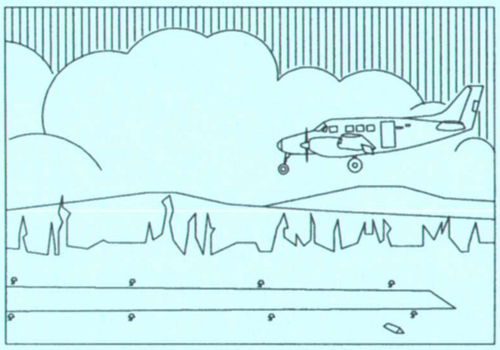
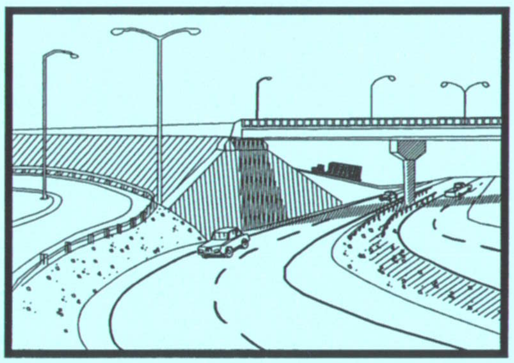
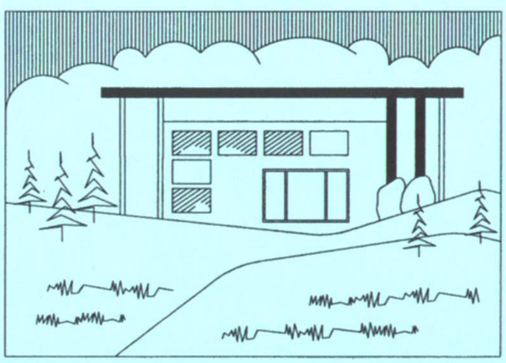
Geotechnical Data Report

Kotzebue to Cape Blossom Road

AKSAS: 76884

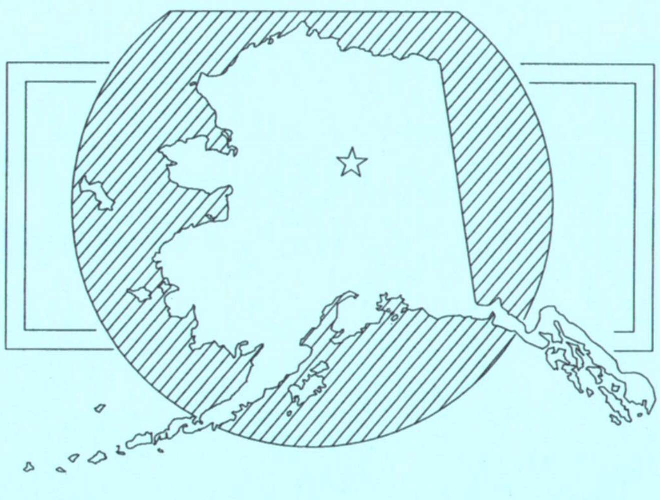






STATE OF ALASKA

Department of Transportation and Public Facilities



NORTHERN REGION

OCTOBER 2009

ALASKA DEPARTMENT OF TRANSPORTATION & PUBLIC FACILITIES
NORTHERN REGION MATERIAL SECTION

GEOTECHNICAL DATA REPORT
KOTZEBUE TO CAPE BLOSSOM ROAD
STATE PROJECT 76884

PREPARED BY:

JULIE ROWLAND
Engineering Geologist

REVIEWED BY:

STEVE MASTERMAN
Regional Geologist

APPROVED BY:

10-26-07

LEO J. WOSTER, P.E.
Materials Engineer

ALASKA DEPARTMENT OF TRANSPORTATION & PUBLIC FACILITIES
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10-26-09

LEO J. WOSTER, P.E.
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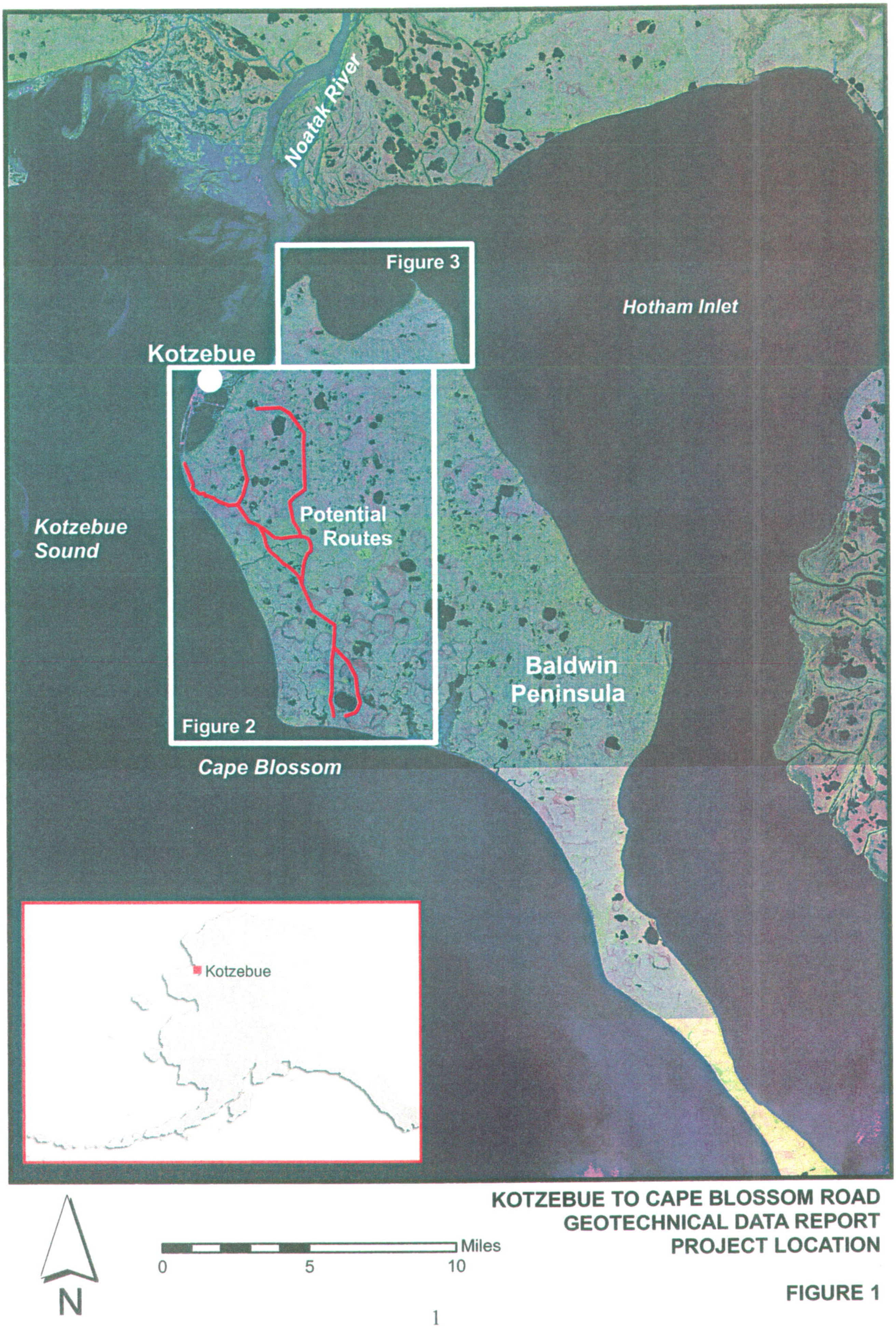


KOTZEBUE TO CAPE BLOSSOM ROAD
GEOTECHNICAL DATA REPORT
PROJECT LOCATION

FIGURE 1

GEOTECHNICAL DATA REPORT
KOTZEBUE TO CAPE BLOSSOM ROAD
STATE PROJECT NO. 76884
NORTHERN REGION

Summary

At the request of ADOT&PF Project Manager Ryan Anderson, Northern Region Materials Section (NRMS) conducted a reconnaissance-level geotechical investigation of various proposed routes between Kotzebue and Cape Blossom. NRMS personnel also explored selected areas looking for materials (gravel). NRMS personnel drilled 44 auger holes to depths of 10 to 42 feet. Drilling occurred from April 6 to 23, 2009.

In general, soils consisted of frozen silt with ice and organics with some zones of massive ice. The exception to this was at Sadie Creek were soils were thawed to some extent and contained fine sand. The sites drilled for material found 22 to 26 feet of frozen silt without encountering granular soils.

Physical setting

Climate

Kotzebue is located in coastal northwestern Alaska, north of the Arctic Circle and south of the Brooks Range. Situated on the northwest tip of the Baldwin Peninsula (protruding into Kotzebue Sound), Kotzebue's climate is transitional between maritime to continental. The following data are from the Western Regional Climate Center web site (*www.wroc.dri.edu*).

Climate data summary for the Kotzebue Airport, period from 1949 to 2005

(in °F)	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR
Aver. High	4.5	3.8	8.8	21.5	38.3	50.6	59.2	56.5	46.7	28.1	14.1	5.0	28.1
Aver. Low	-8.7	-10.4	-7.6	4.0	25.1	38.7	48.6	47.0	36.9	18.9	3.4	-7.9	15.7
Precip (in)	0.46	0.4	0.35	0.43	0.37	0.55	1.43	2.14	1.58	0.8	0.6	0.53	9.63
Snow (in)	7.0	6.0	5.7	5.3	1.4	0.1	0	0	1.1	6.6	9.6	9.1	52.1

The following freeze/thaw indices are based on UCAN data (Unified Climate Access Network) through the AEDIS (Alaska Engineering Design Information System) web site (no longer available). The thawing index, or degree-days above freezing, is a measure of thawing that occurs during the year. The thawing index listed below takes the annual thawing-degree-days (TDD) for the last thirty years and averages them. The design thawing index takes the average of the three warmest (highest) TDD over the last thirty years.

Likewise, the freezing index, or degree-days below freezing, can be used to calculate the depth of ground freezing during winter. The freezing index listed below averages the annual freezing-degree-days (FDD) for the past thirty years. The design freezing index averages the three coldest (highest) FDD for the same period. The alternate freezing index averages the three warmest (lowest) FDD.

Thermal indices based on temperature records, 1976 to 2005, Kotzebue Airport

Thawing Index (average annual thawing-degree-days (TDD) of last 30 years)	2200
Design Thawing Index (average of warmest three annual TDDs in 30 yrs)	2673
Freezing Index (average annual freezing-degree-days (FDD) of last 30 years)	5459
Design Freezing Index (average of coldest three annual FDDs in 30 yrs)	6762
Freezing Index Alt. (average of warmest three annual FDDs in 30 yrs)	4435

Geology

Kotzebue is located on the northwest tip of the Baldwin Peninsula. The Baldwin Peninsula, which separates Hotham Inlet from Kotzebue Sound, lies within the Kobuk-Selawik Lowland physiographic province. The peninsula is a "rolling, lake-dotted lowland containing hills as high as 350 feet, bordered by bluffs" (Wahrhaftig, 1965). It formed as the end moraine of an early Pleistocene glacier that moved west out of the Brooks Range. Marine and glacial sediments were likely mixed as the moraine pushed across the (intermittent) ocean floor. Subsequent to its formation, the peninsula has undergone erosion of its coastline as well as accumulation of thick silt deposits on its uplands. The silt mantle exceeds 70 feet in places where drilled (R&M, 2007), and contains organics and ice, as wedges, lenses and crystals.

Bedrock does not outcrop on the peninsula. Bedrock was reportly intercepted at a depth of 82 feet in a hole drilled 1000 feet west of the airport (Shannon & Wilson, 1982).

The uplands are underlain by permafrost except beneath thaw lakes and larger creeks (i.e. Sadie Creek) where thaw bulbs are present. The active layer is probably 1 to 3 feet thick in undisturbed areas.

Historically, the project area has low seismicity. A search of the Alaska Earthquake Information Center (AEIC) web site (*www.aeic.alaska.edu*) for the area between N66° and N69°, and W162° and W165°, indicates no earthquakes greater than Magnitude 4.0 have been recorded since 1898. Using the USGS interactive probabilistic seismic hazards deaggregation web site, the peak horizontal ground acceleration with a 10% probability of exceedence in 50 years and mean return period of 475 years was calculated to be 0.09396 g for the project site.

Field investigation

Test holes were completed using a Mobil B-24 track-mounted drill, equipped with custom sleds and pulled by snow machine. 4-inch O.D. solid-stem augers were used, and soils samples were collected from auger cuttings. Subsurface conditions were logged in the field, and selected samples were submitted to Northern Regions Materials Laboratory for testing. The testing program included particle size gradations for classification, moisture content, and organic content analyses. Salinity tests were performed on two samples from Sadie Creek by Shannon & Wilson, Inc. Test hole locations were recorded using a hand-held Garmin GPS (datum NAD 83). Holes were backfilled with cuttings.

Site and Subsurface conditions

At the time of exploration, the site was under 1 to 5 feet of packed snow. Terrain was gentle and rolling. Aerial photographs show extensive patterned (polygonal) ground, small lakes and ponds throughout the uplands. Oblique photos of the eroding coastal bluffs show exposed ice wedges within the silt mantle.

Routes to Cape Blossom

We drilled 39 holes along several route segments between existing roads near Kotzebue and a proposed port site east of Cape Blossom. The route segment designations correspond to the lettered segments found in the draft reconnaissance study report for this project (ADOT&PF, 2008, page 9). The terrain the routes cross is relatively uniform, however, the eastern route passes through about 5 miles of hilly terrain in the middle portion, while the western route is flatter overall. The southern half where the routes join is relatively flat with minor elevation changes.

Landforms include thaw ponds and lakes, drained lake beds turned to muskeg, and rolling hills composed of vegetated silt with organics and ice. Patterned ground is evident throughout the area. Aerial photographs show that some areas have more prominent polygons than other areas, either due to a deeper active layer or larger diameter polygons. When drilling in snow-covered polygonal ground, one cannot tell if the drill is set up on a perimeter ice wedge or in the center. Not hitting massive wedge ice in a given hole within this type of terrain does not therefore indicate that massive ice is not present in the general area.

The following is a generalized soil profile:

- Organic mat, 6-12 inches thick with visible ice
- Brown silt with high organics and visible ice (Vs)
- Gray silt (not always present) with slight organics, excess nonvisible ice (Nbe)
- We intercepted massive ice thicker than 3 feet in 11 of the 39 test holes. Significant amounts of ice were commonly present.

- All holes except at Sadie Creek were frozen from the ground surface to the depth drilled. Due the time of year, we could not determine the depth of the active layer.

Because there were no significant differences in soil conditions between the various routes, route selection can be based on criteria other than geotechnical factors such as cost. The western route is more direct and avoids hills so may be cheaper and easier to construct. Roads through hilly terrain may require cutting or cut/fill construction; cutting into these soils should be avoided as it would accelerate thawing.

Sadie Creek

We drilled two test holes adjacent to Sadie Creek along two different route segments. The downstream test hole, 09-1207, was drilled to a depth of 42 feet. Soils consisted of gray silt to silt with sand, with organics. Soils were thawed and wet below 3 ft, (thaw bulb). The relative density appeared to be loose based on drill action. Groundwater seeped into the hole below about 18 ft, and a slurry of wet silt was pumped out by the augers. Salinity of a sample from 17 ft deep was 31.7 parts per thousand (ppt).

The upstream test hole, 09-1225, went to 30 feet. We found gray silt to silt with sand, and organics in this hole as well, but the ground was only thawed between 7 and 17 feet (smaller thaw bulb). Soils were wet and loose where thawed. Drilling was difficult in the deep frozen soils as cuttings did not clear out of the hole readily. Salinity of a sample from 17 ft deep was 26 ppt.

The elevated salinity readings suggests that sea water may have inundated Sadie Creek at some point. Salinity is of potential concern for its corrosion potential on driven piles and for its affect on frozen soil strength properties. It weakens the strength of frozen soils due to the increased unfrozen water content. For general comparison, seawater has an average salinity of 35 ppt. Our samples are a mixture of soil and water so cannot be directly compared.

Coastal material sites

We drilled two areas that were reported as having potential for granular material based on observations of gravel in nearby coastal bluffs (R&M, 2007). We drilled four test holes southeast of Pipe Spit on the plateau above the bluff (09-1249 to 09-1251) and one hole (09-1252) between the airport ridge and the north coast. We found frozen silt with organics and ice to depths of 22 to 26 feet in all test holes. Test hole 09-1251 intercepted massive ice from 16 to 23 feet, the depth drilled. This silt layer is apparently greater than 25 feet thick where drilled and covers any granular soils that may be present.

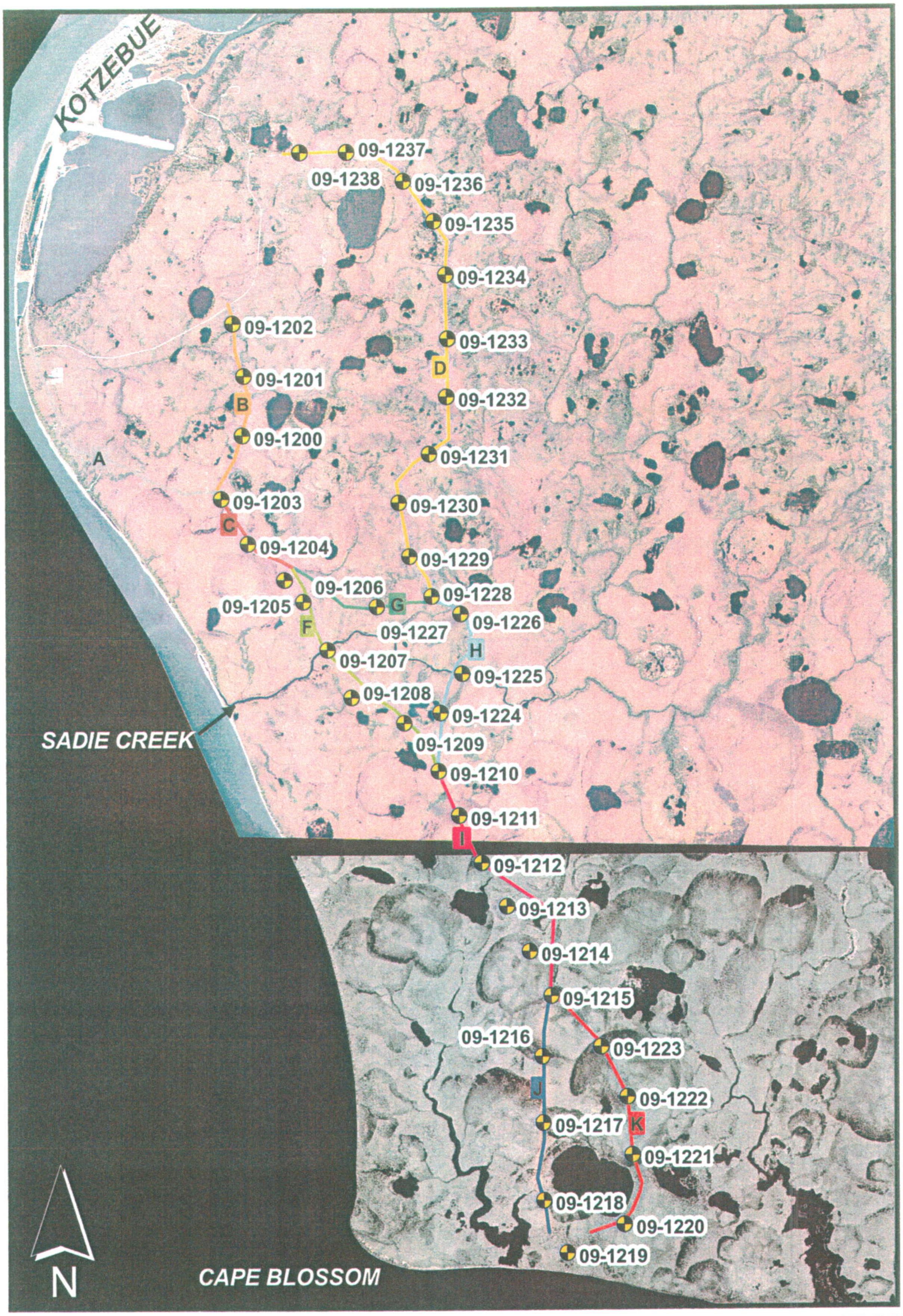
References

ADOT&PF, January 2008, Draft Kotzebue to Cape Blossom Road Reconnaissance Study. which includes as an appendix: Reconnaissance Geology Report, Existing Conditions: Soils, prepared by R&M Consultants, Inc, for the Kotzebue Airport Relocation Feasibility Study, October 2007.

Geode Exploration, 1984, Kotzebue aggregate exploration dredge sites, prepared by Len Nelson, for the City of Kotzebue.

Shannon & Wilson, Inc, 1982, Geotechnical feasibility study, Kotzebue Airport expansion, Kotzebue, Alaska, for ADOT&PF, Northern Region.

Wahrhaftig, Clyde, 1965, Physiographic Divisions of Alaska, U.S. Geological Survey Professional Paper 482, p.27-28.

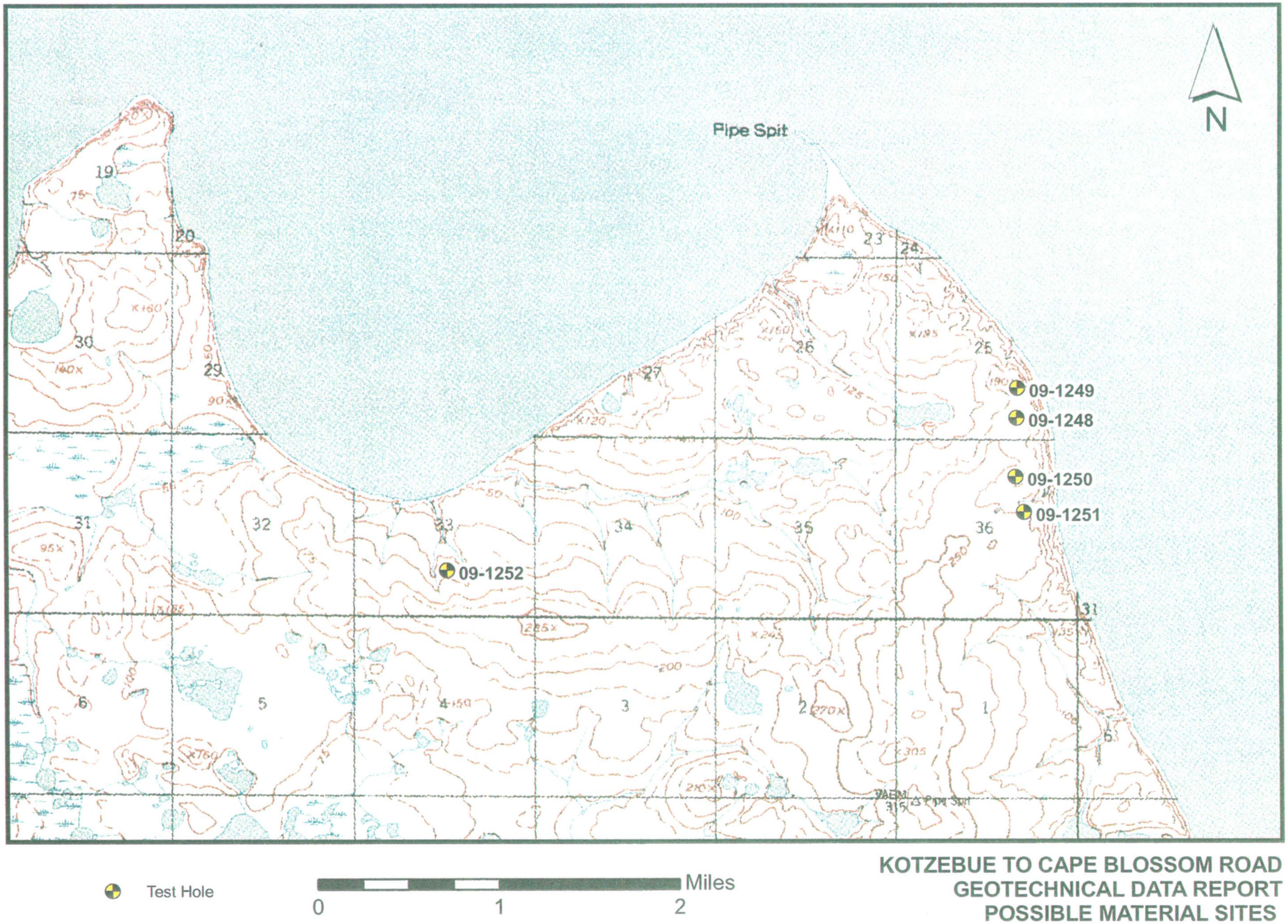


Test Hole

Miles
0 1 2

KOTZEBUE TO CAPE BLOSSOM ROAD
GEOTECHNICAL DATA REPORT
TEST HOLE LOCATIONS

FIGURE 2

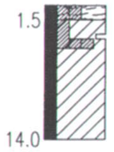


KOTZEBUE TO CAPE BLOSSOM ROAD
GEOTECHNICAL DATA REPORT
POSSIBLE MATERIAL SITES
TEST HOLE LOCATIONS

FIGURE 3

ROAD SEGMENT B

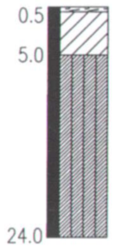
09-1202
N66.86166, W162.54588
07 APR



0.0- 1.5
1.5-14.0

09-1202
Bn-Rd PEAT, Vr
Bn SILT, Org,
Vs to Nbe
SAMPLE 09-6300
(3.0-3.5)
NM 160.7%
ORG 7.4%

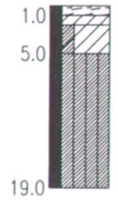
09-1201
N66.85442, W162.54184
07 APR



0.0- 0.5
0.5- 5.0
5.0-24.0

09-1201
ORG MAT
Bn SILT, Org, Nbe
Wh ICE

09-1200
N66.84612, W162.54228
06 APR

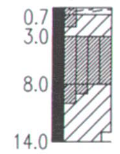


0.0- 1.0
1.0- 5.0
5.0-19.0

09-1200
ORG MAT, Vr
Bn-Gy SILT, Org,
Nbe to Vs
Wh ICE

ROAD SEGMENT C

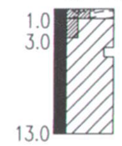
09-1203
N66.83727, W162.54958
07 APR



0.0- 0.7
0.7- 3.0
3.0- 8.0
8.0-14.0

09-1203
ORG MAT, Vr
Bn SILT, hi Org, Vs
Bn-Wh ICE
Bn SILT, Sl Org,
Vs to Nbe
SAMPLE 09-6302
(13.0-14.0)
NM 45.9%
ORG 4.3%

09-1204
N66.83104, W162.53999
07 APR

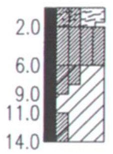


0.0- 1.0
1.0-13.0

09-1204
PEAT, Vr
Bn SILT, Org,
Vs to Nbe
SAMPLE 09-6303
(4.0-5.0)
NM 79.0%
ORG 5.7%

ROAD SEGMENT F

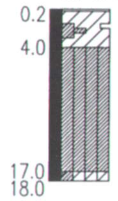
09-1205
N66.82602, W162.52693
08 APR



0.0- 2.0
2.0- 6.0
6.0-14.0

09-1205
PEAT, Vr
SAMPLE 09-6304
(1.5-2.0)
NM 442.1%
ORG 90.2%
Wh ICE
Bn SILT, Org, Vs

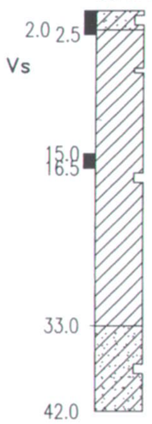
09-1206
N66.82299, W162.52034
08 APR



0.0- 0.2
0.2- 4.0
4.0-17.0
17.0-18.0

09-1206
ORG MAT
Bn SILT, Org, Nbe to Vs
SAMPLE 09-6305
(1.5-2.0)
NM 118.2%
ORG 4.0%
Bn-Wh ICE
Bn SILT

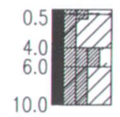
09-1207
N66.81626, W162.51162
08 APR



0.0- 2.0
2.0-33.0
33.0- 42.0

09-1207
Bn Sa SILT, Org
SAMPLE 09-6306
(0.5-1.5)
ML, 65.7% -200, NV,
NP
NM 107.1%, ORG 15.4%
Gy SILT, wet, loose,
sl Org
SAMPLE 09-6307
(6.0-6.5)
ML, 95.6% -200, NV, NP
NM 35.4%, ORG 4.9%
SAMPLE 09-6308
(17.0-18.0)
ML, 92.5% -200
NV, NP
NM 40.5%, ORG 3.6%
Gy SILT w/ Sa, wet,
sl Org
SAMPLE 09-6309
(37.0-38.0)
ML, 70.8%-200, NV, NP
NM 42.7%, ORG 1.9%

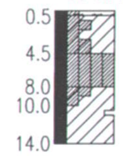
09-1208
N66.80961, W162.50305
09 APR



0.0- 0.5
0.5- 4.0
4.0- 6.0
6.0-10.0

09-1208
ORG MAT
Bn SILT, Org, Vs
Bn ICE w/ Si
Bn SILT, Org, Vs

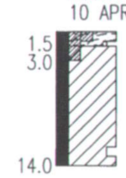
09-1209
N66.80613, W162.48410
09 APR



0.0- 0.5
0.5- 4.5
4.5- 8.0
8.0-14.0

09-1209
ORG MAT
Bn SILT, Org, Vs
Bn ICE
Bn-Gy SILT, Org,
Vs to Nbe
SAMPLE 09-6310
(10.5-11.0)
ML, 98.4% -200
NV, NP
NM 83.6%

09-1214
N66.77427, W162.43904
10 APR

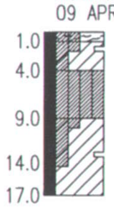


0.0- 1.5
1.5-14.0

09-1214
PEAT w/ Si
SAMPLE 09-6317
(1.0-1.5)
NM 695.9%
ORG 47.0%
Bn-Gy SILT, Org,
Vs to Nbe
SAMPLE 09-6318
(12.0-13.0)
ML, 97.7% -200
NV, NP
NM 39.9%,
ORG 4.9%

ROAD SEGMENT I

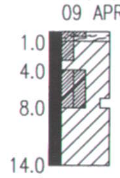
09-1210
N66.79942, W162.47171
09 APR



0.0- 1.0
1.0- 4.0
4.0- 9.0
9.0-17.0

09-1210
ORG MAT
Bn SILT, hi Org, Vs
SAMPLE 09-6311
(1.5-2.0)
NM 186.4%
ORG 24.4%
Bn ICE
Bn-Gy SILT, Org,
Vs to Nbe
SAMPLE 09-6312
(12.5-13.0)
NM 120.2%
ORG 6.4%

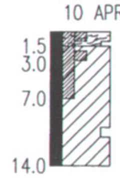
09-1211
N66.79318, W162.46426
09 APR



0.0- 1.0
1.0-14.0

09-1211
ORG MAT
Bn SILT, Org, Vs to Nbe
SAMPLE 09-6313
(7.0-8.0)
NM 120.6%
ORG 9.8%

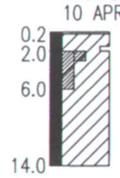
09-1212
N66.78661, 162.45615
10 APR



0.0- 1.5
1.5- 14.0

09-1212
PEAT w/ Si
SAMPLE 09-6314
(1.0-1.5)
NM 603.5%
ORG 78.8%
Bn SILT, Org, Vs to Nbe
SAMPLE 09-6315
(10.0-11.0)
NM 75.1%
ORG 15.2%

09-1213
N66.78059, W162.44720
10 APR



0.0- 0.2
0.2-14.0

09-1213
ORG MAT
Bn-Gy SILT, hi Org,
Vs to Nbe
SAMPLE 09-6316
(1.5-2.0)
NM 95.0%
ORG 24.4%

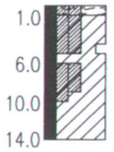
STATE OF ALASKA
DEPARTMENT OF TRANSPORTATION AND PUBLIC FACILITIES
ENGINEERING GEOLOGY UNIT

DATA: JR	KOTZEBUE TO CAPE BLOSSOM ROAD
DRAWN: BAM	
APPROVED:SSM	PROJECT NO. AKSAS 76884
DATE: OCT 2009	V:\Geo\76884 Kotzebue\76884Z01

Oct 23, 2009 - 10:51am - Tab: GeoGen1

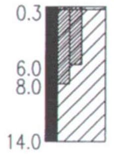
ROAD SEGMENT D

09-1238
N66.88534, W162.52237
16 APR



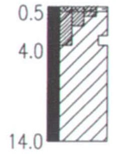
0.0– 1.0 9-1238
ORG MAT
1.0–14.0 Bn SILT, hi Org,
Vs to Nbe
SAMPLE 09-6341
(4.0–5.0)
ML, 53.3% –200
NV, NP
NM 281.6%,
ORG 25.0%

09-1237
N66.88541, W162.50578
16 APR



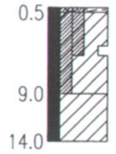
0.0– 0.3 09-1237
ORG MAT
0.3–14.0 Bn-Gy SILT, Org,
Vs to Nbe

09-1236
N66.881, W162.48529
16 APR



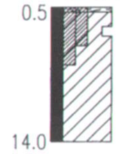
0.0– 0.5 09-1236
ORG MAT
0.5–14.0 Bn SILT, Org,
Vs to Nbe
SAMPLE 09-6340
(3.0–4.0)
NM 134.0%,
ORG 12.6%

09-1235
N66.87599, W162.47427
16 APR



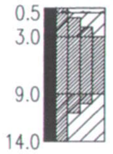
0.0– 0.5 09-1235
ORG MAT
0.5– 9.0 Bn SILT, Org, Vs
SAMPLE 09-6339
(4.0–5.0)
NM 115.8%,
ORG 13.9%
9.0–14.0 Bn-Gy SILT,
sl Org, Nbe

09-1234
N66.86861, W162.46980
16 APR



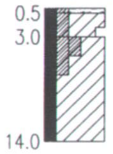
0.0– 0.5 9-1234
ORG MAT
0.5–14.0 Bn SILT, Org,
Vs to Nbe
SAMPLE 09-6338
(2.0–3.0)
NM 181.3%
ORG 31.0%

09-1233
N66.85974, W162.46902
15 APR



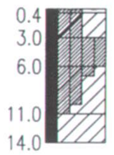
0.0– 0.5 09-1233
ORG MAT
0.5– 3.0 Bn SILT, hi Org, Vs
3.0– 9.0 Wh-Bn ICE
9.0–14.0 Bn SILT, sl Org, Vs

09-1232
N66.85171, W162.46936
15 APR



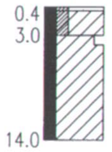
0.0– 0.5 09-1232
ORG MAT
0.5– 3.0 Bn SILT, hi Org, Vs
SAMPLE 09-6337
(2.0–3.0)
NM 206.2%,
ORG 33.1%
3.0–14.0 Gy SILT, sl Org,
Vs to Nbe

09-1231
N66.84327, W162.47560
15 APR



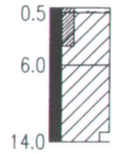
0.0– 0.4 09-1231
ORG MAT
0.4– 3.0 Bn SILT, hi Org, Vs
3.0– 6.0 Wh-Bn ICE
6.0–11.0 Bn-Gy SILT, Org, Vs
11.0–14.0 Gy SILT, Nbe

09-1230
N66.83689, W162.48640
15 APR



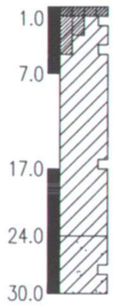
0.0– 0.4 09-1230
ORG MAT
0.4– 3.0 Bn-Gy SILT, Org,
Vs to Nbe
SAMPLE 09-6336
(3.0–4.0)
NM 93.4%, ORG 8.2%

09-1229
N66.82941, W162.48244
15 APR



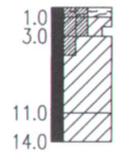
0.0– 0.5 09-1229
ORG MAT, Vr
0.5– 6.0 Bn SILT Org,
Vs to Nbe
6.0–14.0 Gy SILT, sl Org,
Nbe
SAMPLE 09-6335
(13.0–14.0)
ML, 93.8% –200
NV, NP
NM 52.8%,
ORG 2.9%

09-1225
N66.81305, W162.46339
13 APR



0.0– 1.0 09-1225
ICE, Org
1.0–24.0 Gy SILT, wet, Org,
Vs to Nbe.
Trace to slight
sand.
SAMPLE 09-6327
(1.0–2.0)
NM 271.4%, ORG 25.8%
SAMPLE 09-6328
(4.0–5.0)
NM 147.5%, ORG 11.0%
SAMPLE 09-6329
(16.0–17.0)
ML, 89.8% –200
NV, NP
NM 48.5%, ORG 5.5%
24.0– 30.0 Gy SILT w/ Sa, wet,
sl Org
SAMPLE 09-6330
(27.0–28.0)
ML, 84% –200
NV, NP
NM 63.9%

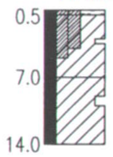
09-1224
N66.80760, W162.47113
13 APR



0.0– 1.0 09-1224
ORG MAT
1.0– 3.0 Bn SILT, hi Org, Vs
SAMPLE 09-6326
(2.0–3.0)
NM 232.0%,
ORG 27.8%
3.0–11.0 Bn SILT, Org, Nbe
11.0–14.0 Gy SILT, Nbe

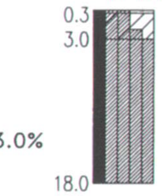
ROAD SEGMENT G

09-1228
N66.82387, W162.47446
14 APR



0.0– 0.5 09-1228
ORG MAT
0.5– 7.0 Bn SILT, Org, Vs
SAMPLE 09-6333
(3.0–3.5)
NM 169.3%, ORG 13.0%
7.0–14.0 Gy SILT, Nbe
SAMPLE 09-6334
(9.0–10.0)
NM 64.0%, ORG 8.3%

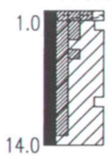
09-1227
N66.82240, W162.49414
14 APR



0.0– 0.3 09-1227
ORG MAT
0.3– 3.0 Bn SILT, Org, Vs
3.0–18.0 Bn-Wh ICE

ROAD SEGMENT H

09-1226
N66.82143, W162.46400
14 APR



0.0– 1.0 09-1226
ORG MAT
1.0–14.0 Bn SILT, Org, Vs
SAMPLE 09-6331
(1.0–2.0)
NM 158.9%, ORG 22.8%
SAMPLE 09-6332
(9.0–10.0)
NM 122.2%, ORG 11.7%

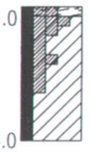
STATE OF ALASKA
DEPARTMENT OF TRANSPORTATION AND PUBLIC FACILITIES
ENGINEERING GEOLOGY UNIT

DATA: JR	KOTZEBUE TO CAPE BLOSSOM ROAD	
DRAWN: BAM		
APPROVED: SSM	PROJECT NO. AKSAS 76884	
DATE: OCT 2009	V:\Geo\76884 Kotzebue\76884Z01	

Oct 23, 2009 – 10:52am – Tab: GeoGen2

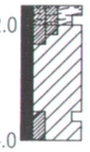
ROAD SEGMENT J

09-1215
N66.76808, W162.43124
10 APR



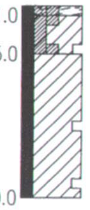
0.0- 1.0 09-1215
ORG MAT
1.0-14.0 Bn-Gy SILT, Org,
Vs to Nbe

09-1216
N66.75967, W162.43442
10 APR



0.0- 2.0 09-1216
ORG MAT w/ Si
SAMPLE 09-6319
(1.0-2.0)
NM 624.1%, ORG 51.5%
2.0-14.0 Bn-Gy SILT, Org
Vs to Nbe
SAMPLE 09-6320
(11.0-12.0)
NM 110.0%
ORG 11.8%

09-1217
N66.75047, W162.43391
11 APR

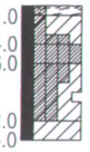


0.0- 1.0 09-1217
ORG MAT
1.0- 5.0 Bn SILT, hi Org, Vs
SAMPLE 09-6321
(4.0-5.0)
NM 231.0%
ORG 19.7%
5.0-20.0 Gy SILT, Org, Nbe
SAMPLE 09-6322
(12.0-13.0)
ML, 93.6% -200
LL 35, NP
NM 42.9%
SAMPLE 09-6323
(18.0-19.0)
NM 53.4%

09-1218
N66.73965, W162.43358
11 APR

0.0- 0.5 09-1218
ORG MAT
0.5- 8.0 Bn SILT, Org,
Vs to Nbe
8.0-14.0 Gy SILT, Nbe

09-1219
N66.73240, W162.42505
11 APR



0.0- 1.0 09-1219
ORG MAT
1.0- 4.0 Bn SILT, Org, Vs
4.0- 6.0 Bn-Wh ICE
6.0-12.0 Bn SILT, Org, Vs
SAMPLE 09-6324
(9.0-10.0)
NM 315.8%
ORG 24.0%
12.0-14.0 Gy-Bn SILT, Nbe

ROAD SEGMENT K

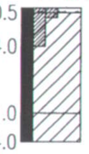
09-1220
N66.73640, W162.40477
11 APR

0.0- 2.0 09-1220
PEAT, Vr
2.0- 4.0 Bn SILT, hi Org, Vs
4.0-14.0 Bn SILT, Org, Nbe

09-1221
N66.74606, W162.40201
11 APR

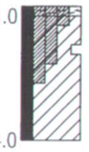
0.0- 0.5 09-1221
ORG MAT
0.5-10.0 Bn SILT, Org, Vs to Nbe
10.0-14.0 Gy SILT, Nbe

09-1222
N66.75409, W162.40382
11 APR



0.0- 0.5 09-1222
ORG MAT
0.5-11.0 Bn SILT, Org,
Vs to Nbe
11.0-14.0 Gy SILT, Nbe

09-1223
N66.76107, W162.41321
13 APR



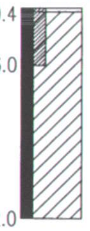
0.0- 1.0 09-1223
ORG MAT
1.0-14.0 Bn SILT, Org, Vs to Nbe
SAMPLE 09-1223
(4.0-5.0)
NM 271.0%
ORG 16.6%

POSSIBLE MATERIAL SITES

09-1248
N66.92519, W162.28958
20 APR

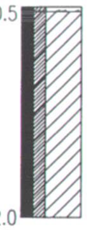
0.0- 0.5 09-1248
ORG MAT
0.5-26.0 Bn-Gy SILT Org,
Vs to Nbe

09-1249
N66.92757, W162.28947
21 APR



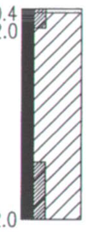
0.0- 0.4 09-1249
ORG MAT
0.4-22.0 Bn-Gy SILT, Org,
Vs to Nbe

09-1250
N66.92048, W162.28975
21 APR



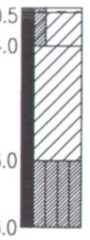
0.0- 0.5 09-1250
ORG MAT
0.5- 22.0 Bn-Gy SILT, Org, Vs

09-1251
N66.91765, W162.28804
21 APR



0.0- 0.4 09-1251
ORG MAT
0.4-22.0 Bn-Gy SILT, Org,
Vs to Nbe

09-1252
N66.91284, W162.40533
23 APR



0.0- 0.5 09-1252
ORG MAT
0.5- 4.0 Bn SILT, Org, Vs
4.0-16.0 Gy SILT, sl Org,
Nbe to Vx
16.0-23.0 Wh-Gy ICE

STATE OF ALASKA
DEPARTMENT OF TRANSPORTATION AND PUBLIC FACILITIES
ENGINEERING GEOLOGY UNIT

DATA: JR	KOTZEBUE TO CAPE BLOSSOM ROAD
DRAWN: BAM	
APPROVED:SSM	PROJECT NO. AKSAS 76884
DATE: OCT 2009	V:\Geo\76884 Kotzebue\76884Z01

STATE OF ALASKA DEPARTMENT OF TRANSPORTATION
NORTHERN REGION
LABORATORY TESTING REPORT

PROJECT NAME:	KOTZEBUE TO CAPE BLOSSOM ROAD
PROJECT NUMBER:	76884
AKSAS NUMBER:	J. ROWLAND
SAMPLED BY:	
MATERIAL SOURCE:	

TEST HOLE NUMBER		09-1207	09-1207	09-1207	09-1207	09-1209	09-1214	09-1217
DEPTH (feet)		0.5-1.5	6.0-6.5	17.0-18.0	37.0-38.0	10.5-11.0	12.0-13.0	12.0-13.0
LATITUDE		N66.81626°	N66.81626°	N66.81626°	N66.81626°	N66.80613°	N66.77427°	N66.75047°
LONGITUDE		W162.51162°	W162.51162°	W162.51162°	W162.51162°	W162.4841°	W162.43904°	W162.43391°
LAB NUMBER		**09-6306**	**09-6307**	**09-6308**	**09-6309**	**09-6310**	**09-6318**	**09-6322**
DATE SAMPLED		8-Apr-09	8-Apr-09	8-Apr-09	8-Apr-09	9-Apr-09	10-Apr-09	11-Apr-09
% Passing	3"							
	2"							
	1.5"							
Gravel	1.0"							
	0.75"							
	0.5"							
	0.375"							
	#4							
	#8							
	#10							
	#16	100			100			
	#30	99			99			100
Sand	**#40**	96			99			99
	#50	88			98			99
	#60	84	100		96			98
	#80	77	99	100	94			97
	#100	74	99	99	92		100	97
Silt/Clay	**#200**	65.7	95.6	92.5	70.8	98.4	97.7	93.6
	0.02							61.6
Hydro	**0.005**							27.2
	0.002							17.4
	0.001							12.6
LIQUID LIMIT		NV	NV	NV	NV	NV	NV	35
PLASTIC INDEX		NP	NP	NP	NP	NP	NP	NP
USCS CLASSIFICATION		ML	ML	ML	ML	ML	ML	ML
USCS SOIL DESCRIPTION								
NATURAL MOISTURE		107.1	35.4	40.5	42.7	83.6	39.9	42.9
ORGANICS		15.4	4.9	3.6	1.9		4.9	
SP. GR. (FINE)								2.90
SP. GR. (COARSE)								
MAX. DRY DENSITY								
OPTIMUM MOISTURE								
L.A. ABRASION								
DEGRAD. FACTOR								
SODIUM SULF. (CRSE)								
SODIUM SULF. (FINE)								
NORDIC ABRASION								
REMARKS		hi Org[1]	sl Org[1]	sl Org[1]			sl Org[1]	

GENERAL COMMENTS

Gradation is based on material passing the 3" sieve, according to Alaska Test Method T-7.

[1] Organic content determination is based on the results of the ATM T-6 test method.

(Soil descriptions shown in parentheses are based on field determinations.)

USCS Soil Description Abbreviations: WG = Well-graded; PG = Poorly-graded; E = Elastic; L = Lean; F = Fat

Appendix

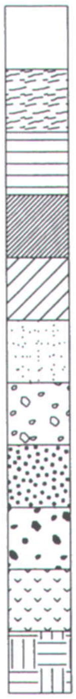
Symbols and definitions

Unified Soils Classification System

Frozen soil classification

SYMBOLS AND DEFINITIONS

BASIC MATERIAL SYMBOLS

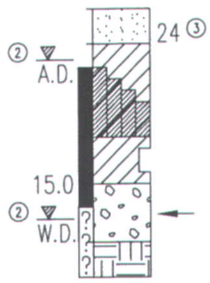


ASPHALT
PEAT
CLAY (Cl)
ICE
SILT (Si)
POORLY GRADED SAND (Sa)
POORLY GRADED GRAVEL (Gr)
WELL GRADED SAND
WELL GRADED GRAVEL
BEDROCK (Bx), soft(Type)
BEDROCK (Bx), hard(Type)

SOFT OR HARD BEDROCK BASED ON DRILLING RATE

NOTE
MAIN COMPONENT (UPPER CASE ... SOLID LINES)
MINOR COMPONENT (Title Case ... DASHED LINES OR SPARSER PATTERN)

TYPICAL LOG



① Station value may also be on centerline e.g. Sta 210+53, CL or lat-long format e.g. N64.56789°, W145.67890°
② W.D.= WHILE DRILLING, A.D.= AFTER DRILLING
③ "N VALUE" INDICATES STANDARD PENETRATION TEST (1.4" I.D., 2.0" O.D. SAMPLER DRIVEN WITH 140 LB. HAMMER, 30" FREE FALL) AND IS SUM OF 2nd AND 3rd 6" OF PENETRATION.

PLAN VIEW SYMBOLS

POWER AUGER TEST HOLE (TH)
HAND AUGER TEST HOLE (TH)
EXPOSED MATERIAL
PROBE
HAND DUG TEST PIT (TP)
DOZER/BACKHOE TEST TRENCH (TT)
BODY OF WATER
FLOW DIRECTION
WASTE BERM
BANK
SWAMP
TREELINE

USCS SIZE DEFINITIONS

BOULDERS (Boulders)	12"+
COBBLES (Cobbles)	3" TO 12"
GRAVEL	#4 TO 3"
ANGULAR FRAGMENTS	#10 +
SAND	#200 TO #4
SILT	#200 TO 0.005 mm
CLAY	MINUS 0.005 mm

SOIL DENSITY/CONSISTENCY DESCRIPTORS

NON-COHESIVE RELATIVE DENSITY	BLOWS/FOOT (N) VALUE	COHESIVE CONSISTENCY	BLOWS/FOOT (N) VALUE
VERY LOOSE	< 4	VERY SOFT	< 2
LOOSE	5-10	SOFT	2-4
MEDIUM DENSE	11-30	FIRM	5-8
DENSE	31-50	STIFF	9-15
VERY DENSE	> 50	VERY STIFF	16-30
		HARD	> 30

TEST RESULTS

_._%-200	= % PASSING #200 SIEVE
NM _._%	= NATURAL MOISTURE
ORG _._%	= ORGANIC CONTENT
SSc _	= SODIUM SULFATE LOSS(coarse)
SSf _	= SODIUM SULFATE LOSS(fine)
LA _	= LOS ANGELES ABRASION
DEG _	= DEGRADATION
LL _	= LIQUID LIMIT (NV = no value)
PI _	= PLASTIC INDEX (NP = non-plastic)

COLOR

Bk = BLACK	Gy = GRAY	Tn = TAN
Bl = BLUE	Or = ORANGE	Wh = WHITE
Bn = BROWN	Rd = RED	Yw = YELLOW
Gn = GREEN		

MISC.

Tr	= TRACE
sl	= SLIGHTLY
hi	= HIGHLY
w/_	= WITH UNSPECIFIED AMOUNT
X'tls	= CRYSTALS
TH	= TEST HOLE
TT	= TEST TRENCH
TP	= TEST PIT

MOISTURE

dry	= < OPTIMUM*	DUSTY, DRY TO THE TOUCH
moist	~ OPTIMUM*	DAMP, NO VISIBLE WATER
wet	= > OPTIMUM*	VISIBLE FREE WATER

* OPTIMUM MOISTURE FOR MAXIMUM DENSITY

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DESCRIPTION AND CLASSIFICATION OF FROZEN SOILS

Part I Description of Soil Phase (a) (Independent of Frozen State)	Major Group: Description (2)	Major Group: Designation (3)	Sub-Group: Description (4)	Sub-Group: Designation (5)	Field Identification (6)	Pertinent Properties of Frozen Materials which may be measured by physical tests to supplement field identification. (7)	Guide for Construction on Soils Subject to Freezing and Thawing: Thaw Characteristics (8)	Guide for Construction on Soils Subject to Freezing and Thawing: Criteria (9)
Part II Description of Frozen Soil	Segregated ice is not visible by eye (b)	N	Poorly Bonded or Friable	Nf	Identify by visual examination. To determine presence of excess ice, use procedure under note (c) below 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.	In-Place Temperature Density and Void Ratio a) In Frozen State b) After Thawing in Place Water Content (Total H_2O, including ice) a) Average b) Distribution Strength a) Compressive b) Tensile c) Shear d) Adfreeze Elastic Properties Plastic Properties Thermal Properties Ice Crystal Structure (using optional instruments.) a) Orientation of Axes b) Crystal size c) Crystal shape d) Pattern of Arrangement	Usually Thaw-Stable	The potential intensity of ice segregation in a soil is dependent to a large degree on its void sizes and may be expressed as an empirical function of grain size as follows: Most inorganic soils containing 3 percent or more of grains finer than 0.02 mm in diameter by weight are frost-susceptible. Gravels, well-graded sands and silty sands, especially those approaching the theoretical maximum density curve, which contain 1.5 to 3 percent finer than 0.02 mm by weight without being frost-susceptible. However, their tendency to occur interbedded with other soils usually makes it impractical to consider them separately. Soils classed as frost-susceptible under the above criteria are likely to develop significant ice segregation and frost heave if frozen at normal rates with free water readily available. Soils so frozen will fall into the thaw-unstable category. However, they may also be classed as thaw-stable if frozen with insufficient water to permit ice segregation. Soils classed as non-frost-susceptible (*NFS) under the above criteria usually occur without significant ice segregation and are not exact and may be inadequate for some structure applications: exceptions may also result from minor soil variations. In permafrost areas, ice wedges, pockets, veins, or other ice bodies may be found whose mode of origin is different from that described above. Such ice may be the result of long-time surface expansion and contraction phenomena or may be glacial or other ice which has been buried under a protective earth cover.
			No excess ice	Nb n				
			Well Bonded	Nb				
			Excess ice	Nb e				
	Segregated ice is visible by eye. (Ice 1 inch or less in thickness) (b)	V	Individual ice crystals or inclusions	Vx	For ice phase, record the following as applicable: Location, Size, Orientation, Shape Thickness, Spacing, Pattern of arrangement, Length, Hardness }, Structure } per part III Below, Color }		Usually Thaw-Unstable	
			Ice coatings on particles	Vc				
			Random or irregularly oriented ice formations	Vr				
			Stratified or distinctly oriented ice formations	Vs	Estimate volume of visible segregated ice present as percent of total sample volume			
Part III Description of Substantial Ice Strata	Ice (Greater than 1 inch in thickness)	Ice	Ice with soil inclusions	Ice + Soil Type	Designate material as ICE (d) and use descriptive terms as follows, usually one item from each group, as applicable:			
			Ice without soil inclusions	Ice	Hardness: Hard, Soft (mass, not individual crystals) Structure: Clear, Cloudy, Porous, Candled, Granular, Stratified Color: e.g.: Colorless, Gray, Blue Admixtures: e.g.: Contains Thin Silt Inclusions	Same as Part II above, as applicable, with special emphasis on Ice Crystal Structure.		

DEFINITIONS:

Ice Coatings on Particles are discernible layers of ice found on or below the larger soil particles in a frozen soil mass. They are sometimes associated with hoarfrost crystals, which have grown into voids produced by the freezing action.

Ice Crystal is a very small individual ice particle visible in the face of a soil mass. Crystals may be present alone or in a combination with other ice formations.

Clear ice is transparent and contains only a moderate number of air bubbles. (e)

Cloudy Ice is translucent, but essentially sound and non-pervious

Porous Ice 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.

Candled ice is ice which has rotted or otherwise formed into long columnar crystals, very loosely bonded together.

Excess Ice is the volume of ice in soil which exceeds the total pore volume that the soil would have under natural unfrozen conditions.

Ice Lenses are lenticular ice formations in soil occurring essentially parallel to each other, generally normal to the direction of heat loss and commonly in repeated layers.

Ice Segregation is the growth of ice as distinct lenses, layers, veins and masses in soils, commonly but not always oriented normal to direction of heat loss.

Well-bonded signifies that the soil particles are strongly held together by the ice and that the frozen soil possesses relatively high resistance to chipping or breaking.

Poorly-bonded signifies that the soil particles are weakly held together by the ice and that the frozen soil consequently has poor resistance to chipping or breaking.

Friable denotes a condition in which material is easily broken up under light to moderate pressure.

Thaw-Stable frozen soils do not, on thawing, show loss of strength below normal, long-time thawed values nor produce detrimental settlement.

Thaw-Unstable frozen soils show on thawing, significant loss of strength below normal, long-time thawed values and/or significant settlement, as a direct result of the melting of the excess ice in the soil.

Modified from: Linell, K. A. and Kaplar, C. W., 1966, *Description and Classification of Frozen Soils*, Proc. International Conference on Permafrost (1963), Lafayette, IN, U.S. National Academy of Sciences, Publ. 1287, pp 481-487.

NOTES:

(a) When rock is encountered, standard rock classification terminology should be used.

(b) 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. However, the impression to the unaided eye 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.

(c) When visual methods may be inadequate, a simple field test to aid evaluation of 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 percent of total volume.

(d) Where special forms of ice, such as hoarfrost, can be distinguished, more explicit description should be given.

(e) Observer should be careful to avoid being misled by surface scratches or frost coating on the ice.