FINAL

SUBSURFACE EXPLORATION

AND

PRELIMINARY FOUNDATION RECOMMENDATIONS

JUNEAU AIRPORT IMPROVEMENTS

JUNEAU, ALASKA
February 15, 2008
W.O. DS9440
Area 6
Report No. 4786

Mr. Paul Wescott, P.E.
Airport Engineer
Juneau International Airport
1873 Shell Simmons Drive, Suite 200
Juneau, Alaska 99801

Subject: Subsurface Exploration and Preliminary Foundation Recommendations
         Juneau Airport Improvements, Juneau, Alaska

Dear Mr. Wescott:

The attached report presents the results of our subsurface exploration and our preliminary foundation
recommendations for the proposed Juneau Airport Improvements in Juneau, Alaska. This report
includes the logs of thirty test borings drilled and eleven test pits excavated during the current
investigation, the results of laboratory tests, and preliminary recommendations regarding foundations,
earthwork, and drainage.

If you have any questions regarding this report or its use, or if we may provide additional services,
please call.

Sincerely,
DOWL Engineers

Reviewed by:
DOWL Engineers

Maria E. Kampsch, P.E.
Geotechnical Engineer

Brian R. Hanson, P.E.
Project Manager

Attachment: As stated
DS9440.Wescott.MEK.BRH.0121508.tla
SUBSURFACE EXPLORATION
AND
PRELIMINARY FOUNDATION RECOMMENDATIONS
JUNEAU AIRPORT IMPROVEMENTS
JUNEAU, ALASKA

Prepared for:
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Prepared by:
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W.O. D59440
Area 6
Report No. 4786

February 2008
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1.0 INTRODUCTION

The City and Borough of Juneau (CBJ) plan to make improvements to the Juneau International Airport (JNU) in Juneau, Alaska. This report presents the results of our field exploration, laboratory soil testing program, and our preliminary recommendations regarding foundation design and site development in support of the proposed Juneau Airport Improvements.

1.1 Planned Development

The proposed Juneau Airport Improvements project includes the following elements:

- dredging the floatplane pond to generate material necessary for improvements,
- expansion of the runway safety area (RSA),
- construction of a new snow removal equipment facility, and
- development of northwest and northeast acreage which increases developable land to expand the airport to meet existing and future needs.

This report documents observed subsurface geotechnical conditions at the site, and provides analyses and interpretations of anticipated site conditions within the project area. It also presents preliminary recommendations for design and construction of anticipated buildings and earthwork required for construction of typical facilities. This report is valid only for the planned development as it is currently understood. Any changes to the current plans may impact the recommendations contained herein and should be evaluated by the project geotechnical engineer.

1.2 Purpose of Investigation

The purpose of this investigation was to determine subsurface soil and groundwater conditions at the site in order to discuss dredging, foundations, earthwork, drainage, frost protection, utility installation, and traffic areas.
1.3 Scope of Work

A geotechnical reconnaissance in support of the Juneau Airport Improvements project was conducted in September 2006. This reconnaissance provided initial information regarding previous dredging, site development, and the quality of the dredge material. The final geotechnical reconnaissance report was submitted to CBJ on December 11, 2006.

On August 16, 2007, DOWL Engineers (DOWL) submitted a proposal to conduct a geotechnical investigation for the Juneau Airport Improvements. The Notice-to-Proceed was received on September 18, 2007, and DOWL performed the investigation. The fieldwork consisted of drilling, excavating, sampling, and logging 30 test borings and 11 test pits within the floatplane pond and in the vicinity of planned improvements.

The approximate locations of the test borings and test pits are shown on Figure A-1, Test Boring/Test Pit Location Map, Appendix A.
Figure 1: Vicinity Map
2.0 PHYSICAL SETTING

The Juneau Airport Improvements project is located on JNU property in Juneau, Alaska. The project areas include the floatplane pond, perimeter dike trail, RSA, and northeast and northwest developments. The project area is bounded to the north by Yandukin and Shell Simmons Drives, to the south and east by the Mendenhall Wetlands State Game Refuge, and to the west by the Mendenhall River.

2.1 Regional Geology

The city of Juneau is located on the northeastern side of Gastineau Channel in southeast Alaska. Juneau lies within the Boundary Ranges of southeastern Alaska and northwestern British Columbia, Canada. The Gastineau Fault lies northeast of Juneau and is part of the active tectonic belt of the Pacific Ocean. The bedrock of the Juneau area consists of layered greenstone, greywacke, slate, greenschist, and metavolcanic flow breccia that were formed mainly during the Mesozoic Era. Unconsolidated material overlies the bedrock and was formed primarily during the Quaternary Period as a result of glacial advances and retreats. The unconsolidated material consists of manmade fill, mass-wasting deposits, glacial deposits, alluvial deposits, marine deposits, and glaciomarine deposits.

2.2 Climate

Juneau is located in a maritime climate zone. The climatological data presented below for the JNU was taken from a range of sources; including the State of Alaska Department of Commerce, Community, and Economic Development Community Database, Environmental Atlas of Alaska, and the Alaska Climate Research Center.

- Mean Annual Precipitation: 58 in
- Mean Annual Snowfall: 94 in
- Mean Maximum Temperature July: 64°F
- Mean Maximum Temperature January: 31°F
- Mean Minimum Temperature July: 49°F
- Mean Minimum Temperature January: 21°F
- Average Summer Temperature Range: 44°F – 65°F
Average Winter Temperature Range: 25°F – 35°F
Freezing Degree Days (°F-day): 700
Thawing Degree Days (°F-day): 4,000
Heating Degree Days (°F-day): 8,574

Average monthly temperatures and precipitation for JNU and vicinity, for the period between 1971 and 2000 are shown in Table 1.

**Table 1: Average Monthly Temperatures and Precipitation**

<table>
<thead>
<tr>
<th>Temperature (°F)</th>
<th>Jan</th>
<th>Feb</th>
<th>Mar</th>
<th>Apr</th>
<th>May</th>
<th>Jun</th>
<th>Jul</th>
<th>Aug</th>
<th>Sept</th>
<th>Oct</th>
<th>Nov</th>
<th>Dec</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature</td>
<td>25.7</td>
<td>28.9</td>
<td>33.7</td>
<td>40.8</td>
<td>47.9</td>
<td>53.9</td>
<td>56.8</td>
<td>55.7</td>
<td>50</td>
<td>42.3</td>
<td>33.3</td>
<td>28.7</td>
</tr>
<tr>
<td>Precipitation (including snowfall) (in)</td>
<td>4.81</td>
<td>4.02</td>
<td>3.51</td>
<td>2.96</td>
<td>3.48</td>
<td>3.36</td>
<td>4.14</td>
<td>5.37</td>
<td>7.54</td>
<td>8.3</td>
<td>5.43</td>
<td>5.41</td>
</tr>
</tbody>
</table>

The construction season in Juneau typically begins early in May and ends in early to mid-November. Snowfall can occur as early as October, and freezing temperatures generally occur in November. The ground generally begins to freeze in November and can remain frozen at depth into late May.
3.0 SITE CONDITIONS

This section reports interpretations and opinions concerning the surface and subsurface soil and groundwater conditions at the site. The site conditions described are valid for the data collected within the scope of work. If additional data becomes available, some or all of the interpretations and opinions expressed herein could change. We should be notified immediately if the conditions found at the site are different from those encountered during this investigation.

The soil descriptions contained herein and the classifications shown on the test boring logs are the project geotechnical engineer's interpretation of the field logs, the visual soil classification performed in the laboratory, and the results of the laboratory soil testing. The largest particle size that can be recovered with standard drill hole samplers is often smaller than the maximum particle size in a gravelly soil deposit. Therefore, the soil descriptions and test results for gravelly soils tend to be biased toward the finer particle sizes.

Refer to the Test Boring Log - Descriptive Guide in Appendix B immediately following the test boring and pit logs for a more detailed presentation on sample sizes, sample quality, frost classifications, soil types, and the soil classification procedures.

The project has been subdivided into five different sites. Each site supports a different aspect of the Juneau Airport Improvements project. These sites include the following:

- Floatplane Pond,
- Perimeter Dike Trail,
- RSA Expansion Area,
- Northwest Development, and
- Northeast Development.
3.1 Floatplane Pond

The site is located near the southern end of JNU. The site is bounded by:

- an access road and Runway 8-26 to the north,
- Mendenhall River and the perimeter dike trail to the west,
- a dike and Jordan Creek to the east, and
- perimeter dike trail to the south.

Eight test borings (Test Borings 19, 20, 21, 22, 23, 24, 25, and 26) were drilled from a small landing craft to depths of 51.5 feet beneath the surface of the water. The locations of the test borings are shown on Figure A-1.

**Site Description.** The main channel of the floatplane pond is about 5,300 feet long and 450 to 600 feet wide. There are two fingers present along the south side of the main channel that extend towards the dike.

**Topography.** The water surface elevation of the pond is around 15 feet. The dike is located around three sides of the pond and the top of the dike has an average elevation of about 25 feet.

**Vegetation.** The south side of the pond is highly vegetated with spruce trees, low brush, and grasses. The vegetated areas have variable relief with fill deposits in excess of ten feet high.

**Surface Drainage.** The pond is affected by the tides and drains through the underlying sands. The pond recharges through an outlet structure located at the west end. It also recharges from surface runoff and drainage from the runway and water flowing through the soils below the airport. At high tide, the outlet opens and allows water to flow into the pond. At low tide it closes, minimizing discharge from the pond (Figure A-2).

**Subgrade Soils.** In general, the soils encountered in the floatplane pond consisted of silt (ML) over sands (SP, SP-SM, SM). The silt layer was observed as a surficial layer, extending to a depth of about 1 to 2.5 feet. The silt was typically soft and contained sand and organics. In several areas (Test Borings 19, 22, 23, and 25) little or no silt was observed.
Underlying the silt is poorly graded sand (SP, SP-SM, SM) with variable amounts of silt and gravel. Silt percentages in the sand averaged five percent but were observed as high as 35 percent. The sand typically contained an average of five to ten percent gravel, is medium dense, and has no to moderate frost susceptibility (NFS-F2).

Silt was observed in Test Boring 20 from 25 feet to 51.5 feet and within Test Boring 21 from 30 feet to 51.5 feet. A layer of silt was encountered in Test Boring 26 from 45 to 50 feet. The silts contain organics, are firm to hard, and contain variable amounts of gravel and sand.

**Water Depths.** The water in the center of the floatplane pond averages 15 to 20 feet in depth on the west end and is over 40 feet in depth on the east end. The average water depth along the shore and within the shallow fingers is less than five feet. A bathymetric survey was completed in September 2006 by Toner-Nordling and Associates, Inc. (TN).

**Flooding.** Water flows into the floatplane pond from the Mendenhall River through the inlet structure during high tide and flood events. Water flows out of the pond by going over the top of the inlet if water levels get too high.

### 3.2 Perimeter Dike Trail

The trail is located near the southern boundary of the airport. The trail is bounded:

- to the north by the floatplane pond,
- to the south by the Mendenhall Wetlands State Game Refuge,
- to the east by Jordan Creek, and
- to the west by Mendenhall River.

Five test borings (Test Borings 27, 28, 29, 30, and 31) were drilled within the dike to depths of 21.5 feet. The locations of the test borings are shown on Figure A-1.

**Site Description.** The dike is an elevated structure with the top of the dike approximately ten feet in width and serves as an emergency vehicle access route. The dike is commonly used as a public access trail; frequent use was observed during our subsurface investigation.
Topography. The dike varies in height from five to ten feet. The top is relatively flat and the sides of the dike are steeply sloped.

Vegetation. The area between the pond and the dike trail is vegetated with large spruce trees. The areas between the southern ends of the fingers and the dike are vegetated with grass.

Surface Drainage. The dike is composed of permeable materials that allow for water movement. Water collection on the top of the dike will flow down the side slopes.

Subgrade Soils. The dike is primarily composed of sand (SP, SP-SM, SM) with variable amounts of silt and gravel. The sands are very loose to medium dense with no to moderate frost susceptibility (NFS-F2). The *in situ* moisture content of this soil was measured to be 6 to 19 percent. A two-foot layer of riprap (RX) was observed at the top of Test Boring 30 and poorly graded gravel with sand (GP) was observed at the surface of Test Boring 27.

The native mineral soils underlying the dike are poorly graded sands with varying amounts of gravel. The sands are loose to medium dense and non-frost susceptible (NFS). The *in situ* moisture content of these soils was measured to be 14 to 23 percent.

A layer of silt (ML) was observed in Test Boring 30 from 9.5 to 11 feet. The silt has low plasticity fines, is very stiff, and contains sand and organics. The silt is highly frost susceptible (F4) with *in situ* moisture contents ranging from 10 to 24 percent.

Groundwater. Groundwater was observed in all of the test borings from 8 to 16 feet while drilling. Surface water is present at the base of the dike. A slotted PVC standpipe was installed in each of the test borings and the water levels were allowed to stabilize over a period of several days before they were measured. Measured groundwater levels confirm water is at the base of the slopes.

The groundwater level observed while drilling is shown on each test boring log and measured groundwater levels are noted at the end of each boring log. In addition, Table 2 summarizes our observations of the groundwater within the dike trail area.
### Table 2: Observed and Measured Groundwater Levels of Test Borings

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>27</td>
<td>15</td>
<td>14</td>
</tr>
<tr>
<td>28</td>
<td>10</td>
<td>9.5</td>
</tr>
<tr>
<td>29</td>
<td>16</td>
<td>12</td>
</tr>
<tr>
<td>30</td>
<td>11</td>
<td>11.5</td>
</tr>
<tr>
<td>31</td>
<td>8</td>
<td>9.5</td>
</tr>
</tbody>
</table>

**Flooding.** The perimeter dike trail might be vulnerable to annual flooding during spring “breakup” or high tide events. The Gastineau Channel inundates the refuge daily at high tide to elevation 16 feet regularly and to 21 feet during spring tides (CBJ 2005). Flood elevations were not observed; however, the potential for flooding should be evaluated.

### 3.3 RSA Expansion Area

The RSA expansion is located on the south side of Runway 8-26. The expansion will extend from the existing RSA at the east end of the floatplane pond to the end of the runway. The east and west ends of the runway will also be expanded.

Nine test borings (Test Borings 11, 12, 13, 14, 15, 16, 17, 18, and 32) were drilled to depths of 16.5 feet. The locations of the test borings are shown on Figure A-1.

**Site Description.** A majority of the expansion area is located within a tidal flat between Runway 8-26 and Jordan Creek. The east and west ends of Runway 8-26 will extend into grassy tidal areas.

**Topography.** Runway 8-26 is built up in excess of ten feet above Jordan Creek and the tidal channels. The sides of the embankment are steeply sloped and contain asphalt, riprap, and miscellaneous debris. The tide channel meanders against the base of the runway between Test Borings 16 and 18, and east of Test Boring 32. Between the base of the runway and the tidal channel, the ground slopes towards the south.

The west end of the runway extends westward across the perimeter dike trail where it steeply slopes down towards the tidal flats and Mendenhall River.
The east end of the runway extends towards the tidal channels and slopes gradually towards the east. Driftwood and miscellaneous debris was observed within the tidal flats.

**Vegetation.** Vegetation consists of grassy sections between tide channels. There are pockets of small brush between Jordan Creek and the dike. Previously developed areas are landscaped with grass.

**Surface Drainage.** The areas west of the dike flow south into the floatplane pond. The areas east of the dike flow south into the tidal channel. At the end of the runway, water drains east into the tidal channels (Figure A-3).

At the west end of the runway, water east of the dike flows south into the floatplane pond, water west of the dike flows west into Mendenhall River.

**Subgrade Soils.** In general, the soils encountered east of Jordan Creek within the floatplane pond area consisted of silts (ML) over sands (SP, SP-SM). The silt averages one to two feet and increases in depth towards the east end of the runway. Silt was observed to 10 feet within Test Boring 32 and 15 feet in Test Boring 12. The silt contains sand, is soft to stiff, and contains organics.

Underlying the silt are poorly graded sands. The sands were typically loose, averaged five to ten percent silt, and have no to moderate frost susceptibility (NFS-F2). Small pieces of driftwood were recovered within the sand.

Test Borings 11 and 13 were constructed within previously developed areas and contain approximately 10 to 11 feet of fill material over sands. The fill consists of sands, gravels (GP), and silts containing various amounts of debris and organics.

The native sands have varying amounts of nonplastic silt, are loose to medium dense, with no to moderate frost susceptibility (NFS-F2). The *in situ* moisture contents of the sands range from 11 to 25 percent and were typically saturated.

**Groundwater.** Groundwater was encountered from the surface to ten feet while drilling. The water table is influenced Jordan Creek and the Gastineau Channel. A slotted PVC standpipe was installed in each of the test borings and the water levels were allowed to
stabilize over a period of several days before they were measured. Large fluctuations in the water table were observed during the field investigation and the borings were drilled and measured during low tide.

The groundwater level observed while drilling is shown on each test boring log. Measured groundwater levels and measurement times are noted at the end of each boring log. In addition, Table 2 summarizes our observations of the groundwater within the project area.

Table 3: Observed and Measured Groundwater Levels of Test Borings

<table>
<thead>
<tr>
<th>Test Boring No.</th>
<th>While Drilling (November 9 through November 17, 2007)</th>
<th>Measured Depth (November 19, 2007)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Depth to Water (ft)</td>
<td>Depth to Water (ft)</td>
</tr>
<tr>
<td>----------------</td>
<td>---------------------</td>
<td>---------------------</td>
</tr>
<tr>
<td>11</td>
<td>5</td>
<td>14</td>
</tr>
<tr>
<td>12</td>
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<td>18</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>32</td>
<td>5</td>
<td>12</td>
</tr>
</tbody>
</table>

**Flooding.** The RSA Expansion Area located is within a tidal flat and is subject to daily tidal action. Tides in excess of 16 feet in elevation were observed during our investigation. The side slopes of areas subject to tidal action are coated in asphalt likely to prevent erosion.

### 3.4 Northwest Development

This area is located in the northwest corner of the airport. The site is bounded:

- to the north by private, commercial, and city property,
- to the west by the Mendenhall River, and
- to the south and east by developed airport property and Duck Creek.
Four test borings (Test Borings 1, 2, 3, and 4) and five test pits (Test Pits G, H, I, and J) were drilled and excavated to depths ranging from 8 to 16.5 feet. The locations of the test borings/test pits are shown on Figures A-1 and A-2.

**Site Description.** A majority of the site is undeveloped. A chain link fence extends along the northern end of the property and continues on the east side of the trail access road. The trail access road is located at the western end of the site about 300 feet east of the Mendenhall River. Duck Creek borders the southern property boundary, separating the bottom quarter of the site from the rest of the area.

The westernmost quarter is partially developed from the trail access road to the west. Within this area are two small gravel pads. The northern pad contains two small structures which are currently utilized as airport offices. The southern pad is gated and is used as a river access point, and about 50 feet south of the pad is the United States Coast Guard LORAN Monitoring Station.

**Topography.** The southern portion of the site is in excess of five feet below current airport grades and the northern section appears to be at or near current grades. A majority of the site is sloped towards the south and the ground surface is uneven.

**Vegetation:** The northern half of the site contains alder trees and the southern half contains grass. Pockets of large spruce trees parallel the fence line at the west end of the site and along the northeast corner.

**Surface Drainage.** Duck Creek bisects the site. On both sides of the creek, drainage flows to the creek. Duck Creek then flows west towards Mendenhall River.

**Subgrade Soils.** The subsurface soils east of the trail access road are generally consistent. Below an organic mat, poorly graded sands and gravels (SP, SP-SM, GP, GP-GM) with varying silt contents were present to depth. These soils contain nonplastic fines, are loose to very dense, and are no to medium frost susceptible (NFS to F2). The *in situ* moisture content ranges from 3 to 21 percent.
Sandy silts (ML) and silty sands (SM) were observed in Test Boring 1 and Test Pit G to depths of nine feet. A layer of silt with sand (ML) was observed in Test Pit H from 3.5 to 4.5 feet.

The silts have varying amounts of low plasticity fines, contain sand, and are generally stiff to hard. They are highly frost susceptible (F4). The in situ moisture content of the silts ranges from 31 to 36 percent.

The silty sands contain about 40 percent silt, are nonplastic, are highly frost susceptible (F4), and have in situ moisture contents to 23 percent.

Fill material was observed in Test Pits J and K between 2.5 and 7 feet. These test pits were excavated at the corners of the southern gravel pad. The fill material in Test Pit J consists of low frost susceptible (F1) gravels with silt and sand (GP-GM). The fill material in Test Pit K consists of highly frost susceptible (F3 to F4) silty gravel (GM) with varying amounts of sand and debris. Observed debris included car parts, wire, metal, wood, bottles, and cans. The fill contains nonplastic fines with in situ moisture contents around eight percent.

**Groundwater.** Groundwater was observed in all the test borings and four of the test pits while drilling and excavating at depths between 4 and 13 feet. A slotted PVC standpipe was installed in each of the test borings and the water levels were allowed to stabilize over a period of several days before they were measured. Groundwater levels rise with proximity to the creek. No groundwater was observed in Test Pit J.

Table 4 summarizes our observations of the groundwater within the project area. “N.O.” indicates the groundwater table was “not observed” while the test pit was excavated.
Table 4: Observed and Measured Groundwater Levels of Test Borings/Test Pits

<table>
<thead>
<tr>
<th>Test Boring/Test Pit No.</th>
<th>While Drilling (November 4 through November 19, 2007) Depth to Water (ft)</th>
<th>Measured Depth (November 17, 2007) Depth to Water (ft)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>9</td>
<td>11.5</td>
</tr>
<tr>
<td>2</td>
<td>8.5</td>
<td>8.5</td>
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<td>3</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>G</td>
<td>8</td>
<td>----</td>
</tr>
<tr>
<td>H</td>
<td>4.5</td>
<td>----</td>
</tr>
<tr>
<td>I</td>
<td>5.5</td>
<td>----</td>
</tr>
<tr>
<td>J</td>
<td>N.O.</td>
<td>----</td>
</tr>
<tr>
<td>K</td>
<td>13</td>
<td>----</td>
</tr>
</tbody>
</table>

Flooding. Duck Creek is located along the south end of the project area and is channelized across the site. Portions of the channelized sections are in excess of five feet in depth and creek depths averaged less than one foot during the investigation. The remaining site is several feet higher in elevation than the creek. The western boundary could have potential for flooding from the Mendenhall River; but it is unlikely that the remaining area could be affected by Mendenhall River tidal action.

3.5 Northeast Development

The site is located south of Egan Drive between Taxiway E-1 and Temsco Helicopters. The site is bounded:

- to the north by Egan Drive,
- to the south by Taxiway A,
- to the east by Temsco Helicopters, and
- to the west by Taxiway E-1.

Four test borings (Test Borings 5, 6, 7, and 8) and six test pits (Test Pits A, B, C, D, E, and F) were drilled and excavated to depths ranging from 10 to 16.5 feet. The locations of the test borings/test pits are shown on Figures A-1 and A-3.
Site Description. A majority of the project area is an undeveloped grass field. An FAA structure is present at the approximate center of the site. An access road is present between Egan Drive and the facility. Underground utilities run from the facility to the southeast.

Topography. The development area is relatively flat with a slight slope towards the south. The site is approximately five to seven feet lower in elevation than the developed areas within and surrounding the site. Small drainage ditches extend along the eastern and southern ends.

Vegetation. The site is covered in grass; small bushes were present around the fill area within the center of the site.

Surface Drainage. A majority of the site is flat. Water collected within the eastern drainage ditch flows south and water within the southern ditch flows east. The water drains east off the site through a culvert located along the Temsco Taxiway.

Subgrade Soils. The site is covered with surface silts (ML) that range in depth from 0.5 to 3 feet. Beneath the silts are sands and gravels (SP, SP-SM, SM, GP) to depth. The soils are loose to dense and have no to moderate frost susceptibility (NFS to F2).

Groundwater. Groundwater was observed from 4 to 5.5 feet while drilling and excavating. A slotted PVC standpipe was installed in each of the test borings and the water levels were allowed to stabilize over a period of several days before they were measured. Measured groundwater levels showed the groundwater level at four feet across the site.

The groundwater level observed while drilling/excavating is shown on each test boring and test pit log and measured groundwater levels are noted at the end of each boring log. Table 5 summarizes our observations of the groundwater within the project area.
### Table 5: Observed and Measured Groundwater Levels of Test Borings/Test Pits

<table>
<thead>
<tr>
<th>Test Boring/Test Pit No.</th>
<th>While Drilling (November 6 through November 19, 2007) Depth to Water (ft)</th>
<th>Measured Depth (November 17, 2007) Depth to Water (ft)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>6</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>7</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>8</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>A</td>
<td>5</td>
<td>----</td>
</tr>
<tr>
<td>B</td>
<td>5.5</td>
<td>----</td>
</tr>
<tr>
<td>C</td>
<td>5</td>
<td>----</td>
</tr>
<tr>
<td>D</td>
<td>4.5</td>
<td>----</td>
</tr>
<tr>
<td>E</td>
<td>5</td>
<td>----</td>
</tr>
<tr>
<td>F</td>
<td>5</td>
<td>----</td>
</tr>
</tbody>
</table>

**Flooding.** The site is situated above any floodplains and contains stream channels off the eastern and southern ends. These channels are sloped towards a culvert located within the Temsco Taxiway routing water away from the site. No indications of flooding were observed during the field investigation. Given its location, flooding should not be a concern on this site.
4.0 ENGINEERING ANALYSIS AND PRELIMINARY RECOMMENDATIONS

This section of the report includes interpretations and opinions concerning the interaction of the planned development with the surface and subsurface conditions detected by the field exploration and laboratory tests. It reflects an evaluation of the data collected during the field exploration and soil laboratory tests, and an understanding of the planned development. The analysis is valid for the data collected within the scope of work. The collection of additional data, or a change in the development plans, could provide information, which would alter some or all the interpretations and opinions expressed herein.

These recommendations are based on professional judgment and experience and the data collected during the site exploration and soil laboratory tests. These recommendations generally are not the only design options available; there may be several acceptable alternatives. These recommendations are not intended to represent the only way, but rather to indicate one appropriate option based on the information available.

4.1 Floatplane Pond Material

The plan is to dredge material from within the floatplane pond for use on other areas of the airport. Dredging previously has been done in the floatplane area and is reflected on the bathymetric survey. The dredging was focused on the eastern end of the pond with material removed to an average depth of 40 feet. A discussion of the dredging process is addressed in the DOWL 2006 report, “Reconnaissance Geotechnical Report - Floatplane Pond”.

There are several types of material that will be needed for future development:

- Crushed aggregate base course-below asphalt pavement (roads and runways),
- Subbase, and
- Common excavations-typically below buildings, to develop building pads, and below road and runway subbase.

A majority of the material within the floatplane pond is suitable for use in the proposed development areas provided proper compaction can be obtained. In general, the typical gradation of the recovered samples was as follows:
Table 6: Typical Material Gradation

<table>
<thead>
<tr>
<th>Sieve Size</th>
<th>Percent Passing</th>
</tr>
</thead>
<tbody>
<tr>
<td>3&quot;</td>
<td>100%</td>
</tr>
<tr>
<td>3/4&quot;</td>
<td>100%</td>
</tr>
<tr>
<td>No. 4</td>
<td>70 - 99% (average 92%)</td>
</tr>
<tr>
<td>No. 10</td>
<td>32 - 98% (average 83%)</td>
</tr>
<tr>
<td>No. 60</td>
<td>5 - 85% (average 39%)</td>
</tr>
<tr>
<td>No. 200</td>
<td>2 - 48% (average 13%)</td>
</tr>
</tbody>
</table>

The amount of surficial silty material present above the sands in the floatplane pond was consistently minimal with thickness of less than six inches to 2.5 feet. However, silts were encountered at depth within Test Borings 20, 21, and 26. In Test Borings 20 and 21, a ridge of silt was observed as shallow as 25 feet and extending beyond the depth of the borings. A smaller silt layer was encountered in Test Boring 26 between 45 and 50 feet below the surface of the water with poorly graded sand observed beneath the silt.

The silts affect the overall quality of material that will be stockpiled for use. If the material present is dredged to an average depth of 40 feet and the silt ridge encountered in Test Borings 20 and 21 is not removed, the average silt content of the dredged material is likely to be about 5 to 10 percent. If the silt is dredged, the silt content of the sands is likely to increase to 20 percent or more. This increase in silt could be substantially higher depending on dredge methods and how much sand is mixed with the silt. However, as the material is dredged, it will be stockpiled adjacent to the pond to drain. Some percentage of the silt will be suspended in the water and drain back into the pond.

Based on the mechanical analyses, the material is sandy and will require blending with imported gravel to meet the requirements for crushed aggregate base course. The material will also require blending with imported gravel to meet the requirements for subbase. The dredged material can be used in common excavations. The dredged material has been successfully used on numerous airport projects in the past and was easily compacted. According to airport personnel, the long-term performance of the material has been more than satisfactory.
4.2 Perimeter Dike Trail

The dike runs along the southern perimeter of the pond. The dike averages ten feet in height and is relatively flat on its apex. The materials within the dike indicate that the dike was built with on-site material consisting of sand. No clay or silt liners were observed in the test borings. A layer of silt encountered in Test Boring 30 between 9.5 and 11 feet contained rootlets indicating the original ground surface. Groundwater was observed and measured at the base of the dike. Rock composed of riprap was observed within the upper two feet of Test Boring 30 and along the side slopes of the dike. Based on the test borings drilled, it does not appear that there is any hydrologic condition that will be affected by dredging the pond.

4.3 RSA Expansion Area

The RSA expansion area is approximately ten feet lower in elevation than Runway 8-26 and slopes towards the south. The existing runway embankment is steeply sloped and coated in asphalt and riprap, likely to reduce the effects of erosion from the incoming tides. There are two areas where the main tidal channel runs directly against the runway. At these locations, the tide was observed as high as two feet against the side of the runway embankment.

Design Criteria. The RSA structural section alternatives were developed using the FAA’s Advisory Circulars (AC) 150/5320-6D titled “Airport Pavement Design and Evaluation” and AC 150/5300-13 titled “Airport Design.” The requirements dictate that the RSA must be capable of supporting snow removal equipment, aircraft rescue and firefighting equipment, and the occasional aircraft. The aircraft cannot suffer from structural damage after using the RSA under dry conditions.

The following criteria were used to develop the RSA structural section alternatives.

- Mean Annual Temperature - 42 degrees Fahrenheit
- Freezing Degree Days – 700
- Design Freezing Degree Days – 1120
- Reduced Subgrade Strength (RSS) Design
- Subgrade Fill Soils – Sands with Silt (~10 percent silt)
- Frost Area Soil Support Index/California Bearing Ratio (CBR) – 6.5
- Aircraft – Boeing 737-900 – 187,000 lb takeoff weight

**Structural Section.** The structural section has to take seasonal freeze depths into account. There are three methods that can be used for design of the structural section:

- Complete Frost Protection Method. The Complete Frost Protection method is designed to keep all of the frost from penetrating into the frost susceptible subgrade. In Juneau, depth of freeze can reach six feet.

- Limited Subgrade Frost Penetration. This method limits the amount of frost heave by keeping 65 percent of the freeze depth within the NFS fill material. Based on six feet of freeze, the structural section would be about 47 inches thick.

- Reduced Subgrade Strength. The RSS method is designed to provide a pavement that has load bearing capacity during thaw; a period of time when the subbase is weakest. This method does not address frost heave.

The following pavement sections are based on the RSS method. Using a CBR of 6.5, a structural section 32 inches thick is required.

**Alternative 1**

- 3 inches of hot mix asphalt (4 inches if critical)
- 8 inches of crushed aggregate base course (Item No. P-209)
- 21 inches of subbase (Item No. P-154)

**Alternative 2**

- 3 inches of hot mix asphalt (4 inches if critical)
- 12 inches of stabilized subbase (Plant Mix Bituminous Pavements - Item No. P-401)
- 8 inches of crushed aggregate base course (Item No. P-209)
- 10 inches of subbase (Item No.P-154)
Alternative 2 provides a stronger section given the weight of the governing aircraft, but is still designed to the RSS method. Both alternatives provide an adequate structural section during periods of thaw.

**Side Slopes.** The side slopes must be protected from erosion due to tidal influences. Riprap, large stone, or other materials should be used.

### 4.4 Development Areas

The northwest and northeast development areas encountered similar conditions. Both of these areas must be filled to match surrounding grades. In the northwest development area, Duck Creek will be relocated to the northern end of the property.

The development areas should involve careful consideration and planning prior to dredge activities. Currently, both sites contain several feet of loose, poor quality fill or unsuitable materials consisting of peat or organic silt. In general, these materials are not acceptable for use below buildings or other load bearing areas. In addition, both sites need to be raised in elevation to match surrounding areas.

If the unsuitable materials are left in place and site grades raised with dredged materials, earthwork for each future building will be extensive as the buildings cannot be constructed on the unsuitable material buried at depth. If the unsuitable soils are not removed, the structures may experience differential settlement. Foundation options will then consist of removing all of the dredge material as well as the unsuitable materials, and replacing with the recompacted dredge material and additional approved backfill or founding the buildings on a driven pile foundation system bearing on deeper, suitable soils. Both deep excavations and piles can be costly.

If a site plan is developed prior to dredging material, the poor quality soils within the development areas or at a minimum, from below proposed building footprints could be removed in advance. Once dredge operations begin, the dredged material could then be placed and compacted, site grades raised, and the development areas prepared for construction.
4.5 Building Foundations

Buildings constructed within the development areas can be placed on spread footings founded on properly compacted fill material if all of the existing fill material, organics, organic silt or other unsuitable soils have been removed and replaced. The allowable soil bearing pressure varies with the type and density of the material below the structure. For planning purposes, an allowable bearing pressure of 3,000 pounds per square foot may be used to develop preliminary foundation plans.

Perimeter footings of warm buildings should be founded at least 36 inches below the adjacent exterior grade. Additionally, all interior footings should be founded at least 18 inches below the lowest adjacent grade unless constrained by the floor slabs. Footings in unheated areas should be founded at a minimum depth of five feet. Any footings extending more than five feet outside the heated building lines should be considered cold footings.

Floor Slabs. Floor slabs should be supported on a minimum of one-foot of properly compacted structural fill. The upper six inches below the floor slabs should consist of structural fill with gravel no larger than two inches in diameter.

4.6 Earthwork

Excavation. Any peat, organic silt, debris, all existing fill, and any frozen soil must be removed from beneath potential building footprint areas and replaced with suitable, properly compacted fill material. The use and compaction of the dredged material will have a significant effect on future structures. If the fill material is not properly compacted, and confirmation test borings show very low blow counts, the allowable soil bearing pressure will decrease. Overexcavation and replacement of the fill material may be required or structures may be founded on driven piles. It is important that all poor quality soils be removed in their entirety and the dredge material be properly placed and compacted.

Excavations should be done utilizing a backhoe with a smooth-bladed bucket from outside the excavation to minimize disturbance of the subgrade soils. Soils that are disturbed, pumped, or rutted by construction activity should be redensified, if possible, or completely removed and replaced with structural fill. Some of the removed fill can be reused as structural fill if it meets the requirements for structural fill as described herein.
Geotextiles. A separation geotextile is used to permanently separate two distinct layers of soil in an excavation. For this project, the soils at depth in some areas may be soft to firm silts, requiring a geotextile.

Sensitive Soils. The near surface silts are sensitive to disturbance by construction equipment, particularly when wet or saturated. If silty soils are pumped or rutted during construction, they become weak and highly compressible, and therefore not suitable for support of structural fill, footings, or slabs. Due to the high water content of these silty soils, it can be very difficult, if not impossible, to recompact once disturbed, and therefore the disturbed soils generally must be overexcavated and replaced with compacted structural fill.

Running Sands. Clean sands can present difficulties when excavating below the water table. The sands may be stable when confined by surrounding soils, but seepage forces can create a “quick” condition and wash the sands into the excavation, resulting in slumping and caving of the sides. This phenomenon is locally referred to as a running sand or heaving sand condition, and can greatly increase the size of an excavation. Removal of fill material below the water table or construction of underground utilities may encounter this condition during trenching operations.

The condition can be controlled by drawing the elevation of the water table down to below the bottom of the planned excavation, and with an appropriate dewatering system prior to excavation, and maintaining the dewatering until the backfill is above the level of the water table.

Cut Slopes. Temporary cut slopes for utility trenches and for foundation excavations in both granular and fine-grained soils have been known to stand temporarily at very steep angles; however, they also have been known to fail suddenly, without warning, claiming lives. It is the responsibility of the contractor to determine appropriate temporary cut slopes or shoring for excavations and trenches for the site soils, and surface loading conditions. As a minimum, the contractor should be in full compliance with all federal, state, and local safety requirements for trenching and shoring.
Permanent Cut and Fill Slopes/Dredge Slopes. Within the floatplane pond, slopes should not be steeper than 3 horizontal to 1 vertical. On the rest of the site, permanent cut and fill slopes should not be steeper than 2 horizontal to 1 vertical. Erosion protection, such as topsoil and seeding should be placed as soon as practical after slopes are constructed. Fill slopes should first be constructed to slightly beyond the fill limits, and then trimmed back to the final permanent design slope.

Frozen Soils. Do not place fill, construct foundations, slab-on-grade, or asphalt pavement over frozen soils. Do not fill or backfill with frozen soils.

Structural Fill. Structural fill is defined as load-bearing fill placed under roads, driveways, and parking areas. All structural fill should consist of NFS sand or gravel meeting the following gradation requirements:

<table>
<thead>
<tr>
<th>Sieve Size</th>
<th>Percent Finer</th>
</tr>
</thead>
<tbody>
<tr>
<td>3”</td>
<td>100*</td>
</tr>
<tr>
<td>1-1/2”</td>
<td>70-100</td>
</tr>
<tr>
<td>3/4”</td>
<td>30-100</td>
</tr>
<tr>
<td>1⁄₂”</td>
<td>25-100</td>
</tr>
<tr>
<td>No. 4</td>
<td>20-49</td>
</tr>
<tr>
<td>No. 40</td>
<td>0-25</td>
</tr>
<tr>
<td>No. 200</td>
<td>0-6</td>
</tr>
<tr>
<td>0.02 mm</td>
<td>0-3</td>
</tr>
</tbody>
</table>

* The fill may contain up to ten percent cobbles.

The upper six inches of structural fill below spread footings, grade beams, slabs, and pavements should not contain particles larger than two inches to facilitate fine grading.

Other NFS fill material, which does not meet this gradation requirement, may be acceptable for use. However, the gradation of such material should be evaluated by the project geotechnical engineer prior to its use.

Limits of Fill and Backfill. Structural fill and backfill should extend laterally from the edge of footings, slabs-on-grade, and pavements one-foot for each foot of fill beneath the footing, slab or pavement.

Fill Testing. Frequent, in-place density tests should be performed in each lift of fill to verify that the fill has been properly compacted prior to placing subsequent lifts. The number of
tests performed in each lift should be commensurate with the size of the area worked by the contractor, the variability of the soil types used as fill, and the amount of time an inspector spends on site observing the work.

### 4.7 Dewatering and Drainage

It likely will be necessary to dewater excavations. This will depend on:

- the final grading plan,
- the contractor’s approach to the work, and
- the weather at the time of construction.

It is important that any water be removed from excavations until they are properly backfilled. It is the contractor's responsibility to determine the appropriate dewatering techniques for the construction methods he chooses and for the soil and water conditions encountered. As a minimum, the contractor should be in compliance with any permits for discharge of water, given the proximity of water in the area.

Finish floor elevations should be established and site grades should be constructed and maintained to rapidly drain surface and roof runoff away from the building and pavement subgrade soils. Footing drains may be required for some structures depending on site grades.

### 4.8 Paved Traffic Areas

On this site, paved traffic areas could be constructed by either removing all unsuitable soils and replacing with structural fill, or by overlaying the existing fill and organics with structural fill. The preferred method should include consideration of earthwork costs and long-term maintenance costs. The overlay method has a low initial earthwork cost, but potentially high long-term maintenance costs, while the remove and replace method has a high initial construction cost, but reduced maintenance costs. The choice of which approach to use should be based on the owner's construction and maintenance budgets, and on the expected and/or required performance criteria of the owner. A discussion of the potential methods follows:
**Removal and Replacement.** For an earthwork solution consisting of removal and replacement, all existing fill and organics would be completely removed from the traffic areas and be replaced with properly compacted backfill. This approach will result in the best performing traffic section and minimal long-term maintenance costs.

Based on the anticipated traffic loads and the variation in frost classification of the native and fill soils, we recommend the following minimum pavement section for the parking, driveway and roads:

- two inches of asphalt pavement, over
- two inches of leveling course (D1), over
- the minimum thickness of subbase shown in the table below:

<table>
<thead>
<tr>
<th>Thickness of NFS Subbase (ft)</th>
<th>Frost Classification of Subgrade Soil</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>NFS</td>
</tr>
<tr>
<td>1.5</td>
<td>F1</td>
</tr>
<tr>
<td>1.7</td>
<td>F2</td>
</tr>
<tr>
<td>2.3</td>
<td>F3</td>
</tr>
<tr>
<td>3.3</td>
<td>F4/Fill/Organics</td>
</tr>
</tbody>
</table>

If constructing over the dredged material, the soils observed will likely be F2 soils, requiring an estimated 1.7 feet of structural fill.

**Overlay.** Asphaltic concrete paving may be constructed on a gravel section overlying existing fill and organics if the settlement and resulting maintenance costs offset by reduced construction costs are acceptable. With this approach, a separation geotextile is placed on the existing fill and a minimum of three feet of structural fill subbase is placed over the existing soil/geotextile and compacted to the required density.

### 4.9 Observation

It is important to the performance of the planned Juneau Airport Improvements that any organic soils are removed where specified, and that structural fill consists of proper materials and is adequately compacted. All excavation and backfill should be observed by qualified inspection/testing personnel under the supervision of a geotechnical engineer. Several in-
place density tests should be performed in each lift of the structural fill to verify that minimum fill densities are being attained.

The inspection/testing personnel should be employed by the owner or owner’s representative, not by the contractor, to avoid any inherent conflict of interest and to better ensure that the required level of quality assurance is achieved.
5.0 RESEARCH AND FIELD EXPLORATION

This section presents the technical data obtained from office research and the field investigation. The methods and procedures used in obtaining the data are presented. The data should be considered accurate only at the locations specified and only to the degree implied by the methods used. The data presented was obtained specifically to address the needs of the design, and may not be adequate for construction purposes.

5.1 Research

In 2006, a reconnaissance geotechnical report consisting of office research and a site visit was conducted in support of the Juneau Airport Improvements project. DOWL began the reconnaissance geotechnical report by researching existing soils information in the project area from their in-house soils library. In addition, the following organizations were also contacted.

- TN,
- FAA,
- CBJ,
- JNU,
- State of Alaska Department of Transportation and Public Facilities – Southeast, and
- R&M Consultants – Juneau office.

The information obtained included the draft Environmental Impact Statement, construction improvement plans for the taxiway extension and Fixed Base Operator lots, soils information for the approach lighting system, and plans from the Directional Localizer Road relocation project.

5.2 Field Exploration

During the current investigation, the field exploration was divided into two main segments; the floatplane pond and remaining areas. The division was based on two separate drill rigs and drilling methods.
**Floatplane Pond.** The test boring program for the floatplane pond was conducted from November 1 through November 15, 2007. Eight test borings were drilled, sampled, and logged in select locations within the floatplane pond to 51.5 feet below the water surface. The test borings were drilled to evaluate the quality of material present within the pond.

Each test boring was located in the field through aerial photo interpretation and analyzing a topographic map. In addition, a hand-held Garmin Global Positioning System (GPS) 12 unit was used to record six of the locations. The accuracy of the GPS unit is dependent on several factors, including the number of satellites available and the position of the satellites. The locations of the test borings are shown on Figure A-1.

The test borings were drilled utilizing a pallet drill mounted on a small landing craft boat. The drill is owned and operated by Denali Drilling, Inc. The landing craft was owned and operated by Four Seasons Marine Services. Drilling was supervised and the samples logged by John Rego, a geologist with our firm.

As the soil samples were recovered, they were visually classified and sealed in plastic bags to preserve the natural water content. The samples were then transported to DOWL’s laboratory, Alaska Testlab, in accordance with ASTM 4220, for further testing.

**Remaining Areas.** The test boring and test pit exploration for the perimeter dike trail, RSA expansion, northwest development, and northeast development was conducted from November 4 through November 17, 2007. Twenty-one test borings were drilled, sampled, and logged in the vicinity of the proposed improvements footprint to depths of 21.5 feet.

A total of eleven test pits were excavated within the northeast and northwest development areas. The test pits were excavated to further delineate subsurface conditions across the sites. Each test pit was excavated to competent mineral soils. The test pits varied in depth between 8 to 14 feet.

Each test pit and test boring was located in the field by swing tying off existing landmarks using a fiberglass tape or through aerial photo interpretation. These methods are only as accurate as implied. In addition, a GPS 12 unit was used to record select test boring locations. The approximate locations of the test borings are shown on Figure A-1.
The test borings were drilled utilizing a CME-55 Nodwell-mounted drill fitted with continuous flight, hollow-stem auger. The rigs are owned and operated by Denali Drilling, Inc. The drilling was supervised and the samples logged by a DOWL geologist.

**Sampling.** Within the floatplane pond, three-inch O.D. casing was driven from the boat to approximately twenty feet below the mudline, the borings were further advanced by using mud wash rotary drilling. Disturbed samples were obtained at the mudline or closest five-foot interval, then at five-foot intervals thereafter using a split-spoon sampler. Standard Penetration Tests (SPT) were performed in each of the test borings. The results are an indication of the relative density or consistency of the subsoil.

In the remaining areas, disturbed samples were obtained at depths of two and a half feet, five feet, and then at five-foot intervals thereafter using a split-spoon sampler. Either SPT or modified penetration tests were performed in each of the test borings.

Where the SPT was performed, samples were obtained by driving a two-inch outside-diameter, split-spoon sampler a distance of 18 inches ahead of the auger with a 140-pound hammer falling 30 inches in accordance with ASTM D1586. The standard penetration resistance (N) value shown on the test boring logs indicates the number of blows required to drive the sampler the last 12 inches. The N-values shown in the logs are raw data from the field and have not been adjusted for sampling equipment type or overburden pressure.

The penetration test is a modification of the SPT in that the hammer weight and sampler are larger and are often used to retrieve larger samples of soil. The penetration test was performed in three of the test borings. The penetration test is performed by driving a two and one-half-inch inside-diameter, split-spoon sampler a distance of 18 inches ahead of the auger with a 340-pound hammer falling 30 inches. The penetration resistance value shown on the test boring logs indicates the number of blows required to drive the sampler the last 12 inches. The values shown in the logs are raw data from the field and have not been adjusted for sampling equipment type or overburden pressure.
As the soil samples were recovered, they were visually classified and sealed in plastic bags to preserve the natural water content. The samples were then transported to DOWL’s laboratory, Alaska Testlab, in accordance with ASTM 4220, for further testing.

Slotted PVC pipe was installed in each of the test borings and the depth to the groundwater was measured after the water levels appeared to have stabilized.

No environmental testing or monitoring was conducted as a part of this investigation.
6.0 LABORATORY TESTS

This section of the report presents the technical data obtained during the soil laboratory testing in narrative, tabular, and graphic form. The methods and procedures used in obtaining the data are described herein. The data should be considered accurate only to the degree implied by the methods used.

An engineering technician visually classified each sample recovered and the natural water content was measured. Index tests were performed on selected samples and consisted of grain size.

Soil samples will be stored until July 1, 2008, after which time they will be discarded unless other arrangements are made.

6.1 Visual Classification

In the laboratory, an engineering technician visually classified each soil sample obtained from the field exploration. The visual classification procedure consists of:

- identifying the color of the soil,
- estimating the percentages of gravel, sand, and minus No. 200 particle sizes,
- estimating the maximum particle size,
- estimating the size range of the sand particles,
- identifying the shape of the particles,
- estimating the dry strength of the soil when a water content test is performed,
- estimating the plasticity description of the soil and plasticity index,
- comparing the natural water content with respect to the Atterberg limits, and
- identifying the Unified Soil Classification System group.
6.2 Moisture Content

The natural water content of each sample was determined in accordance with ASTM D2216, Standard Test Method for Laboratory Determination of Water (Moisture) Content of Soil and Rock. The water contents are reported on the graphic test boring logs, Appendix B.

6.3 Particle Size Distribution Tests

Forty-four particle-size distribution tests were performed on selected soil samples in accordance with ASTM D422. These tests consisted of mechanical sieving, the results of which are presented graphically as Appendix C.

6.4 Plasticity Index Test

One plasticity index test was performed in accordance with ASTM D4318, Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils. The liquid limit, plastic limit, and plasticity index number obtained from the test are plotted and used to classify the cohesive soil as silt or clay. In addition, the limits are used to estimate strength and settlement characteristics of the soil. The results of the plasticity index test is presented on Figure C-1, Appendix C.
7.0 REFERENCES


Staff, 1996, Community Information Summary - Juneau, Department of Commerce, Community, and Economic Development, Research and Analysis Section, Anchorage, Alaska.

APPENDIX A

TEST BORING/TEST PIT LOCATION MAPS
Test Boring/Pit Location Map - Northeast Development

JUNEAU AIRPORT IMPROVEMENTS
Juneau, Alaska

FIGURE A-3
SANDY SILT, gray, about 30% sand, low plasticity, fine sand, damp, firm, ORGANICS present ~10% by volume (plants), ORGANIC odor
becoming sandier, about 40% sand, stiff, ORGANICS present ~10% by volume (roots and plants)

Groundwater encountered at 9' while drilling
auger action indicates gravelly soil
POORLY GRADED SAND WITH GRAVEL, brown, about 20% gravel, 5% silt, gravel subrounded to 3/4", coarse sand, saturated, loose

POORLY GRADED SAND, brown, about 5% gravel, 5% silt, gravel subrounded to 1/2", medium sand, saturated, dense

TEST BORING COMPLETED ON 11-4-07
PVC STANDPIPE INSTALLED TO 16.5'
GROUNDWATER MEASURED AT 11.5' ON 11/17/07
POORLY GRADED SAND WITH SILT AND GRAVEL, brown, 45% gravel, 7% silt, gravel subrounded to 1.5", medium sand, damp, medium dense, gravel subangular to 1.5"

Groundwater encountered at 8.5’ while drilling

POORLY GRADED GRAVEL WITH SAND, light brown, about 35% sand, 5% silt, gravel subangular to 1", coarse sand, saturated, loose

POORLY GRADED SAND, brown, about 5% gravel, 5% silt, gravel subrounded to 3/8", medium sand, saturated, very dense, blowcounts not accurate - sampler full due to heave

TEST BORING COMPLETED ON 11-4-07
PVC STANDPIPE INSTALLED TO 16.5'
GROUNDWATER MEASURED AT 8.5' ON 11/17/07
**Test Boring Completed on 11-4-07**

**PVC Standpipe Installed to 16.5’**

**Groundwater Measured at 3’ on 11/17/07**

### Soil Graph

<table>
<thead>
<tr>
<th>Depth (Feet)</th>
<th>Blows / Foot</th>
<th>Sample No.</th>
<th>Soil Type</th>
<th>Frost Depth</th>
<th>Soil Class</th>
<th>Frost Class</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-5</td>
<td>9</td>
<td>1</td>
<td>SP</td>
<td>TD</td>
<td>NFS</td>
<td></td>
</tr>
<tr>
<td>5-10</td>
<td>17</td>
<td>10</td>
<td>NFS</td>
<td>TD</td>
<td>SP</td>
<td></td>
</tr>
<tr>
<td>10-15</td>
<td>17</td>
<td>42</td>
<td>SP</td>
<td>TD</td>
<td>DFS</td>
<td></td>
</tr>
<tr>
<td>15-16.5</td>
<td>19</td>
<td>39</td>
<td>DFS</td>
<td>TD</td>
<td>POORLY GRADED SAND</td>
<td>brown, about 5% gravel, 5% silt, gravel subrounded to 3/4&quot;, medium sand, saturated, loose</td>
</tr>
</tbody>
</table>

**Forest Surface**

- No sample recovered - driving a cobble ahead of sampler
- Groundwater encountered at 4’ while drilling

**Groundwater Encountered at 4’ While Drilling**

**Soil Class**

- POORLY GRADED SAND: brown, about 5% gravel, 5% silt, gravel subrounded to 3/4", medium sand, saturated, loose
- Gravel subangular to 3/8", dense
- Becoming sandier, about 5% silt
Groundwater encountered at 2' while drilling.

POORLY GRADED SAND, light brown, about 5% gravel, 5% silt, gravel subrounded to 1/2", medium sand, saturated, very loose

POORLY GRADED SAND WITH GRAVEL, brown, about 15% gravel, 5% silt, gravel subangular to 1", medium sand, saturated, medium dense

POORLY GRADED SAND, brown, about 5% gravel, 5% silt, gravel subangular to 1/2", medium sand, saturated, dense

becoming sandier, about 5% silt

TEST BORING COMPLETED ON 11-4-07

PVC STANDPIPE INSTALLED TO 16.5'

GROUNDWATER MEASURED AT 3' ON 11/17/07
POORLY GRADED SAND WITH GRAVEL, gray, about 45% sand, 5% silt, gravel subrounded to 1", medium sand, damp, medium dense

Groundwater encountered at 4' while drilling

POORLY GRADED SAND WITH SILT AND GRAVEL, gray, about 15% gravel, 10% silt, gravel subrounded to 1", medium sand, saturated, loose

POORLY GRADED SAND, tan, about 5% gravel, 5% silt, gravel subrounded to 1/2", medium sand, saturated, medium dense

TEST BORING COMPLETED ON 11-6-07
PVC STANDPIPE INSTALLED TO 15'
GROUNDWATER MEASURED AT 4' ON 11/17/07

DRILLING CO.: Denali Drilling, Inc.
EQUIPMENT: CME-55 Nodwell
OPERATOR: James (Buck) Voeller
METHOD: 4.25 in. ID hollow-stem auger

CLIENT: Toner-Nordling & Associates
PROJECT: Juneau Float Plane AIP
LOGGED BY: John A. Rego, Jr.
TEST BORING COMPLETED: 11-6-07
W.O. D59440

LOG OF TEST BORING 5

FIGURE B-5
## TEST BORING 6

**LOCATION:** SEE TEST BORING LOCATION MAP  
**ELEVATION:**

<table>
<thead>
<tr>
<th>DEPTH (FEET)</th>
<th>OTHER TESTS</th>
<th>BLOW</th>
<th>FOOT</th>
<th>SAMPLE NO.</th>
<th>SAMPLE TYPE</th>
<th>SOIL GRAPH</th>
<th>SOIL CLASS</th>
<th>FROST DEPTH</th>
<th>FROST CLASS</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td></td>
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<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>1.0</td>
<td>ML</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16.5</td>
<td>TD=16.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**GRASS SURFACE**
- **SILT,** light brown, indicated by cuttings

**POORLY GRADED SAND WITH GRAVEL,** gray, about 15% gravel, 5% silt, gravel subrounded to 1/2", medium sand, wet, medium dense

Groundwater encountered at 4' while drilling
- becoming more gravelly, about 25% gravel, 5% silt, gravel subrounded to 1", saturated

becoming sandier, about 15% gravel, 5% silt, gravel subrounded to 3/4"

becoming more gravelly, about 20% gravel, 5% silt, gravel subrounded to 1", dense

### TEST BORING COMPLETED ON 11-6-07  
PVC STANDPIPE INSTALLED TO 16.5'  
GROUNDWATER MEASURED AT 4' ON 11/17/07

**LOG OF TEST BORING 6**

**KEY**  
- TD = Total Depth  
- G = Groundwater After Drilling  
- S = Grab Sample  
- Q = SPT Sample  
- SPT = Shelby Tube - pushed  
- W = 2.5" I.D. Spoon Sample  
- 340# weight, 30' fall

**DRILLING CO.:** Denali Drilling, Inc.  
**EQUIPMENT:** CME-55 Nodwell  
**OPERATOR:** James (Buck) Voeller  
**METHOD:** 4.25 in. ID hollow-stem auger

**CLIENT:** Toner-Nordling & Associates  
**PROJECT:** Juneau Float Plane AIP  
**LOGGED BY:** John A. Rego, Jr.  
**W.O.:** D59440
GRASS SURFACE
SANDY SILT, light brown, about 30% sand, low plasticity, fine sand, damp, stiff, **ORGANICS** present ~10% by volume (plants)

POORLY GRADED SAND WITH GRAVEL, brown, about 15% gravel, 5% silt, gravel subrounded to 3/4", medium sand, wet, medium dense
Groundwater encountered at 4' while drilling
saturated, loose

POORLY GRADED SAND, brown, about 10% gravel, 5% silt, gravel subrounded to 1/2", medium sand, saturated, medium dense

TEST BORING COMPLETED ON 11-6-07
PVC STANDPIPE INSTALLED TO 15'
GROUNDWATER MEASURED AT 4' ON 11/17/07

**KEY**
- TD = Total Depth
- G = Groundwater After Drilling
  - Grab Sample
  - SPT Sample
  - Shelby Tube - pushed
  - 2.5" I.D. Spoon Sample 340# weight, 30" fall

**LOG OF TEST BORING 7**

**LOCATION:** SEE TEST BORING LOCATION MAP
**ELEVATION:**

**DEPTH**

- 3.0
- 9.5
- 16.5
### Test Boring 8

**Location:** See Test Boring Location Map

**Elevation:**

<table>
<thead>
<tr>
<th>Depth (Feet)</th>
<th>Soil Class</th>
<th>Frost Class</th>
<th>Soil Frost</th>
<th>Moisture Content (%)</th>
</tr>
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<td>9</td>
</tr>
<tr>
<td>20</td>
<td>2</td>
<td>SP</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>16</td>
<td>3</td>
<td></td>
<td>3</td>
<td>6</td>
</tr>
<tr>
<td>17</td>
<td>4</td>
<td></td>
<td>4</td>
<td>14</td>
</tr>
</tbody>
</table>

**Other Tests**

**Blows/Foot**

**Sample No.**

**Sample Type**

**Moisture Content (%)**

**Groundwater** measured at 4' on 11/17/07

**Soil Graph**

**Frost Depth**

**Sample**

**Soil Frost**

**Moisture Content (%)**

**Grass Surface**

**Poorly Graded Sand**, brown, about 10% gravel, 5% silt, gravel subrounded to 1", medium sand, damp, loose

Groundwater encountered at 4' while drilling

becoming sandier, about 5% gravel, 5% silt, gravel subrounded to 3/4", saturated, very loose

becoming more gravelly, about 10% gravel, 5% silt, loose

becoming sandier, about 5% gravel, 5% silt, gravel subrounded to 1/2", medium dense

**Test Boring Completed On 11-6-07**

**PVC Standpipe Installed To 16.5’**

**Groundwater Measured At 4’ On 11/17/07**

---

**Drilling Co.:** Denali Drilling, Inc.

**Equipment:** CME-55 Nodwell

**Operator:** James (Buck) Voeller

**Method:** 4.25 in. ID hollow-stem auger

**Client:** Toner-Nordling & Associates

**Project:** Juneau Float Plane AIP

**Logged By:** John A. Rego, Jr.

**Test Boring Completed:** 11-6-07

**W.O.:** D59440
TEST BORING 11

LOCATION: SEE TEST BORING LOCATION MAP
ELEVATION: DEPTH

GRASS SURFACE

FILL, POORLY GRADED SAND WITH SILT AND GRAVEL, gray, 33% gravel, 5% silt, gravel subrounded to 3/4", medium sand, wet, medium dense

Groundwater encountered at 5' while drilling

FILL, SILTY SAND WITH GRAVEL, gray, 25% gravel, 36% silt, nonplastic, gravel subrounded to 1", medium sand, saturated, medium dense, ORGANICS present ~10% by volume (plants), ORGANIC odor

POORLY GRADED SAND WITH SILT AND GRAVEL, tan, about 30% gravel, 10% silt, gravel subrounded to 1/2", medium sand, saturated, medium dense

POORLY GRADED SAND WITH Silt and GRAVEL, tan, about 20% gravel, 5% silt, gravel subrounded to 1/2", medium sand, saturated, medium dense

TEST BORING COMPLETED ON 11-17-07
PVC STANDPIPE INSTALLED TO 16.5'
GROUNDWATER MEASURED AT 14' ON 11/19/07 AT 1700 HOURS

LOG OF TEST BORING 11

TABLE

<table>
<thead>
<tr>
<th>DEPTH (FEET)</th>
<th>Blows / Foot</th>
<th>Moisture Content (%)</th>
<th>Soil Class</th>
<th>Frost Class</th>
</tr>
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<tbody>
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<td>0</td>
<td>SP</td>
<td>F2</td>
</tr>
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<td>SM</td>
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<td>SM</td>
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<td>0</td>
<td>0</td>
<td>SP</td>
<td></td>
</tr>
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DRILLING CO.: Denali Drilling, Inc.
EQUIPMENT: CME-55 Nodwell
OPERATOR: James (Buck) Voeller
METHOD: 4.25 in. ID hollow-stem auger

CLIENT: Toner-Nordling & Associates
PROJECT: Juneau Float Plane AIP
LOGGED BY: John A. Rego, Jr.
TEST BORING COMPLETED: 11-17-07

W.O. D59440

LOG OF EXPLORATION 59440.GPJ  BLANK2.GDT  12/7/07

GRASS SURFACE

FILL, POORLY GRADED SAND WITH SILT AND GRAVEL, gray, 33% gravel, 5% silt, gravel subrounded to 3/4", medium sand, wet, medium dense

Groundwater encountered at 5' while drilling

FILL, SILTY SAND WITH GRAVEL, gray, 25% gravel, 36% silt, nonplastic, gravel subrounded to 1", medium sand, saturated, medium dense, ORGANICS present ~10% by volume (plants), ORGANIC odor

POORLY GRADED SAND WITH SILT AND GRAVEL, tan, about 30% gravel, 10% silt, gravel subrounded to 1/2", medium sand, saturated, medium dense

POORLY GRADED SAND WITH Silt and GRAVEL, tan, about 20% gravel, 5% silt, gravel subrounded to 1/2", medium sand, saturated, medium dense

TEST BORING COMPLETED ON 11-17-07
PVC STANDPIPE INSTALLED TO 16.5'
GROUNDWATER MEASURED AT 14' ON 11/19/07 AT 1700 HOURS

LOG OF TEST BORING 11

TABLE

<table>
<thead>
<tr>
<th>DEPTH (FEET)</th>
<th>Blows / Foot</th>
<th>Moisture Content (%)</th>
<th>Soil Class</th>
<th>Frost Class</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
<td>SP</td>
<td>F2</td>
</tr>
<tr>
<td>4.5</td>
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<td>F4</td>
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<td>SP</td>
<td>F2</td>
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<tr>
<td>14.5</td>
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<td>F2</td>
</tr>
<tr>
<td>16.5</td>
<td>0</td>
<td>0</td>
<td>SP</td>
<td></td>
</tr>
</tbody>
</table>

DRILLING CO.: Denali Drilling, Inc.
EQUIPMENT: CME-55 Nodwell
OPERATOR: James (Buck) Voeller
METHOD: 4.25 in. ID hollow-stem auger

CLIENT: Toner-Nordling & Associates
PROJECT: Juneau Float Plane AIP
LOGGED BY: John A. Rego, Jr.
TEST BORING COMPLETED: 11-17-07

W.O. D59440

LOG OF EXPLORATION 59440.GPJ  BLANK2.GDT  12/7/07

GRASS SURFACE

FILL, POORLY GRADED SAND WITH SILT AND GRAVEL, gray, 33% gravel, 5% silt, gravel subrounded to 3/4", medium sand, wet, medium dense

Groundwater encountered at 5' while drilling

FILL, SILTY SAND WITH GRAVEL, gray, 25% gravel, 36% silt, nonplastic, gravel subrounded to 1", medium sand, saturated, medium dense, ORGANICS present ~10% by volume (plants), ORGANIC odor

POORLY GRADED SAND WITH SILT AND GRAVEL, tan, about 30% gravel, 10% silt, gravel subrounded to 1/2", medium sand, saturated, medium dense

POORLY GRADED SAND WITH Silt and GRAVEL, tan, about 20% gravel, 5% silt, gravel subrounded to 1/2", medium sand, saturated, medium dense

TEST BORING COMPLETED ON 11-17-07
PVC STANDPIPE INSTALLED TO 16.5'
GROUNDWATER MEASURED AT 14' ON 11/19/07 AT 1700 HOURS

LOG OF TEST BORING 11

TABLE

<table>
<thead>
<tr>
<th>DEPTH (FEET)</th>
<th>Blows / Foot</th>
<th>Moisture Content (%)</th>
<th>Soil Class</th>
<th>Frost Class</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
<td>SP</td>
<td>F2</td>
</tr>
<tr>
<td>4.5</td>
<td>0</td>
<td>0</td>
<td>SM</td>
<td>F4</td>
</tr>
<tr>
<td>9.5</td>
<td>0</td>
<td>0</td>
<td>SP</td>
<td>F2</td>
</tr>
<tr>
<td>14.5</td>
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<tr>
<td>16.5</td>
<td>0</td>
<td>0</td>
<td>SP</td>
<td></td>
</tr>
</tbody>
</table>

DRILLING CO.: Denali Drilling, Inc.
EQUIPMENT: CME-55 Nodwell
OPERATOR: James (Buck) Voeller
METHOD: 4.25 in. ID hollow-stem auger

CLIENT: Toner-Nordling & Associates
PROJECT: Juneau Float Plane AIP
LOGGED BY: John A. Rego, Jr.
TEST BORING COMPLETED: 11-17-07

W.O. D59440
**LOG OF TEST BORING 12**

**LOCATION:** SEE TEST BORING LOCATION MAP

**ELEVATION:**

<table>
<thead>
<tr>
<th>Depth (Feet)</th>
<th>Soil Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.0</td>
<td>Silt with Sand</td>
<td>Brown, about 20% sand, low plasticity, fine sand, damp, stiff, Organics present ~15% by volume (roots), Organic odor</td>
</tr>
<tr>
<td>9.5</td>
<td>Sandy Silt</td>
<td>Gray, about 35% sand, low plasticity, fine sand, saturated, very soft, Organic odor</td>
</tr>
<tr>
<td>14.5</td>
<td>Poorly Graded Sand</td>
<td>Gray, about 5% gravel, 5% silt, gravel subrounded to 1/2&quot;, medium sand, saturated, loose</td>
</tr>
</tbody>
</table>

**TEST BORING COMPLETED ON 11-6-07**

**PVC STANDPIPE INSTALLED TO 17'**

**GROUNDWATER MEASURED AT 5.5' ON 11/19/07 AT 1710 HOURS**

**LOGGED BY:** John A. Rego, Jr.

**PROJECT:** Juneau Float Plane AIP

**DRILLING CO.:** Denali Drilling, Inc.

**EQUIPMENT:** CME-55 Nodwell

**OPERATOR:** James (Buck) Voeller

**METHOD:** 4.25 in. ID hollow-stem auger

**CLIENT:** Toner-Nordling & Associates

**LOGGED BY:** John A. Rego, Jr.

**TEST BORING COMPLETED:** 11-6-07

**W.O.:** D59440
**TEST BORING 13**

**LOCATION:** SEE TEST BORING LOCATION MAP

**ELEVATION:**

**DEPTH**

<table>
<thead>
<tr>
<th>Soil Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>GRASS SURFACE</strong></td>
<td>FILL, POORLY GRADED GRAVEL WITH SAND, light brown, 48% sand, 1% silt, gravel subangular to 1.5”, medium sand, damp, very dense, DEBRIS present ~20% by volume (asphalt)</td>
</tr>
<tr>
<td></td>
<td>FILL, SANDY SILT, light brown, about 5% gravel, 30% sand, low plasticity, gravel subrounded to 1/2”, medium sand, damp, very stiff, DEBRIS present ~15% by volume (wood)</td>
</tr>
<tr>
<td><em>DEBRIS</em> (wood)</td>
<td>Groundwater encountered at 11’ while drilling</td>
</tr>
<tr>
<td><strong>POORLY GRADED SAND WITH SILT AND GRAVEL</strong></td>
<td>brown, about 15% gravel, 10% silt, gravel subrounded to 3/4”, medium sand, saturated, loose</td>
</tr>
<tr>
<td></td>
<td>gravel subrounded to 1/2”, medium dense</td>
</tr>
</tbody>
</table>

**TEST BORING COMPLETED ON 11-9-07**

PVC STANDPIPE INSTALLED TO 16.5’

GROUNDWATER MEASURED AT 8’ ON 11/19/07 AT 1715 HOURS
## TEST BORING 14

**LOCATION:** SEE TEST BORING LOCATION MAP  
**ELEVATION:**

<table>
<thead>
<tr>
<th>Soil Class</th>
<th>Sample No.</th>
<th>Moisture Content (%)</th>
<th>Blows / Foot</th>
<th>Groundwater After Drilling</th>
</tr>
</thead>
<tbody>
<tr>
<td>MA</td>
<td>14</td>
<td>13</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>SP</td>
<td>18</td>
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<tr>
<td>NFS</td>
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<td>14.5</td>
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<tr>
<td>NFS</td>
<td>16</td>
<td>16.5</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**GRASS SURFACE**  
Groundwater encountered at 2' while drilling

**POORLY GRADED SAND WITH GRAVEL**, tan, 22% gravel, 3% silt, gravel subrounded to 1", medium sand, saturated, medium dense  
becoming sandier, about 15% gravel, 5% silt, gravel subrounded to 1/2", loose

**POORLY GRADED SAND WITH GRAVEL**, tan, about 10% gravel, 5% silt, gravel subrounded to 1/2", medium sand, saturated, medium dense

**TEST BORING COMPLETED ON 11-9-07**  
PVC STANDPIPE INSTALLED TO 16'  
GROUNDWATER MEASURED AT 6' ON 11/19/07 AT 1722 HOURS

**DRILLING CO.:** Denali Drilling, Inc.  
**CLIENT:** Toner-Nordling & Associates  
**EQUIPMENT:** CME-55 Nodwell  
**PROJECT:** Juneau Float Plane AIP  
**OPERATOR:** James (Buck) Voeller  
**LOGGED BY:** John A. Rego, Jr.  
**METHOD:** 4.25 in. ID hollow-stem auger  
**TEST BORING COMPLETED:** 11-9-07  
**W.O.:** D59440
### Test Boring 15

**Location:** See Test Boring Location Map

**Elevation:**

<table>
<thead>
<tr>
<th>Sample No.</th>
<th>Soil Class</th>
<th>Frost Depth</th>
<th>Frost Class</th>
</tr>
</thead>
<tbody>
<tr>
<td>ML</td>
<td>F4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NFS</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SP</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Log of Exploration 59440.GPJ  BLANK2.GDT  12/7/07**

- **Grass Surface, Silt,** brown, observed in cuttings
- **Poorly Graded Sand,** tan, about 10% gravel, 5% silt, gravel subrounded to 1/2", medium sand, damp, loose
- Groundwater encountered at 10' while drilling
  - becoming sandier, about 5% gravel, 5% silt, saturated, medium dense
- becoming more gravelly, about 10% gravel, 5% silt, gravel subrounded to 3/4", dense

**Test Boring Completed on 11-9-07**

PVC Standpipe installed to 16.5'

Groundwater measured at 7' on 11/19/07 at 1725 hours

**Client:** Toner-Nordling & Associates

**Location:** See Test Boring Location Map

**Elevation:**

**Log of Test Boring 15**

**Figure B-13**
**TEST BORING 16**

**LOCATION:** SEE TEST BORING LOCATION MAP

**ELEVATION:**

<table>
<thead>
<tr>
<th>Depth (Feet)</th>
<th>MA</th>
<th>SP</th>
<th>Sample No.</th>
<th>Soil Graph</th>
<th>Soil Class</th>
<th>Frost Depth</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>21</td>
<td>1</td>
<td>1</td>
<td>NFS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>15</td>
<td>5</td>
<td>1A</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>17</td>
<td>6</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>17</td>
<td>9</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16.5</td>
<td>18</td>
<td>5</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**SAND SURFACE:** Groundwater encountered at surface

**POORLY GRADED SAND:** reddish brown, 6% gravel, 3% silt, gravel subrounded to 1/2", medium sand, saturated, very loose

gray, becoming sandier, about 5% silt

becoming more gravelly, about 10% gravel, 5% silt, gravel subrounded to 3/4", loose

gravel subrounded to 1/4"

becoming sandier, about 5% gravel, 5% silt, gravel subrounded to 1/2", very loose

**TEST BORING COMPLETED ON 11-16-07**

**PVC STANDPIPE INSTALLED TO 16.5’**

**GROUNDWATER MEASURED AT SURFACE ON 11/19/07**

**AT 1730 HOURS**

---

**LOG OF TEST BORING 16**

**LOGGED BY:** John A. Rego, Jr.

**PROJECT:** Juneau Float Plane AIP

**CLIENT:** Toner-Nordling & Associates

**DRILLING CO.:** Denali Drilling, Inc.

**EQUIPMENT:** CME-55 Nodwell

**OPERATOR:** James (Buck) Voeller

**METHOD:** 4.25 in. ID hollow-stem auger

**KEY**

- MA = Mechanical Analysis
- TD = Total Depth
- = Groundwater After Drilling
- = Grab Sample
- = SPT Sample
- = Shelby Tube - pushed
- = 2.5" I.D. Spoon Sample

**W.O.:** D59440

**FIGURE B-14**
TEST BORING 17

LOCATION: SEE TEST BORING LOCATION MAP
ELEVATION:

<table>
<thead>
<tr>
<th>DEPTH</th>
<th>Soil Class</th>
<th>Soil Frost Depth</th>
<th>Frost Class</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>ML</td>
<td>F4</td>
<td></td>
</tr>
<tr>
<td>2.0</td>
<td>SP</td>
<td>F4</td>
<td></td>
</tr>
<tr>
<td>4.5</td>
<td>NFS</td>
<td>F2</td>
<td></td>
</tr>
<tr>
<td>9.5</td>
<td>NFS</td>
<td>F2</td>
<td></td>
</tr>
<tr>
<td>16.5</td>
<td>SP</td>
<td>F2</td>
<td></td>
</tr>
</tbody>
</table>

GRASS SURFACE
SILT, brown, observed in cuttings

POORLY GRADED SAND, gray, about 5% gravel, 5% silt, gravel subrounded to 1/4", medium sand, wet, medium dense

Groundwater encountered at 5' while drilling

POORLY GRADED SAND WITH SILT AND GRAVEL, gray, about 10% gravel, 5% silt, gravel subrounded to 1/2", medium sand, saturated, loose, trace ORGANICS (roots)

POORLY GRADED SAND, gray, about 5% silt, medium sand, saturated, loose, trace ORGANICS (roots)

POORLY GRADED SAND, gray, about 5% silt, medium sand, becoming more gravelly, about 5% gravel, 5% silt, gravel subrounded to 1/2", contains a 2" piece of driftwood

TEST BORING COMPLETED ON 11-16-07
PVC STANDPIPE INSTALLED TO 16.5'
GROUNDWATER MEASURED AT 3.5' ON 11/19/07 AT 1736 HOURS

DRILLING CO.: Denali Drilling, Inc.
EQUIPMENT: CME-55 Nodwell
OPERATOR: James (Buck) Voeller
METHOD: 4.25 in. ID hollow-stem auger

CLIENT: Toner-Nordling & Associates
PROJECT: Juneau Float Plane AIP
LOGGED BY: John A. Rego, Jr.
TEST BORING COMPLETED: 11-16-07
W.O. D59440

LOG OF TEST BORING 17
FIGURE B-15
**LOG OF TEST BORING 18**

**LOCATION:** See Test Boring Location Map

**ELEVATION:**

<table>
<thead>
<tr>
<th>DEPTH (FEET)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
</tr>
<tr>
<td>5</td>
</tr>
<tr>
<td>10</td>
</tr>
<tr>
<td>15</td>
</tr>
<tr>
<td>20</td>
</tr>
<tr>
<td>25</td>
</tr>
<tr>
<td>30</td>
</tr>
<tr>
<td>35</td>
</tr>
</tbody>
</table>

**DEPT = 16.5'**

**SPT** Sample Type

**SP - Grass Surface**

**POORLY GRADED SAND WITH SILT** gray, about 10% silt, medium sand, wet, medium dense, trace **ORGANICS** (roots)

**POORLY GRADED SAND** tan/gray, about 5% silt, medium sand, saturated, loose

contains 1" piece driftwood

very loose

**TEST BORING COMPLETED ON 11-16-07**

**PVC STANDPIPE INSTALLED TO 16.5'**

**GROUNDWATER MEASURED AT 4' ON 11/19/07 AT 1739 HOURS**

**DRILLING CO.:** Denali Drilling, Inc.

**EQUIPMENT:** CME-55 Nodwell

**OPERATOR:** James (Buck) Voeller

**METHOD:** 4.25 in. ID hollow-stem auger

**CLIENT:** Toner-Nordling & Associates

**PROJECT:** Juneau Float Plane AIP

**LOGGED BY:** John A. Rego, Jr.

**LOG OF TEST BORING 18**

**FIGURE B-16**
TEST BORING 19

LOCATION: N2383584.4 / E2507189.8

FLOAT PLANE POND

POORLY GRADED SAND, gray/tan, about 5% gravel, 5% silt, gravel subrounded to 1/2", medium sand, saturated, dense

POORLY GRADED SAND WITH GRAVEL, gray, about 20% gravel, 5% silt, gravel subrounded to 1", coarse sand, saturated, dense

POORLY GRADED SAND, gray, about 10% gravel, 5% silt, gravel subrounded to 1/2", medium sand, saturated, medium dense

cuttings indicate surface sediment

LOGGED BY: John A. Rego, Jr.

(continued on next page)
**TEST BORING 19 (Continued)**

<table>
<thead>
<tr>
<th>Sample No.</th>
<th>Soil Type</th>
<th>Soil Graph</th>
<th>Frost Depth</th>
<th>Frost Class</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>F4</td>
<td>Silty sand</td>
<td>39.5</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>NFS</td>
<td>Poorly graded sand, gray, about 5% gravel, 5% silt, gravel subrounded to 3/8&quot;, medium sand, saturated, medium dense</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>SP</td>
<td>Poorly graded sand with silt, gray, 1% gravel, 9% silt, gravel subrounded to 3/8&quot;, medium sand, saturated, medium dense</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>T2</td>
<td></td>
<td>49.5</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>SM</td>
<td></td>
<td>51.5</td>
<td></td>
</tr>
</tbody>
</table>

**TEST BORING COMPLETED ON 11-11-07**

---

**LOG OF TEST BORING 19**

**LOCATION:** N2383584.4 / E2507189.8

**ELEVATION:**

**DEPTH (FEET):**

<table>
<thead>
<tr>
<th>Depth (Feet)</th>
<th>Moisture Content (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>35</td>
<td>24</td>
</tr>
<tr>
<td>40</td>
<td>17</td>
</tr>
<tr>
<td>45</td>
<td>16</td>
</tr>
<tr>
<td>50</td>
<td>24</td>
</tr>
<tr>
<td>55</td>
<td>25</td>
</tr>
<tr>
<td>60</td>
<td>24</td>
</tr>
<tr>
<td>65</td>
<td>24</td>
</tr>
<tr>
<td>70</td>
<td>25</td>
</tr>
</tbody>
</table>

**Other Tests:**

- MA: Mechanical Analysis
- TD: Total Depth
- Groundwater After Drilling
- Grab Sample
- SPT Sample
- Shelby Tube - pushed
- 2.5" I.D. Spoon Sample 340# weight, 30" fall

**Soil Class:**

- SM: Silt
- SP: Sand
- NFS: Poorly graded sand, gray, about 5% gravel, 5% silt, gravel subrounded to 3/8", medium sand, saturated, medium dense
- T2: Poorly graded sand with silt, gray, 1% gravel, 9% silt, gravel subrounded to 3/8", medium sand, saturated, medium dense

**Sample Type:**

- Silty sand, gray, 7% gravel, 48% silt, nonplastic, gravel subrounded to 3/4", medium sand, saturated, medium dense

**LOGGED BY:** John A. Rego, Jr.

**DRILLING CO.:** Denali Drilling, Inc.

**EQUIPMENT:** Pallet Drill, Landing Craft

**OPERATOR:** James (Buck) Voeller

**METHOD:** 3 in. OD Casing

**DRILLING CO.:** Denali Drilling, Inc.

**CLIENT:** Toner-Nordling & Associates

**PROJECT:** Juneau Float Plane AIP

**LOGGED BY:** John A. Rego, Jr.

**TEST BORING COMPLETED:** 11-11-07

**W.O.:** D59440

---

**LOG OF EXPLORATION 59440.GPJ  BLANK2.GDT  12/7/07**
FLOAT PLANE POND

casing sank ~2' under own weight

POORLY GRADED SAND WITH GRAVEL, gray, about 15% gravel, 5% silt, gravel subrounded to 1/2", medium sand, saturated, medium dense, ORGANIC odor

SANDY SILT WITH GRAVEL, gray, about 20% gravel, 20% sand, nonplastic, gravel subrounded to 3/4", fine sand, saturated, very stiff, ORGANIC odor

SANDY SILT, gray, 1% gravel, 34% sand, nonplastic, gravel subrounded to 3/8", fine sand, saturated, firm, ORGANIC odor

(continued on next page)
**SILT WITH SAND**, gray, 2% gravel, 26% sand, nonplastic, gravel subrounded to 3/8", fine sand, saturated, stiff, ORGANIC odor

becoming siltier, about 20% sand, very stiff

becoming siltier, 18% sand, stiff

**SANDY SILT**, gray, about 30% sand, nonplastic, fine sand, saturated, very stiff

---

**TEST BORING COMPLETED ON 11-13-07**
TEST BORING 21

LOCATION: N2382922.5 / E2508027.8
ELEVATION: W.O.
DEPTH

FLOAT PLANE POND

SANDY Silt, dark gray, about 30% sand, low plasticity, fine sand, saturated, stiff

POORLY GRADED SAND WITH SILT AND GRAVEL, brown, about 45% gravel, 10% silt, gravel subangular to 1.5", medium sand, saturated, medium dense

POORLY GRADED SAND, gray, 5% gravel, 2% silt, gravel subrounded to 3/4", medium sand, saturated, medium dense

becoming siltier, about 5% gravel, 5% silt, gravel subrounded to 3/8"

SILTY SAND WITH GRAVEL, gray, about 15% gravel, 15% silt, gravel subrounded to 1/2", medium sand, saturated, dense

(continued on next page)

LOG OF TEST BORING 21

FIGURE B-19
TEST BORING 21 (Continued)

LOCATION: N2382922.5 / E2508027.8
ELEVATION:

Frost Depth

Sample No.  Soil Type  Soil Class  Soil Graph  Blows / Foot  Moisture Content (%)

MA 28 16 7  F4  SILT WITH SAND, dark gray, 25% sand, low plasticity, fine sand, saturated, very stiff, ORGANIC odor

32 15 8  ML  becoming siltier, about 20% sand

MA 38 23 9  F4  SILT, dark gray, 8% sand, low plasticity, fine sand, saturated, very stiff

34 22 10  ML  

DEPTH (FEET)

TEST BORING COMPLETED ON 11-10-07

Soil Class

LOCATION: N2382922.5 / E2508027.8
ELEVATION:

OTHER TESTS

Sample Type

key: = Mechanical Analysis
TD = Total Depth
G = Groundwater After Drilling
G = Grab Sample
S = SPT Sample
ST = Shelby Tube - pushed
S = 2.5" I.D. Spoon Sample
W.0. = 340# weight, 30' fall

MOISTURE CONTENT

MOISTURE CONTENT

Frost Depth

TEST BORING COMPLETED ON 11-10-07

LOG OF TEST BORING 21

FIGURE B-19
POORLY GRADED SAND, gray, 11% gravel, 3% silt, gravel subrounded to 3/4", medium sand, saturated, medium dense

tan, becoming sandier, about 5% gravel, 5% silt

tan/gray, becoming sandier, 3% gravel, 2% silt, gravel subrounded to 1/2"

becoming more gravelly, about 10% gravel, 5% silt, gravel subrounded to 3/4", dense

no sample recovered - driving a cobble ahead of sampler
POORLY GRADED SAND WITH GRAVEL, tan/gray, about 15% gravel, 5% silt, gravel subangular to 1/2", medium sand, saturated, medium dense

POORLY GRADED SAND, tan/gray, 10% gravel, 3% silt, gravel subrounded to 1/2", medium sand, saturated, medium dense

POORLY GRADED SAND WITH GRAVEL, tan, about 15% gravel, 5% silt, gravel subangular to 3/4", medium sand, saturated, medium dense

TEST BORING COMPLETED ON 11-13-07
POORLY GRADED SAND, tan, about 5% gravel, 5% silt, gravel subrounded to 3/4", medium sand, saturated, medium dense

becoming sandier, 6% gravel, 3% silt, gravel subangular to 1/2"

dense

becoming more gravelly, about 10% gravel, 5% silt, gravel subangular to 3/8", medium dense

(continued on next page)
### TEST BORING 23 (Continued)

**LOCATION:** SEE TEST BORING LOCATION MAP  
**ELEVATION:**

<table>
<thead>
<tr>
<th>DEPTH (FEET)</th>
<th>Soil Class</th>
<th>Soil Graph</th>
<th>Sample Type</th>
<th>Moisture Content (%)</th>
<th>Blows / Foot</th>
</tr>
</thead>
<tbody>
<tr>
<td>35</td>
<td>F4</td>
<td>SM</td>
<td>MA</td>
<td>36</td>
<td>28</td>
</tr>
<tr>
<td>40</td>
<td>F2</td>
<td>SP</td>
<td>MA</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>45</td>
<td>F4</td>
<td>SM</td>
<td>MA</td>
<td>38</td>
<td>21</td>
</tr>
<tr>
<td>50</td>
<td>F2</td>
<td>SP</td>
<td>MA</td>
<td>30</td>
<td>23</td>
</tr>
<tr>
<td>55</td>
<td>F4</td>
<td>SM</td>
<td>MA</td>
<td>40</td>
<td>28</td>
</tr>
<tr>
<td>60</td>
<td>F2</td>
<td>SP</td>
<td>MA</td>
<td>45</td>
<td>20</td>
</tr>
<tr>
<td>65</td>
<td>F4</td>
<td>SM</td>
<td>MA</td>
<td>50</td>
<td>21</td>
</tr>
<tr>
<td>70</td>
<td>F2</td>
<td>SP</td>
<td>MA</td>
<td>55</td>
<td>20</td>
</tr>
</tbody>
</table>

**LOGGED BY:** John A. Rego, Jr.  
**LOGGED BY:** D59440  
**PROJECT:** Juneau Float Plane AIP  
**EQUIPMENT:** Pallet Drill, Landing Craft  
**OPERATOR:** James (Buck) Voeller  
**METHOD:** 3 in. OD Casing  
**CLIENT:** Toner-Nordling & Associates  
**DRILLING CO.:** Denali Drilling, Inc.

**SILTY SAND**, gray, 1% gravel, 37% silt, gravel subrounded to 1/2", medium sand, saturated, medium dense

**POORLY GRADED SAND WITH SILT**, gray, about 10% silt, medium sand, saturated, medium dense

**SILTY SAND**, gray, about 35% silt, nonplastic, medium sand, saturated, medium dense

becoming siltier, 1% gravel, 37% silt, nonplastic

**TEST BORING COMPLETED ON 11-12-07**
FLOAT PLANE POND

Casing sank 2' under own weight

Silt in top of spoon, strong organic odor

Poorly graded sand, dark gray, about 5% silt, medium sand, saturated, loose

Poorly graded sand with silt, gray, 5% gravel, 10% silt, gravel subrounded to 1/2", medium sand, saturated, loose

(continued on next page)
Frost Depth

TEST BORING 24 (Continued)

LOCATION: N2382624.4 / E2510351.9
ELEVATION: DEPTH

DEPTH

Other Tests
Moisture
Blows / Foot
Sample No.
Sample Type
Soil Graph
Soil Class
Soil Frost Depth
Sample Class
Frost Class

35
14 34 3
NFS
POORLY GRADED SAND, tan, about 5% gravel, 5% silt,
gravel subrounded to 1/2", medium sand, saturated, dense

becoming more gravelly, about 10% gravel, 5% silt, gravel
subangular to 3/8", medium dense

becoming sandier, 5% gravel, 3% silt, gravel subrounded to 3/4"
dense

51.5

TEST BORING COMPLETED ON 11-15-07

LOGGED BY: John A. Rego, Jr.

CLIENT: Toner-Nordling & Associates

PROJECT: Juneau Float Plane AIP

LOGGED BY: John A. Rego, Jr.

TEST BORING COMPLETED: 11-15-07

W.O. D59440

LOG OF TEST BORING 24

FIGURE B-22
## Test Boring 25

**Location:** See Test Boring Location Map

**Elevation:**

<table>
<thead>
<tr>
<th>Depth (Feet)</th>
<th>Sample Type</th>
<th>Soil Class</th>
<th>Soil Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.0</td>
<td>F3</td>
<td>SM</td>
<td>Silty Sand with Gravel, dark gray, 30% gravel, 21% silt, nonplastic, gravel subrounded to 1&quot;, medium sand, saturated, loose, casing difficult to drive at 4'</td>
</tr>
<tr>
<td>4.0</td>
<td>NFS</td>
<td>SM</td>
<td>Poorly Graded Sand with Gravel, gray, about 20% gravel, 5% silt, gravel subrounded to 1&quot;, medium sand, saturated, medium dense</td>
</tr>
<tr>
<td>14.5</td>
<td>NFS</td>
<td>SM</td>
<td>Poorly Graded Sand, gray, about 5% gravel, 5% silt, gravel subrounded to 3/8&quot;, medium sand, saturated, medium dense</td>
</tr>
<tr>
<td>24.5</td>
<td>F2</td>
<td>SP</td>
<td>Poorly Graded Sand with Silt, gray, about 10% gravel, 10% silt, gravel subrounded to 3/4&quot;, medium sand, saturated, medium dense</td>
</tr>
<tr>
<td>29.5</td>
<td>NFS</td>
<td>SM</td>
<td>Poorly Graded Sand, gray, about 5% gravel, 5% silt, gravel subrounded to 3/4&quot;, coarse sand, saturated, medium dense</td>
</tr>
<tr>
<td>34.5</td>
<td></td>
<td>H2O</td>
<td></td>
</tr>
</tbody>
</table>

**No sample recovered - driving a cobble ahead of sampler**

**Other Tests:**

- MA = Mechanical Analysis
- TD = Total Depth
- H = Groundwater After Drilling
- S = SPT Sample
- F3 = 2.5" I.D. Spoon Sample # weight, 30" fall

**Key:**

- = Grab Sample
- = Shelby Tube - pushed
- = 3.0" I.D. Spoon Sample
- = 1.5" I.D. Spoon Sample
- = 30" Characters
- = 2.5" I.D. Spoon Sample
- = 2.0" I.D. Spoon Sample
- = 1.5" I.D. Spoon Sample
- = 1.0" I.D. Spoon Sample
- = 0.5" I.D. Spoon Sample
- = 0.25" I.D. Spoon Sample
- = 0.125" I.D. Spoon Sample
- = 0.0625" I.D. Spoon Sample
- = 0.03125" I.D. Spoon Sample
- = 0.015625" I.D. Spoon Sample
- = 0.0078125" I.D. Spoon Sample
- = 0.00390625" I.D. Spoon Sample
- = 0.001953125" I.D. Spoon Sample
- = 0.0009765625" I.D. Spoon Sample
- = 0.00048828125" I.D. Spoon Sample
- = 0.000244140625" I.D. Spoon Sample
- = 0.0001220703125" I.D. Spoon Sample
- = 0.00006103515625" I.D. Spoon Sample
- = 0.000030517578125" I.D. Spoon Sample
- = 0.0000152587890625" I.D. Spoon Sample
- = 0.00000762939453125" I.D. Spoon Sample
- = 0.000003814697265625" I.D. Spoon Sample
- = 0.0000019073486328125" I.D. Spoon Sample
- = 0.00000095367431640625" I.D. Spoon Sample
- = 0.000000476837158203125" I.D. Spoon Sample
- = 0.0000002384185791015625" I.D. Spoon Sample
- = 0.00000011920928955078125" I.D. Spoon Sample
- = 0.000000059604644775390625" I.D. Spoon Sample
- = 0.0000000298023223876953125" I.D. Spoon Sample
- = 0.00000001490116119384765625" I.D. Spoon Sample
- = 0.000000007450580596923828125" I.D. Spoon Sample
- = 0.0000000037252902984619109375" I.D. Spoon Sample
- = 0.0000000018626451492309554688" I.D. Spoon Sample
- = 0.0000000009313225746154777344" I.D. Spoon Sample
- = 0.0000000004656612873077388672" I.D. Spoon Sample
- = 0.0000000002328306436538694336" I.D. Spoon Sample
- = 0.0000000001164153218269347168" I.D. Spoon Sample
- = 0.0000000000582076609134673584" I.D. Spoon Sample
- = 0.0000000000291038304567336744" I.D. Spoon Sample
- = 0.0000000000145519152283668372" I.D. Spoon Sample
- = 0.0000000000072759576141834186" I.D. Spoon Sample
- = 0.0000000000036379788070917093" I.D. Spoon Sample
- = 0.0000000000018189894035458546" I.D. Spoon Sample
- = 0.0000000000009094947017729273" I.D. Spoon Sample
- = 0.0000000000004547473508864636" I.D. Spoon Sample
- = 0.0000000000002273736754432318" I.D. Spoon Sample
- = 0.0000000000001136868377216159" I.D. Spoon Sample
- = 0.0000000000000568434188608079" I.D. Spoon Sample
- = 0.0000000000000284217094304039" I.D. Spoon Sample
- = 0.0000000000000142108547152019" I.D. Spoon Sample
- = 0.0000000000000071054273576009" I.D. Spoon Sample
- = 0.0000000000000035527136788005" I.D. Spoon Sample
- = 0.0000000000000017763568394002" I.D. Spoon Sample

**Drilling Co.:** Denali Drilling, Inc.

**Equipment:** Pallet Drill, Landing Craft

**Operator:** James (Buck) Voeller

**Method:** 3 in. OD Casing

**Log by:** John A. Rego, Jr.

**Location:** See Test Boring Location Map

**Elevation:**

- 0
- 5
- 10
- 15
- 20
- 25
- 30
- 35
- 40

**Test Boring Completed:** 11-2-07

**W.O.:** D59440

**Client:** Toner-Nordling & Associates

**Project:** Juneau Float Plane AIP

**Other Tests:**

- Grab Sample
- Shelby Tube - pushed
- 2.5" I.D. Spoon Sample
- 30" fall
**TEST BORING 25 (Continued)**

<table>
<thead>
<tr>
<th>Sample Type</th>
<th>Soil Class</th>
<th>Frost Depth</th>
<th>Other Tests</th>
<th>Moisture Content (%)</th>
<th>Blows / Foot</th>
<th>Sample No.</th>
<th>Soil Graph</th>
<th>Frost Class</th>
<th>TD (Feet)</th>
</tr>
</thead>
<tbody>
<tr>
<td>MA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>23</td>
<td>13</td>
<td>7</td>
<td>F3</td>
<td>39.5</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td><strong>Silty Sand</strong>, gray, 2% gravel, 20% silt, gravel subrounded to 1/2&quot;, fine sand, saturated, medium dense</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>16</td>
<td>12</td>
<td>8</td>
<td>F2</td>
<td>49.5</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td><strong>Poorly Graded Sand With Silt</strong>, gray, about 5% gravel, 10% silt, gravel subrounded to 1/2&quot;, medium sand, saturated, medium dense</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>15</td>
<td>16</td>
<td>10</td>
<td>F1</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td><strong>Poorly Graded Sand</strong>, gray, frail, 1% gravel, 4% silt, gravel subrounded to 3/8&quot;, medium sand, saturated, medium dense</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**LOCATION:** SEE TEST BORING LOCATION MAP  
**ELEVATION:**  
**DEPTH:**

**TEST BORING COMPLETED ON 11-2-07**

---

**KEY**  
MA = Mechanical Analysis  
TD = Total Depth  
G = Groundwater After Drilling  
S = Grab Sample  
F = Shelby Tube - pushed  
D = 2.5" I.D. Spoon Sample  
340# weight, 30" fall

**LOG OF TEST BORING 25**  
**LOGGED BY:** John A. Rego, Jr.  
**DRILLING CO.:** Denali Drilling, Inc.  
**EQUIPMENT:** Pallet Drill, Landing Craft  
**OPERATOR:** James (Buck) Voeller  
**METHOD:** 3 in. OD Casing  
**PROJECT:** Juneau Float Plane AIP  
**CLIENT:** Toner-Nordling & Associates  
**LOGGED BY:** John A. Rego, Jr.  
**TEST BORING COMPLETED:** 11-2-07  
**W.O.** D59440  

---

**REFERENCE:** FIGURE B-23
LOG OF TEST BORING 26

LOCATION: N2382175.8 / E2509740.8
ELEVATION: DEPTH

FLOAT PLANE POND

H2O

54
MA

1

ML

F-4

NFS

SP

1A

SILT WITH SAND, dark brown, about 20% sand, low plasticity, fine sand, saturated, soft, ORGANIC odor, sampler sank 6" under weight of hammer

POORLY GRADED SAND WITH GRAVEL, dark gray, 20% gravel, 4% silt, gravel subrounded to 3/4", medium sand, saturated, very loose, ORGANIC odor

POORLY GRADED SAND, tan, about 5% gravel, 5% silt, gravel subrounded to 3/4", medium sand, saturated, medium dense

POORLY GRADED SAND WITH GRAVEL, tan, about 15% gravel, 5% silt, gravel subrounded to 3/4", medium sand, saturated, medium dense

POORLY GRADED SAND, gray, about 5% gravel, 5% silt, gravel subangular to 1/2", medium sand, saturated, medium dense

becoming sandier, 1% gravel, 4% silt, gravel subrounded to 3/8"

(continued on next page)
TEST BORING 26 (Continued)

LOCATION: N2382175.8 / E2509740.8
ELEVATION:

TEST BORING COMPLETED ON 11-14-07

POORLY GRADED SAND, dark gray, about 5% silt, medium sand, saturated, medium dense, ORGANIC odor

SANDY SILT, dark gray, 43% sand, fine sand, saturated, hard, ORGANIC odor, contains shells to ~5% by volume

DEPTH (FEET)

35
40
45
50
55
60
65
70

DEPT (FEET)

17 25 6
18 37 7
35 16 8
23 24 9

MOISTURE CONTENT (%)

TD=51.5'

17 25 6
18 37 7
35 16 8
23 24 9

BLOWs / Foot

MA 35 16 8

SD

F4

ML

SP

NFS

Soil Class

Frost Depth

Frost Class

35
40
45
50
55
60
65
70

340# weight, 30' fall

EQUIPMENT:
Pallet Drill, Landing Craft

OPERATOR:
James (Buck) Voeller

METHOD:
3 in. OD Casing

DRILLING CO.:
Denali Drilling, Inc.

CLIENT:
Toner-Nordling & Associates

PROJECT:
Juneau Float Plane AIP

LOGGED BY:
John A. Rego, Jr.

TEST BORING COMPLETED:
11-14-07

W.O. D59440

LOG OF TEST BORING 26

FIGURE B-24
**LOG OF TEST BORING 27**

**LOCATION:** N2382897.3 / E2506924.9

**ELEVATION:**

<table>
<thead>
<tr>
<th>DEPTH (FEET)</th>
<th>other Tests</th>
<th>Moisture Content (%)</th>
<th>Blows / Foot</th>
<th>Sample No.</th>
<th>Sample Type</th>
<th>Soil Class</th>
<th>Frost Depth</th>
<th>Frost Class</th>
</tr>
</thead>
<tbody>
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<td>NFS</td>
<td>4.5</td>
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<tr>
<td>6</td>
<td>14</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td>F2</td>
<td>SM</td>
<td>9.5</td>
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<tr>
<td>5</td>
<td>28</td>
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<td>19.5</td>
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<td>13</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>21.5</td>
</tr>
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</table>

**KEY**
- MA = Mechanical Analysis
- TD = Total Depth
- = Groundwater After Drilling
- = Grab Sample
- = SPT Sample
- = Shelby Tube - pushed
- = 2.5" I.D. Spoon Sample
  - 340# weight, 30" fall

**DRILLING CO.:** Denali Drilling, Inc.
**CLIENT:** Toner-Nordling & Associates
**EQUIPMENT:** CME-55 Nodwell
**PROJECT:** Juneau Float Plane AIP
**OPERATOR:** James (Buck) Voeller
**LOGGED BY:** John A. Rego, Jr.
**METHOD:** 4.25 in. ID hollow-stem auger
**TEST BORING COMPLETED ON 11-5-07**
**PVC STANDPIPE INSTALLED TO 21.5’**
**GROUNDWATER MEASURED AT 14’ ON 11/17/07**

**Frost Depth**

- **GRAVEL SURFACE**
- **FILL, POORLY GRADED GRAVEL WITH SAND,** brown, about 30% sand, 5% silt, gravel subrounded to 1.5", medium sand, damp, medium dense
- **FILL, SILTY SAND WITH GRAVEL,** brown, 37% gravel, 13% silt, gravel subrounded to 1", medium sand, damp, loose
- **POORLY GRADED SAND WITH GRAVEL,** dark gray, about 35% gravel, 5% silt, gravel subrounded to 3/4", medium sand, damp, medium dense
- Groundwater encountered at 15’ while drilling becoming sandier, about 15% gravel, 5% silt, saturated
- **POORLY GRADED SAND,** gray, about 5% gravel, 5% silt, gravel subangular to 1/2", medium sand, saturated, very dense, blowcounts not accurate - sampler full due to heave

**FIGURE B-25**
Gravel Surface

**Fill, Poorly Graded Sand with Silt**, brown, about 10% gravel, 10% silt, gravel subrounded to 1/2", medium sand, damp, medium dense

**Fill, Poorly Graded Sand with Gravel**, gray, about 15% gravel, 5% silt, gravel subrounded to 3/4", medium sand, damp, loose

Groundwater encountered at 10' while drilling

**Poorly Graded Sand**, gray, about 10% gravel, 5% silt, gravel subrounded to 1/2", medium sand, saturated, medium dense

becoming more gravelly, 12% gravel, 2% silt, gravel subrounded to 3/4"

becoming sandier, about 5% silt

**PVC Standpipe installed to 21.5’**

**Groundwater measured at 9.5’ on 11/17/07**

**Test Boring completed on 11-5-07**

**Log of Test Boring 28**

**Location:** N2382322.8 / E2507518.3

**Elevation:**

**Drilling Co.:** Denali Drilling, Inc.

**Equipment:** CME-55 Nodwell

**Operator:** James (Buck) Voeller

**Method:** 4.25 in. ID hollow-stem auger

**Logging By:** John A. Rego, Jr.

**Client:** Toner-Nordling & Associates

**Project:** Juneau Float Plane AIP

**Log of Exploration 59440.GPJ  Blank2.GDT  12/7/07**

**Test Boring completed:** 11-5-07

**W.O. D59440**
TEST BORING 29

LOCATION: N2381830.7 / E2508499.1
ELEVATION:

DEEPTH (FEET)

0
10
20
30
40
50
60
70
80
90
100

GRASSY SURFACE

FILL, POORLY GRADED SAND, brown, about 5% gravel, 5% silt, gravel subrounded to 1/2", medium sand, damp, medium dense

POORLY GRADED SAND, brown, about 10% gravel, 5% silt, gravel subrounded to 1/2", medium sand, damp, medium dense

POORLY GRADED SAND WITH GRAVEL, gray/tan, 30% gravel, 5% silt, gravel subrounded to 1", medium sand, wet, medium dense

POORLY GRADED SAND, gray, about 10% gravel, 5% silt, gravel subrounded to 1/2", medium sand, wet to saturated, loose

Groundwater encountered at 16' while drilling

becoming sandier, about 5% gravel, 5% silt, gravel subrounded to 3/8", saturated

TEST BORING COMPLETED ON 11-5-07
PVC STANDPIPE INSTALLED TO 21.5'
GROUNDWATER MEASURED AT 12' ON 11/17/07

LOG OF TEST BORING 29

FIGURE B-27
TEST BORING 30

LOCATION: SEE TEST BORING LOCATION MAP
ELEVATION: DEPTH

GRAVEL SURFACE
FILL, difficulty drilling, gravels to 3" (~20%), cobbles to 1' (~20%)

FILL, no sample recovered - driving a cobble ahead of sampler brown, POORLY GRADED SAND WITH GRAVEL indicated by cuttings

FILL, 27% gravel, 3% silt, gravel subrounded to 1", medium sand, damp, medium dense

SILT WITH SAND, light brown, about 15% sand, low plasticity, fine sand, wet, very stiff, ORGANICS present ~10% by volume (rootlets)

Groundwater encountered at 11' while drilling
POORLY GRADED SAND, brown, about 10% gravel, 5% silt, gravel subrounded to 1/2", medium sand, saturated, medium dense
dense

TEST BORING COMPLETED ON 11-5-07
PVC STANDPIPE INSTALLED TO 21.5'
GROUNDWATER MEASURED AT 11.5' ON 11/17/07

LOG OF TEST BORING 30

DRILLING CO.: Denali Drilling, Inc.
EQUIPMENT: CME-55 Nodwell
OPERATOR: James (Buck) Voeller
METHOD: 4.25 in. ID hollow-stem auger

CLIENT: Toner-Nordling & Associates
PROJECT: Juneau Float Plane AIP
LOGGED BY: John A. Rego, Jr.
TEST BORING COMPLETED: 11-5-07
W.O. D59440

LOG OF EXPLORATION 59440.GPJ BLANK2.GDT 12/7/07

340# weight, 30" fall

FIGURE B-28
Groundwater encountered at 8' while drilling.

**GRAVEL SURFACE**

**FILL, POORLY GRADED SAND**, brown, about 5% silt, medium sand, damp, loose

**FILL, SILTY SAND**, brown, 1% gravel, 19% silt, nonplastic, gravel subrounded to 3/8", medium sand, damp, very loose, ORGANICS present ~10% by volume (plants)

Groundwater encountered at 8' while drilling.

**POORLY GRADED SAND**, gray, about 10% gravel, 5% silt, gravel subrounded to 3/4", medium sand, saturated, loose

becoming sandier, about 5% gravel, 5% silt, gravel subrounded to 1/2", dense, sampler full due to heave

becoming sandier, about 5% silt, loose

**GRUNDWATERP MEASURED AT 9.5' ON 11/17/07**

**TEST BORING COMPLETED ON 11-5-07**

**PVC STANDPIPE INSTALLED TO 21.5'**

**GROUNDWATER MEASURED AT 9.5' ON 11/17/07**
TEST BORING 32

LOCATION: SEE TEST BORING LOCATION MAP

ELEVATION: DEPTH

GRASS SURFACE
SANDY SILT, brown, about 30% sand, low plasticity, fine sand, damp, stiff, ORGANICS present ~10% by volume (grass, roots)

POORLY GRADED SAND WITH SILT, dark gray, 1% gravel, 8% silt, gravel subrounded to 3/8", medium sand, wet, medium dense, trace of COAL

Groundwater encountered at 5' while drilling
SANDY SILT, dark gray, about 35% sand, low plasticity, fine sand, saturated, contains shell fragments

POORLY GRADED SAND, tan, about 5% gravel, 5% silt, gravel subrounded to 1/2", medium sand, saturated, loose

blowcount not accurate - sampler full due to heave

TEST BORING COMPLETED ON 11-16-07
PVC STANDPIPE INSTALLED TO 21.5'
GROUNDWATER MEASURED AT 12' ON 11/19/07 AT 1743 HOURS

DRILLING CO.: Denali Drilling, Inc.
EQUIPMENT: CME-55 Nodwell
OPERATOR: James (Buck) Voeller
METHOD: 4.25 in. ID hollow-stem auger

CLIENT: Toner-Nordling & Associates
PROJECT: Juneau Float Plane AIP
LOGGED BY: John A. Rego, Jr.
TEST BORING COMPLETED: 11-16-07
W.O. D59440
TEST PIT A

LOCATION: SEE TEST PIT LOCATION MAP
ELEVATION: 

DEPTH

-2" GRASS SURFACE
SANDY SILT, gray, about 30% sand, low plasticity, medium sand, damp, ORGANICS present ~20% by volume (roots)

1.0

POORLY GRADED SAND WITH SILT AND GRAVEL, reddish brown, 33% gravel, 6% silt, gravel subrounded to 1", medium sand, damp

2.0

POORLY GRADED SAND WITH GRAVEL, brown, about 15% gravel, 5% silt, gravel subrounded to 1", medium sand, damp

Groundwater encountered at 5' while excavating

becoming more gravelly, about 40% gravel, 5% silt, saturated

sidewalls collapsing, pit will not remain open

TEST PIT COMPLETED ON 11-19-07

EXCAVATOR: City and Borough of Juneau
EQUIPMENT: Hitachi 200C
OPERATOR: Corey
METHOD: Excavator

CLIENT: Toner-Nordling & Associates
PROJECT: Juneau Float Plane AIP
LOGGED BY: John A. Rego, Jr.
TEST PIT COMPLETED: 11-19-07
W.O. D59440

LOG OF TEST PIT A
FIGURE B-31
-2" GRASS SURFACE

SANDY SILT, brown, about 30% sand, low plasticity, medium sand, damp, ORGANICS present ~20% by volume (roots)

POORLY GRADED SAND WITH SILT AND GRAVEL, reddish brown, about 20% gravel, 10% silt, gravel subrounded to 3/4", medium sand, damp

SILTY SAND WITH GRAVEL, gray, about 20% gravel, 30% silt, nonplastic, gravel subrounded to 3/4", medium sand, damp

POORLY GRADED SAND WITH GRAVEL, tan, about 20% gravel, 5% silt, gravel subrounded to 1", medium sand, damp

Groundwater encountered at 5.5’ while excavating

POORLY GRADED GRAVEL WITH SAND, gray, about 35% sand, 5% silt, gravel subrounded to 2", medium sand, saturated

sidewalls collapsing, pit will not remain open

TEST PIT COMPLETED ON 11-19-07
TEST PIT C

LOCATION:  SEE TEST PIT LOCATION MAP
ELEVATION: DEPTH

~2" GRASS SURFACE

SANDY SILT, gray, about 30% sand, low plasticity, medium sand, damp

POORLY GRADED SAND WITH SILT, reddish brown, 15% gravel, 10% silt, gravel subrounded to 3/4", medium sand, damp

POORLY GRADED SAND, tan, about 5% silt, medium sand, damp

POORLY GRADED SAND WITH GRAVEL, gray, 38% gravel, 1% silt, gravel subrounded to 2", medium sand, wet to saturated

Groundwater encountered at 5' while excavating

sidewalls collapsing, pit will not remain open

TEST PIT COMPLETED ON 11-19-07

KEY
MA = Mechanical Analysis
TD = Total Depth
Grab Sample
SPT Sample
Shelby Tube - pushed
2.5" I.D. Spoon Sample
340# weight, 30" fall

EXCAVATOR: City and Borough of Juneau
EQUIPMENT: Hitachi 200C
OPERATOR: Corey
METHOD: Excavator

CLIENT: Toner-Nordling & Associates
PROJECT: Juneau Float Plane AIP
LOGGED BY: John A. Rego, Jr.
TEST PIT COMPLETED: 11-19-07
W.O. D59440
### Test Pit D

**Location:** See Test Pit Location Map  
**Elevation:**

<table>
<thead>
<tr>
<th>Soil Type</th>
<th>Depth (ft)</th>
</tr>
</thead>
<tbody>
<tr>
<td>~2” Grass Surface</td>
<td>0.5</td>
</tr>
<tr>
<td>Sandy Silt, gray, about 30% sand, nonplastic, medium sand, damp</td>
<td>1.0</td>
</tr>
<tr>
<td>Poorly Graded Sand with Silt, reddish brown, about 10% gravel, 10% silt, gravel subrounded to 3/4&quot;, medium sand, damp</td>
<td>2.0</td>
</tr>
<tr>
<td>Silty Sand, tan, about 20% silt, nonplastic, medium sand, damp</td>
<td></td>
</tr>
<tr>
<td>Poorly Graded Sand with Gravel, gray, about 20% gravel, 5% silt, gravel subrounded to 1&quot;, medium sand, wet to saturated</td>
<td></td>
</tr>
</tbody>
</table>

- Groundwater encountered at 4.5’ while excavating

- Sidewalls collapsing, pit will not remain open

**TEST PIT COMPLETED ON 11-19-07**

---

**Key:***
- TD = Total Depth
- ML = Grab Sample
- SP = SPT Sample
- SM = Shelby Tube - pushed
- NFS = 2.5" I.D. Spoon Sample 340# weight, 30’ fall

**EXCAVATOR:** City and Borough of Juneau  
**CLIENT:** Toner-Nordling & Associates  
**EQUIPMENT:** Hitachi 200C  
**PROJECT:** Juneau Float Plane AIP  
**OPERATOR:** Corey  
**METHOD:** Excavator  
**LOGGED BY:** John A. Rego, Jr.  
**TEST PIT COMPLETED:** 11-19-07  
**W.O.:** D59440

---

**Log of Exploration 59440.GPJ  BLANK2.GDT  12/7/07**

**Groundwater encountered at 4.5’ while excavating**
**TEST PIT E**

**LOCATION:** See Test Pit Location Map

**ELEVATION:**

<table>
<thead>
<tr>
<th>Sample</th>
<th>Soil Class</th>
<th>Soil Graph</th>
<th>Frost Depth</th>
<th>Frost Class</th>
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<tbody>
<tr>
<td>SP</td>
<td>ML</td>
<td>F4</td>
<td>0.5</td>
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<tr>
<td>SP</td>
<td>SP</td>
<td>F2</td>
<td>1.0</td>
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</tr>
<tr>
<td>SP</td>
<td>NFS</td>
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<td>3.0</td>
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<td></td>
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</table>

**Soil Description:**

- **~2" GRASS SURFACE**
- **SILT WITH SAND,** gray, about 20% sand, low plasticity, fine sand, damp
- **POORLY GRADED SAND WITH SILT,** reddish brown, about 5% gravel, 10% silt, gravel subrounded to 3/4", medium sand, damp
- **POORLY GRADED SAND,** white, about 5% silt, medium sand, damp
- **POORLY GRADED SAND WITH GRAVEL,** gray, 46% gravel, 1% silt, gravel subrounded to 1.5", medium sand, wet to saturated

Groundwater encountered at 5' while drilling

becoming sandier, about 45% sand, 5% silt, saturated

sidewalls collapsing, pit will not remain open

**TEST PIT COMPLETED ON 11-19-07**

**EXCAVATOR:** City and Borough of Juneau

**EQUIPMENT:** Hitachi 200C

**OPERATOR:** Corey

**METHOD:** Excavator

**CLIENT:** Toner-Nordling & Associates

**PROJECT:** Juneau Float Plane AIP

**LOGGED BY:** John A. Rego, Jr.

**TEST PIT COMPLETED:** 11-19-07

**W.O.:** D59440

**KEY:**

- MA = Mechanical Analysis
- TD = Total Depth
- = Grab Sample
- = SPT Sample
- = Shelby Tube - pushed
- = 2.5" I.D. Spoon Sample
- 340# weight, 30" fall

**LOG OF TEST PIT E**

**FIGURE B-35**
~2" GRASS SURFACE
SILT, gray, about 10% sand, low plasticity, fine sand, damp,
ORGANICS present ~10% by volume (roots)

POORLY GRADED SAND WITH SILT AND GRAVEL, reddish
brown, about 15% gravel, 10% silt, gravel subrounded to 1", medium sand, damp

POORLY GRADED GRAVEL WITH SAND, white, about 45%
sand, 5% silt, gravel subrounded to 1.5", medium sand, damp

POORLY GRADED SAND WITH GRAVEL, gray, about 40%
gravel, 5% silt, gravel subrounded to 1", medium sand, wet to saturated

Groundwater encountered at 5' while excavating

sidewalls collapsing, difficult to keep pit open

TEST PIT COMPLETED ON 11-19-07
TEST PIT G

LOCATION: SEE TEST PIT LOCATION MAP
ELEVATION: DEPTH

GRASS SURFACE
SILTY SAND, brown, about 40% silt, nonplastic, fine sand, damp,
ORGANICS present ~20% by volume (roots)

ORGANICS present (bark, sticks)

POORLY GRADED SAND WITH GRAVEL, tan, 22% gravel, 1%
silt, gravel subrounded to 1.5", medium sand, damp

Groundwater encountered at 8' while excavating

POORLY GRADED GRAVEL WITH SILT AND SAND, brown,
about 25% sand, 10% silt, gravel subrounded to 2", coarse sand,
saturated

sidewalls collapsing

TEST PIT COMPLETED ON 11-19-07

EXCAVATOR: City and Borough of Juneau
EQUIPMENT: Hitachi 200C
OPERATOR: Corey
METHOD: Excavator

CLIENT: Toner-Nordling & Associates
PROJECT: Juneau Float Plane AIP
LOGGED BY: John A. Rego, Jr.
TEST PIT COMPLETED: 11-19-07
W.O. D59440

LOG OF TEST PIT G

FIGURE B-37
**TEST PIT H**

LOCATION: See Test Pit Location Map
ELEVATION: DEPTH

- **~2" GRASS SURFACE**
  - Silt, brown, about 10% sand, low plasticity, fine sand, damp
  - 0.5

- **POORLY GRADED GRAVEL WITH SAND**, reddish brown, 42% sand, 2% silt, gravel subrounded to 3", medium sand, damp
  - 3.5

- **SILT WITH SAND**, gray, 21% sand, low plasticity, fine sand, wet
  - 4.5
  - Groundwater encountered at 4.5' while excavating

- **POORLY GRADED GRAVEL WITH SAND**, brown, about 45% sand, 5% silt, gravel subrounded to 2", coarse sand, saturated
  - 9.5

  - sidewalls collapsing, pit will not remain open

**TEST PIT COMPLETED ON 11-19-07**

---

**LOG OF TEST PIT H**

EXCAVATOR: City and Borough of Juneau
EQUIPMENT: Hitachi 200C
OPERATOR: Corey
METHOD: Excavator

CLIENT: Toner-Nordling & Associates
PROJECT: Juneau Float Plane AIP
LOGGED BY: John A. Rego, Jr.
TEST PIT COMPLETED: 11-19-07
W.O. D59440
**TEST PIT I**

**LOCATION:** SEE TEST PIT LOCATION MAP  
**ELEVATION:**

<table>
<thead>
<tr>
<th>Soil Type</th>
<th>Sample No.</th>
<th>Moisture Content (%)</th>
<th>Frost Class</th>
</tr>
</thead>
<tbody>
<tr>
<td>GRASS SURFACE</td>
<td>ML</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SILT, gray, about 10% sand, nonplastic, fine sand, damp</td>
<td>GP</td>
<td></td>
<td></td>
</tr>
<tr>
<td>POORLY GRADED GRAVEL WITH SILT AND SAND, reddish brown, about 35% sand, 10% silt, gravel subrounded to 1.5&quot;, medium sand, damp</td>
<td>GM</td>
<td></td>
<td></td>
</tr>
<tr>
<td>POORLY GRADED SAND, tan, about 5% silt, medium sand, damp</td>
<td>NFS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>POORLY GRADED GRAVEL WITH SAND, light brown, about 45% sand, 5% silt, gravel subrounded to 1.5&quot;, medium sand, wet to saturated</td>
<td>SP</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- Groundwater encountered at 5.5' while excavating
- sidewalls collapsing, pit will not remain open

**TEST PIT COMPLETED ON 11-19-07**

**EQUIPMENT:** Hitachi 200C  
**OPERATOR:** Corey  
**METHOD:** Excavator  
**EXCAVATOR:** City and Borough of Juneau  
**CLIENT:** Toner-Nordling & Associates  
**PROJECT:** Juneau Float Plane AIP  
**LOGGED BY:** John A. Rego, Jr.  
**TEST PIT COMPLETED:** 11-19-07  
**W.O.:** D59440
TEST PIT J

LOCATION: SEE TEST PIT LOCATION MAP
ELEVATION: 0
DEPTH: 14.0'

FILL, POORLY GRADED GRAVEL WITH SILT AND SAND,
brown, 46% sand, 5% silt, gravel subrounded to 3", medium sand,
damp, DEBRIS present (metal bucket and pipe)

2.5

SANDY SILT, mottled gray/brown, about 5% gravel, 35% sand,
nonplastic, fine sand, damp, ORGANICS present ~15% by volume
(plants), ORGANIC smell

8.0

POORLY GRADED GRAVEL WITH SILT AND SAND, brown,
about 30% sand, 5% silt, gravel subrounded to 2", medium sand,
damp

14.0

TEST PIT COMPLETED ON 11-19-07
NO GROUNDWATER OBSERVED WHILE EXCAVATING

EXCAVATOR: City and Borough of Juneau
EQUIPMENT: Hitachi 200C
OPERATOR: Corey
METHOD: Excavator

CLIENT: Toner-Nordling & Associates
PROJECT: Juneau Float Plane AIP
LOGGED BY: John A. Rego, Jr.
TEST PIT COMPLETED: 11-19-07
W.O. D59440

LOG OF TEST PIT J
FIGURE B-40
TEST PIT K

LOCATION: SEE TEST PIT LOCATION MAP
ELEVATION: DEPTH

- GRAVEL SURFACE
  FILL, SILTY GRAVEL WITH SAND, brown, about 30% sand, 30% silt, gravel subrounded to 2", medium sand, damp

- FILL, SILTY GRAVEL, mixed with GARBAGE and DEBRIS (car parts, wire, wood, metal, bowls, bottles, and cans)

- POORLY GRADED GRAVEL WITH SAND, brown, about 35% sand, 5% silt, gravel subrounded to 1", medium sand, damp

- POORLY GRADED GRAVEL WITH SILT AND SAND, light brown, about 35% sand, 10% silt, gravel subrounded to 1", medium sand, damp

Groundwater encountered at 13’ while excavating

TEST PIT COMPLETED ON 11-19-07

EXCAVATOR: City and Borough of Juneau
EQUIPMENT: Hitachi 200C
OPERATOR: Corey
METHOD: Excavator

LOGGED BY: John A. Rego, Jr.
CLIENT: Toner-Nordling & Associates
PROJECT: Juneau Float Plane AIP
LOGGED BY: John A. Rego, Jr.
TEST PIT COMPLETED: 11-19-07

W.O. D59440

DAYTON ENGINEERS

LOG OF TEST PIT K

FIGURE B-41
**TEST BORING LOG - DESCRIPTIVE GUIDE**

Soil Descriptions - The soil is classified visually in the field based on drill action, auger cuttings, and sample information. The recovered soil samples are classified visually again in the laboratory. The soil description on the boring log is based on an interpretation of the field and laboratory visual classifications, along with the results of laboratory particle-size distribution analyses and Atterberg Limits tests which may have been performed.

The soil classification is based on ASTM Designation D2487 "Standard Test Method for Classification of Soils for Engineering Purposes" and ASTM D2488 "Standard Practice for Description and Identification of Soils (Visual - Manual Procedure)". The soil frost classification is based on the system developed by the U.S. Army Corps of Engineers and is performed in accordance with the Departments of the Army and Air Force Publication TM 5-822-5 “Pavement Design for Roads, Streets, Walks, and Open Storage Areas”. Outlines of these classification procedures are presented on the following pages.

The soil color is the subjective interpretation of the individual logging the test boring.

The plasticity of the minus No. 40 fraction of the soil is described and the fine-grained soils are identified from manual tests using the following table as a guide:

<table>
<thead>
<tr>
<th>Soil Symbol</th>
<th>Dry Strength</th>
<th>Dilatancy</th>
<th>Toughness</th>
</tr>
</thead>
<tbody>
<tr>
<td>ML</td>
<td>none to low</td>
<td>slow to rapid</td>
<td>low or thread cannot be formed</td>
</tr>
<tr>
<td>CL</td>
<td>medium to high</td>
<td>none to slow</td>
<td>medium</td>
</tr>
<tr>
<td>MH</td>
<td>low to medium</td>
<td>none to slow</td>
<td>low to medium</td>
</tr>
<tr>
<td>CH</td>
<td>high to very high</td>
<td>none</td>
<td>high</td>
</tr>
</tbody>
</table>

---

**Plasticity Description**

**Criteria**

Nonplastic

A 1/8" (3.2mm) thread cannot be rolled at any water content.

Low

A thread can barely be rolled and the lump cannot be formed when drier than the plastic limit.

Medium

The thread is easy to roll and not much time is required to reach the plastic limit. The thread cannot be rerolled after reaching the plastic limit. The lump crumbles when drier than the plastic limit.

High

It takes considerable time rolling and kneading to reach the plastic limit. The thread can be rerolled several times after reaching the plastic limit. The lump can be formed without crumbling when drier than the plastic limit.

Laboratory Atterberg Limits tests usually are performed on a few of the plastic soils and results are reported on the test boring log. These laboratory tests are performed in accordance with ASTM D4318 "Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils."

The shape of the gravel particles is described based on this guide:

**Angular:** particles have sharp edges and relatively plane sides with unpolished surfaces.

**Subangular:** particles are similar to angular but have somewhat rounded edges.
Subrounded: particles exhibit nearly plane sides but have well-rounded corners and edges.
Rounded: particles have smoothly curved sides and no edges.

The size of gravel and sand particles is described using this guide:

<table>
<thead>
<tr>
<th>Coarse:</th>
<th>Gravel</th>
<th>Sand</th>
</tr>
</thead>
<tbody>
<tr>
<td>Passes 3&quot; (75 mm) sieve, retained on 3/4&quot; (19 mm) sieve</td>
<td>Passes No. 4 sieve, retained on No. 10 sieve</td>
<td></td>
</tr>
<tr>
<td>Medium:</td>
<td>N/A</td>
<td>Passes No. 10 sieve, retained on No. 40 sieve</td>
</tr>
<tr>
<td>Fine:</td>
<td>Passes 3/4&quot; (19 mm) sieve, retained on No. 4 sieve</td>
<td>Passes No. 40 sieve, retained on No. 200 sieve</td>
</tr>
</tbody>
</table>

The soil moisture is described as:

dry: powdery, dusty, no visible moisture.
damp: enough moisture to affect the color of the soil; moist.
wet: water in pores but not dripping; capillary zone above water table.
saturated: dripping wet, contains significant free water, or sampled below water table.

The subjective estimate of the density of coarse-grained soils is based on the observed drill action and on drive sample data. The guide below is used for sands with minor amounts of fine gravel; however, blowcounts can be affected strongly by gravel content, thermal state, drilling procedures, condition of equipment and performance of the test.

<table>
<thead>
<tr>
<th>Standard Penetration Resistance N (blows / foot) or N (blows / 300 mm)</th>
<th>Soil Density</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 - 5</td>
<td>Very loose</td>
</tr>
<tr>
<td>6 - 10</td>
<td>Loose</td>
</tr>
<tr>
<td>11 - 30</td>
<td>Medium dense</td>
</tr>
<tr>
<td>31 - 50</td>
<td>Dense</td>
</tr>
<tr>
<td>More than 50</td>
<td>Very dense</td>
</tr>
</tbody>
</table>

An estimate of the consistency of fine-grained soils is based on the observed drill action and on drive sample data. The guide below is used:

<table>
<thead>
<tr>
<th>Standard Penetration Resistance N (blows / foot) or N (blows / 300 mm)</th>
<th>Soil Consistency</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 - 2</td>
<td>Very soft</td>
</tr>
<tr>
<td>3 - 4</td>
<td>Soft</td>
</tr>
<tr>
<td>5 - 8</td>
<td>Firm</td>
</tr>
<tr>
<td>9 - 15</td>
<td>Stiff</td>
</tr>
<tr>
<td>15 - 30</td>
<td>Very stiff</td>
</tr>
<tr>
<td>More than 30</td>
<td>Hard</td>
</tr>
</tbody>
</table>
**Soil Layer Boundaries** - Generally, there is a gradual transition from one soil type to another in a natural soil deposit, and it is difficult to determine accurately the boundaries of the soil layers.

- A *diagonal line* between soil layers on the graphic boring log indicates the general region of transition from one soil layer to another.

- A *dashed diagonal line* indicates the soil boundary was detected only by a change in the recovered samples and the actual boundary may be anywhere between the indicated sample depths.

- A *horizontal line* between soil layers indicates a relatively distinct transition between soil types was observed in the recovered samples and/or by a distinct change in drill action.

**Sample Interval** - The sample interval is shown graphically on the test boring log and generally is accurate to about 0.5 foot (0.15 meter).

**Frost Depth and Soil Temperatures** - If frozen ground is encountered during drilling, the interval of frozen soil is shown graphically on the test boring log. Generally, the temperature of a few soil samples is measured and shown on the boring log. These sample temperatures only give a qualitative indication of the *in situ* soil temperatures. The temperature of samples can be influenced significantly by the ambient air temperature and friction during drilling and sampling.

**Soil Moisture Content** - Generally, laboratory soil moisture content tests are performed on all recovered samples. Only about 30 grams of the minus No. 4 material typically is used for the moisture content test, so results reported on the log may not reflect accurately the *in situ* moisture content of gravelly soils.

**Soil Density** - The soil density shown on the test boring logs generally is determined by measuring the wet weight, moisture content, and physical dimensions of relatively undisturbed specimens.

**Ground Water** - The depth to ground water observed during drilling generally is shown on the test boring log. The depth to ground water observed during drilling can differ significantly from the depth to the actual ground water table, particularly in fine-grained soils. When more accurate water level measurements are desired, we typically install perforated PVC pipe in a boring to monitor the ground water level.

**Penetration Resistance, N** - Standard penetration tests (SPT) are performed in accordance with ASTM Designation D1586 "Standard Method for Penetration Test and Split-Barrel Sampling of Soils." A modified penetration test using a 2.5-inch (63.5 mm) I.D. split spoon driven with a 340-pound (154.2 kg) hammer falling 30 inches (.76 m) is performed to obtain larger samples, particularly in gravelly soils. The boring log key describes the graphic symbols used to differentiate between sample types.

**Undisturbed Samples** - Undisturbed Shelby tube samples are obtained in accordance with ASTM Designation D1587, "Standard Practice for Thin-Walled Tube Sampling of Soils." Generally, 3-inch (76.2 mm) O.D. Shelby tubes are used. Relatively undisturbed liner samples are obtained in accordance with ASTM Designation D3550, "Standard Practice for Ring-Lined Barrel Sampling of Soils," except a thick-walled cutting shoe is used. Typically, the sampler is driven using a 340-pound (154.2 kg) weight falling 30 inches (.76 m). The typical brass liner has an I.D. of 2.4 inches (91 mm).

**Grab Samples** - Grab samples are obtained from the auger flights. The sample depth and interval indicated on the test boring log should be considered a rough approximation. The grab samples may not be representative of *in situ* soils, particularly in layered soil deposits.
CLASSIFICATION OF SOILS FOR ENGINEERING PURPOSES
ASTM DESIGNATION: D2487
Based on the Unified Soil Classification System

<table>
<thead>
<tr>
<th>Coarse-Grained Soils</th>
<th>Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests(^4)</th>
<th>Soil Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gravels</td>
<td>Clean Gravels: ( Cu \geq 4 ) and ( 1 \leq Cc \leq 3^{E} ) ( )</td>
<td>GW Well-graded gravel(^F)</td>
</tr>
<tr>
<td>More than 50% retained on #200 sieve</td>
<td>Less than 5% fines(^C): ( Cu &lt; 4 ) and/or ( 1 &gt; Cc &gt; 3^{E} ) ( )</td>
<td>GP Poorly graded gravel(^F)</td>
</tr>
<tr>
<td></td>
<td>Gravel with Fines: Fines classify as ML or MH ( )</td>
<td>GM Silty gravel (F,G,H)</td>
</tr>
<tr>
<td></td>
<td>More than 12% fines(^C): Fines classify as CL or CH ( )</td>
<td>GC Clayey gravel (F,G,H)</td>
</tr>
<tr>
<td>Sands</td>
<td>Clean Sands: ( Cu \geq 6 ) and ( 1 \leq Cc \leq 3^{E} ) ( )</td>
<td>SW Well-graded sand(^d)</td>
</tr>
<tr>
<td>50% or more of coarse fraction passes #4 sieve</td>
<td>Less than 5% fines(^D): ( Cu &lt; 6 ) and/or ( 1 &gt; Cc &gt; 3^{E} ) ( )</td>
<td>SP Poorly graded sand(^I)</td>
</tr>
<tr>
<td></td>
<td>Sands with Fines: Fines classify as ML or MH ( )</td>
<td>SM Silty Sand (G,H,I)</td>
</tr>
<tr>
<td></td>
<td>More than 12% fines(^D): Fines classify as CL or CH ( )</td>
<td>SC Clayey Sand (G,H,I)</td>
</tr>
<tr>
<td>Fine-Grained Soils</td>
<td>Silts and Clays</td>
<td>- Inorganic: ( PL &gt; 7 ) and plots on or above &quot;A&quot; line ( J )</td>
</tr>
<tr>
<td></td>
<td>Liquid limit less than 50</td>
<td>- Organic: Liquid limit - oven dried ( &lt; 0.75 )</td>
</tr>
<tr>
<td></td>
<td>#200 sieve</td>
<td>- Liquid limit - not dried ( )</td>
</tr>
<tr>
<td></td>
<td>- Silts and Clays</td>
<td>- Inorganic: PI plots on or above &quot;A&quot; line ( H )</td>
</tr>
<tr>
<td></td>
<td>Liquid limit 50 or more</td>
<td>- PI plots below &quot;A&quot; line ( L )</td>
</tr>
<tr>
<td></td>
<td>- Organic: Liquid limit - oven dried ( &lt; 0.75 ) ( )</td>
<td>OH Organic clay (K,L,M,P)</td>
</tr>
<tr>
<td></td>
<td>- Liquid limit - not dried ( )</td>
<td>OH Organic clay (K,L,M,Q)</td>
</tr>
<tr>
<td>Highly organic soils</td>
<td>Primarily organic matter, dark in color, and organic odor ( )</td>
<td>PT Peat ( )</td>
</tr>
</tbody>
</table>

\(^A\) Based on the material passing the 3-in. (75mm) sieve.
\(^B\) If field sample contains cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.
\(^C\) Gravels with 5 to 12% fines require dual symbols:
  GW-GM well-graded gravel with silt
  GW-GC well-graded gravel with clay
  GP-GM poorly graded gravel with silt
  GP-GC poorly graded gravel with clay

\(^D\) Sands with 5 to 12% fines require dual symbols:
  SW-SM well-graded sand with silt
  SW-SC well-graded sand with clay
  SP-SM poorly graded sand with silt

\(^E\) If soil includes \( 35 \% \) or more clayey silt, add "silt" to group name.

\(^F\) If soil contains \( \geq 15 \% \) sand, add "with sand" to group name.

\(^G\) If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.

\(^H\) If fines are organic, add "with organic fines" to group name.

\(^I\) If soil contains \( \geq 15 \% \) gravel, add "with gravel" to group name.

\(^J\) If Atterberg Limit test in hatched area, soil is a CL-ML, silt- clay.

\(^K\) If soil contains 15 to 29% plus No. 200, add "with sand" or "with gravel", whichever is predominant.

\(^L\) If soil contains \( \geq 30 \% \) plus No. 200, predominantly sand, add "sandy" to group name.

\(^M\) If soil contains \( \geq 30 \% \) plus No. 200, predominantly gravel, add "gravelly" to group name.

\(^N\) PI \( \geq 4 \) and plots on or above "A" line.

\(^O\) PI < 4 or plots below "A" line.

\(^P\) PI plots on or above "A" line.

\(^Q\) PI plots below "A" line.
### DESCRIPTION OF FROZEN SOILS (Visual-Manual Procedure) ASTM Designation: D4083

#### Part I
**Description of Soil Phase**

<table>
<thead>
<tr>
<th>Group Symbol</th>
<th>Description</th>
<th>Subgroup Symbol</th>
<th>Description</th>
<th>Field Identification</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>Poorly bonded or friable</td>
<td>N_f</td>
<td>Identify by visual examination. To determine presence of excess ice, use procedures under Note 2 and hand magnifying lens as necessary. For soils not fully saturated, estimate degree of ice saturation; medium, low. Note presence of crystals or of ice coatings around larger particles.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>No excess ice</td>
<td>N_b</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Well-bonded ice</td>
<td>N_bn</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Excess ice</td>
<td>N_be</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Part II
**Description of Frozen Soil**

<table>
<thead>
<tr>
<th>Part II Description of Frozen Soil</th>
<th>Segregated ice is not visible by eye</th>
<th>Segregated ice is visible by eye (ice 1-inch (25 mm) or less in thickness)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Symbol</td>
<td>V</td>
<td>V</td>
</tr>
<tr>
<td>Description</td>
<td>Individual ice crystal or inclusions</td>
<td>Ice coatings on particles</td>
</tr>
<tr>
<td>Subgroup Symbol</td>
<td>V_x</td>
<td>V_c</td>
</tr>
<tr>
<td>Field Identification</td>
<td>For ice phase, record the following when applicable:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Location Structure</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Orientation Color</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Thickness Size</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Length Shape</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Spacing Hardness</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Pattern of arrangement</td>
<td></td>
</tr>
<tr>
<td>Ice volume</td>
<td>Estimate volume of visible segregated ice present as percentage of total sample volume.</td>
<td></td>
</tr>
</tbody>
</table>

#### Part III
**Description of Substantial Ice**

<table>
<thead>
<tr>
<th>Part III Description of Substantial Ice</th>
<th>Ice (greater than 1-inch (25 mm) in thickness)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Symbol</td>
<td>ICE</td>
</tr>
<tr>
<td>Description</td>
<td>Ice without soil inclusions</td>
</tr>
<tr>
<td>Soil Type</td>
<td>ICE</td>
</tr>
<tr>
<td>Designate material as ICE (Note 3)</td>
<td>Use descriptive terms as follows, usually one item from each group, where applicable:</td>
</tr>
<tr>
<td>Hardness</td>
<td>Structure (Note 4)</td>
</tr>
<tr>
<td>HARD</td>
<td>CLEAR</td>
</tr>
<tr>
<td>SOFT</td>
<td>CLOUDY</td>
</tr>
<tr>
<td>[of mass, not individual crystals]</td>
<td>POROUS</td>
</tr>
<tr>
<td>CANDLED</td>
<td>GRANULAR</td>
</tr>
<tr>
<td>STRATIFIED</td>
<td>STRATIFIED</td>
</tr>
<tr>
<td>Color (Examples):</td>
<td>Admixtures (Examples)</td>
</tr>
<tr>
<td>COLORLESS</td>
<td>CONTAINS FEW THIN</td>
</tr>
<tr>
<td>GRAY</td>
<td>Silt Inclusions</td>
</tr>
<tr>
<td>BLUE</td>
<td></td>
</tr>
</tbody>
</table>

**Note 1:** Frozen soils in the N group may, on close examination, indicate presence of ice within the voids of the material by crystalline reflections or by a sheen on fractured or trimmed surfaces. The impression received by the unaided eye, however, is that none of the frozen water occupies space in excess of the original voids in the soil. The opposite is true of frozen soils in the V group.

**Note 2:** When visual methods may be inadequate, a simple field test to aid in evaluation of the volume of excess ice can be made by placing some frozen soil in a small jar, allowing it to melt, and observing the quantity of supernatant water as a percentage of total volume.

**Note 3:** Where special forms of ice such as hoar frost can be distinguished, more explicit description should be given.

**Note 4:** Observer should be careful to avoid being misled by surface scratches or frost coating on the ice.

**DEFINITIONS**

1. Ice coatings on Particles - discernible layers of ice found on or below larger soil particles in a frozen soil mass.
2. Ice Crystal - a very small individual ice particle visible in the face of a soil mass. Crystals may be present alone or in combination with other ice formations.
3. Clear ice - ice that is transparent and contains only a moderate number of air bubbles.
4. County ice - ice that is translucent or relatively opaque due to the content of air or for other reasons, but which is essentially sound and impervious.
5. Porous ice - ice that contains numerous voids, usually interconnected and usually resulting from melting at air bubbles or along crystal interfaces from presence of salt or other materials in the water, or from the freezing of saturated snow. Though porous, the mass retains its structural unity.
6. Candled ice - ice that has rolled or otherwise formed into long columnar crystals, very loosely bonded together.
7. Chandelier ice - ice that is composed of coarse, more or less equidimensional crystals, weakly bonded together.
8. Ice Lens - lens-like ice formations in soil occurring essentially parallel to each other, generally normal to the direction of heat loss, and commonly in repeated layers.
9. Ice Segregation - the growth of ice within soil in excess of the amount that may be produced by the in-place conversion of the original void moisture to ice. Ice segregation occurs most often as distinct lenses, layers, veins, and masses, commonly, but not always, oriented normal to the direction of heat loss.
10. Well-Bonded - a condition in which the soil particles are strongly held together by the ice so that the frozen soil possesses relatively high resistance to chipping or breaking.
11. Poorly Bonded - a condition in which the soil particles are weakly held together by the ice so that the frozen soil has poor resistance to chipping and breaking.
12. Thaw Stable - the characteristics of frozen soils that, upon thawing, do not show less of strength in comparison to normal, long-term thawed values nor produce detrimental settlement.
<table>
<thead>
<tr>
<th>Frost Group</th>
<th>Kind of Soil</th>
<th>Percentage Finer than 0.02 mm by Weight</th>
<th>Typical Soil Types Under Unified Soil Classification System</th>
</tr>
</thead>
<tbody>
<tr>
<td>NFS³</td>
<td>(a) Gravels Crushed stone Crushed rock</td>
<td>0 to 1.5</td>
<td>GW and GP</td>
</tr>
<tr>
<td></td>
<td>(b) Sands</td>
<td>0 to 3</td>
<td>SW and SP</td>
</tr>
<tr>
<td>PFS⁴ (MOA NFS) (MOA F2)</td>
<td>(a) Gravels Crushed stone Crushed rock</td>
<td>1.5 to 3</td>
<td>GW and GP</td>
</tr>
<tr>
<td></td>
<td>(b) Sands</td>
<td>3 to 10</td>
<td>SW and SP</td>
</tr>
<tr>
<td>S1 (MOA F1)</td>
<td>Gravelly soils</td>
<td>3 to 6</td>
<td>GW, GP, GW-GM, and GP-GM</td>
</tr>
<tr>
<td>S2 (MOA F2)</td>
<td>Sandy soils</td>
<td>3 to 6</td>
<td>SW, SP, SW-SM, and SP-SM</td>
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<td>F1</td>
<td>Gravelly soils</td>
<td>6 to 10</td>
<td>GM, GW-GM, and GP-GM</td>
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<td>F2</td>
<td>(a) Gravelly soils</td>
<td>10 to 20</td>
<td>GM, GW-GM, and GP-GM</td>
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<tr>
<td></td>
<td>(b) Sands</td>
<td>6 to 15</td>
<td>SM, SW-SM, and SP-SM</td>
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<tr>
<td>F3</td>
<td>(a) Gravelly soils</td>
<td>Over 20</td>
<td>GM and GC</td>
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<tr>
<td></td>
<td>(b) Sands, except very fine silty sands</td>
<td>Over 15</td>
<td>SM and SC</td>
</tr>
<tr>
<td></td>
<td>(c) Clays, PI&gt;12</td>
<td></td>
<td>CL and CH</td>
</tr>
<tr>
<td>F4</td>
<td>(a) All silts</td>
<td></td>
<td>ML and MH</td>
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<td></td>
<td>(b) Very fine silty sands</td>
<td>Over 15</td>
<td>SM</td>
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<tr>
<td></td>
<td>(c) Clays, PI&gt;12</td>
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<td>CL and CL-ML</td>
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<tr>
<td></td>
<td>(d) Varved clays and other fine-grained, banded sediments</td>
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<td>CL and ML</td>
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<td></td>
<td></td>
<td>CL, ML, and SM</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>CL, CH, and ML</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>CL, CH, ML and SM</td>
</tr>
</tbody>
</table>

² Corps of Engineers Frost groups directly correspond to the Municipality of Anchorage soil frost classification groups, except as noted.
³ Non Frost-Susceptible.
⁴ Possibly frost-susceptible, but requires laboratory test to determine frost design soil classification.
APPENDIX C

LABORATORY TEST RESULTS
PLASTICITY INDEX TEST RESULTS

Specimen Identification | LL | PL | PI | MC (%) | USCS Classification of Finer Fraction
--- | --- | --- | --- | --- | ---
Test Boring 32, Sample 1, Depth 3.0 ft | 33 | 24 | 9 | 35 | Silt

Client: Toner-Nordling & Associates
Project: Juneau Float Plane AIP
W.O. D59440

Figure C-1
Client: Toner-Nordling & Associates
Project: JNU Float Plane AIP 3-02-0133-046-2005

Location: Test Boring 2
Sample 1
Depth: 2.5' - 4'

Engineering Classification: Poorly Graded SAND with Silt and Gravel, SP-SM
Frost Classification: Not Measured

David L. Andersen
David L. Andersen, P.E., Technical Advisor
Client: Toner-Nordling & Associates

Project: JNU Float Plane AIP 3-02-0133-046-2005

Location: Test Boring 11
Sample 1
Depth: 2.5' - 4'

Engineering Classification: Poorly Graded SAND with Silt and Gravel, SP-SM
Frost Classification: Not Measured

% Size Distribution:
- +3 in: Not included in test = ~%
- 3" 86%
- 2" 80%
- 1 1/2" 67%
- 1" 60%
- 3/4" 60%
- 1/2" 45%
- 3/8" 26%
- No. 4 16%
- No. 8 9%
- No. 10 5.2%

Total Wt. = 407.7 g

Total Wt. of Fine Fraction = 273.9 g

David L. Andersen, P.E., Technical Advisor

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© Alaska Testlab, 1999
Location: Test Boring 11
Sample 2
Depth: 5' - 6.5'

Engineering Classification: Silty SAND with Gravel, SM
Frost Classification: Not Measured

Client: Toner-Nordling & Associates
Project: JNU Float Plane AIP 3-02-0133-046-2005

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David L. Andersen, P.E., Technical Advisor

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4040 B Street Anchorage Alaska 99503 • 907/562-2000 • 907/563-3953
Client: Toner-Nordling & Associates

Project: JNU Float Plane AIP 3-02-0133-046-2005

Location: Test Boring 12
Sample 1A
Depth: 3' - 4'

Engineering Classification: Poorly Graded SAND , SP
Frost Classification: NFS MOA

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4040 B Street Anchorage Alaska 99503 • 907/562-2000 • 907/563-3953
Location: Test Boring 13
Sample 1
Depth: 2.5' - 4'

Engineering Classification: Poorly Graded GRAVEL with Sand, GP
Frost Classification: NFS MOA

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David L Andersen
David L. Andersen, P.E., Technical Advisor
Client: Toner-Nordling & Associates
Project: JNU Float Plane AIP 3-02-0133-046-2005

Location: Test Boring 14
Sample 1
Depth: 2.5' - 4'

Engineering Classification: Poorly Graded SAND with Gravel, SP
Frost Classification: Not Measured

David L. Andersen, P.E., Technical Advisor
Location: Test Boring 16  
Sample 1  
Depth: 2.5' - 3.25'  

Engineering Classification: Poorly Graded SAND, SP  
Frost Classification: NFS MOA  

David L Andersen  
David L. Andersen, P.E., Technical Advisor
Client: Toner-Nordling & Associates
Project: JNU Float Plane AIP 3-02-0133-046-2005

Location: Test Boring 19
Sample 4
Depth: 35' - 36.5'

Engineering Classification: Silty SAND, SM
Frost Classification: Not Measured

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<td>90%</td>
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<tr>
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<td>89%</td>
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<tr>
<td>No. 8</td>
<td>85%</td>
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<td>No. 10</td>
<td>75%</td>
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<tr>
<td>No. 16</td>
<td>48%</td>
</tr>
</tbody>
</table>

Total Wt. of Fine Fraction = 371g

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4040 B Street Anchorage Alaska 99503 • 907/562-2000 • 907/563-3953
Client: Toner-Nordling & Associates
Project: JNU Float Plane AIP 3-02-0133-046-2005

Location: Test Boring 19
Sample 7
Depth: 50' - 51.5'

Engineering Classification: Poorly Graded SAND with Silt, SP-SM
Frost Classification: Not Measured

**PARTICLE-SIZE**

**DIST. ASTM D422**

W.O. D59440
Lab No. 2007-2080
Received: 11/29/07
Reported: 12/3/07

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<td></td>
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<tr>
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<td>81%</td>
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<td>55%</td>
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<tr>
<td>No. 100</td>
<td>28%</td>
</tr>
<tr>
<td>No. 200</td>
<td>9.4%</td>
</tr>
</tbody>
</table>

Total Wt. = 587.8g
Total Wt. of Fine Fraction = 454.2g

© Alaska Testlab, 1999

David L Andersen
David L. Andersen, P.E., Technical Advisor

4040 B Street Anchorage Alaska 99503 • 907/562-2000 • 907/563-3953
Client: Toner-Nordling & Associates
Project: JNU Float Plane AIP 3-02-0133-046-2005

Location: Test Boring 20
Sample 3
Depth: 30' - 31.5'

Engineering Classification: Sandy SILT, ML
Frost Classification: F4

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David L Andersen
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Client: Toner-Nordling & Associates
Project: JNU Float Plane AIP 3-02-0133-046-2005

Location: Test Boring 20
Sample 4
Depth: 35' - 36.5'

Engineering Classification: SILT with Sand, ML
Frost Classification: F4

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<tr>
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<td>97%</td>
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<td>No. 16</td>
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<td>96%</td>
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Total Wt. of Fine Fraction = 308.9 g

© Alaska Testlab, 1999

David L. Andersen, P.E., Technical Advisor

4040 B Street Anchorage Alaska 99503 • 907/562-2000 • 907/563-3953
Location: Test Boring 20  
Sample 6  
Depth: 45' - 46.5'

Engineering Classification: SILT with Sand, ML  
Frost Classification: F4

David L Andersen  
David L. Andersen, P.E., Technical Advisor

4040 B Street Anchorage Alaska 99503 • 907/562-2000 • 907/563-3953
Client: Toner-Nordling & Associates

Project: JNU Float Plane AIP 3-02-0133-046-2005

Location: Test Boring 21
Sample 2
Depth: 10' - 11.5'

Engineering Classification: Poorly Graded SAND , SP
Frost Classification: NFS MOA

PARTICLE-SIZE

W.O. D59440
Lab No. 2007-2084
Received: 11/29/07
Reported: 12/3/07

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</table>

Total Wt. = 449.4g
Total Wt. of Fine Fraction = 426.5g

0.02 mm

© Alaska Testlab, 1999

David L. Andersen, P.E., Technical Advisor
Client: Toner-Nordling & Associates

Project: JNU Float Plane AIP 3-02-0133-046-2005

Location: Test Boring 21

Sample 7

Depth: 35' - 36.5'

Engineering Classification: SILT with Sand, ML

Frost Classification: F4

Particle Size (mm)

Percent Passing by Weight

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<tr>
<td>#4</td>
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<td>3/8&quot;</td>
<td>100%</td>
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<tr>
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<td>97%</td>
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<td>99%</td>
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<td>96%</td>
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<tr>
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<tr>
<td>No. 10</td>
<td>100%</td>
</tr>
<tr>
<td>No. 8</td>
<td>100%</td>
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</tbody>
</table>

Total Wt. of Fine Fraction = 411.5g

Total Wt. = 412.1g

David L. Andersen, P.E., Technical Advisor

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Client: Toner-Nordling & Associates

Project: JNU Float Plane AIP 3-02-0133-046-2005

Location: Test Boring 21
Sample 9
Depth: 45' - 46.5'

Engineering Classification: SILT, ML
Frost Classification: F4

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PARTICLE-SIZE

DIST. ASTM D422

W.O. D59440
Lab No. 2007-2086
Received: 11/29/07
Reported: 12/3/07

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<tr>
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<td>100%</td>
</tr>
<tr>
<td>No. 4</td>
<td>100%</td>
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Total Wt. = 540.5g
No. 8 99%
No. 10 99%
No. 16 98%
No. 20 98%
No. 30 96%
No. 40 96%
No. 50 96%
No. 60 96%
No. 80 96%
No. 100 95%
No. 200 92%

Total Wt. of Fine Fraction = 540.2g

0.02 mm

© Alaska Testlab, 1999
Client: Toner-Nordling & Associates

Project: JNU Float Plane AIP 3-02-0133-046-2005

Location: Test Boring 22

Sample 1

Depth: 10' - 11.5'

Engineering Classification: Poorly Graded SAND , SP

Frost Classification: Not Measured

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David L Andersen
David L. Andersen, P.E., Technical Advisor

4040 B Street Anchorage Alaska 99503 • 907/562-2000 • 907/563-3953
client: Toner-Nordling & Associates

Location: Test Boring 22
Sample 3
Depth: 20' - 21.5'

Engineering Classification: Poorly Graded SAND, SP
Frost Classification: NFS MOA

Size Passing Specification

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<th>Percentage Passing by Weight</th>
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<td>93%</td>
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<td>No. 16</td>
<td>95%</td>
</tr>
<tr>
<td>No. 20</td>
<td>97%</td>
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<tr>
<td>No. 30</td>
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<td>100%</td>
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<tr>
<td>No. 200</td>
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</tr>
<tr>
<td>Total Wt.</td>
<td>623.9g</td>
</tr>
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Total Wt. of Fine Fraction = 352.8g

David L. Andersen, P.E., Technical Advisor

4040 B Street Anchorage Alaska 99503 • 907/562-2000 • 907/563-3953
Location: Test Boring 22
Sample 6
Depth: 40' - 41.5'

Engineering Classification: Poorly Graded SAND , SP
Frost Classification: NFS MOA

Particle Size (mm) vs. Percent Passing by Weight

© Alaska Testlab, 1999

David L Andersen
David L. Andersen, P.E., Technical Advisor

PARTICLE-SIZE
DIST. ASTM D422

W.O. D59440
Lab No. 2007-2089
Received: 11/29/07
Reported: 12/3/07

Size | Passing Specification
--- | ---
+3 in Not Included in Test = ~%
3" |
2" | 100%
1 1/2" | 100%
1" | 100%
3/4" | 100%
1/2" | 100%
3/8" | 97%
No. 4 | 90%
No. 8 | 90%
No. 10 | 75%
No. 16 | 48%
No. 20 | 48%
No. 30 | 20%
No. 40 | 20%
No. 50 | 9%
No. 60 | 9%
No. 80 | 4%
No. 100 | 4%
No. 200 | 2.5%

Total Wt. = 506.3g
Total Wt. of Fine Fraction = 453.9g

0.02 mm
Client: Toner-Nordling & Associates

Project: JNU Float Plane AIP 3-02-0133-046-2005

Location: Test Boring 23
Sample 2
Depth: 20' - 21.5'

Engineering Classification: Poorly Graded SAND , SP
Frost Classification: NFS MOA

Particlesize

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<tr>
<td>No. 200</td>
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</tr>
</tbody>
</table>

Total Wt. = 331.69g
Total Wt. of Fine Fraction = 310.35g

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Technical Advisor

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Project: JNU Float Plane AIP 3-02-0133-046-2005

Location: Test Boring 23
Sample 5
Depth: 35' - 36.5'

Engineering Classification: Silty SAND , SM
Frost Classification: Not Measured

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Client: Toner-Nordling & Associates

Project: JNU Float Plane AIP 3-02-0133-046-2005

Location: Test Boring 23
Sample 8
Depth: 50' - 51.5'

Engineering Classification: Silty SAND, SM

Frost Classification: Not Measured

Particle Size (mm)

- 3 in Not Included in Test = ~%
- 3" 
- 2" 
- 1 1/2" 
- 1" 
- 3/4" 
- 1/2" 
- 3/8" 100%
- No. 4 99%
- No. 8 98%
- No. 10 96%
- No. 16 94%
- No. 20 93%
- No. 30 91%
- No. 40 90%
- No. 50 89%
- No. 60 87%
- No. 80 82%
- No. 100 71%
- No. 200 37%

Total Wt. = 394.82g

Total Wt. of Fine Fraction = 392.28g

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Project: JNU Float Plane AIP 3-02-0133-046-2005

Location: Test Boring 24
Sample 2
Depth: 30' - 31.5'

Engineering Classification: Poorly Graded SAND with Silt, SP-SM
Frost Classification: Not Measured

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Project: JNU Float Plane AIP 3-02-0133-046-2005
Location: Test Boring 24
Sample 5
Depth: 45' - 46.5'
Engineering Classification: Poorly Graded SAND , SP
Frost Classification: Not Measured

Frost Classification: Not Measured

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</table>

Total Wt. = 582.2g
Total Wt. of Fine Fraction = 439.5g

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David L. Andersen, P.E., Technical Advisor
Client: Toner-Nordling & Associates

Project: JNU Float Plane AIP 3-02-0133-046-2005

Location: Test Boring 25
Sample 1
Depth: 2' - 3.5'

Engineering Classification: Silty SAND with Gravel, SM
Frost Classification: Not Measured

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<tr>
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Total Wt. of Fine Fraction = 158.2g

0.02 mm
Client: Toner-Nordling & Associates

Project: JNU Float Plane AIP 3-02-0133-046-2005

Location: Test Boring 25
Sample 4
Depth: 20' - 21.5'

Engineering Classification: Poorly Graded SAND , SP
Frost Classification: Not Measured

### Particle Size Distribution

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<tr>
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<tr>
<td>No. 200</td>
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</tbody>
</table>

Total Wt. = 469.2g

Total Wt. of Fine Fraction = 421.4g

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Project: JNU Float Plane AIP 3-02-0133-046-2005  

Location: Test Boring 25  
Sample 7  
Depth: 35' - 36.5'  
Engineering Classification: Silty SAND , SM  
Frost Classification: Not Measured  

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<tr>
<td>No. 100</td>
<td></td>
</tr>
<tr>
<td>No. 200</td>
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</table>

Total Wt. = 336.4g  
Total Wt. of Fine Fraction = 336.01g  

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Client: Toner-Nordling & Associates

Project: JNU Float Plane AIP 3-02-0133-046-2005

Location: Test Boring 25
Sample 10
Depth: 50' - 51.5'

Engineering Classification: Poorly Graded SAND, SP
Frost Classification: Not Measured

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Client: Toner-Nordling & Associates

Project: JNU Float Plane AIP 3-02-0133-046-2005

Location: Test Boring 26
Sample 1A
Depth: 6' - 7'

Engineering Classification: Poorly Graded SAND with Gravel, SP
Frost Classification: Not Measured

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Client: Toner-Nordling & Associates
Project: JNU Float Plane AIP 3-02-0133-046-2005

Location: Test Boring 26
Sample 5
Depth: 30' - 31.5'

Engineering Classification: Poorly Graded SAND , SP
Frost Classification: Not Measured

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Client: Toner-Nordling & Associates

Project: JNU Float Plane AIP 3-02-0133-046-2005

Location: Test Boring 26
Sample 8
Depth: 45' - 46.5'

Engineering Classification: Sandy SILT, ML
Frost Classification: F4

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Project: JNU Float Plane AIP 3-02-0133-046-2005

Location: Test Boring 27
Sample 2
Depth 5' - 6.5'

Engineering Classification: Silty SAND with Gravel, SM
Frost Classification: Not Measured

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PARTICLE-SIZE

DIST. ASTM D422

W.O. D59440
Lab No. 2007-2102
Received: 11/29/07
Reported: 12/4/07

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Total Wt. = 350.5g
Total Wt. of Fine Fraction = 221.2g

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Project: JNU Float Plane AIP 3-02-0133-046-2005

Location: Test Boring 28
Sample 4
Depth 15' - 16.5'

Engineering Classification: Poorly Graded SAND , SP
Frost Classification: NFS MOA

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PARTICLE-SIZE
DIST. ASTM D422

W.O. D59440
Lab No. 2007-2103
Received: 11/29/07
Reported: 12/4/07

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Total Wt. = 643g
No. 8    72%
No. 10   49%
No. 16   26%
No. 20   12%
No. 30   3%
No. 40   1.5%
No. 50   0.02 mm
No. 60   0.001
No. 80   0.01
No. 100  0.1
No. 200  1.0

Total Wt. of Fine Fraction = 431.3g

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Location: Test Boring 29
Sample 3
Depth 10' - 11.5'

Engineering Classification: Poorly Graded SAND with Gravel, SP
Frost Classification: Not Measured

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### Particle Size

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Total Wt. = 570.3g
Total Wt. of Fine Fraction = 396.2g

---

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---

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Project: JNU Float Plane AIP 3-02-0133-046-2005

Location: Test Boring 30
Sample 1
Depth 5' - 6.5'

Engineering Classification: Poorly Graded SAND with Gravel, SP
Frost Classification: Not Measured

Particle Size (mm)

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Client: Toner-Nordling & Associates
Project: JNU Float Plane AIP 3-02-0133-046-2005

Location: Test Boring 31
Sample 2
Depth 5' - 6.5'

Engineering Classification: Silty SAND, SM
Frost Classification: Not Measured

Particle Size (mm)

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Client: Toner-Nordling & Associates

Project: JNU Float Plane AIP 3-02-0133-046-2005

Location: Test Boring 32
Sample 1A
Depth 3' - 4'

Engineering Classification: Poorly Graded SAND with Silt, SP-SM
Frost Classification: Not Measured

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<tr>
<td>No. 200</td>
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</tr>
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</table>

Total Wt. = 492.9g
Total Wt. of Fine Fraction = 493g

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David L. Andersen
David L. Andersen, P.E., Technical Advisor
Client: Toner-Nordling & Associates

Project: JNU Float Plane AIP 3-02-0133-046-2005

Location: Test Pit A
Sample 2
Depth 1' - 1.5'

Engineering Classification: Poorly Graded SAND with Silt and Gravel, SP-SM
Frost Classification: Not Measured

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<th>PASSING SPECIFICATION</th>
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</tr>
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<td>1 1/2&quot;</td>
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<tr>
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<td>81%</td>
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<td>3/4&quot;</td>
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<td>No. 60</td>
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<td>9%</td>
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<tr>
<td>No. 200</td>
<td>5.8%</td>
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</table>

Total Wt. = 5243.2g
Total Wt. of Fine Fraction = 331.6g

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Client: Toner-Nordling & Associates

Project: JNU Float Plane AIP 3-02-0133-046-2005

Location: Test Pit C
Sample 1
Depth 1' - 1.5'

Engineering Classification: Poorly Graded SAND with Silt, SP-SM
Frost Classification: Not Measured

- 0.02 mm
- 0.001
- 0.01
- 0.1
- 1
- 10
- 100

Percent Passing by Weight

Particle Size (mm)

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Project: JNU Float Plane AIP 3-02-0133-046-2005

Location: Test Pit C
Sample 3
Depth 5' - 6'

Engineering Classification: Poorly Graded SAND with Gravel, SP
Frost Classification: NFS MOA

---

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Project: JNU Float Plane AIP 3-02-0133-046-2005

Location: Test Pit E
Sample 1
Depth 4' - 5'

Engineering Classification: Poorly Graded SAND with Gravel, SP
Frost Classification: NFS MOA

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<tr>
<td>1 1/2&quot;</td>
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<tr>
<td>1&quot;</td>
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</tbody>
</table>

Total Wt. = 8225.6g
Total Wt. of Fine Fraction = 319.7g

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Project: JNU Float Plane AIP 3-02-0133-046-2005

Location: Test Pit G
Sample 2
Depth 7' - 8'

Engineering Classification: Poorly Graded SAND with Gravel, SP
Frost Classification: NFS MOA

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Client: Toner-Nordling & Associates
Project: JNU Float Plane AIP 3-02-0133-046-2005

Location: Test Pit H
Sample 1
Depth 1' - 2'

Engineering Classification: Poorly Graded GRAVEL with Sand, GP
Frost Classification: NFS MOA

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<td>1 1/2&quot;</td>
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Total Wt. of Fine Fraction = 334.7g

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David L. Andersen, P.E., Technical Advisor
Client: Toner-Nordling & Associates

Project: JNU Float Plane AIP 3-02-0133-046-2005

Location: Test Pit H
Sample 2
Depth 4' - 4.5'

Engineering Classification: SILT with Sand, ML
Frost Classification: F4

### Particle Size Distribution (ASTM D422)

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</tr>
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</table>

Total Wt. of Fine Fraction = 312.5g

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David L Andersen, P.E., Technical Advisor
Client: Toner-Nordling & Associates

Project: JNU Float Plane AIP 3-02-0133-046-2005

Location: Test Pit J
Sample 1
Depth 1' - 2'

Engineering Classification: Poorly Graded GRAVEL with Silt and Sand, GP-GM
Frost Classification: Not Measured

Particulate Size (mm)

0.02 mm

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