APPENDIX G

Geotechnical Report

Reconnaissance Geotechnical Report
Mat-Su Rail Corridor
Mat-Su Valley, Alaska

JUNE 2003

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1.0 INTRODUCTION

This report presents the results of our filed reconnaissance and baseline geotechnical engineering studies along a new Alaska Railroad Corporation (ARRC) rail corridor extending from Port MacKenzie north to either Wasilla or Houston, Alaska. The purpose of this study was to compile existing subsurface information along the various proposed corridors, to verify the accuracy of this information by ground proofing in the field, and provide baseline geotechnical observations regarding the constructability of a new rail spur along these corridors. Existing information was attained from state, federal, and private agencies. Ground proofing was performed subsequently in several different stages and observations made during these exercises were considered in formulating our baseline analyses. Presented in this report are descriptions of the site and project, a list and summary of existing subsurface information in the project area, an explanation of our reconnaissance activities, an interpretation of subsurface conditions considering both existing and new data, and conclusions from our studies. The primary goal of this presentation is to determine the correlation of existing, mapped soil data with observed soil conditions in the field.

Authorization to proceed with this work was received in the form of a signed proposal from Mr. Norm Gutcher, P.E. of Tryck, Nyman, Hayes in November, 2001. Our work was conducted in general accordance with our October 1, 2002 proposal.

2.0 SITE AND PROJECT DESCRIPTION

The project site covers a relatively large swath of land spanning from Port MacKenzie in the south to as far north as Willow, Alaska. A vicinity map is included as Figure 1 showing the general project location. As shown on this figure, Port MacKenzie is only around 3 miles north of Anchorage, however the two locations are separated by the Knik Arm. Currently access to Port MacKenzie is gained via Knik Goose Bay and West Port MacKenzie Roads making travel time to the Port approximately 2 hours from Anchorage or 1 hour from Wasilla. There is currently no rail service to the area with the nearest tracks located more than 20 miles to the north (the main line between Wasilla and Fairbanks).

Recently, increasing development in the Mat-Su Valley, preliminary studies on a Knik Arm bridge crossing and Ferry System, and improvements to Port MacKenzie itself have prompted the ARRC and the State of Alaska (SOA) to explore the possibility of constructing rail access to Port MacKenzie. An accompanying highway has also been considered in the development of this project to provide better access to the Port and surrounding real-estate.

At this time, the project is in a stage of early development and several potential corridors have been delineated for the proposed new railroad spur to the Port. From these possibilities, one favored route was selected, extending north from Port MacKenzie, to the north side of Big Lake, then northeast to the Wasilla area. Later in the project, an alternative route was considered that would carry the tracks northwest out of the Port crossing the Little Susitna River, then north past the west side of Redshirt Lake, and finally northeast, connecting to main line tracks in the Houston area. The approximate locations of each route are included on the site plan in Figure 2.

Construction of a rail spur from Port MacKenzie north to the mainline tracks will present many engineering and logistical challenges. Much of the land between Port MacKenzie and Houston/Wasilla is either privately owned or included within the boundaries of State Park or critical habitat areas. Each corridor also provides for a variety of terrain obstacles such as swampy areas, lakes, rivers, hills, and ridges, and with these various terrains are a wide range of possible soil conditions including soft, compressible organic soils to dense, granular glacial and alluvial soils.

3.0 LITERATURE SEARCH

The most useful literature resource available to us was the United States Department of Agriculture/Natural Resources Conservation Service (USDA/NRCS) Soil Survey of Matanuska-Susitna Valley Area, Alaska. This data was released on CDROM on June 30, 2002 and is available free of charge at the USDA/NRCS regional office in Wasilla, Alaska. Compilation and mapping of soil information included in the package was completed in 1995. Surface soil conditions were generally determined using satellite imagery, high altitude aerial photography, and field visits for confirmation. Original mapping was conducted for the soils included from the ground surface down to a depth of about 5 feet and lateral extents were defined using a 1:24,000 scale. More detailed technical information about the data compilation is available on the above referenced CDROM or on the USDA/NRCS website.

For purposes of this study, three soil types were focused on from the database: Sand Soils, Gravel Soils, and Hydric Soils. Maps were constructed for each of the soils using the electronic database and ArcView 8.1 and are included in Figures 3, 4, and 5. Soil boundaries included on Figures 3 through 5 describe the probability of the surface soils in that area being gravelly, sandy, or hydric in nature. The approximate routes of rail corridors have been superimposed atop these maps. It should be noted that these are only rough corridor locations and that they are subject to realignment in the future. Additionally, we believe that the soils classified and divided in this database and shown on Figures 3 through 5 are too generalized for any purpose other than preliminary planning of a detailed exploration plan. The stations presented on Figures 3 through 5 mark the various locations visited during our field reconnaissance conducted for this project. A detailed description of each station and various photographs taken in the field are presented for the eastern and western corridors in Appendices A and B, respectively.

In addition to the USDA/NRCS Soil Survey, an Alaska Department of Transportation and Public Facilities (ADOT&PF) report issued in 1983 was also reviewed during the literature search. This report was created for initial work on a Knik Arm crossing and included soil terrain mapping and unit descriptions in more specific detail in comparison to the more recent USDA/NRCS report mentioned above. These earlier maps were created by ADOT&PF at 1:63,360 scale. Because the large fold-out maps for this report are poor quality and difficult to read in some areas, they have not been included with this memo, however, the unit descriptions given in the report can be correlated with soil units delineated in the USDA/NRCS Soil Survey which is less detailed.

While the USDA/NRCS survey only breaks the soil types into three categories (gravelly, sandy, and hydric), the ADOT&PF terrain mapping divides the surface soils into nine different physiological units: colluvial, eolian, fluvial, glacial, glaciofluvial, man-made, marine, glaciomarine, and organic. Because of the geologic history of the project area, the differentiated units listed above are very complexly inter-related and, at this point, only simplified generalizations can be made about soil trends in the area. It is our opinion that the USDA/NRCS survey does a relatively good job of making these generalizations by breaking up surface soils into gravelly, sandy, or hydric areas.

4.0 SOIL CONDITIONS

In general, the attached soil maps show that surface soil conditions along the two corridors are variable ranging from well drained sands and gravels to low-lying boggy deposits. Coarse grained sands and gravels are mostly associated with topographic highs (rolling hills and plateaus) within the project area. Hydric soils (or saturated, poorly drained soils) are mostly associated with topographic lows including marshy and boggy areas and flood plains near rivers.

5.0 FIELD RECONNAISSANCE

Field reconnaissance was conducted to “ground proof” the existing data that was researched at the beginning of the project. These activities were conducted during three different times. The first exercise was conducted on May 31, 2002, along the proposed location of the eastern corridor. From November 5th to November 9th, the southern two thirds of the western corridor were explored and the remaining northern section of that corridor was visited on January 14, 2003. During each of the reconnaissance outings, stations were located at various points of interest. Location control during these activities was provided by a handheld global positioning system (GPS) capable of providing geographic locations within approximately 20 feet.

The eastern route was explored by an engineer from our office in late May 2002. At that time, this corridor was the most favored, and as we understand it had been previously approved as a rail corridor some time ago. Access to the various corridor locations was gained with a 4-wheel drive truck traveling on existing roadways and trails. Much of this alignment, except for the northernmost regions just south of the Parks Highway and the ARRC main line, are readily accessible using these existing roads. The abundant roadway access, however, is also indicative of denser populations and the presence of large amounts of private land. Stations were established, the locations of which are shown on Figures 3 through 5, and several soils samples were collected from exposed cuts. Detailed station descriptions, photographs, etc. are included in Appendix A.

Later in the project, increased consideration was given to a western alignment requiring additional explorations. The western corridor was explored over two separate engagements, the first of which (November 2002) consisted of a week-long canoe supported field trip in which two engineers from our office traversed much of the southern two thirds of the corridor on rivers, lakes, and on foot. Due to lack of abundant, natural or man-made soil exposure, small test pits were dug by hand at various locations to glimpse into the subsurface.

The western corridor was revisited in January 2003, and the northern third of the corridor was explored using the existing roadways and trails in the Houston area. Photographs and detailed station descriptions for this corridor are displayed in Appendix B. Station locations along this portion of the project are also presented on Figures 3 through 5.

6.0 GENERAL FIELD OBSERVATIONS

Detailed descriptions of the observations at each station in the field are presented in the attached Appendices A and B for the east and west corridors, respectively. These observations have been generalized and a summary is presented below.

6.1 East Corridor

The northernmost area along this corridor that was visited was the north shore of West Beaver Lake. The stretch of the corridor that spans this northern section (generally north of Big Lake to the Parks Highway), crosses relatively persistent, marshy areas whose extent, location, and shape are generally controlled by long, finger-like, low-lying (less than 100 feet of relief) ridges. The long axes of said ridges are largely oriented northeast to southwest and are quite visible in topographic maps of the region. In the field, the ridges appeared (in exposed locations) to be primarily sandy gravel to gravelly sand. With a lack of significant fine grained materials, the rounded nature of the larger grains, and the linear nature of these features, we believe that the ridges are likely glaciofluvial features, or eskers. Because of the relatively low relief in this area, it is our opinion that the marshy areas are likely to be relatively shallow or less than 10 feet thick, except in marshy areas adjacent to lakes where the depths could be significantly greater.

South of Big Lake to approximately West Ayershire Road, the corridor crosses a section of land that undulates significantly with higher relief than the northern portions of this alignment. As evident from exposed soils in road cuts in this area, the soils along this section typically consisted of silty, sandy gravel and silty, gravelly sand. Additionally, some boulders were observed occasionally; some greater than 1.5 feet in diameter. Many of the low lying areas contained lake and marshy features; however, they were largely limited in size and extent. Observed topography and soil conditions in this section suggest that soils were of glacial origin and are likely reflective of glacial moraines and tills forming kames and kettles. Though probably not of the same origin, this soil is similar to the Elmendorf Moraines found on the other side of Knik Arm in Elmendorf Air Force Base and Fort Richardson.

South of West Ayershire Road, the corridor extends to the south along the eastern edge of a large, plateau-like land feature that has largely been developed for farmland. Soils exposed in this area in road cuts and borrow pits consist primarily of gravelly sand with little or no silt. The flat topography and clean, sandy nature of the soils found on this feature are very similar to features encountered in downtown Anchorage in the Naptowne Outwash. It is our opinion that the large flat area encompassing this portion of the corridor is a similar outwash feature deposited by glacial melt water transporting well graded, clean sediment from a receding glacier. Just to the east on the outwash feature, the topography becomes very undulating and more representative of a glacial moraine-like deposit. This area has been mapped as an extension of the Elmendorf Moraine.

South of the outwash feature described above, the corridor winds down to Port MacKenzie through hilly terrain mapped as the Elmendorf Moraine. This material, as observed in the field, tends to contain more silt and gravel fractions than the outwash soils. Additionally, low-lying areas are swampy and marshy, containing dotted lakes. This area appears quite similar to the portion of land between Big Lake and West Ayershire Road.

6.2 West Corridor

North and west of the ridge west of Redshirt Lake and the Little Susitna River is relatively flat with isolated areas of high ground or hills (usually 30 to 40 feet above the flats). The low, flat areas are typically covered with relatively thick organic material or peat. Examining maps and viewing the landforms, it appears that this area is representative of ancient floodplains or an alluvial bench of the nearby Susitna River. According to several hand probes conducted in area peat, it is on the order of 5 to 10 feet thick. It is unclear if the hand probes conducted in these peats met refusal from hard or dense mineral soils or frozen peat. Several shallow test pits dug on some of the isolated, short hills in the flat lands show a relatively sandy and silty mineral soil horizon on the surface. It is likely that these isolated features are loess (soils deposited by wind action) deposits. Further north along the corridor (as it approaches Vera Lake and the Houston area) the topography slowly gains elevation and the low boggy areas are fewer and isolated primarily to the fringes of the dotted lakes. Exposed soils in gravel pits and road cuts show cross bedded sands and gravels suggesting that these areas are an extension of the floodplains or the alluvial bench noted to the south.

South of these areas, we largely encountered soils and landforms that appeared primarily to be controlled by past glacial activity. The ridge line to the west of Redshirt Lake and the Little Susitna River (that has commonly been referred to as a “moraine”) appeared to more closely resemble a large esker/kame formation with a hummocky surface forming many small kettles or isolated, shallow depressions. While moraines are defined as soil masses deposited directly by ice or melting ice, eskers and kames are deposited by glaciofluvial processes. Moraines (like the Elmendorf Moraine closer to the Knik Arm) are typically comprised of a wide range of well graded particle sizes from silts and clays up to semi-angular gravels and large boulders. Glaciofluvial sediments (those deposited by rivers of water flowing on, through, or beneath glacial ice) tend to contain cleaner sand and gravel with fewer cobble and boulder sized particles. According to our limited explorations and small, hand-dug test pits, it appears that the above mentioned ridge formation is largely gravelly sand to silty, gravelly sand. Additionally, the above discussed formation appeared to be generally well drained. Surface vegetation on the ridge feature are thick stands of cottonwood, spruce trees and low brush.

On the southern end of the corridor where it crosses the Little Susitna River, the topography and soils appears to be controlled by another form of glaciofluvial deposition. Landforms in this area are typically flat high-ground (ranging from 30 to 60 feet above the elevation of the Little Susitna River) with narrow, radiating, finger-shaped ridges that control the meander of the river. Exposures in the river banks and in several shallow test holes revealed similar soils to those found in the higher ridges to the west with the exception that the sand appeared to be coarser in these soils and the included gravel was somewhat more rounded. The dominant soil type appeared to be gravelly sand in this area and the less hummocky nature of the topography suggests that these soils most likely represent a large outwash similar to the Naptowne Outwash found in the downtown Anchorage area. Also well drained, the dominant vegetation tends to be cottonwood with a significant amount of thick white spruce stands.

Near surface soils that were observed in our small test pits in the upper 1 to 1.5 foot below the ground surface were relatively uniform throughout the project area. In areas of good drainage, a 0.5 to 1 foot layer of organics was encountered that included decayed plant matter and roots. Typically a thin layer less than 6 inches thick of gray volcanic ash was found between the organic layer and mineral soils. As stated above, the dominant soils along the alignment are gravelly sand to silty, gravelly sand. Some isolated areas of highly gravelly soils were observed, most were related to the river beds. On average, gravel appeared to make up approximately 20 percent of the soil matrix with an average maximum grain size of around 2 inches. Gravel, cobbles, and boulders larger than 2 inches were very sparsely scattered.

7.0 CONCLUSIONS

We believe that both of the literature sources and observations made in our field reconnaissance are in good agreement. In comparing the two literature sources, there is a strong correlation between hydric soils from the NRCS survey and deposits delineated in the ADOT study as organic deposits and other low-lying, potentially silty deposits like marine, glaciomarine, fluted and lowland tills, and abandoned floodplains. Observations made during our field reconnaissance also agree strongly with the existing literature in that many of the low-lying areas are poorly drained and (especially in the northern and western extents of the eastern corridor) in these areas, many lakes and peat bogs have formed.

As shown in Figures 3 and 4, gravelly and sandy soils are closely related to each other, with the exception that sandy soils have been identified to somewhat of a wider extent mostly around major stream and river features. In examining the ADOT soils report, there are strong correlations to the sand and gravel soils noted by the NRCS survey. Sand and gravel units are closely related to active (and some abandoned) fluvial deposits, glacial moraines, and glaciofluvial deposits (eskers, kames, and outwashes). In addition, sand soil areas in the NRCS survey correlate well with eolian and active floodplain deposits. As with the hydric soils, these conditions (and their mapped locations in the literature) are in close agreement with observations made in the field during our original reconnaissance effort.

Although the correlation between existing literature, and the correlation between these sources and the field observations have been determined to be generally good, there were observations made in the field that suggested a weaker correlation in certain areas. Many of these weaker correlations occur in the extreme north and west portions of the project, specifically along the western corridor. While the ADOT soils report is in general agreement with our field observations, the NRCS survey seems to have a lower level of detail in this area. Field observations along the Little Susitna River and the western ridges revealed areas of apparently higher gravel contents. Except for isolated areas around the Little Susitna River, the NRCS report generally shows sand soils for this relatively large region. It is our opinion that (according to our field observations) this is likely an underestimation of the actual amount of gravel material available in this area. There are many smaller ridges around the Little Susitna River (besides those directly controlling the path of the river) and north of Red Shirt Lake that, while there is no erosion to expose subsoils, likely have a higher chance of containing gravel than suggested by the NRCS map.

As mentioned above, we believe that the available literature on the soils in the project area, on average, has a relatively strong correlation with actual soil conditions observed in the field. However, due to the scale at which both sources were mapped, we believe that the fine details of the surface deposits have probably not been very precisely determined. It is our opinion that the available soils data will be well used if it is considered in generalized route and borrow source selection, project feasibility, and (possibly) in determining rough, preliminary project cost determination. We strongly recommend that, once preliminary studies have been completed, more extensive subsurface explorations be conducted in the design phase of this project.

8.0 CLOSURE AND LIMITATIONS

The analyses, conclusions, and recommendations contained in this report are based on site conditions as they existed at the times of our reconnaissance. It is assumed that the exploratory, hand dug test pits and other observed soil exposures are representative of the subsurface conditions throughout the site, i.e., the subsurface conditions everywhere are not significantly different from those disclosed by the explorations.

During construction or further, more detailed, explorations, subsurface conditions may be different from those encountered in these and prior explorations. If there is a substantial lapse of time between the submittal of this report and the start of work at the site, or if conditions have changed due to natural causes or construction operations at or adjacent to the site, it is recommended that this report be reviewed to determine the applicability of the conclusions.

We recommend that we be retained to perform additional, more detailed explorations, once a final railway corridor has been agreed upon. Additional explorations that may be appropriate could include the advancement of borings or test pits. It is our opinion that the information included in this report should not be used in final design without performing a more detailed exploration program worthy of a design project of this magnitude.

Unanticipated soil conditions are commonly encountered and cannot fully be determined by merely observing surface soil exposures. Such unexpected conditions frequently require that additional expenditures be made to attain a properly constructed project. Therefore, some contingency fund is recommended to accommodate such potential extra costs. Shannon & Wilson has prepared the attachments in Appendix A "Important Information About Your Geotechnical/Environmental Report" to assist you and others in understanding the use and limitations of the reports.

Sincerely,

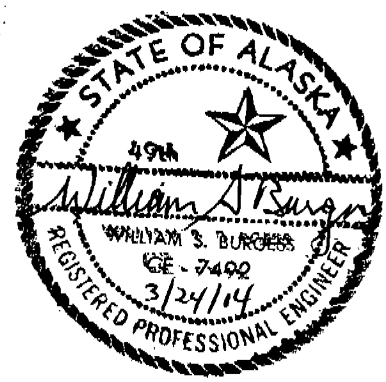
SHANNON & WILSON, INC.

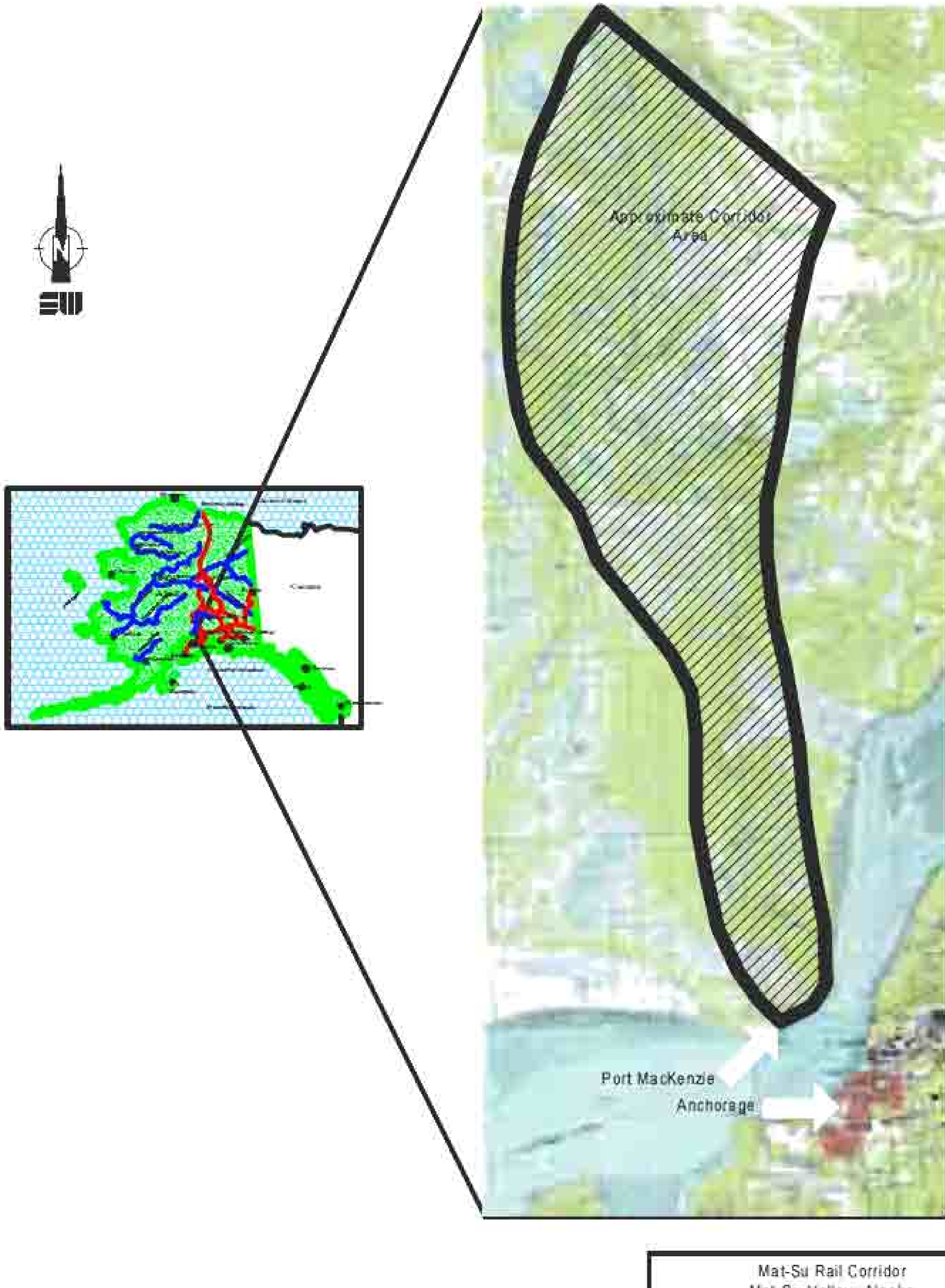
Prepared by:

Kyle Brennan
Geotechnical Engineer

Reviewed by:

William S. Burgess, P.E.
Associate





Mat-Su Rail Corridor
Mat-Su Valley, Alaska

Vicinity Map

July 2003

32-1-01506

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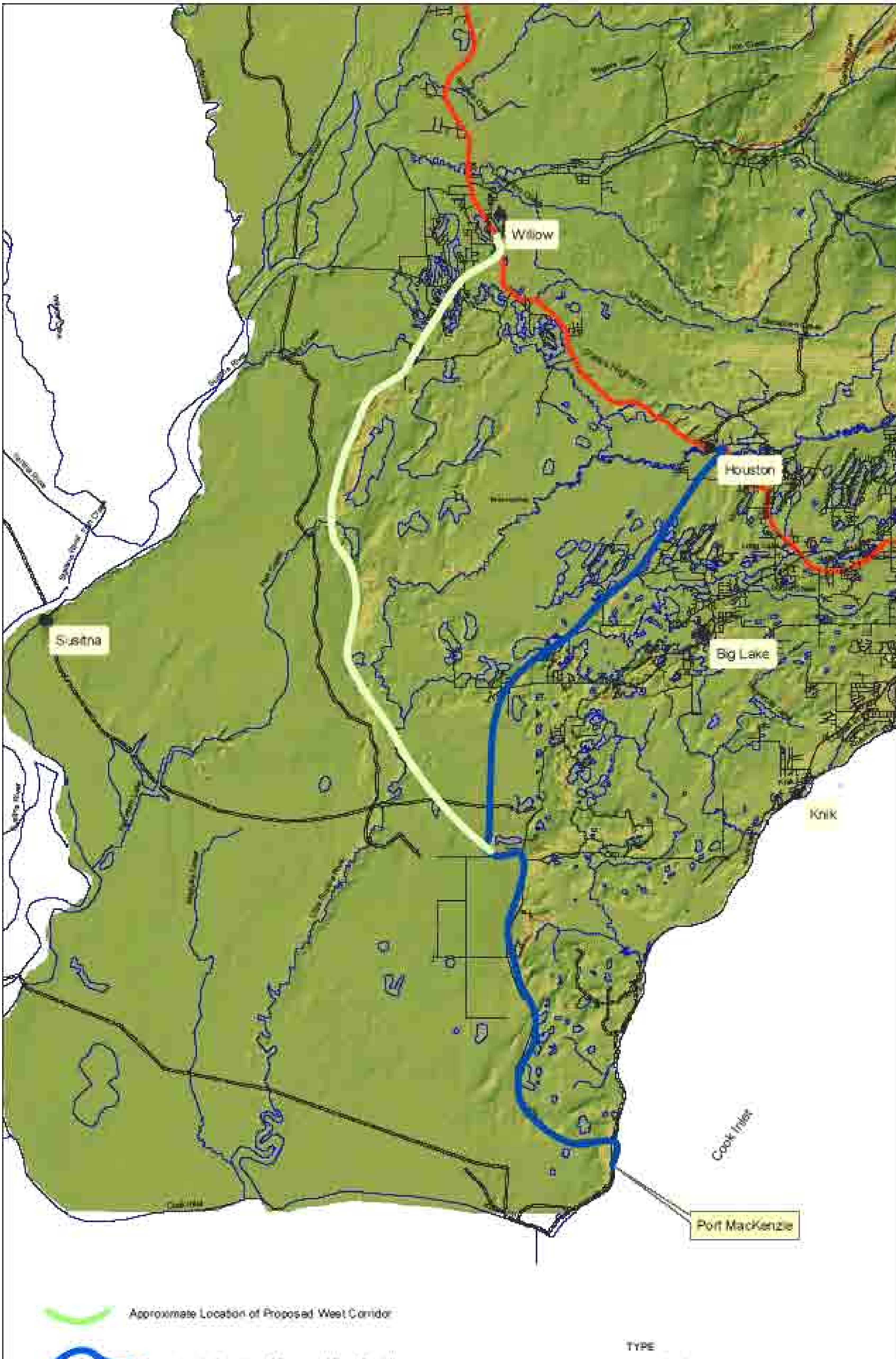
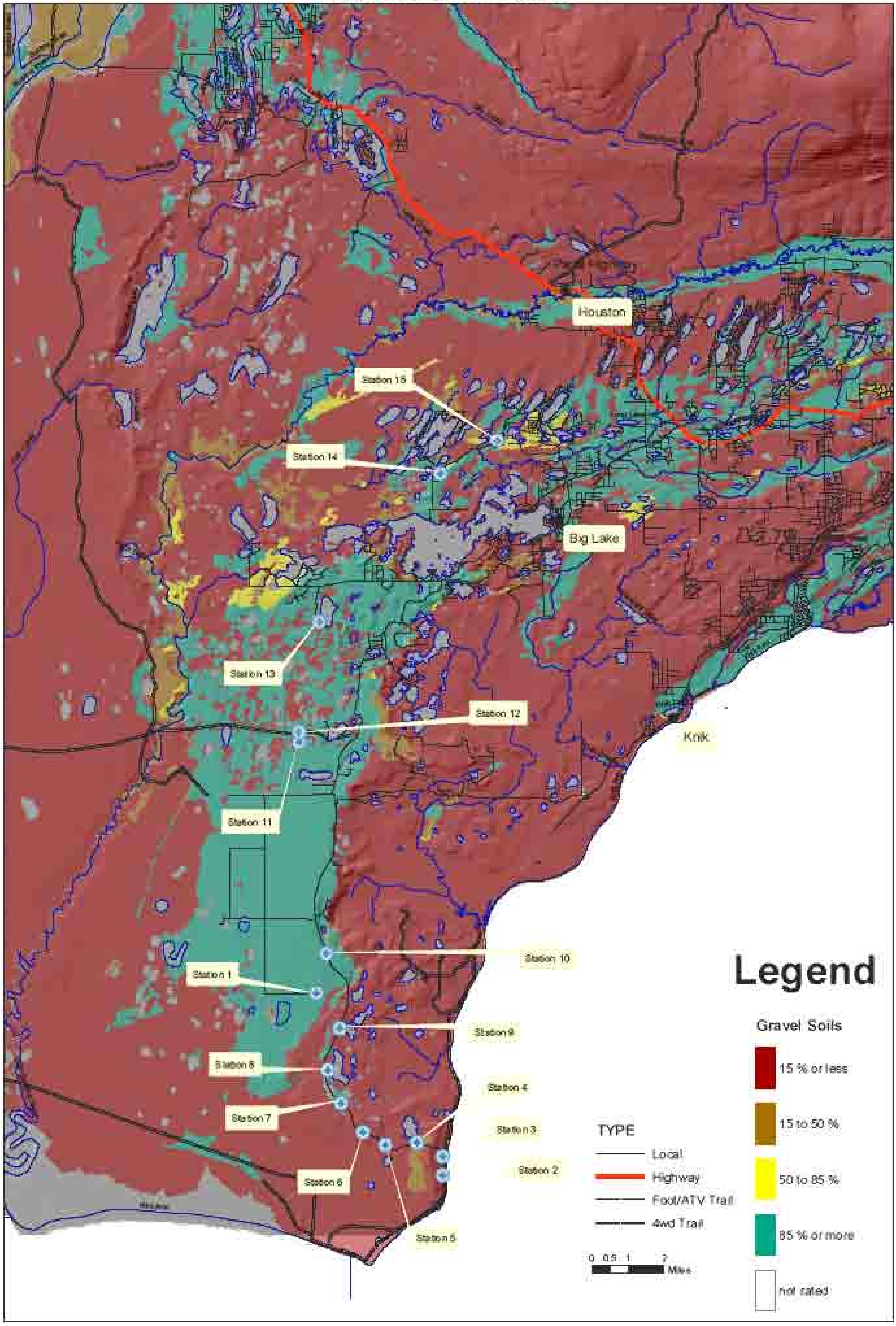
Fig. 1



Willow
Houston
Susitna
Big Lake
Knik
Cook Inlet
Port MacKenzie
Approximate Location of Proposed West Corridor
Approximate Location of Proposed East Corridor
Map Adapted From USDA/NRCS Mat-Su Valley Soil Survey, 1995
TYPE
Local
Highway
Foot/ATV Trail
4wd Trail
Mat Su Rail Corridor
Site Plan
June 2003
Figure 2

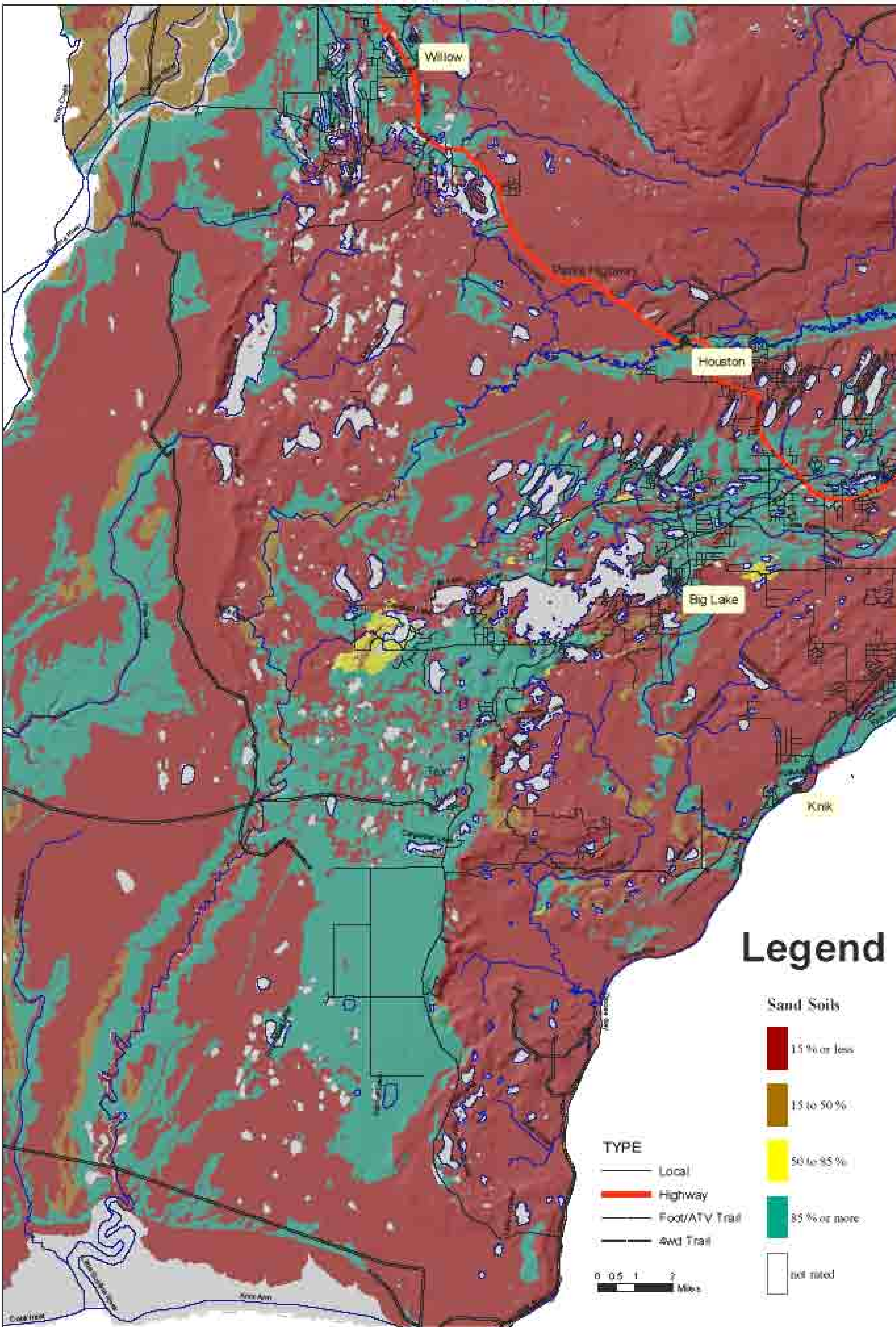
GRAVELLY SOILS



MatSu Rail Corridor
Preliminary Recconnaissance

Figure 1

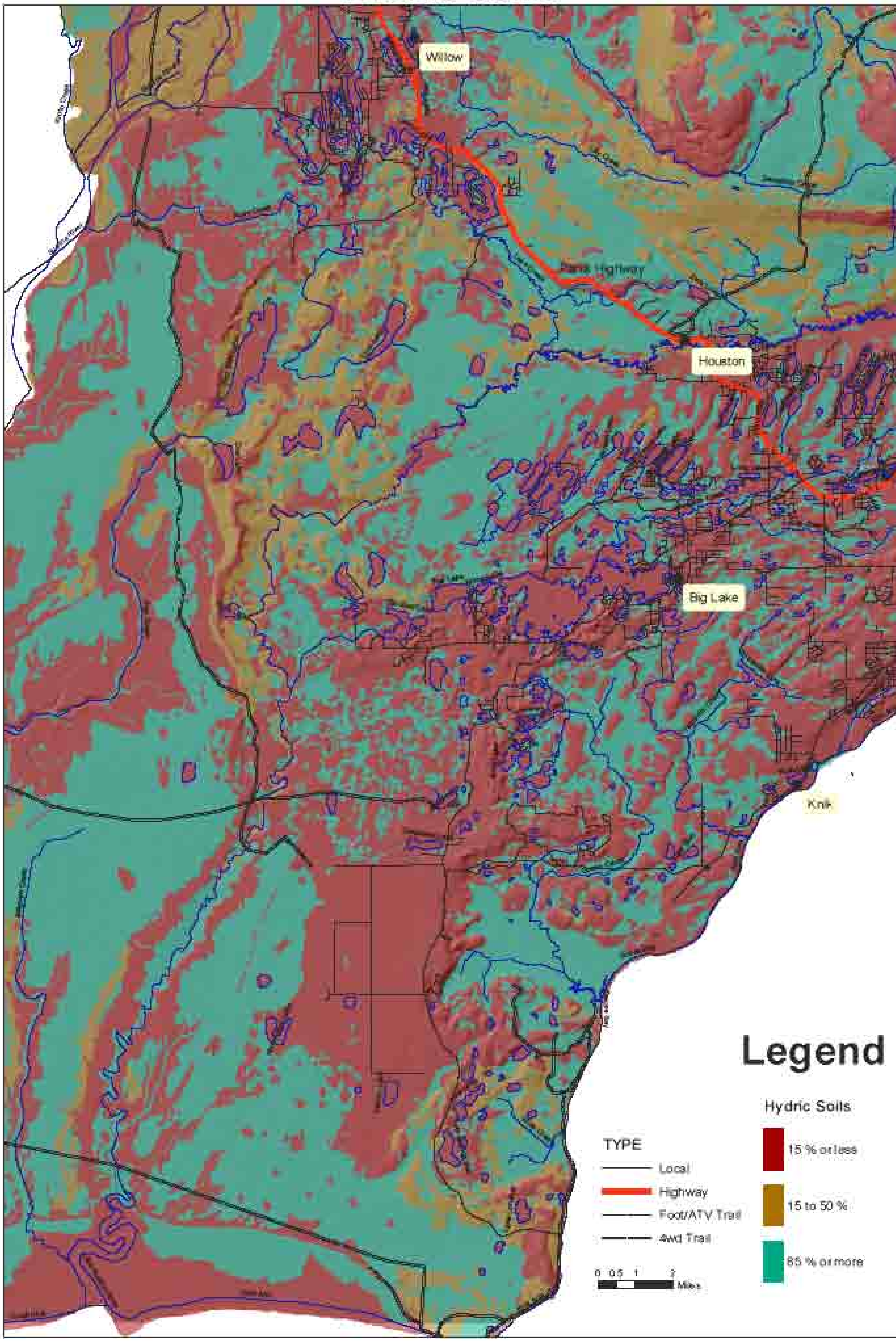
SANDY SOILS



MatSu Rail Corridor
Preliminary Recconnaissance

Figure 2

HYDRIC SOILS



MatSu Rail Corridor
Preliminary Recconnaissance

Figure 3

APPENDIX A

EAST CORRIDOR DETAILS

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Table A-1
Detailed Station Descriptions East Corridor

Station	Coordinate Location	Station Observations	Photo Reference
East 1	658,859 W 6,804,770 N UTM Zone 5	Small gravel pit off West Reddane Road. Material looks like outwash, possibly related to that found on the Anchorage side of Knik Arm. The farming areas in general are pretty flat and well drained with medium sized spruce, cottonwood and alder coverage.	Photo 1; Figure A-1
East 2	343,344 W 6,796,820 N UTM Zone 6	On West Port MacKenzie Road just north of Port MacKenzie. The ground surface is relatively undulating and vegetative cover is thicker with rather large spruce and cottonwood trees. High ground appears well drained, however low ground appears marshy and hydric. Topography and poorly drained low areas are typical of morainal features found in the Elmendorf Moraine.	Photo 2; Figure A-1
East 3	343,381 W 6,797,275 N UTM Zone 6	Looking north on West Port MacKenzie Road showing typical undulating landscape and dense, large vegetation in undisturbed areas.	Photo 3; Figure A-2
East 4	343,037 W 6,798,246 N UTM Zone 6	A large through cut in West Port MacKenzie Road. Exposed soils appear to consist of primarily slightly silty, gravelly sand to slightly silty, sandy gravel. Topography of surrounding ground is undulating with well drained high areas and marshy low ground. A 4x4 trail branches from the road extending to Lorain Lake from here. Many other 4x4 trails exist in this area.	Photo 4; Figure A-2
East 5	340,792 W 6,798,429 N UTM Zone 6	First significant boggy area to the north of Port MacKenzie. Road grade is approximately 4 feet above the marsh grade with no obvious signs of distress. The road runs approximately east-west here. North of the road is typically hilly morainal terrain; the flat marsh reaches indefinitely to the south.	Photo 5; Figure A-3
East 6	339,519 W 6,798,545 N UTM Zone 6	Small road cut on West Port MacKenzie Road. Exposed soils are silty sand to slightly silty sand. Immediat area around station is typical of morainal topography.	Photo 6; Figure A-3
East 7	659,118 W 6,800,306 N UTM Zone 5	Typical of the multitude of 4x4 trails crossing the landscape. Vegetative ground cover is relatively thick and ground surface is undulating. Lower areas shown in the background are poorly drained and soft, higher ground is well drained. This area is likely still within the boundary of the Elmendorf Moraine.	Photo 7; Figure A-4
East 8	659,145 W 6,801,293 N UTM Zone 5	A large marshy area crossed by West Port MacKenzie Road. The marsh extends on the other side of the road to an approximately equal extent as shown in the photograph. This area is likely a glaciofluvial deposit of fine grained sediments that form this poorly drained basin. To the north of this station, the ground climbs to the higher, flatter, well drained areas used for farming. Although the marsh is laterally expansive, the good condition of the road surface suggests that the thickness of organic/compressible materials may not be very thick.	Photo 8; Figure A-4
East 9	659,660 W 6,803,287 N UTM Zone 5	A shallow road cut on West Port MacKenzie Road in relatively clean, sandy gravel soils. Relatively clean soils (low silt content) and subrounded to rounded particles suggest that these soils are likely outwash soils. Vegetation consists of rather large cottonwood tree stands.	Photo 9; Figure A-5
East 10	659,458 W 6,806,642 N UTM Zone 5	Ground at this location is very flat. To the west of the road (left in the photograph) are flat, well drained farming lands and to the east of the road, the ground slopes down toward Knik Arm and Goose Bay. Because of lack of relief, few road cuts exist in this area. The limited soil exposure suggests that the soils are primarily sands with varying amounts of gravel.	Photo 10; Figure A-5
East 11	657,434 W 6,816,372 N UTM Zone 5	A 4x4 trail north of Carpenter Lake. Topography is more undulating and is typical of glacial moraine deposits. Vegetation includes large spruce and cottonwood trees with high, well drained areas and low, poorly drained basins that are sometimes fill by small kettle lakes. This moraine is likely not related to the Elmendorf Moraine to the east, but may be an older moraine deposit as determined by the less severe topographical relief.	Photo 11; Figure A-6

Table A-1
Detailed Station Descriptions East Corridor

East 12	657,462 W 6,815,870 N UTM Zone 5	Typical small kettle lake north of Carpenter Lake. Land immediately around the lake is relatively marshy surrounded by low lying hills. The lake does not appear to be very deep as the lake bed seems to be relatively flat close to shore, under around 3 to 5 feet of water.	Photo 12; Figure A-6
East 13	658,301 W 6,821,779 N UTM Zone 5	Diamond Lake access point. Diamond Lake is a larger kettle lake amid gently hilly ground. As shown in the photograph, the vegetation is very thick here consisting of tall spruce and cottonwood trees	Photo 13; Figure A-7
East 14	344,762 W 6,828,246 N UTM Zone 6	Large road cut on the south side of West Lakes Road north of Big Lake. Soils are generally slightly silty, gravelly sand with areas of increased gravel content. The terrain begins to flatten out north of this area with significantly more expansive marshy areas. Isolated hills are formed here as relatively linear features oriented northeast to southwest and are likely glaciofluvial esker formations.	Photo 14; Figure A-7
East 15	347,280 W 6,829,446 N UTM Zone 6	An example of the relatively exapnsive marshy areas north of Big Lake. Poorly drained soils dominate the landscape and are often associated with small lakes. Roads constructed on these soil conditions appear to be performing well with no significant differential settlement or rutting. Accordingly, organic soils are likely not excessively deep (probably less than 10 feet thick) along this portion of the east corridor.	Photos 15 & 16; Figure A-8

Photo 1: Station East 1, small borrow pit located at the east end of Reddane Road. Contains relatively clean sands and gravels.

Photo 2: Station East 2, view of Port MacKenzie, Knik Arm, and Anchorage from fore to background.

Mat-Su Rail Corridor Mat-Su Valley, Alaska	
PHOTOS 1 and 2	
June 2003 32-1-01506	
SHANNON & WILSON, INC. Geotechnical & Environmental Consultants	Fig. A-1

Photo 3: Station East 3, Undulating terrain north of Port MacKenzie looking north.

Photo 4: Station East 4, large through cut on West Point MacKenzie Road. Exposed are relatively clean sands and gravels.

Mat-Su Rail Corridor
Mat-Su Valley, Alaska

PHOTOS 3 and 4

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Fig. A-2

Photo 5: Station East 5, boggy area along Point MacKenzie Road.
Looking southease, road grade approximately 4 feet above marsh elevation.

Photo 6: Station East 6, small cut on West Point MacKenzie Road looking northeast.
Typically dense birch and spruce vegetation shown in background.

Mat-Su Rail Corridor
Mat-Su Valley, Alaska

PHOTOS 5 and 6

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Fig. A-3

Photo 7: Station East 7, one of the many 4x4 trails found in the area penetrating into the dense birch and spruce tree stands in gently undulating terrain.

Photo 8: Station East 8, looking west from Point MacKenzie Road over a large marshy area. The marsh is present on the east side of the road to approximately the same extent.

Mat-Su Rail Corridor Mat-Su Valley, Alaska	
PHOTOS 7 and 8 June 2003 32-1-01506	
SHANNON & WILSON, INC. Geotechnical & Environmental Consultants	**Fig. A-4**

Photo 9: Station East 9, small road cut on Point MacKenzie Road
exposing clean, sands and gravels.

Photo 10: Station East 10, looking north on Point MacKenzie Road
showing the very flat topography of this area. To the left is farming land
and sloping bluff down to Goose Bay is to the right.

Mat-Su Rail Corridor
Mat-Su Valley, Alaska

PHOTOS 9 and 10

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Fig. A-5

Photo 11: Station East 11, 4x4 trail north of Carpenter Road over gently undulating terrain. Shows typical dense alder, spruce, and birch trees.

Photo 12: Station East 12, a typical marshy area that dot the terrain north of Carpenter Lake. High areas surrounding the ponds are evident by the larger trees and are likely well drained sands and gravels.

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PHOTOS 11 and 12

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Fig. A-6

Photo 13: Station East 13, Diamond Lake parking area surrounded by typically dense alder, spruce, and birch trees.

Photo 14: Station East 14, large road cut on south side of West Lakes Road north of Big Lake. Exposed soils consist of clean sands and gravels. These ridges are long narrow features separated by poorly drained marshes and Lakes.

Mat-Su Rail Corridor
Mat-Su Valley, Alaska

PHOTOS 13 and 14

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Fig. A-7

Photo 15: Station East 15, looking west over typical marsh land with a small pond north of Big Lake.

Photo 16: Station East 15, looking east over same marshy area consisting of a peat bog with sparse black spruce trees. Area was previously burned.

Mat-Su Rail Corridor Mat-Su Valley, Alaska	
PHOTOS 15 and 16	
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APPENDIX B

WEST CORRIDOR DETAILS

List of Tables:

List of Figures:

Table B-1
Detailed Station Descriptions West Corridor

Station	Coordinate Location	Station Observations	Photo Reference
West 1	651,212 W 6,840,368 N UTM Zone 5	Near Red Shir Lake trailhead on the northern extension of a large ridge that runs north-south on the west side of Red Shirt Lake. Area appears to be an old, overgrown sand/gravel pit. Exposed soils in cut appear to be primarily clean sand with isolated areas of coarse gravel and cobbles and/or silt.	Photo 17; Figure B-1
West 2	650,854 W 6,840,858 N UTM Zone 5	On an isolated, small hill northwest of Station West 1. Topography in the area is dominated by flat, marshy land with sparse, isolated hills. Marshy areas are covered with muskeg and thin, short spruce trees. Walking through marsh it appears that the muskeg or peat is only around 2 to 3 feet deep. Short hills appear to be well drained and covered with tall birch and spruce trees. A hand dug test pit exposed limited surface organices overlying 1 foot of gray volcanic ash on top of tan to brown, silty SAND.	Photo 18; Figure B-1
West 3	650,910 W 6,841,214 N UTM Zone 5	On a slightly larger mound than West 2. A hand dug test pit revealed similar soils exposed in the previous station. It is likely that these small hills are eolian deposited fine sand and silt (old dunes) deposited by adiabatic winds from previous glaciers in the Susitna Valley.	NA
West 4	647,692 W 6,833,013 N UTM Zone 5	South of Redshirt Lake, the terraine is hummocky and typical of glacial deposits of moraines, eskers, or kames. Poorly drained low spots are penetrated by a handheld penetrometer approximately 3 feet, while high spots are penetrated less than 1 foot. Small test pit exposes silty, gravelly sand. A 2 foot diameter erratic was also observed at the site, however, average largest fraction was estimated to be about 1 to 3 inches.	Photos 19 &20; Figure B-2
West 5	647,469 W 6,832,713 N UTM Zone 5	A small marshy area. Ground is flat and covered with peat and sporadic, small spruce trees. A handheld probe penetrated 6 feet. Very difficult to retrieve penetrometer from that depth and tip was clean and cold when removed from the ground. Possible frozen ground (permafrost) at depth.	Photo 21; Figure B-3
West 6	647,253 W 6,831,939 N UTM Zone 5	On the banks of a small creek flowing out of Red Shirt Lake. Topography is similar to glaciofluvial formations like eskers and kames. Significant amount of gravel was observed in the river bed. A 10-foot high bench was formed on the north side of the river. A hand-dug test pit in the side of the bench revealed around 1 foot of sand and silt overlying silty, sandy gravel. Gravel content in soils affected by river action appears to be higher than the average soil condition in the area.	Photo 22; Figure B-3 and Photo 23; Figure B-4
West 7	649,623 W 6,828,333 N UTM Zone 5	At the top of the ridge line that runs north-south, west of the Little Susitna River. Ridge feature is significantly steeper on the east facing side. The west facing side is a generally shallow slope down to the Susitna Valley. The soils look relatively well drained except for isolated lows where water and organics have collected. Organics are primarily decayed plant matter with no peat growth. A hand dug test pit shows upper ash and silt at the surface overlying slightly silty, gravelly sand similar to Photo 18. Coarse particles are rounded suggesting transportation before deposition. The ridge feature could be a large glaciofluvial esker, or a medial moraine.	Photo 24; Figure B-4
West 8	649,144 W 6,828,452 N UTM Zone 5	On western slope of large ridge. Located in a small low lying area on side of the ridge. Test pit dug revealed about 2 feet of decayed organics over hard, tan, sandy silt. The topagraphic feature is typical of low areas dotted around the ridge fromation.	Photos 25 & 26; Figure B-5
West 9	651,605 W 6,828,351 N UTM Zone 5	Approximately 75 foot high bluff on Little Susitna River exposing gravelly sand soils. Gravel is rounded. Finger shaped, small ridge lines (controlling the track of the river) appear to be smaller eskers deposited by past glaciers.	Photo 27; Figure B-6
West 10	650,885 W 6,824,813 N UTM Zone 5	Another bluff on the Little Susitna River that exposes sandy silt to silty sand soils. This bluff is only 30 feet high. The large blocks at the toe of the slope in the photographs are large chunks of frozen silt.	Photo 28; Figure B-6

Table B-1
Detailed Station Descriptions West Corridor

West 11	651,350 W 6,822,683 N UTM Zone 5	A small finger ridge on the banks of the Little Susitna River. A hand dug test pit exposed one foot of ash and silt overlying silty, gravelly sand. The soils here look a lot like the soils encountered on the high portions of the larger ridge explored at Station West 7. This smaller ridge (about 50 feet high) and other numerous ridges like it around the Little Susitna River are likely extensions of the larger feature.	NA
West 12	652,208 W 6,821,489 N UTM Zone 5	A 30 to 50 foot bluff on the Little Susitna River. Exposed soils appear to be primarily sand and silt with isolated areas of gravel. Gravel is typically fine grained or less than 1 inch.	Photo 29; Figure B-7
West 13	653,230 W 6,818,516 N UTM Zone 5	Station located on high, flat ground above the Little Susitna and Cabin Creek. Ground is approximately 50 to 70 feet higher than the drainage elevation. Test pit reveals approximately 6 inches of organics overlying clean sand and sandy gravel. A few small (less than 0.5 inches) pieces of coal were encountered in the hand excavation. Gravel is fine grained and rounded (around 1 inch). Land form and soils suggest that this is an outwash formation deposited by meltwaters beyond the margins of past glacial activity.	Photo 30; Figure B-7
West 14	651,343 W 6,845,444 N UTM Zone 5	Station is located close to private property. The land around the lake is very flat, however does not appear to be boggy. Cottonwood and spruce trees dominate the vegetation cover and encroach close to the banks of the lake. Soil exposure is not present, however the area appears to be relatively well drained.	NA
West 15	651,690 W 6,846,021 N UTM Zone 5	Near a cabin on Boot Lake. The oposite side of the lake appears to contain more topagraphic relief than this side, the lake looks a little boggy around its banks. Vegetation is same as described in Station West 14 otherwise.	Photo 31; Figure B-8
West 16	651,272 W 6,844,699 N UTM Zone 5	Small boggy looking area or an old overgrown pond. Immediate area appears to be poorly drained, however surrounding ground is somewhat higher and is likely well drained.	Photo 32; Figure B-8
West 17	651,663 W 6,844,483 N UTM Zone 5	Walking along the southern banks of Veru Lake. The banks are around 4 feet high with minimal soil exposure. Some soils exposed in the banks appear to be silty, gravelly sand. Areas above the river banks appear to be well drained. No auf ice was observed on the banks of the lake.	NA
West 18	651,976 W 6,844,532 N UTM Zone 5	A relatively fresh excavation around 10 to 15 feet deep. Exposed soils comprise of relatively clean gravelly sand with isolated veines of sandy gravel. Maximum grain size is approximately 3 inches. Average silt content appears to be 3 to 7 percent. Soils are cross bedded just like alluvial deposits.	Photo 33; Figure B-9
West 19	648,636 W 6,846,414 N UTM Zone 5	Area is very flat and appears to be well drained. This site is up on what looks like an old bench of the Susitna River.	NA
West 20	654,593 W 6,844,300 N UTM Zone 5	Station overlooks a small fen that drains into Rainbow Lake. It is pretty hilly in this area with more of the isolated, low bogs and kettle lakes. Could be near a transition from areas of sediment controlled by the Susitna river, and old glacio fluvial action. Some exposed soils on the hill side are primarily silty, gravelly sand with the coarsest material around 2 inches.	Photo 34; Figure B-9
West 21	654,140 W 6,844,824 N UTM Zone 5	A road cut approximately 15 to 20 feet high at the intersection of Crystal Lake Road and Michigan Road. Material consists of silty, gravelly sand to silty, sandy gravel. Material is a little coarser (maximum around 3 to 4 inches) and appears to be silty enough to be a glacio fluvial deposit.	Photo 35; Figure B-10
West 22	655,328 W 6,846,621 N UTM Zone 5	A small cut above Jean Lake exposes several feet of silty, sandy gravel at the surface transitioning to silty, gravelly sand at depth. Topography and soils appear to be kames (high spots) and kettles (low spots). High ground appears to be well drained, low spots look pretty poorly drained.	Photo 36; Figure B-10

Table B-1
Detailed Station Descriptions West Corridor

West 23	654,656 W 6,846,982 N UTM Zone 5	Large borrow pit near Long Lake. Pit walls approaching 40 feet expose pretty uniform slightly silty to silty, gravelly sand. Gravel mostly exists in one to two foot seams and is generally not bigger than 3 to 4 inches. Undisturbed ground around the pit is pretty flat with isolated hills. Soils look like old alluvial deposits, but topography looks more like glacio fluvial. This area could be a margin area, near the boundary of the two different depositional evironments.	Photo 37; Figure B-11
West 24	656,470 W 6,847,370 N UTM Zone 5	This is a small pit behind Radar Hill. The soils exposed in this pit appear to be very similar to those exposed in the pit in Station West 23, however, they may be a littler siltier.	Photo 38; Figure B-11

Photo 17: Station West 1, near Red Shirt Lake trail head. Appears to be an old sand/gravel pit. Soils primarily sand with isolated areas of gravel or silt.

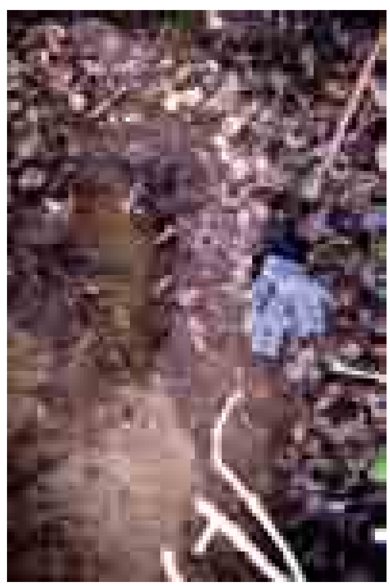

Photo 18: Station West 2, test hole dug exposing thin surface organics and gray ash layer overlying silty sand.

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PHOTOS 17 and 18	
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Photo 19: Station West 4, erratic encountered south of Red Shirt Lake.

Photo 20: Station West 4, typical high spot in local hummocky terrain. High and low spots (average relief of around 30 to 50 feet) are somewhat elongated like eskers.

Mat-Su Rail Corridor Mat-Su Valley, Alaska	
PHOTOS 19 and 20	
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Photo 21: Station West 5, small marshy area surrounded by spruce trees. A probe penetrated 6 feet into ground and was cold and hard to retrieve, possibly frozen at depth.

Photo 22: Station West 6, creek flowing out of Red Shirt Lake (several miles up stream). Sand and a significant amount of gravel was observed in the river bed.

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Mat-Su Valley, Alaska

PHOTOS 21 and 22

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Fig. B-3

Photo 23: Station West 6, test hole dug into 10 foot bluff on creek bank showing about 1 foot of sand and silt overlying silty, sandy gravel.

Photo 24: Station West 7, atop north-south ridge west of the Little Susitna River. Soils appear well drained with widely spaced spruce and birch trees.

Mat-Su Rail Corridor Mat-Su Valley, Alaska	
PHOTOS 23 and 24	
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Photo 25: Station West 8, western slope of large ridge from Station West 7. Terraine is hummocky with well drained high areas surrounding isolated, poorly drained low spots.

Photo 26: Station West 8, small test pit showing around 2 feet of decayed organics overlying hard, tan sandy silt.

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PHOTOS 25 and 26

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Fig. B-5

Photo 27: Station West 9, bluff on east side of Little Susitna River exposing gravelly sand soils.

Photo 28: Station West 10, bluff along west edge of Little Susitna River exposing silty sand soils. Large blocks are chunks of frozen silt.

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PHOTOS 27 and 28

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Fig. B-6

Photo 29: Station West 12, bluff on west side of Little Susitna River exposing sand and silt with isolated areas of fine gravel.

Photo 30: Station West 13, on high ground east of the Little Susitna River. Topography and rounded grains in test hole suggest the terrain has transitioned to an outwash plain.

Mat-Su Rail Corridor Mat-Su Valley, Alaska	
PHOTOS 29 and 30	
June 2003	32-1-01506
SHANNON & WILSON, INC. Geotechnical & Environmental Consultants	**Fig. B-7**

Photo 31: Station West 15, Boot Lake. Surrounded by boggy areas. Higher ground on opposite side contains larger trees and is likely well drained like high ground observed on the east corridor north of Carpenter Lake.

Photo 32: Station West 16, small boggy area surrounded by tall spruce and birch trees. Likely an overgrown pond.

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PHOTOS 31 and 32

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Fig. B-8

Photo 33: Station West 18, a fresh excavation about 10 to 15 feet deep exposing relatively clean gravelly sand. Soils are crossbedded like an alluvial deposit.

Photo 34: Station West 20, small creek that drains a boggy area into Rainbow Lake. Sand and gravel observed in the creek bed.

Mat-Su Rail Corridor Mat-Su Valley, Alaska	
PHOTOS 33 and 34	
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SHANNON & WILSON, INC. Geotechnical & Environmental Consultants	**Fig. B-9**

Photo 35: Station West 21, a 15 to 20 foot road cut on Crystal Lake Road exposing sands and gravels ranging from clean to slightly silty.

Photo 36: Station West 22, small cut on the east hillside above Jean Lake. Areas with no ice or snow cover reveal relatively gravelly soils.

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PHOTOS 35 and 36	
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SHANNON & WILSON, INC. Geotechnical & Environmental Consultants	**Fig. B-10**

Photo 37: Station West 23, a very large borrow pit east of Long Lake.
Soils in cut are clean, interbedded sands and gravels, likely alluvial.
The cut face is approximately 30 feet high.

Photo 38: Station West 24, a small borrow pit at Radar Hill exposing
clean sands and gravels, pit wall is about 20 feet high.

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PHOTOS 37 and 38	
June 2003	32-1-01506
SHANNON & WILSON, INC. Geotechnical & Environmental Consultants	Fig. B-11

APPENDIX C

IMPORTANT INFORMATION ABOUT YOUR GEOTECHNICAL/ENVIRONMENTAL REPORT

Date: June 23, 2003
To: Ted Trueblood, P.E.
Tryck, Nyman, Hayes, Inc.

Important Information About Your Geotechnical/Environmental Proposal

CONSULTING SERVICES ARE PERFORMED FOR SPECIFIC PURPOSES AND FOR SPECIFIC CLIENTS.

Consultants prepare reports to meet the specific needs of specific individuals. A report prepared for a civil engineer may not be adequate for a construction contractor or even another civil engineer. Unless indicated otherwise, your consultant prepared your report expressly for you and expressly for the purposes you indicated. No one other than you should apply this report for its intended purpose without first conferring with the consultant. No party should apply this report for any purpose other than that originally contemplated without first conferring with the consultant.

THE CONSULTANT'S REPORT IS BASED ON PROJECT-SPECIFIC FACTORS.

A geotechnical/environmental report is based on a subsurface exploration plan designed to consider a unique set of project-specific factors. Depending on the project, these may include: the general nature of the structure and property involved; its size and configuration; its historical use and practice; the location of the structure on the site and its orientation; other improvements such as access roads, parking lots, and underground utilities; and the additional risk created by scope-of-service limitations imposed by the client. To help avoid costly problems, ask the consultant to evaluate how any factors that change subsequent to the date of the report may affect the recommendations. Unless your consultant indicates otherwise, your report should not be used: (1) when the nature of the proposed project is changed (for example, if an office building will be erected instead of a parking garage, or if a refrigerated warehouse will be built instead of an unrefrigerated one, or chemicals are discovered on or near the site); (2) when the size, elevation, or configuration of the proposed project is altered; (3) when the location or orientation of the proposed project is modified; (4) when there is a change of ownership; or (5) for application to an adjacent site. Consultants cannot accept responsibility for problems that may occur if they are not consulted after factors, which were considered in the development of the report, have changed.

SUBSURFACE CONDITIONS CAN CHANGE.

Subsurface conditions may be affected as a result of natural processes or human activity. Because a geotechnical/environmental report is based on conditions that existed at the time of subsurface exploration, construction decisions should not be based on a report whose adequacy may have been affected by time. Ask the consultant to advise if additional tests are desirable before construction starts; for example, groundwater conditions commonly vary seasonally.

Construction operations at or adjacent to the site and natural events such as floods, earthquakes, or groundwater fluctuations may also affect subsurface conditions and, thus, the continuing adequacy of a geotechnical/environmental report. The consultant should be kept apprised of any such events, and should be consulted to determine if additional tests are necessary.

MOST RECOMMENDATIONS ARE PROFESSIONAL JUDGMENTS.

Site exploration and testing identifies actual surface and subsurface conditions only at those points where samples are taken. The data were extrapolated by your consultant, who then applied judgment to render an opinion about overall subsurface conditions. The actual interface between materials may be far more gradual or abrupt than your report indicates. Actual conditions in areas not sampled may differ from those predicted in your report. While nothing can be done to prevent such situations, you and your consultant can work together to help reduce their impacts. Retaining your consultant to observe subsurface construction operations can be particularly beneficial in this respect.

A REPORT'S CONCLUSIONS ARE PRELIMINARY.

The conclusions contained in your consultant's report are preliminary because they must be based on the assumption that conditions revealed through selective exploratory sampling are indicative of actual conditions throughout a site. Actual subsurface conditions can be discerned only during earthwork; therefore, you should retain your consultant to observe actual conditions and to provide conclusions. Only the consultant who prepared the report is fully familiar with the background information needed to determine whether or not the report's recommendations based on those conclusions are valid and whether or not the contractor is abiding by applicable recommendations. The consultant who developed your report cannot assume responsibility or liability for the adequacy of the report's recommendations if another party is retained to observe construction.

THE CONSULTANT'S REPORT IS SUBJECT TO MISINTERPRETATION.

Costly problems can occur when other design professionals develop their plans based on misinterpretation of a geotechnical/environmental report. To help avoid these problems, the consultant should be retained to work with other project design professionals to explain relevant geotechnical, geological, hydrogeological, and environmental findings, and to review the adequacy of their plans and specifications relative to these issues.

BORING LOGS AND/OR MONITORING WELL DATA SHOULD NOT BE SEPARATED FROM THE REPORT.

Final boring logs developed by the consultant are based upon interpretation of field logs (assembled by site personnel), field test results, and laboratory and/or office evaluation of field samples and data. Only final boring logs and data are customarily included in geotechnical/environmental reports. These final logs should not, under any circumstances, be redrawn for inclusion in architectural or other design drawings, because drafters may commit errors or omissions in the transfer process.

To reduce the likelihood of boring log or monitoring well misinterpretation, contractors should be given ready access to the complete geotechnical engineering/environmental report prepared or authorized for their use. If access is provided only to the report prepared for you, you should advise contractors of the report's limitations, assuming that a contractor was not one of the specific persons for whom the report was prepared, and that developing construction cost estimates was not one of the specific purposes for which it was prepared. While a contractor may gain important knowledge from a report prepared for another party, the contractor should discuss the report with your consultant and perform the additional or alternative work believed necessary to obtain the data specifically appropriate for construction cost estimating purposes. Some clients hold the mistaken impression that simply disclaiming responsibility for the accuracy of subsurface information always insulates them from attendant liability. Providing the best available information to contractors helps prevent costly construction problems and the adversarial attitudes that aggravate them to a disproportionate scale.

READ RESPONSIBILITY CLAUSES CLOSELY.

Because geotechnical/environmental engineering is based extensively on judgment and opinion, it is far less exact than other design disciplines. This situation has resulted in wholly unwarranted claims being lodged against consultants. To help prevent this problem, consultants have developed a number of clauses for use in their contracts, reports and other documents. These responsibility clauses are not exculpatory clauses designed to transfer the consultant's liabilities to other parties; rather, they are definitive clauses that identify where the consultant's responsibilities begin and end. Their use helps all parties involved recognize their individual responsibilities and take appropriate action. Some of these definitive clauses are likely to appear in your report, and you are encouraged to read them closely. Your consultant will be pleased to give full and frank answers to your questions.

The preceding paragraphs are based on information provided by the
ASFE/Association of Engineering Firms Practicing in the Geosciences, Silver Spring, Maryland