> Log# <u>TB-12</u> Rig Type: <u>Viper Auger</u> Contractor: <u>RECON</u> Date Comp.: <u>11-2-13</u>
--	---	--

TB-12 Figure 1/1



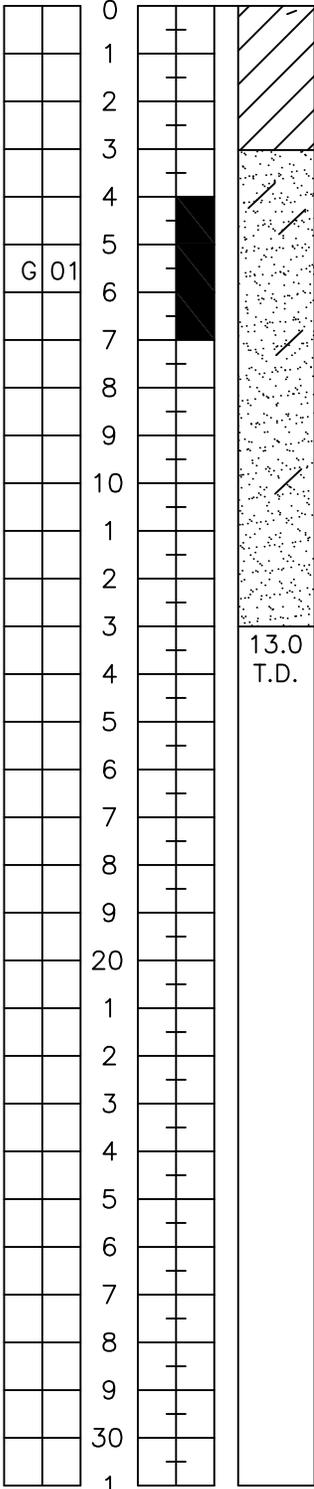
0060: TB-12 location



0061: Typical Sand

# GEOLOGIC LOG TEST BORE: TB - 13

Sample Method	Sample Number	Depth In Feet	Blows per Foot	Sample Interval	Frozen Interval	Graphic Log	Ground Elev.: _____ Total Depth : _____ Bottom Elev.: _____ Collar Elev.: _____ Reference: _____	Vegetation: <u>Burned black spruce</u> Remarks: _____ _____ _____	Location: _____ Garmin 62 GPS N 64° 34.518' N 149° 29.160' Elev 473 ft
---------------	---------------	---------------	----------------	-----------------	-----------------	-------------	--	--	--



0.0-3.0' SILT loam, brown, dry

3.0-13.0' Fine-Medium SAND w/ trace silt, tan-gray, slightly moist, medium density, SM

T.D. @ 13.0'

Photos: 0071 - Typical Sand  
0072 - TB-13 Location

Notes: Near crest of NNE trending low ridge  
Possible cut or MS

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 Ph: (907) 746-3630

Project No.: \_\_\_\_\_ Sheet 1 of 1 Log# TB-13  
 Project Name: Totchaket Road Phase I  
 Location: Totchaket Road MP 9-15  
 Method Used: 2.5" solid flight auger  
 Engineer: Isaac Rowland, PE  
 Date Begun: 11-3-13  
 Rig Type: Viper Auger  
 Contractor: RECON  
 Date Comp.: 11-3-13

**TB-13 - Figure 1/1**



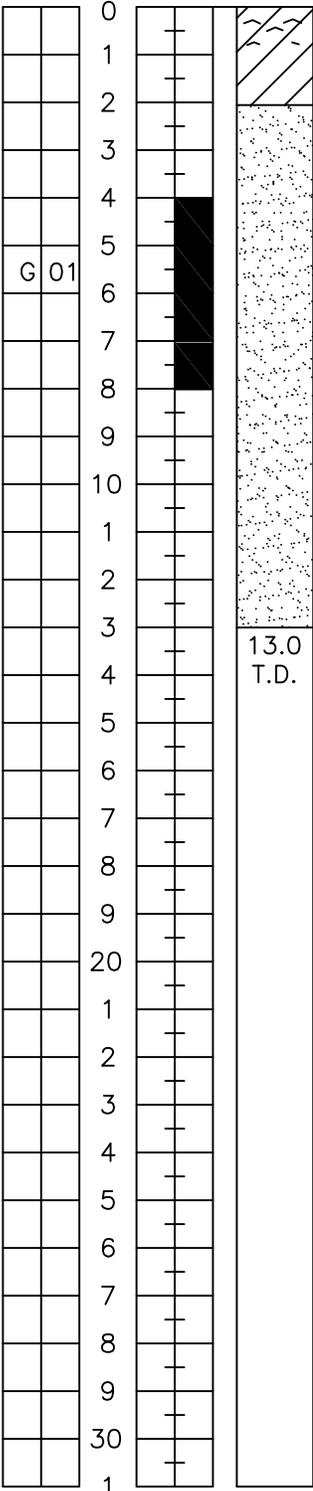
0071: Typical Sand



0072: TB-13 location

# GEOLOGIC LOG      TEST BORE: TB - 14

Sample Method	Sample Number	Depth In Feet	Blows per Foot	Sample Interval	Frozen Interval	Graphic Log	Ground Elev.: _____ Total Depth : _____ Bottom Elev.: _____ Collar Elev.: _____ Reference:     _____	Vegetation: <u>Burned aspen + blk spruce</u> Remarks: _____ _____ _____	Location: _____ Garmin 62 GPS N 64° 34.516' N 149° 29.658' Elev 471 ft
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0.0–2.0'      SILT loam, dark brown, slightly moist

2.0–13.0'      Fine–Medium SAND, tan, dry, medium density, SM

T.D. @ 13.0'

Photos:      0073 – Typical Sand  
                  0074 – TB-14 Location looking east

Notes:      Several small knobs in area may require cuts

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 Ph: (907) 746-3630

Project No.: \_\_\_\_\_      Sheet 1 of 1      Log# TB-14  
 Project Name: Totchaket Road Phase I  
 Location: Totchaket Road MP 9-15  
 Method Used: 2.5" solid flight auger      Rig Type: Viper Auger  
 Engineer: Isaac Rowland, PE      Contractor: RECON  
 Date Begun: 11-3-13      Date Comp.: 11-3-13

## TB-14 - Figure 1/1



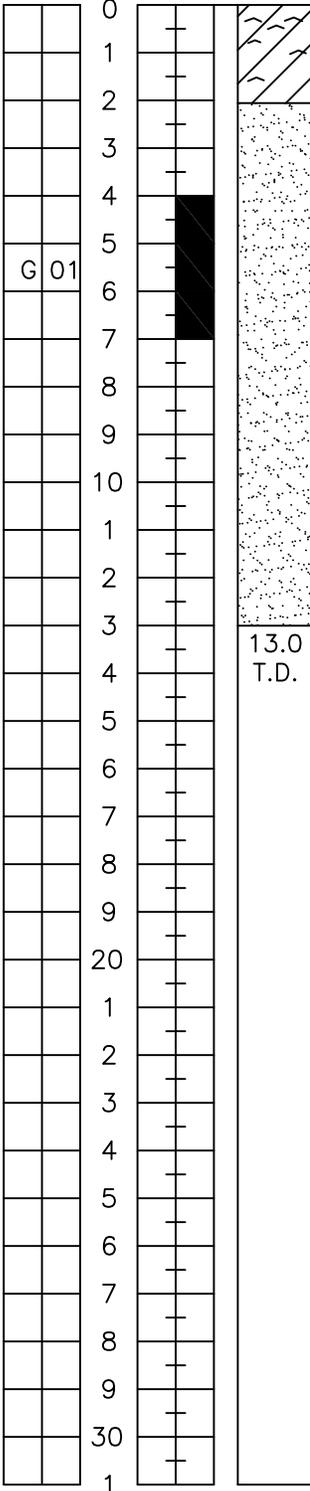
0073: Typical Sand



0074: TB-14 location looking east

# GEOLOGIC LOG      TEST BORE: TB - 15

Sample Method	Sample Number	Depth In Feet	Blows per Foot	Sample Interval	Frozen Interval	Graphic Log	Ground Elev.: _____ Total Depth : _____ Bottom Elev.: _____ Collar Elev.: _____ Reference:        _____	Vegetation: <u>Burned</u> <u>black spruce</u> Remarks: _____ _____ _____	Location: Garmin 62 GPS N 64° 34.514' N 149° 30.159' Elev 472 ft
---------------	---------------	---------------	----------------	-----------------	-----------------	-------------	---	--	--



0.0-2.0'      SILT loam w some clay & organics, brown, moist, cohesive

2.0-13.0'      Fine-Medium SAND, tan-brown, slightly moist, medium density, SM

T.D. @ 13.0'

Photos:      0075 - TB-15 Location  
                  0076 - Typical sand

Notes:      Several small NE trending dunes in area may require cuts

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 Ph: (907) 746-3630

Project No.: \_\_\_\_\_ Sheet 1 of 1 Log# TB-15  
 Project Name: Totchaket Road Phase I  
 Location: Totchaket Road MP 9-15  
 Method Used: 2.5" solid flight auger Rig Type: Viper Auger  
 Engineer: Isaac Rowland, PE Contractor: RECON  
 Date Begun: 11-3-13 Date Comp.: 11-3-13

# TB-15 - Figure 1/1



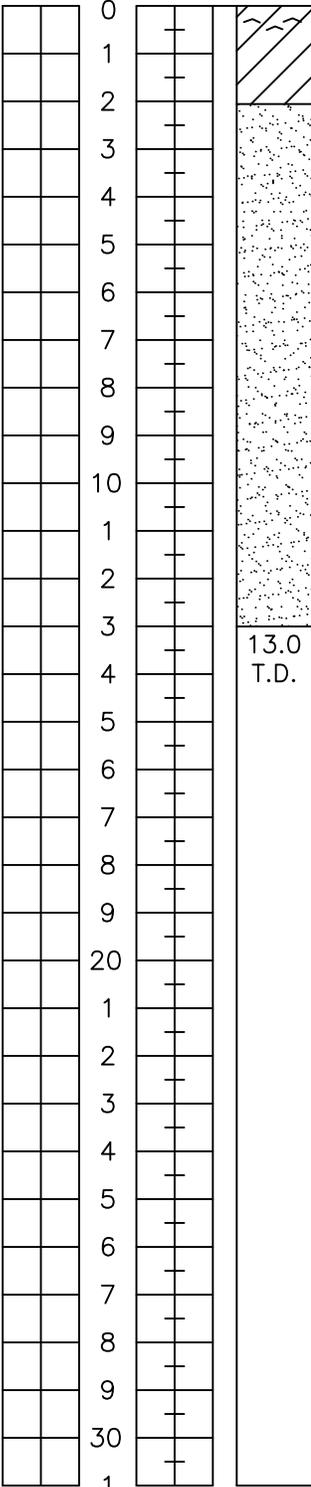
0075: TB-15 location



0076: Typical Sand

# GEOLOGIC LOG TEST BORE: TB - 16

Sample Method	Sample Number	Depth In Feet	Blows per Foot	Sample Interval	Frozen Interval	Graphic Log	Ground Elev.: _____ Total Depth : _____ Bottom Elev.: _____ Collar Elev.: _____ Reference: _____	Vegetation: <u>Burned</u> Wt spruce & aspen _____ Remarks: _____ _____ _____	Location: _____ Garmin 62 GPS N 64° 34.516' N 149° 30.659' Elev 500 ft
---------------	---------------	---------------	----------------	-----------------	-----------------	-------------	--	--	--



0.0-2.0' SILT loam, brown, dry

2.0-13.0' Fine-Medium SAND, tan-brown, slightly moist, medium density, SM

13.0 T.D.  
T.D. @ 13.0'

Photos: 0077 - TP-16 looking east  
 0078 - TP-16 looking west  
 0079 - Typical Sand

Notes: Moved location ~150' west to small ridge, road cut.  
 Possible small MS

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 Ph: (907) 746-3630

Project No.: \_\_\_\_\_ Sheet 1 of 1 Log# TB-16  
 Project Name: Totchaket Road Phase I  
 Location: Totchaket Road MP 9-15  
 Method Used: 2.5" solid flight auger  
 Engineer: Isaac Rowland, PE  
 Date Begun: 11-3-13  
 Rig Type: Viper Auger  
 Contractor: RECON  
 Date Comp.: 11-3-13

**TB-16 - Figure 1/2**



0077: TB-16 location looking east



0078: location looking west

## TB-16 - Figure 2/2



0079: Typical Sand



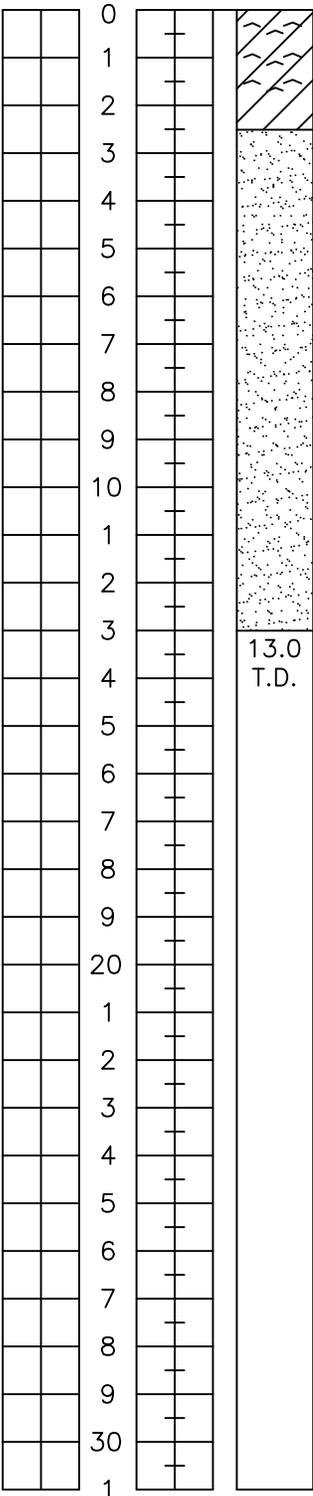
## TB-17 - Figure 1/1



0080: TB-17 location looking west

# GEOLOGIC LOG      TEST BORE: TB - 18

Sample Method	Sample Number	Depth In Feet	Blows per Foot	Sample Interval	Frozen Interval	Graphic Log	Ground Elev.: _____ Total Depth : _____ Bottom Elev.: _____ Collar Elev.: _____ Reference:     _____	Vegetation: <u>Burned</u> black spruce Remarks: _____ _____ _____	Location: Garmin 62 GPS N 64° 34.514' N 149° 31.659' Elev 528 ft
---------------	---------------	---------------	----------------	-----------------	-----------------	-------------	--	---	--



0.0-2.5'      SILT loam w some organics, brown, moist

2.5-13.0'      Fine-Medium SAND, tan-brown, slightly moist, medium density, SM

T.D. @ 13.0'

Photos:      0081 - TP-18 looking west  
                  0082 - Typical sand

Notes:      Located on flat. No sample.

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Project No.: \_\_\_\_\_ Sheet 1 of 1 Log# TB-18  
 Project Name: Totchaket Road Phase I  
 Location: Totchaket Road MP 9-15  
 Method Used: 2.5" solid flight auger Rig Type: Viper Auger  
 Engineer: Isaac Rowland, PE Contractor: RECON  
 Date Begun: 11-3-13 Date Comp.: 11-3-13

# TB-18 - Figure 1/1



0081: TB-18 location looking west



0082: Typical sand

Totchaket Road – 11/3/13



**TB-18A - Figure 1/2**



0083: Typical Sand



0084: Location looking south down dune

Totchaket Road – 11/3/13

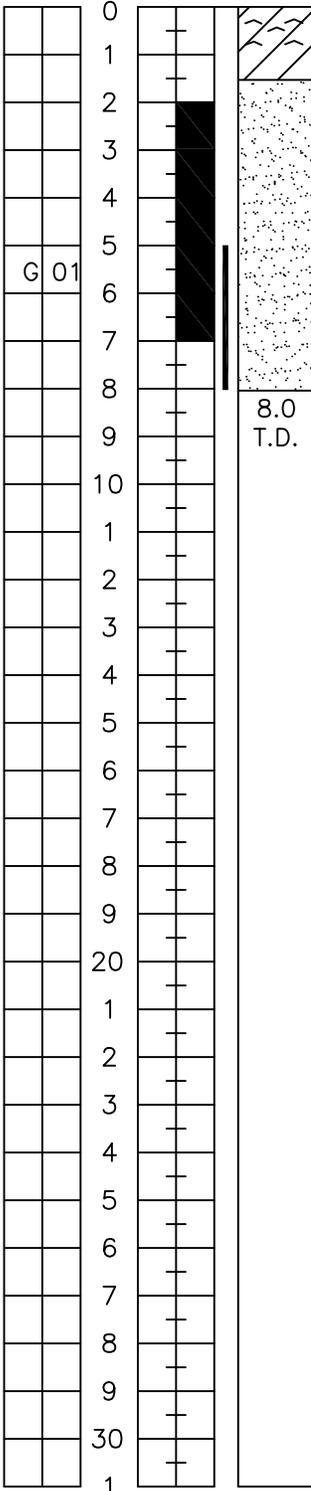
## TB-18A - Figure 1/2



0085: TB-18A location looking west

# GEOLOGIC LOG      TEST BORE: TB - 19

Sample Method	Sample Number	Depth In Feet	Blows per Foot	Sample Interval	Frozen Interval	Graphic Log	Ground Elev.: _____ Total Depth : _____ Bottom Elev.: _____ Collar Elev.: _____ Reference:        _____	Vegetation: <u>Burned</u> black spruce Remarks: _____ _____ _____	Location: _____ Garmin 62 GPS N 64° 34.517' N 149° 32.161' Elev 509 ft
---------------	---------------	---------------	----------------	-----------------	-----------------	-------------	---	---	--



0.0–1.5'      SILT loam w some organics, brown, slightly moist

---

1.5–8.0'      Fine–Medium SAND, tan–brown, slightly moist, medium density, SM

---

5.0'            Frozen at 5'

---

T.D. @ 8.0'

---

Photos:        0086 – TB–19 Location  
                   0087 – Typical Sand

---

Notes:         On a small flat near several small dunes.      Permafrost at 5'

---

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Project No.: \_\_\_\_\_      Sheet 1 of 1      Log#TB–19  
 Project Name: Totchaket Road Phase I  
 Location: Totchaket Road MP 9–15  
 Method Used: 2.5" solid flight auger      Rig Type: Viper Auger  
 Engineer: Isaac Rowland, PE      Contractor: RECON  
 Date Begun: 11–3–13      Date Comp.: 11–3–13

## TB-19 - Figure 1/1



0086: TB-19 Location



0087: Typical Sand

Totchaket Road – 11/3/13

# GEOLOGIC LOG TEST BORE: TB - 20

Sample Method	Sample Number	Depth In Feet	Blows per Foot	Sample Interval	Frozen Interval	Graphic Log	Ground Elev.: _____ Total Depth : _____ Bottom Elev.: _____ Collar Elev.: _____ Reference: _____	Vegetation: <u>Burned</u> <u>black spruce</u> Remarks: _____ _____ _____	Location: _____ Garmin 62 GPS N 64° 34.516' N 149° 32.669' Elev 504 ft
---------------	---------------	---------------	----------------	-----------------	-----------------	-------------	--	--	--

0	+	
1	+	
2	+	
3	+	
4	+	
5	+	
6	+	
7	+	
8	+	
9	+	
10	+	
11	+	
12	+	
13	+	
14	+	
15	+	
16	+	
17	+	
18	+	
19	+	
20	+	
21	+	
22	+	
23	+	
24	+	
25	+	
26	+	
27	+	
28	+	
29	+	
30	+	
31	+	
32	+	
33	+	
34	+	
35	+	
36	+	
37	+	
38	+	
39	+	
40	+	
41	+	
42	+	
43	+	
44	+	
45	+	
46	+	
47	+	
48	+	
49	+	
50	+	

0.0-1.5' SILT loam w some organics, brown, moist

---

1.5-13' Fine-Medium SAND, brown, moist, medium density, SM

---

T.D. @ 13.0'

---

13.0 T.D.

---

Photos:      0088 - TB- Location looking West  
               0089 - Typical Sand

---

Notes:        On flat. No sample taken.

---

<b>RECON, LLC</b> Rowland Engineering Consultants 481 W. Arctic Ave. Palmer, Alaska 99645 Ph: (907) 746-3630	Project No.: _____ Project Name: <u>Totchaket Road Phase I</u> Location: <u>Totchaket Road MP 9-15</u> Method Used: <u>2.5" solid flight auger</u> Engineer: <u>Isaac Rowland, PE</u> Date Begun: <u>11-3-13</u>	Sheet <u>1</u> of <u>1</u> Log# <u>TB-20</u> Rig Type: <u>Viper Auger</u> Contractor: <u>RECON</u> Date Comp.: <u>11-3-13</u>
--	---	--

## TB-20 - Figure 1/1



0088: TB-20 Location looking west

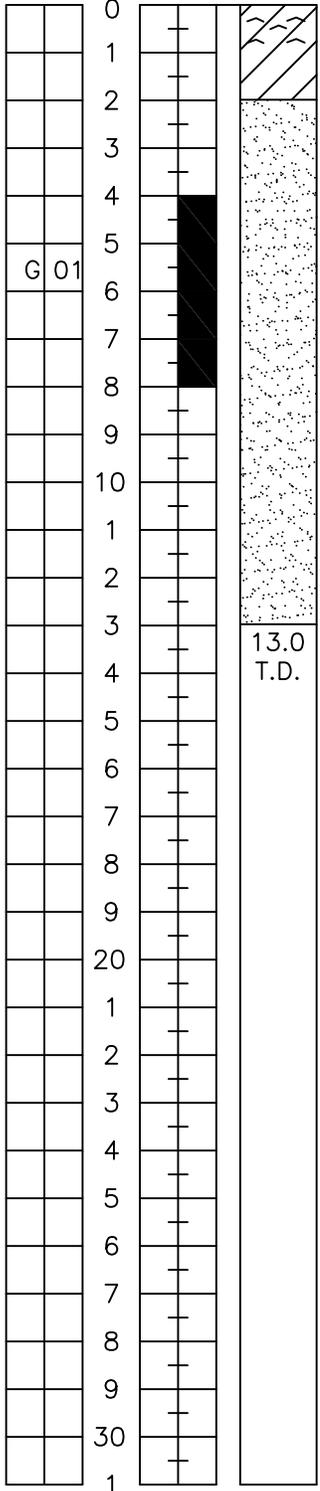


0089: Typical Sand

Totchaket Road – 11/3/13

# GEOLOGIC LOG TEST BORE: TB - 21

Sample Method	Sample Number	Depth In Feet	Blows per Foot	Sample Interval	Frozen Interval	Graphic Log	Ground Elev.: _____ Total Depth : _____ Bottom Elev.: _____ Collar Elev.: _____ Reference: _____	Vegetation: <u>Burned spruce and aspen</u> Remarks: _____ _____ <u>Large Dune</u>	Location: _____ Garmin 62 GPS N 64° 34.515' N 149° 33.349' Elev 532 ft
---------------	---------------	---------------	----------------	-----------------	-----------------	-------------	--	--	--



0.0-2.0' SILT loam w some organics, brown, slightly moist

---

1.5-13' Fine-Medium SAND, light brown, dry, medium density, SM

---

T.D. @ 13.0'

---

Photos: 0090 - TB-21, Crest of dune looking North  
0091 - Typical Sand

---

Notes: Site moved ~300 ft to crest of dune. Large cut / MS.

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 Ph: (907) 746-3630

Project No.: \_\_\_\_\_ Sheet 1 of 1 Log# TB-21  
 Project Name: Totchaket Road Phase I  
 Location: Totchaket Road MP 9-15  
 Method Used: 2.5" solid flight auger Rig Type: Viper Auger  
 Engineer: Isaac Rowland, PE Contractor: RECON  
 Date Begun: 11-3-13 Date Comp.: 11-3-13

## TB-21 - Figure 1/1



0090: TB-21 Crest of dune, looking north

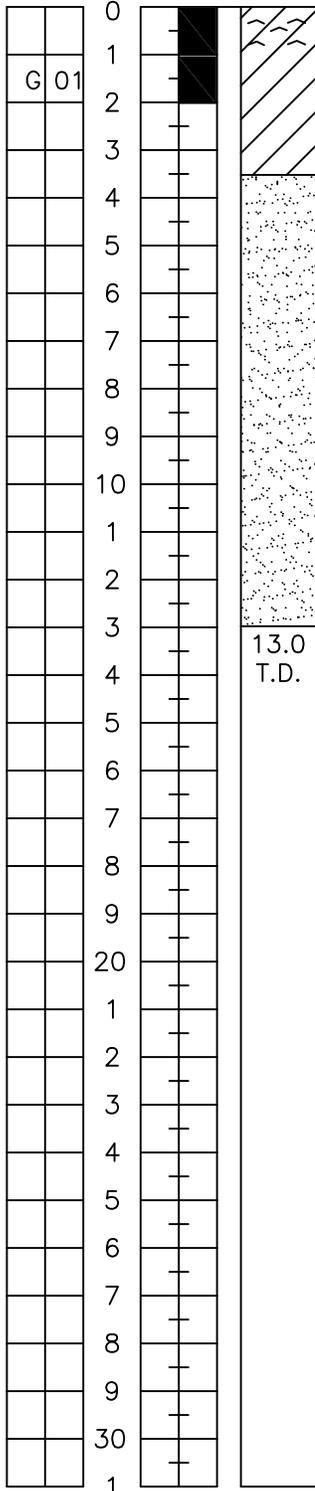


0091: Typical Sand

Totchaket Road – 11/3/13

# GEOLOGIC LOG TEST BORE: TB - 22

Sample Method	Sample Number	Depth In Feet	Blows per Foot	Sample Interval	Frozen Interval	Graphic Log	Ground Elev.: _____ Total Depth : _____ Bottom Elev.: _____ Collar Elev.: _____ Reference: _____	Vegetation: <u>Burned</u> black spruce Remarks: _____ _____ _____	Location: _____ Garmin 62 GPS N 64° 34.514' N 149° 33.667' Elev 487 ft
---------------	---------------	---------------	----------------	-----------------	-----------------	-------------	--	---	--



0.0-3.5' SILT loam w some organics, brown, moist, somewhat cohesive

---

3.5-13' Fine-Medium SAND, light brown, dry, medium density, SM

---

T.D. @ 13.0'

---

Photos: 0092 - Typical Sand  
0093 - TB-22 Location

---

Notes: On flat between dunes.

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 Ph: (907) 746-3630

Project No.: \_\_\_\_\_ Sheet 1 of 1 Log#TB-22  
 Project Name: Totchaket Road Phase I  
 Location: Totchaket Road MP 9-15  
 Method Used: 2.5" solid flight auger Rig Type: Viper Auger  
 Engineer: Isaac Rowland, PE Contractor: RECON  
 Date Begun: 11-3-13 Date Comp.: 11-3-13

## TB-22 - Figure 1/1



0092: TB-22 Typical Sand



0093: TB-22 Location

Totchaket Road – 11/3/13



## TB-23 - Figure 1/1



0095: TB-23 Location looking west



## TB-24 - Figure 1/1



0096: TB-24 Typical Sand



0097: TB-24 Location looking east



## TB-25 - Figure 1/1



0098: TB-25 Typical Sand



0099: TB-25 Location looking north



# TB-26 - Figure 1/1



0100: TB-26 Location



0101: TB-26 Typical Sand

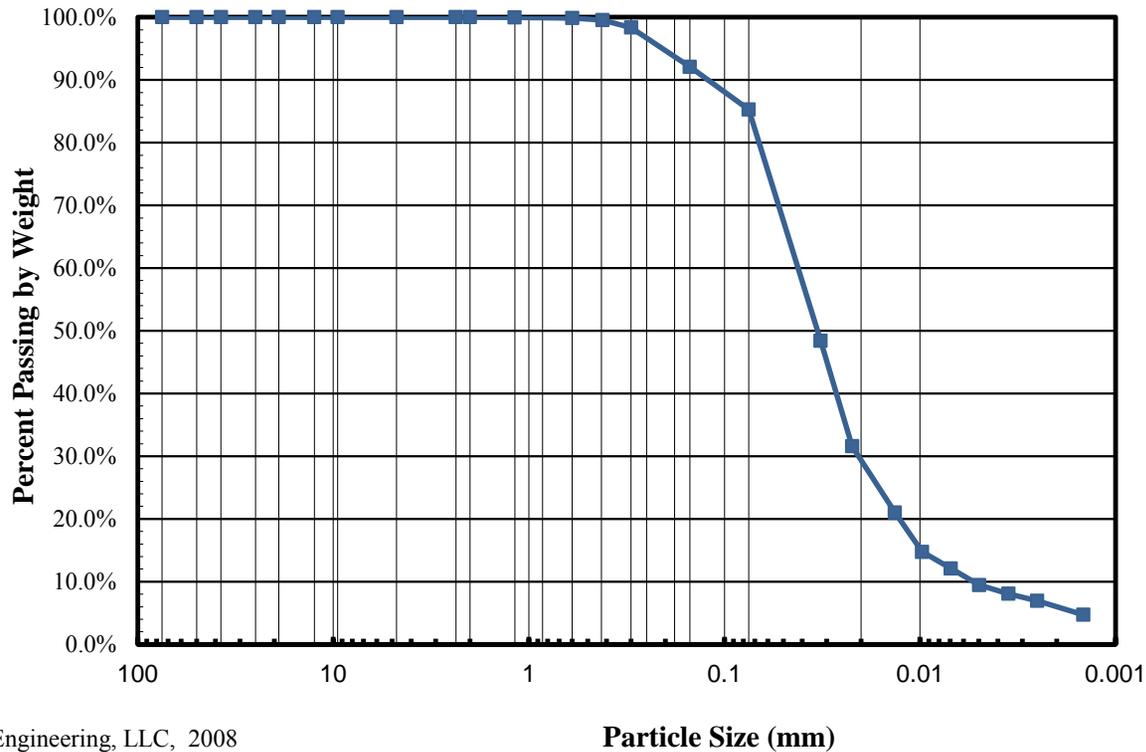
# Appendix C

## Sieve Analysis Results

8301 Old Seward Hwy.  
Anchorage, AK 99518  
(907) 644-3923  
(907) 644-0997

5886 E. Shop Circle  
Palmer, Ak 99645  
(907)631-6047  
(907)631-6048

Client: Recon  
Project: Totchaket Silt  
Material Description: TB03-01 @ 1-3'  
Sample Location:



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**Sieve Analysis  
ASTM C 136**

Job No. 1825  
Lab No. 845  
Received November 13, 2013  
Reported November 18, 2013

SIZE	PASSING	SPECIFICATION	
		Low	High
3"	100%		
2"	100%		
1 1/2"	100%		
1"	100%		
3/4"	100%		
1/2"	100%		
3/8"	100%		
No. 4	100%		
<b>Plasticity Index ASTM D4318</b>			
Non Plastic			
<b>Moisture Content As Received ASTM C 123</b>			
25.1%			

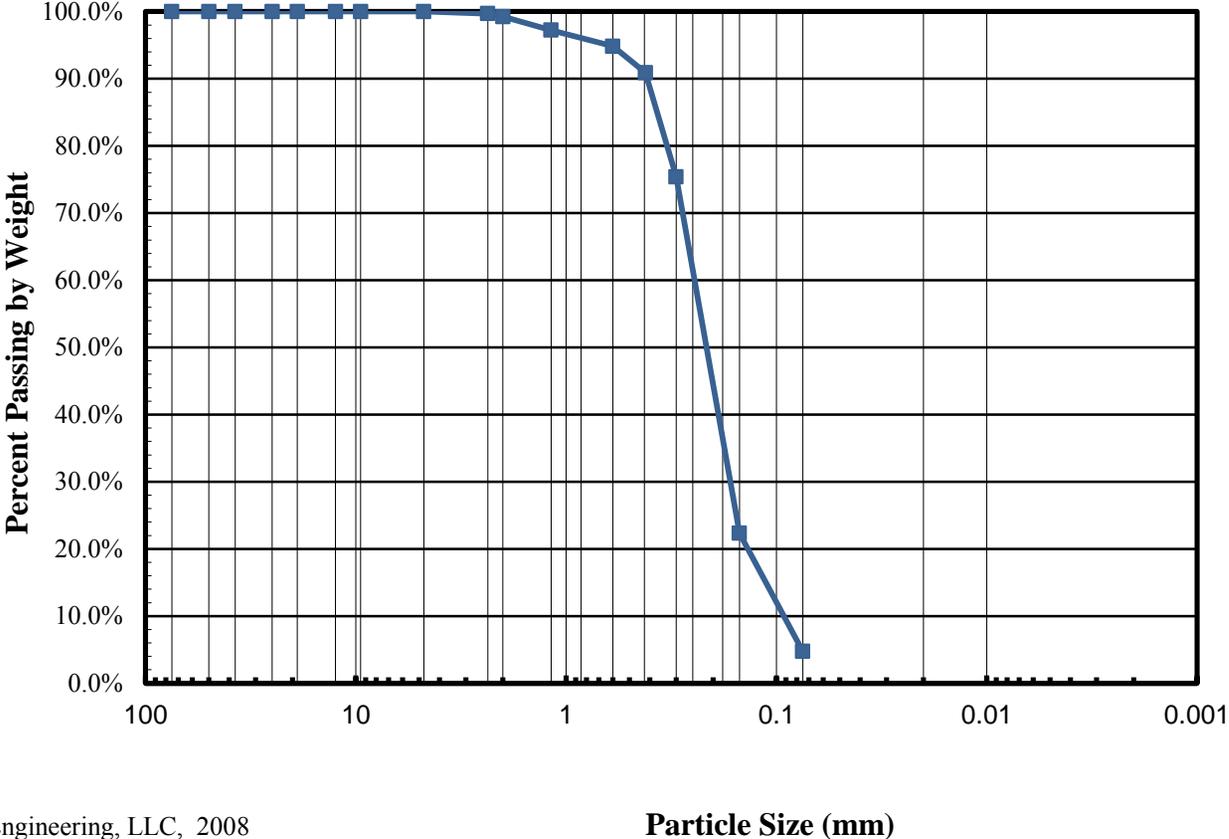
Reviewed By:  
Crystal Redding  
Group Manager

8301 Old Seward Hwy. Anchorage, AK 99518 (907) 644-3923 (907) 644-0997	5886 E. Shop Circle Palmer, AK 99645 (907) 631-6047 (907) 631-6048
---	---

**Sieve Analysis  
ASTM C 136**

Job No. 1825  
 Lab No. 849  
 Received November 13, 2013  
 Reported November 18, 2013

Client: Recon  
 Project: Totchaket  
 Material Description: Sand  
 Sample Location: TB05-02 @ 8-12'



SIZE	PASSING	SPECIFICATION	
		Low	High
3"	100%		
2"	100%		
1 1/2"	100%		
1"	100%		
3/4"	100%		
1/2"	100%		
3/8"	100%		
No. 4	100%		
<b>Moisture Content As Received</b>			
No. 8	100%		
No. 10	99%		
No. 16	97%		
No. 30	95%		
No. 40	91%		
No. 50	75%		
No. 100	22%		
No. 200	4.7%		

**Moisture Content As Received  
ASTM C 123**

1.6%

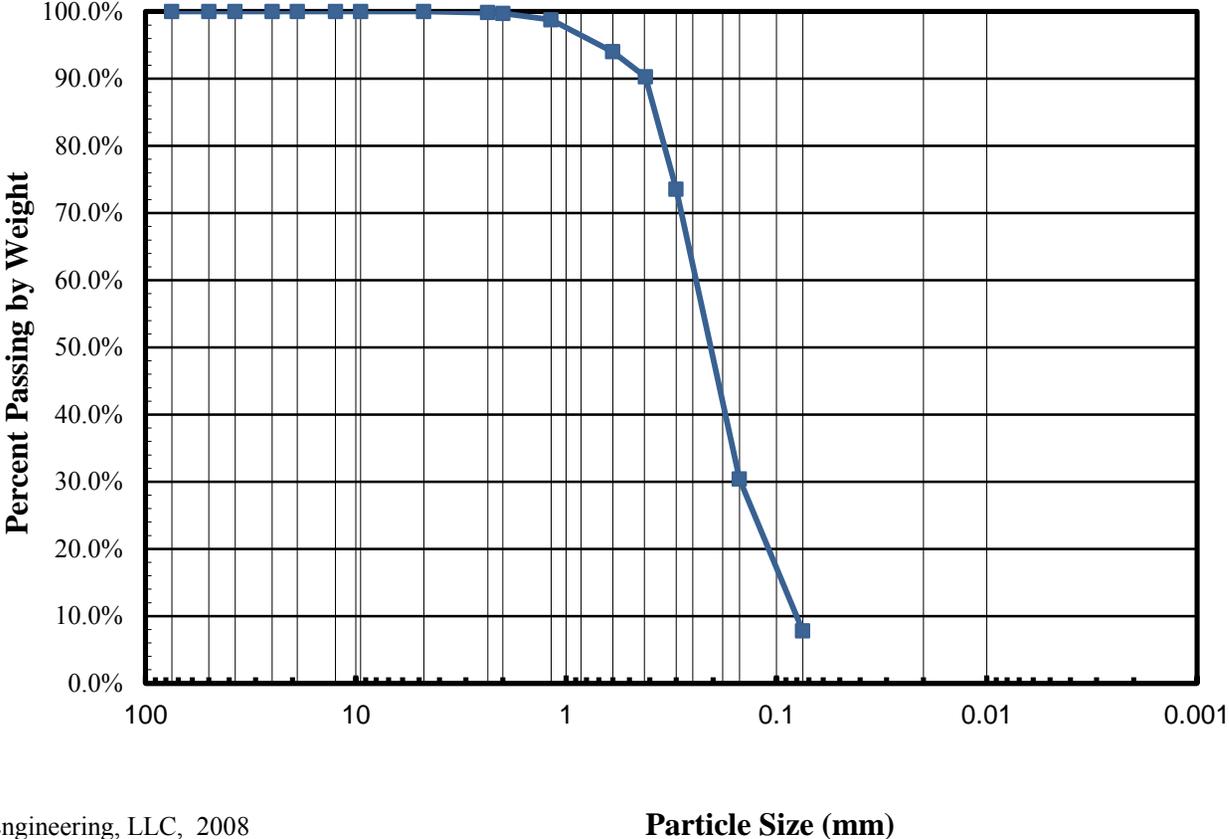
Reviewed By:  
Crystal Redding  
Group Manager

8301 Old Seward Hwy. Anchorage, AK 99518 (907) 644-3923 (907) 644-0997	5886 E. Shop Circle Palmer, AK 99645 (907) 631-6047 (907) 631-6048
---	---

**Sieve Analysis  
ASTM C 136**

Job No. 1825  
 Lab No. 850  
 Received November 13, 2013  
 Reported November 18, 2013

Client: Recon  
 Project: Totchaket  
 Material Description: Sand  
 Sample Location: TB08-01 @ 1.5-4.0'



SIZE	PASSING	SPECIFICATION	
		Low	High
3"	100%		
2"	100%		
1 1/2"	100%		
1"	100%		
3/4"	100%		
1/2"	100%		
3/8"	100%		
No. 4	100%		
<b>Moisture Content As Received</b>			
No. 8	100%		
No. 10	100%		
No. 16	99%		
No. 30	94%		
No. 40	90%		
No. 50	74%		
No. 100	30%		
No. 200	7.8%		

**Moisture Content As Received  
ASTM C 123**

3.4%

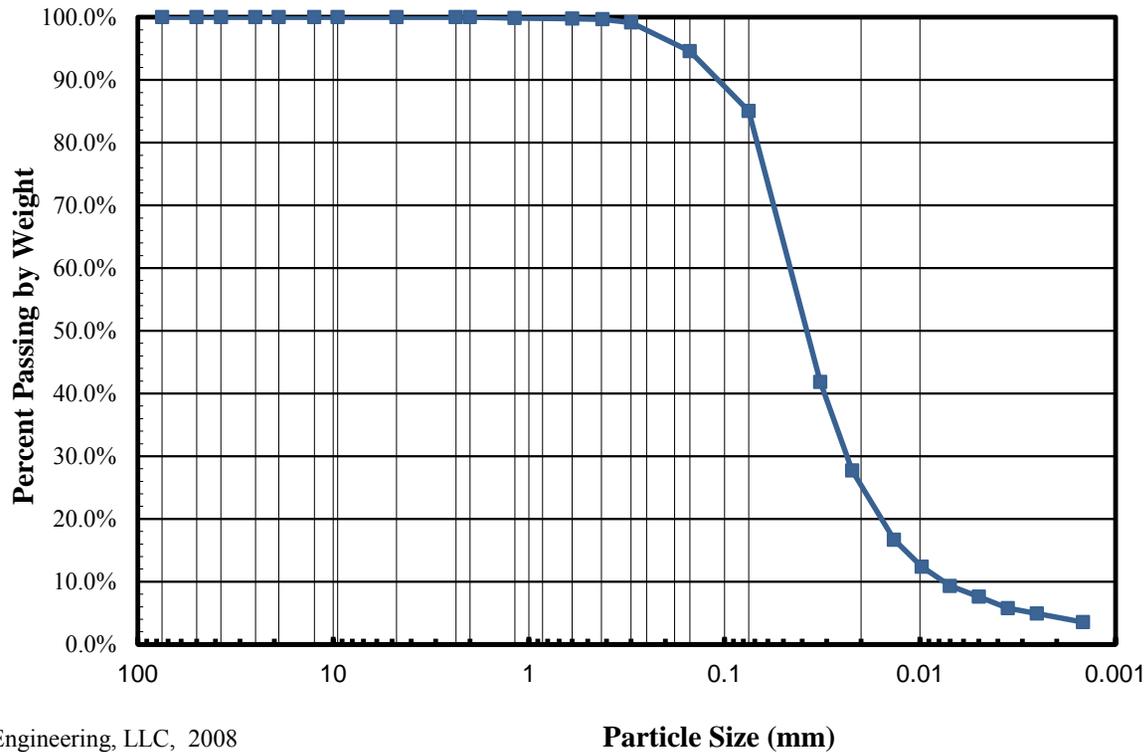
Reviewed By:  
Crystal Redding  
Group Manager



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Anchorage, AK 99518  
(907) 644-3923  
(907) 644-0997

5886 E. Shop Circle  
Palmer, Ak 99645  
(907)631-6047  
(907)631-6048

Client: Recon  
Project: Totchaket Silt  
Material Description: TB11-01 @ 1-4'  
Sample Location:



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**Sieve Analysis  
ASTM C 136**

Job No. 1825  
Lab No. 847  
Received November 13, 2013  
Reported November 18, 2013

SIZE	PASSING	SPECIFICATION	
		Low	High
3"	100%		
2"	100%		
1 1/2"	100%		
1"	100%		
3/4"	100%		
1/2"	100%		
3/8"	100%		
No. 4	100%		
<b>Plasticity Index ASTM D4318</b>			
No. 8	100%		
No. 10	100%		
No. 16	100%		
No. 30	100%		
No. 40	100%		
No. 50	99%		
No. 100	95%		
No. 200	85.0%		
0.02mm	27.7%		
0.002 mm	4.9%		
0.001mm	3.6%		
<b>Moisture Content As Received ASTM C 123</b>			
21.6%			

Reviewed By:  
Crystal Redding  
Group Manager

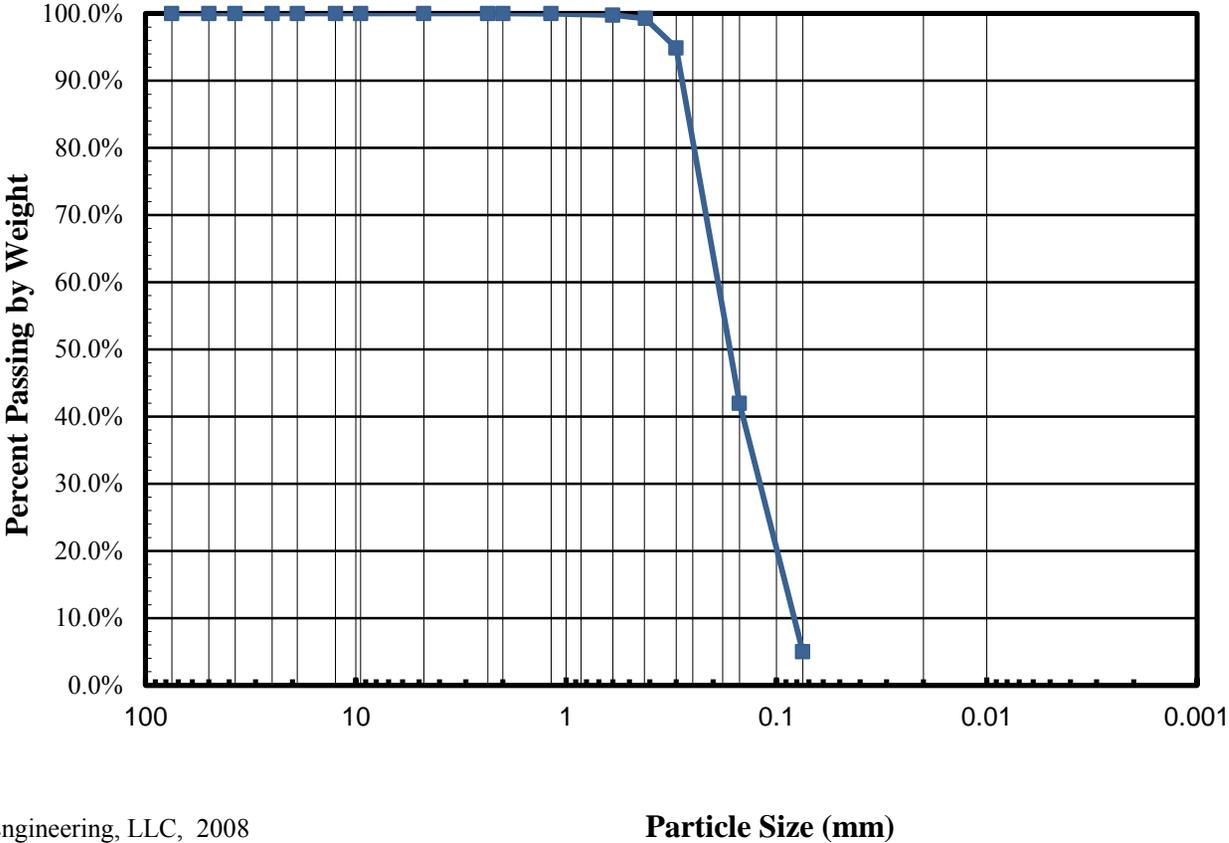
8301 Old Seward Hwy. Anchorage, AK 99518 (907) 644-3923 (907) 644-0997	5886 E. Shop Circle Palmer, AK 99645 (907) 631-6047 (907) 631-6048
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**Sieve Analysis  
ASTM C 136**

Job No. 1825  
 Lab No. 851  
 Received November 13, 2013  
 Reported November 18, 2013

Client: Recon  
 Project: Totchaket  
 Material Description: Sand  
 Sample Location: TB16-01 @ 4-8'

SIZE	PASSING	SPECIFICATION	
		Low	High
3"	100%		
2"	100%		
1 1/2"	100%		
1"	100%		
3/4"	100%		
1/2"	100%		
3/8"	100%		
No. 4	100%		
<b>Moisture Content As Received</b>			
No. 8	100%		
No. 10	100%		
No. 16	100%		
No. 30	100%		
No. 40	99%		
No. 50	95%		
No. 100	42%		
No. 200	5.0%		



**Moisture Content As Received  
ASTM C 123**

3.5%

Reviewed By:  
Crystal Redding  
Group Manager

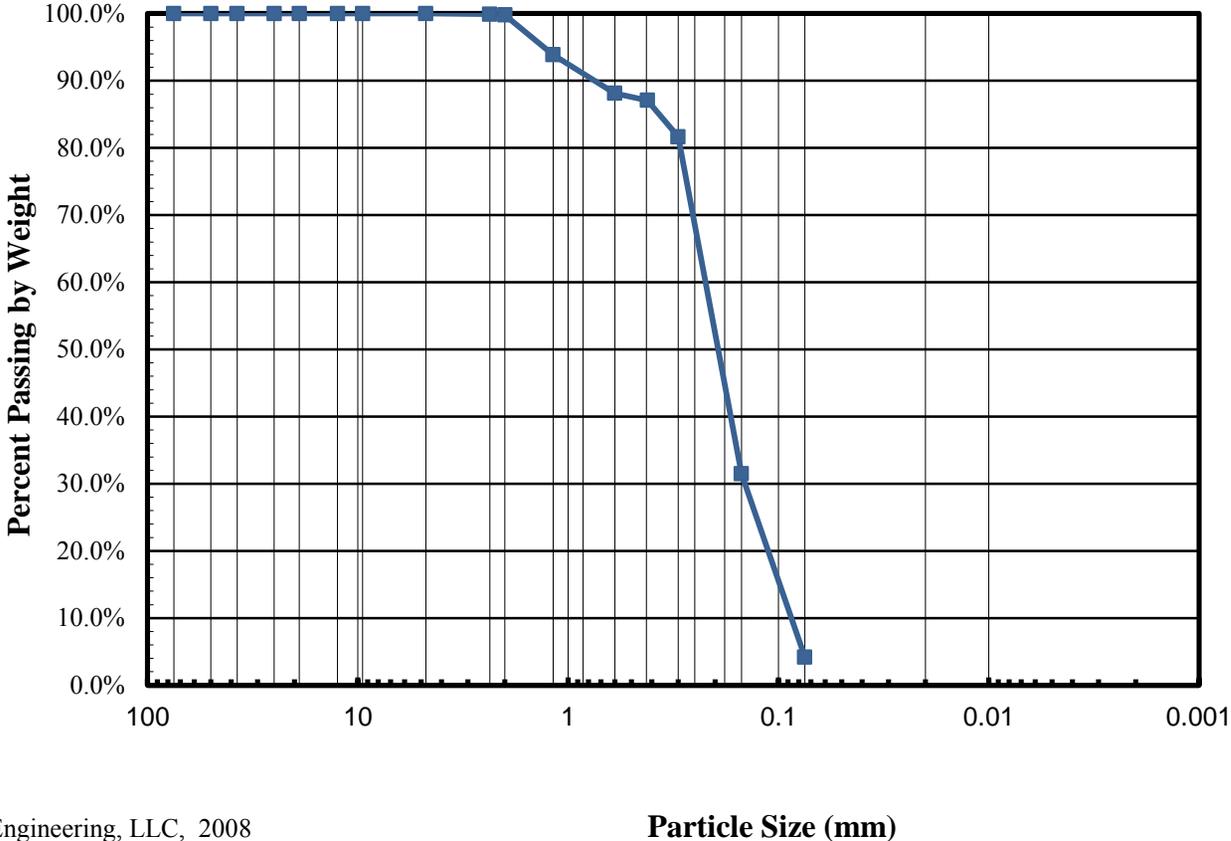


8301 Old Seward Hwy. Anchorage, AK 99518 (907) 644-3923 (907) 644-0997	5886 E. Shop Circle Palmer, AK 99645 (907) 631-6047 (907) 631-6048
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**Sieve Analysis  
ASTM C 136**

Job No. 1825  
 Lab No. 852  
 Received November 13, 2013  
 Reported November 18, 2013

Client: Recon  
 Project: Totchaket  
 Material Description: Sand  
 Sample Location: TB18A-01 @ 4-8'



SIZE	PASSING	SPECIFICATION	
		Low	High
3"	100%		
2"	100%		
1 1/2"	100%		
1"	100%		
3/4"	100%		
1/2"	100%		
3/8"	100%		
No. 4	100%		
<b>Moisture Content As Received</b>			
No. 8	100%		
No. 10	100%		
No. 16	94%		
No. 30	88%		
No. 40	87%		
No. 50	82%		
No. 100	31%		
No. 200	4.2%		

**Moisture Content As Received  
ASTM C 123**

3.8%

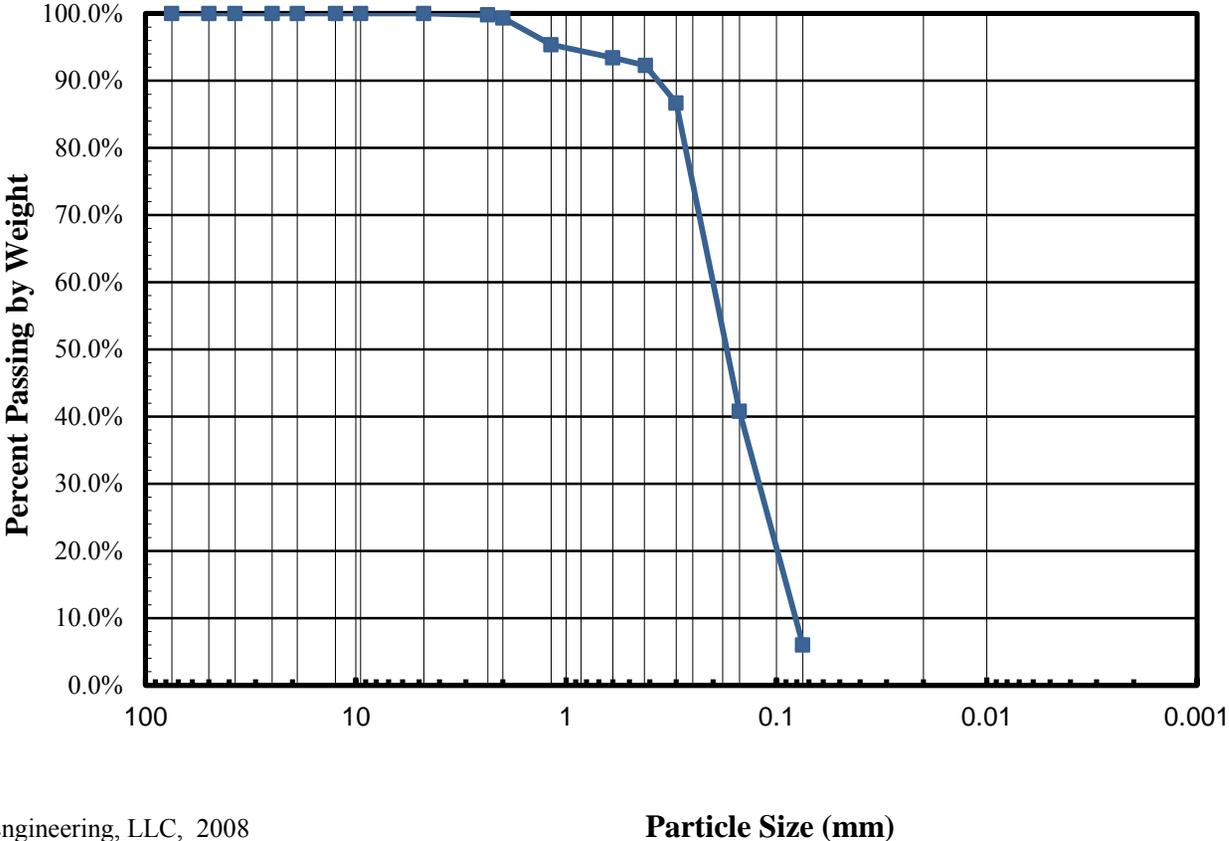
Reviewed By:  
Crystal Redding  
Group Manager

8301 Old Seward Hwy. Anchorage, AK 99518 (907) 644-3923 (907) 644-0997	5886 E. Shop Circle Palmer, AK 99645 (907) 631-6047 (907) 631-6048
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**Sieve Analysis  
ASTM C 136**

Job No. 1825  
 Lab No. 853  
 Received November 13, 2013  
 Reported November 18, 2013

Client: Recon  
 Project: Totchaket  
 Material Description: Sand  
 Sample Location: TB21-01 @ 4-8'



SIZE	PASSING	SPECIFICATION	
		Low	High
3"	100%		
2"	100%		
1 1/2"	100%		
1"	100%		
3/4"	100%		
1/2"	100%		
3/8"	100%		
No. 4	100%		
No. 8	100%		
No. 10	99%		
No. 16	95%		
No. 30	93%		
No. 40	92%		
No. 50	87%		
No. 100	41%		
No. 200	6.0%		

**Moisture Content As Received  
ASTM C 123**

3.1%

Reviewed By:  
Crystal Redding  
Group Manager