EVACUATION AND SCHOOL ACCESS ROAD PROJECT KIVALINA, ALASKA

ROUTE RECONNAISSANCE STUDY

Submitted to:
Native Village of Kivalina

Revised:
June 2014

Submitted by:
WHPacific

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Figures

Tables

Appendices

ADEC	Alaska Department of Environmental Conservation
ADF&G	Alaska Department of Fish and Game
ADNR	Alaska Department of Natural Resources
ADOT&PF	Alaska Department of Transportation and Public Facilities
AK	Alaska
ANCSA	Alaska Native Claims Settlement Act
ATV	All-terrain vehicle
AVEC	Alaska Village Electric Cooperative
BIA	Bureau of Indian Affairs
BLM	Bureau of Land Management
CL	Centerline
CY	Cubic Yard
DCCED	Alaska Department of Commerce, Community, and Economic Development
DGGS	ADNR, Division of Geological and Geophysical Surveys
DMLW	ADNR, Division of Mining, Land and Water
E	East
EA	Environmental Assessment
EFH	Essential Fish Habitat
EIS	Environmental Impact Assessment
ENE	East-Northeast
ESE	East-Southeast
°F	Degrees Fahrenheit
FAA	Federal Aviation Administration
FHWA	Federal Highway Administration
FONSI	Finding of No Significant Impact
ft	Feet
GPS	Global Position System
H	Horizontal
IRA	Indian Reorganization Act
LF	Linear Feet
mi.	Mile
MSL	Mean sea level
N	North
NAB	Northwest Arctic Borough
NANA	NANA Regional Corporation
NE	Northeast
NEPA	National Environmental Policy Act
NIHA	Northwest Inupiat Housing Authority
NMFS	U.S. National Marine Fisheries Service

NNE	North-Northeast
No.	Number
NOAA	National Oceanic and Atmospheric Administration
NVK	Native Village of Kivalina
NW	Northwest
NWABSD	Northwest Arctic Borough School District
P.E.	Professional Engineer
P.O.	Post Office
ROW	Right-of-way
S	South
SE	Southeast
Secs	Sections
SF	Square Feet
SHPO	State Historic Preservation Office
U.S.	United States
USACE	U.S. Army Corps of Engineers
USCG	U.S. Coast Guard
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Service
USS	U.S. Survey
V	Vertical
W	West
WRCC	Western Regional Climate Center
‘	Feet
%	Percent
$	U.S. Dollar

1 Executive Summary

The Native Village of Kivalina (NVK) hired WHPacific, Incorporated (WHPacific) to perform a route reconnaissance study to evaluate and recommend an evacuation road alignment between Kivalina and Kisimigiuqtuq Hill.

Kivalina is precariously located on a low lying barrier island, between the Chukchi Sea and Kivalina Lagoon. The severity of recent storms has put the village at serious risk of being inundated by an ocean storm event. Currently, there is no way to safely escape the island during a significant storm event. It is critical that an evacuation road be constructed that will allow residents to safely evacuate the island and reach higher ground.

This Route Reconnaissance Study included performing literature research, field reconnaissance, geotechnical investigation, and review of environmental requirements. New aerial photography and a limited amount of topographical information was obtained. Meetings were held with the community, local councils, and various governmental agencies.

The study identified various potential routes between Kivalina and Kisimigiuqtuq Hill, the location the village previously identified as their evacuation destination point. This report evaluates three alternative alignments: the Southern, Northern, and Combined Routes.

The evaluation and recommendations are based on the following: concerns raised by the residents of Kivalina; geotechnical information, i.e. soils and potential material sources; topographical mapping and aerial photography; right-of-way and property issues; environmental concerns; design and construction costs; other potential uses of the road, i.e. school site, gravel source, airport site, landfill site, water source, village relocation, etc.; and maintenance requirements.

The Southern Route is recommended as the preferred alternative. This route begins at the northwest edge of the village near the southern end of the airport, crosses Kivalina Lagoon with a causeway and bridge(s), continues through a low tidally-influenced area and then the tundra, and terminates at the lower slope of Kisimigiuqtuq Hill. The estimated cost to construct the Southern Route is $41 million.

It is also recommended that the Wulik River material sites, identified in the geotechnical investigation, be further investigated and proved out.

Given the emergency nature of the project, it is recommended that all means to accelerate and streamline the funding, design, permitting, and construction processes be pursued. A document titled, "*A Plan Forward*," is included to help the NVK navigate through the design phase of the project.

2 Introduction

2.1 Purpose of Report

On July 3, 2013, the Native Village of Kivalina (NVK) contracted with WHPacific, Incorporated (WHPacific) to perform a route reconnaissance study to evaluate and recommend an evacuation road alignment between Kivalina and Kisimigiuqtuq Hill. The original Bureau of Indian Affairs (BIA) Route Numbers for the road to Kisimigiuqtuq Hill were Sections 10, 20, and 30 of Route 1250 and all of Route 1260. Since the draft of this report was completed, NVK has submitted Route 1290 for inclusion into the BIA inventory, as it more accurately reflects the recommendations of this Route Reconnaissance Report.

The primary purpose of this report is to consolidate the known information, both existing and newly obtained, regarding the evacuation road route alternatives into one document. This report will be used by the NVK Council to evaluate and select their preferred route in which to proceed to design, and ultimately construction, with.

The secondary purpose of this report is to allow the sharing of project information and status with the various stakeholders of this project. Because of the size and magnitude of this project, coordination with various governmental agencies and funding agencies is essential. Keeping all parties involved and informed will be critical to success.

Another important purpose of this report is to get a good look at the path forward. Various required pre-construction tasks have been identified and their costs estimated. This information will be valuable in planning and obtaining funding.

2.2 Need for Project

Kivalina is a traditional Inupiat (Eskimo) village located in northwest Alaska. Its precarious position on a low lying barrier island, between the Chukchi Sea and Kivalina Lagoon, and the severity of recent storms, have put the village at serious risk of being inundated by an ocean storm event.

Currently, there is no way for the villagers to escape the island by foot or wheeled vehicles; the only way to leave is by plane or boat. During a storm event both of these means of escape would be extremely dangerous, if not impossible. If a storm surge reaches a level where evacuation of the village is necessary, there is no way for people to evacuate. It is extremely important that an evacuation road be constructed that will allow the residents to safely escape from the barrier island and reach higher ground.

2.3 Description of the Project and Report

The report is organized roughly in the order that the project was executed. However, many of the tasks were on-going throughout the project.

Before the first preliminary routes were identified, much research was conducted to gather existing project-related data that would be used to prepare this report. Of particular importance, early on, was obtaining the mapping and aerial photography used to create the base map used for the field work and to identify potential routes. The researched information is most obviously seen in Sections 3 and 4, but was used and incorporated throughout the entire route reconnaissance and selection process. A list of the sources contacted and the information obtained is included in Appendix A.

Once the base map was created, potential routes were drawn on the map. At this stage, routes were identified primarily based on the starting and ending points, and avoiding water bodies and Native Allotments. These initial routes were used at the early council and community meetings to gather input and comments regarding the actual routes that should be investigated during the field reconnaissance and geotechnical exploration phase.

Throughout the project, meetings were held regularly with the NVK and City of Kivalina councils, the community, and agencies. Summaries of these meetings are included in Section 5. The meeting minutes are included in Appendix B.

After the first community meeting, the initial routes were modified and distributed to the field reconnaissance and geotechnical exploration teams. The reconnaissance and geotechnical field work occurred concurrently so that the support helicopter costs could be shared. The field reconnaissance efforts are described in Section 6 and the Field Reconnaissance Report is included in Appendix C. The geotechnical investigation efforts are described in Section 7 and the Geotechnical Report is included in Appendix D.

Based on the information obtained during the field reconnaissance, geotechnical investigation, and second community meeting, the alternative routes were again modified. The resulting alternative route alignments are described in Section 8.

Also as part of this project, an environmental review was performed. An earlier, cursory, review was done in 2012, but was very conservative in nature. This updated review was more in-depth and based on a greater understanding of the project. The information learned and the recommended environmental strategy are described in Section 9.

In 2012, required pre-construction tasks were identified and their associated costs were estimated. A construction cost estimate was also prepared at that time. Now that the project is better defined and the issues clearer, these tasks and costs have been revised to

reflect the current understanding. The updated estimated pre-construction and construction costs are summarized and described in Section 10. The Conceptual-Level Construction Cost Estimates are included in Appendix E.

After all the information was gathered and processed, the alternative routes were evaluated based on many factors, including: the physical alignments, geotechnical information, gravel sources, property ownership, environmental considerations, costs, and public and agency concerns. The analysis of the road route alignments is described in Section 11.

Based on all of the information gathered as part of this project, WHPacific presents our preferred alignment and offers other recommendations. WHPacific's recommendations are located in Section 12.

Finally, to help the NVK navigate the remainder of this complex project we have included a section titled "A Plan Forward." This suggested plan forward is described in Section 13. The *"A Plan Forward"* document is included in Appendix F.

3 Community Information and Existing Conditions

3.1 Location

Kivalina is located in northwestern Alaska, within the Northwest Arctic Borough, approximately 80 miles northwest of Kotzebue, 310 miles southwest of Barrow, 510 miles west-northwest of Fairbanks, and 640 miles northwest of Anchorage. (See Figure 1 – Location Map, at the end of this section.) The village is situated on the southeast tip of a 5.5-mile long barrier island located between the Chukchi Sea (Arctic Ocean) and Kivalina Lagoon. (See Figure 2 – Area Map, at the end of this section.)

The project's beginning point, the village of Kivalina, is in the Kotzebue Recording District and is located in Section 21, Township 27 N, Range 26 W, of the Kateel River Meridian. The community's geographical coordinates are approximately 67° 43' North, 164° 32' West.

The project's destination point, Kisimigiuqtuq Hill, is located in Section 19, Township 28 N, Range 25 W, of the Kateel River Meridian. The project alternative routes are located within Townships 27 and 28 N, Ranges 25 and 26 W, of the Kateel River Meridian. The geographical coordinates of Kisimigiuqtuq Hill's summit are approximately 67° 49' North, 164° 23' West.

3.2 Access

Access into and out of Kivalina is primarily by plane. The Alaska Department of Transportation and Public Facilities (ADOT&PF) owns and maintains the Kivalina airport. Regularly scheduled and charter air service is available from Kotzebue.

There are no roads to Kivalina. However, in the winter there are marked snow machine trails connecting to other villages and Kotzebue. There are also numerous subsistence trails within the area. Depending on the season, small boats, snow machines, all-terrain vehicles (ATVs), and/or full-sized vehicles are used for local transportation.

Barges deliver bulk goods when the Chukchi Sea is ice-free, which is generally between mid-June and early November. Crowley Marine Services usually barge in goods from Kotzebue during July and August.

3.3 Population and Economy

At the time of the 2010 U.S. Census, the population of Kivalina was 374. The 2012 Alaska Department of Commerce, Community, and Economic Development (DCCED) certified population estimate was 402. The 2010 Census also revealed that Alaska Natives represented 96.3 percent of the population and that that the average household had approximately five people in it.

The residents of Kivalina rely heavily on traditional subsistence practices. Employment opportunities are limited. The main employers are the Native Village of Kivalina, City of Kivalina, McQueen School, Maniilaq Association, and the local stores. The Red Dog Mine (located approximately 53 miles northeast) also offers some employment. A few residents hold commercial fishing permits. Numerous artisans work with ivory and whale bone and make jewelry and carvings.

3.4 Governments

The Native Village of Kivalina (NVK) is a federally recognized tribe governed by the Kivalina IRA Council. The Council is both a traditional council and a federally recognized government by virtue of its Indian Reorganization Act (IRA) constitution.

Kivalina was incorporated as a second class city in the Northwest Arctic Borough (NAB) in 1969. The City also has a City Council.

Contact information is listed below.

Native Village of Kivalina
Kivalina IRA Council
P.O. Box 50051
Kivalina, AK 99750
Phone: (907) 645-2153
Fax: (907) 645-2193
E-mail: tribeadmin@kivaliniq.org
President: Millie Hawley
Tribal Administrator: Stanley Hawley

City of Kivalina
P.O. Box 50079
Kivalina, AK 99750
Phone: (907) 645-2137
Fax: (907) 645-2175
Mayor: Austin Swan, Sr.

Northwest Arctic Borough
P.O. Box 1110
Kotzebue, Alaska 99752
Phone: (907) 442-2500
Fax: (907) 442-2930
E-mail: info@nwabor.org
Mayor: Reggie Joule

While not governments, NANA Regional Corporation (NANA) and Maniilaq Association (a regional non-profit tribal consortium providing health, tribal, and social services) also serve the Native community in Kivalina. Their contact information is listed below.

NANA Regional Corporation
P.O. Box 49
Kotzebue, Alaska 99752
Phone: (907) 442-3301
Fax: (907) 442-2866
President: Marie Greene

Maniilaq Association
P.O. Box 256
Kotzebue, Alaska 99752
Phone: 1-800-478-3312
President / CEO: Ian Erlich

3.5 History and Culture

The northwest coastal region of Alaska has been inhabited for thousands of years by Inupiat Eskimos. Coastal Inupiat residents had established villages and trading routes long before European contact and exploration. The area around Kivalina was a traditional stopping-off point for travelers between Arctic coastal communities and Kotzebue Sound communities. In the mid-19th century, the people of Kivalina lived in small settlements along the Wulik, Kivalina, and upper Kukpuk Rivers. Kivalina village was first recorded as "Kivualinagmut" in 1847 by the Russian Imperial Navy. At that time it was located at the northern end of Kivalina Lagoon. In 1885, the U.S. Navy recorded the village as "Kuveleek."

The community settled at their present village location in 1905 when the federal government built a school on the island. A post office was established in 1940, and an air airstrip was built in 1960. Kivalina was incorporated as a second class city in 1969. Construction of a new school, new houses, and an electric system followed in the 1970's.

Kivalina is a traditional Inupiat village, whose traditional culture is based on subsistence hunting and gathering of whales, fish, caribou, moose, berries, and root plants. Today the people of Kivalina combine a subsistence lifestyle with a modern wage economy. Residents maintain their traditional ties to the land by employing the skills and values that have been passed down for generations.

3.6 Infrastructure – Housing, Utilities, and Services

The 2010 U.S. Census reported 99 houses in Kivalina; 85 were occupied, and 14 were vacant.

Community water is obtained from the Wulik River using a seasonal three-mile long surface transmission line. Raw water is stored in a 700,000-gallon tank prior to treatment. Treated water is then stored in 500,000-gallon tank. Water transmission lines extend only to the washeteria and school; there are no piped water services to the homes. Residents obtain treated water from a watering point at the City of Kivalina's water plant and then transport it by ATV to their homes. A few homes have water storage tanks that provide running water for the kitchen.

There are also no piped sewer services from the homes. Residents use "honey-buckets," which must be transported and emptied into a containment bunker near the north end of the landfill, over a mile away. Residents dispose of their non-septic wastewater (grey water) outside of their houses. The washeteria, clinic, and school have septic systems.

The landfill is a Class III unpermitted landfill, located approximately one mile northwest of the village center. Access to the landfill requires crossing the length of the airport property, as it is located a few hundred yards beyond the north of the end of the runway. The close proximity of the landfill to the runway is a Federal Aviation Administration (FAA) violation, which has raised serious safety concerns due to bird interference with planes.

Electric service is provided by the Alaska Village Electric Cooperative (AVEC). Fuel oil is the primary heat source. Telephone and internet services are provided by OTZ Telephone Cooperative and GCI.

McQueen School, which includes pre-kindergarten through grade 12, is administered by the Northwest Arctic Borough School District (NWABSD). In the fall of 2013 the school had 136 students and 9 teachers.

Local health care is provided by Maniilaq Association at the Kivalina Clinic. Primary health care is obtained at the Maniilaq Health Center in Kotzebue or at the Alaska Native Medical Center in Anchorage.

Other structures in the community include the following government, commercial, and public facilities: NVK/City office, post office, community hall, Alaska Army National Guard, Kivalina Friends Church, Epiphany Church (Episcopal), Kivalina Native store and warehouse, heavy equipment storage building, and ADOT&PF hangar.

3.7 Infrastructure – Transportation

3.7.1 Roads

There are approximately 1.5 miles of roads and streets in Kivalina, with loosely defined traveled ways that range from between 10 and 40 feet in width. The roads appear to have been constructed by scraping off the surface organic layer and utilizing the underlying sands and gravels as the road surface. The roads are not maintained, have undulating surface profiles, and have numerous large depressions where deep ponding occurs during wet weather.

3.7.2 Bridges

There are no bridges in Kivalina.

3.7.3 Airports

The State of Alaska owns and maintains the Kivalina airport, which is located just northwest of, and adjacent to, the village. The airport only has one runway, due to the narrow width of the island. The gravel-surfaced runway is 3,000 feet long by 60 feet wide, oriented in a northwest - southeast direction, and is lit by medium intensity runway edge lights. During the spring thaw the runway develops potholes that can be hazardous.

3.7.4 Barge Landings / Docks / Boat Landings

Kivalina does not have a developed barge landing facility. Barges currently off-load on the beach along the ocean front side of the island. The water in the lagoon is very shallow, generally less than five feet deep, and cannot accommodate barges.

There are no docks in Kivalina, so small boats are moored in the lagoon along the beach on the east side of the village.

3.8 Land Ownership and Right-of-Way

Under Section 12(a) of the Alaska Native Claims Settlement Act (ANCSA), the local Village Corporation was entitled to select the surface rights to 92,160 acres of land. The Village Corporation has since merged with NANA Regional Corporation (NANA). Village lands are now held and managed by NANA. There have been no ANCSA 14(c)(3) actions in Kivalina, but talks are underway. NANA owns the subsurface rights to all NANA and Village lands.

There are numerous Native Allotments located in the area surrounding the village, primarily along the Kivalina and Wulik Rivers. The known Native Allotments are shown in Figure 2.

Street rights-of-way (ROW) were provided for in the Kivalina Townsite Survey (US Survey No. 5582). ROW varies from 20 to 40 feet; however there are numerous buildings

and obstacles located within the ROW. In addition to the platted roadways, there are unplatted roads which have evolved from local traffic patterns.

3.9 Gravel Sources

There are no developed borrow sources located in the Kivalina area. An economical source of borrow material will need to be identified and developed, as construction of an evacuation road will require a substantial amount of borrow material.

Sands and gravels are available from the barrier islands, but because of the narrowness of the islands, the low elevation, and their susceptibility to erosion, these sources should not be considered.

The *"Kivalina Borrow Material Exploration,"* performed by DOWL/BBFM Engineers in 1998, found numerous sources of gravel borrow material along the Wulik River. These sites were located along the lower stretches of the river, approximately one to five miles upriver from the mouth.

ADOT&PF, U.S. Army Corps of Engineers (USACE), and R&M Consultants explored for borrow material at the bottom of Kivalina Lagoon, in 1984, 2001, and 2002, respectively. These limited explorations revealed areas with silt, sand, and/or gravel material. The unfrozen bottom sediment may be suitable for borrow, if it was excavated by suction dredge in the summer. However, before this option is pursued, a more thorough exploration and evaluation program would need to be undertaken to better define the extents, quantity, and quality of the material and the costs to recover it.

As part of this project, a preliminary geotechnical investigation was performed by Golder Associates. That investigation found gravel and sand deposits along both the Wulik and Kivalina Rivers, as well as in numerous remnant channels of the Wulik River, located to the west of the existing channel. A summary of that investigation is presented in Section 6 of this report.

All gravel mined for this project will be required to pay royalties to the owner of the gravel. If gravel is mined from within the Wulik or Kivalina Rivers, the Alaska Department of Natural Resources (ADNR), Division of Mining, Land and Water (DMLW) will require royalties of $0.50 per cubic yard (CY), if a government entity recognized by the State of Alaska is the permit holder, otherwise it will be $2.00 per CY. NANA's royalty charges are $2.50 per CY for gravel taken from their lands. If the material is mined from a Native Allotment, then the price would be negotiated with the property owner.

3.10 Natural Hazards

The precipitous location of Kivalina, on a narrow barrier island along the ocean, puts the village at significant risk of a storm surge washing over the village in a high-water event. In the working draft of the letter report entitled, *"Reformulation of Water-Surface Elevation Frequency-of-Occurrence Relationships for Kivalina, Alaska,"* dated July 2003, the USACE states that the 100-year water-surface elevation, due to storm surge, is 4.97 meters (16.3 feet) above Mean Sea Level (MSL). The average elevation of the village is less than 10 feet above MSL. If this predicted storm surge event hit Kivalina, the entire village would be under water. The threat of a storm surge that could inundate Kivalina is severe.

The island is also subject to severe erosion on three sides: along the ocean side, near Singauk Entrance at the south tip of the village, and on the lagoon side where the flow from the Wulik and Kivalina Rivers converge. Erosion has been occurring steadily for many years, with signs of acceleration in recent years. In 2004, over 40 feet of shoreline was lost during a single storm event. Many structures are in danger of being damaged or destroyed by the effects of the beach erosion. In 2010, the USACE completed a beach erosion control project that installed riprap along the seaward side of the island, adjacent to the village. The lagoon side and airport are still unprotected and vulnerable.

Effects of climate change are significant in Arctic regions. Since the early 1980's, the time between spring break-up of sea ice and fall freeze-up along Arctic shorelines has increased from barely three months to as much as five months. This substantially extends the time window for coastal erosion, as well as for significant damage from storm surges.

Threats from earthquakes are low, as Kivalina is in seismic risk zone one (low risk).

3.11 Climate

Kivalina is located within Alaska's Transitional Climatic Zone. The Chukchi Sea has a major weather impact on the area, but because it is frozen approximately half the year, Kivalina has a climate that is transitional between Maritime and Continental.

The following data, relative to the project area, are from the *Environmental Atlas of Alaska* and the Western Regional Climate Center (WRCC).

Table 1. Climate Data

	Environmental Atlas of Alaska	WRCC (1998 - 2008)	Units
Mean Annual Temperature	19	22	°F
January Temperature Range	-13 to -1	-11 to -7	°F
July Temperature Range	43 to 53	44 to 55	°F
Extreme Low Temperature		- 46	°F
Extreme High Temperature		96	°F
Mean Annual Precipitation	17	10	inches
Mean Annual Snowfall	40		inches
Thawing Index	1,350		°F - days
Design Thawing Index	2,250		°F - days
Freezing Index	6,100		°F - days
Design Freezing Index	6,550		°F - days
Prevailing Wind (Winter)		NNE	
Prevailing Wind (Spring)		N	
Prevailing Wind (Summer)		W	
Prevailing Wind (Fall)		N	

3.12 Physiography and Topography

Kivalina is located within the Arctic Foothills Physiographic Province of Alaska, which is generally characterized by rolling hills and gentle slopes. The community of Kivalina, however, is located at the southeastern tip of an approximately 5.5-mile long barrier island separating Kivalina Lagoon on the east from the Chukchi Sea on the west. The island, part of a 9.5-mile long barrier reef, has the overall appearance of a barrier island migrating shoreward, with a steep beach profile on the seaward shore, and sandy spit depositions on the lagoon side. Two tidal inlets define the island: Singauk Entrance, by the village, and Kivalik Inlet, 5.5 miles to the northwest.

Two rivers flow into Kivalina Lagoon: the Kivalina River at the northern end of the lagoon and the Wulik River at the southern end. The flood plains of both rivers are broad and braided.

Kisimigiuqtuq Hill has an elevation of 460 feet. Near the summit, the slopes are steep, but they gradually lessen to moderate and then shallow slopes near the base. The base of the

hill is at an elevation of approximately 80 feet. From the base of the hill, the topography slopes gently to the lagoon, approximately six miles to the southwest.

The project is located between the base of Kisimigiuqtuq Hill and the village of Kivalina. In general, the topography along the alternative alignments ranges from flat to gently sloping. The surface vegetation ranges from wet tundra with tussocks and two-foot tall grasses, to dry tundra with dwarf birch and willow. Polygonal ground is found in some of the higher areas, and indicate the presence of ice wedges. Shallow water ponds are located along the base of slopes. More specific descriptions are located in the sections describing each alternative.

3.13 Geology and Soils

Bedrock is seldom exposed in the area, except in the hills to the north of the project. Kisimigiuqtuq Hill is the only hill within the project area and is characterized by exposed limestone subcrop and rock rubble at the ground surface. While no large outcrops of limestone were observed at the surface, it is anticipated that below the surface larger frost-fractured rocks and boulders may exist.

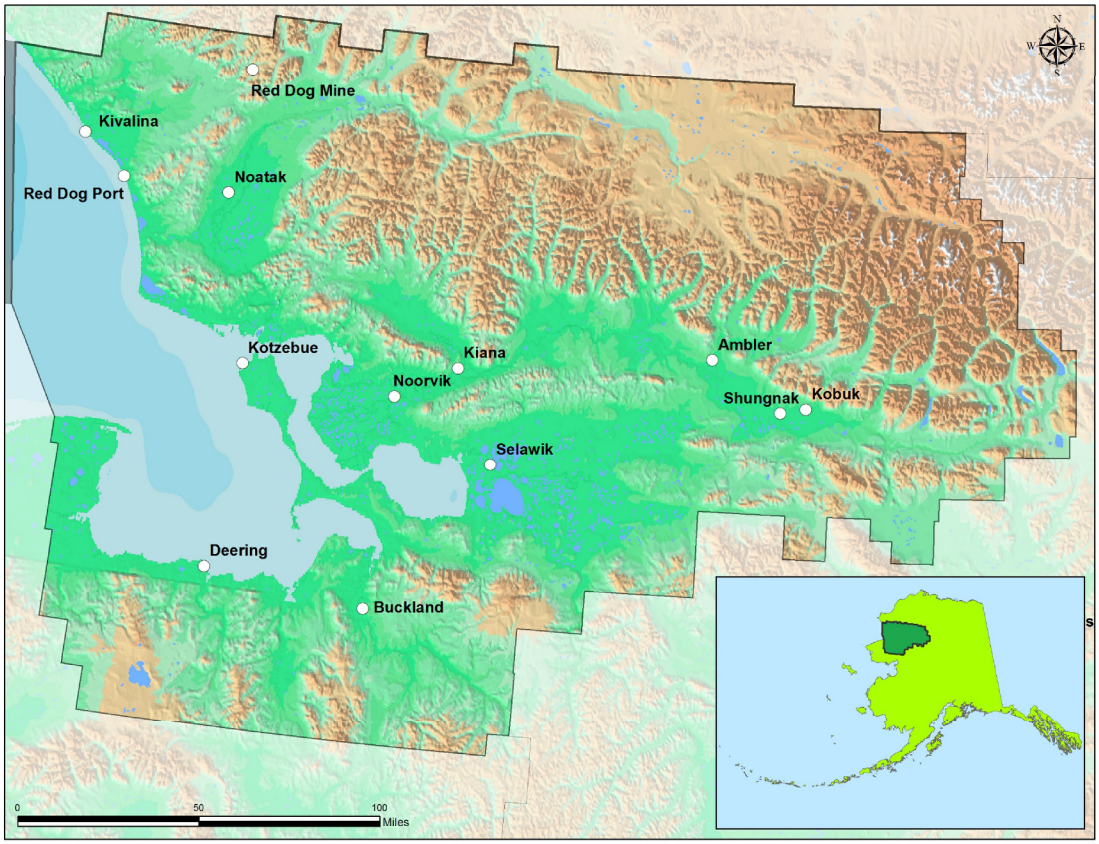
Sea level fluctuation has resulted in the accumulation of sandy beach deposits at various locations, both offshore and inland from the present coastline. These deposits are similar in composition to the present beach deposits, but in many cases have been partially or totally eroded away or buried by newer fine grained material.

The drainage patterns of the Wulik and Kivalina Rivers have controlled much of the post-glacial deposition of local sediments. Glacial deposits in the headwaters have been reworked by stream and river action and are the source of gravelly sand and sandy gravel deposits in the modern floodplains. Wind-blown silt and sand is often present as a near-surface veneer which, with surface vegetation, forms the present tundra cover. Along the eastern edge of Kivalina Lagoon, between the two rivers, a vegetation covered tidal influenced zone extends as much as two miles inland.

The Kivalina and Wulik Rivers have numerous gravel bars and beaches along their current banks. Relict channels of the Wulik River were also observed north of its present channel. Sand and gravel deposits, visible at the surface, were observed in many locations along these relict channels.

Beneath one to two feet of seasonally thawed material, the mainland east of the lagoon is almost universally underlain by permafrost. Horizontally layered ice masses are common and near vertical ice wedges that developed in soil contraction cracks have resulted in a surficial feature known as polygonal patterned ground. The segregated ice is generally confined to the fine-grained, organic-rich surface material, but under some conditions ice wedges have penetrated into the underlying granular material.

The active soil layer is generally 0.5 feet to 2 feet below the surface. In the tidal area near the lagoon, the depth extends down to 6 feet in areas. There is the potential that thaw bulbs may be found in the vicinity of the Wulik and Kivalina Rivers.



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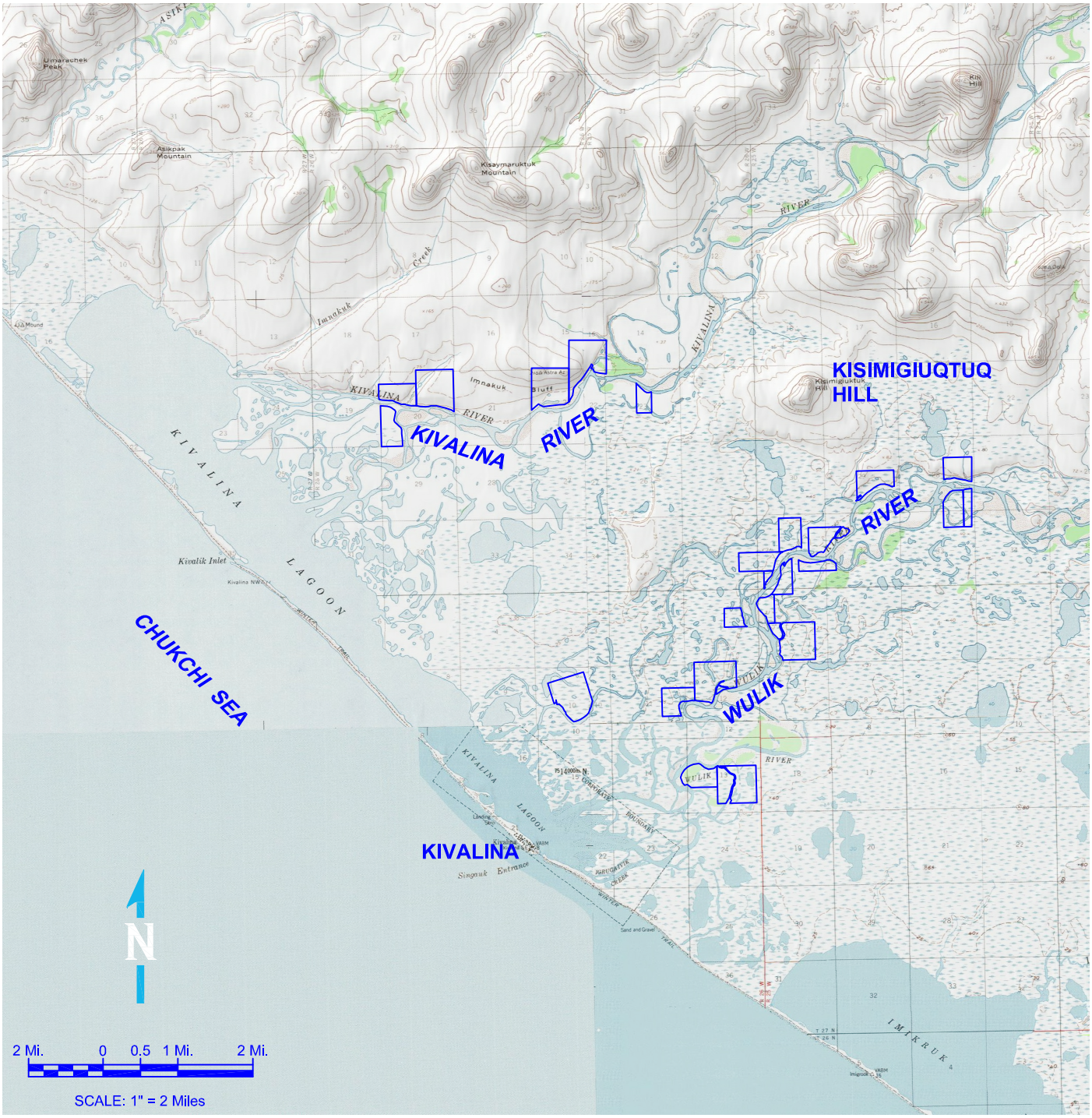
Location Maps
State and Regional

Evacuation Road Reconnaissance Study
Native Village of Kivalina

JOB NO.:	5557
DATE:	June 2014
DRAWN BY:	SEC
CHECKED BY:	SEC
FIGURE NO.:	1



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Area Map
Kivalina, Alaska

Evacuation Road Reconnaissance Study
Native Village of Kivalina

JOB NO.:	5557
DATE:	June 2014
DRAWN BY:	SEC
CHECKED BY:	SEC
FIGURE NO.:	2

4 Preliminary Route Selection

4.1 Gather Existing Data

Prior to performing the field portion of the route reconnaissance study, WHPacific staff contacted numerous governmental agencies to gather information relevant to this project. A considerable amount of information has been gathered and was very useful in helping us more fully understand the project history, issues, and environment. The information gathered consists of aerial photography, maps, reports, surveys, plats, and other miscellaneous data. A list of the information collected and the agencies contacted is included in Appendix A.

4.2 Prepare Base Mapping

USGS maps, Google Earth photography, and Native Allotment data were utilized to create the preliminary mapping that was used at the community and council meetings held in Kivalina on July 23, 2013. Two potential road alignments were presented on this initial map. This map can be seen in the meeting minutes from the July 23 meeting minutes, located in Appendix B.

Just prior to the field work, new aerial photography, flown on June 12, 2013, by AeroMetric for the NAB Community Profile Mapping project, was obtained from DCCED. These aerial photos were added to the base map and used for the field reconnaissance and geotechnical investigation. This revised map can be seen in the Field Reconnaissance Trip Report, located in Appendix C.

After the field reconnaissance was completed, additional aerial photography, flown on August 20, 2013, was obtained from AeroMetric and incorporated into the base map. All of the known data, including information obtained at the November 19, 2013 community meeting, was then incorporated into the final route alternatives that are described and shown in Section 8.

4.3 Preliminary Routes

Two potential route alignments were presented to the councils and the public at the July 23, 2013 meetings held in Kivalina. Both alignments (Southern and Northern Routes) were the same for the first approximately three miles. These routes started at the village's selected starting point, between the village and the airport, crossed the lagoon, and then continued northeast through the low wet area. From this point the Northern Route headed NNW to the point labeled elevation 81 on the USGS map. The Northern Route then continued along the "high" ground to the west side of Kisimigiuqtuq Hill. The Southern Route continued northeast through the "wet" area, to the east side of Kisimigiuqtuq Hill. These routes are shown on the map included in the meeting minutes from the July 23

meeting, located in Appendix B. These initial routes were based on the topography shown on USGS maps, water bodies seen on the aerial photography, beginning and ending points, and Native Allotment locations.

The original alignment that utilized BIA Route Numbers 1250 and 1260 "exactly" as shown on the inventory maps was eliminated from consideration early in the process. This alignment crossed the Wulik River in numerous locations, crossed at least four Native allotments, was considerably longer, and would be significantly more expensive to construct.

After the July 23 meetings in Kivalina, the initial alignments were refined and a new section of alignment added. The original Southern Route was basically unchanged. However, the beginning of the Northern Route was revised to start at Kivalina, headed northwest along the east side of the runway, and then crossed the lagoon at a point approximately 1.5 miles north of the village. It then headed northeast across the "higher and drier" ground and connected to the original Northern Route at the 81-foot elevation point. The "connector piece" was retained as an alternative option. The beginning section of the Northern Route was added at the suggestion from the public meeting in an attempt to avoid the "lower and wetter" ground along the first part of the Southern Route. These routes are shown on the map included in Field Reconnaissance Trip Report, located in Appendix C.

The final versions of the road routes were refined after the field work and November 19 public meeting. This version differed from the previous version in two ways. The connector between the Northern and Southern Routes was modified to connect the Northern Route to the Southern Route, instead of the other way around. Also, the termination points were changed to a common point that was determined during the field reconnaissance. These route alternatives are described and shown in Section 8.

5 Public Involvement

5.1 General

Throughout the project, numerous meetings have been held with the NVK Council, City of Kivalina Council, community of Kivalina, and Evacuation Road Steering Committee, many of which also included representatives from government agencies. These meetings provided valuable information, insight, and direction on how to proceed with the route analyses. By including both the community and the governmental agencies in the route selection process, the NVK is building wide support for the project and increasing the chance of a successful project that will benefit the majority of the people affected. These meetings are summarized below.

5.2 July 23, 2013; Meeting of the Joint Councils

A joint meeting with the Kivalina IRA Council and the City Council was held in Kivalina on July 23, 2013. In attendance, besides the council members, were representatives from WHPacific, USACE, and NWABSD. The purpose of the meeting was to discuss the status of the evacuation road reconnaissance study with the councils prior to the public meeting scheduled for later that night.

WHPacific project civil engineer, Mr. Steve Coleman, discussed the process that was being used to perform the reconnaissance study and how it fit into the overall design process. He presented a map showing two possible routes that he identified in the preliminary office study. The routes access Kisimigiuqtuq Hill by avoiding as much of the wet areas and Native Allotments as possible. Mr. Coleman emphasized the need to locate a suitable gravel source, as the project would require a considerable amount of gravel. Discussion was centered around potential gravel sources and road routes.

USACE engineer, Mr. David Williams, explained the Corps involvement in the project. He stated that they had funds available to perform the preliminary engineering and design of the lagoon crossing. This would include performing the geotechnical investigation at the bridge and causeway location, bathymetric survey, lagoon environmental studies, hydrology study of the lagoon, and the preliminary (35%) design of the causeway and bridge(s).

Kathy Christy, with the NWABSD, provided background on the school district's desire to construct a new school at Kisimigiuqtuq Hill. She stated that the NWABSD was preparing a grant application to submit to the State legislature.

The official meeting minutes are located in Appendix B.

5.3 July 23, 2013; Public Meeting

A public meeting was held in Kivalina on July 23, 2013. Ninety-nine people signed the official sign-in sheet, but considerably more were present, if the presenters, out-of-town guests, children, and unregistered attendees are included. The purpose of the meeting was to discuss the status of the evacuation road reconnaissance study with the community and to solicit comments and concerns regarding the routes, gravel sources, and other local issues. Representatives from WHPacific, USACE, and NWABSD each discussed different aspects of the project.

Community members raised questions and concerns regarding the seriousness of the storms, gravel quantities needed, gravel locations in the Wulik River, wetlands, schedule, height of the causeway, bridge, and funding. An additional route was suggested: cross the lagoon approximately 1.5 miles north of the village in order to avoid the low wet land directly across from the village. WHPacific project civil engineer, Mr. Steve Coleman, said that he would include that in the field reconnaissance.

The official meeting minutes are located in Appendix B.

5.4 July 30, 2013; Evacuation Road Steering Committee Meeting

The quarterly Evacuation Road Steering Committee meeting was held in Anchorage on July 30, 2013. The purpose of the meeting was to discuss the status of the evacuation road reconnaissance study with the various agencies. Representatives from NVK, City of Kivalina, WHPacific, USACE, NWABSD, NANA, DCCED, NAB, and Alaska Department of Education were present, either in person or via telephone.

David Williams, engineer with the USACE, said that he expects to perform the geotechnical work at the causeway/bridge site in March or April of 2014.

Steve Coleman, project engineer with WHPacific, gave the group a summary of the information presented in Kivalina at the July 23, 2013 meetings. He stated that the field work was scheduled to occur from August 14 to 18 and would be supported by helicopter. Mr. Coleman presented the updated map showing three alignment route alternatives. The new alignment, crossing the lagoon north of the village, generated discussion. While the high ground was attractive, crossing the airport property would be problematic. The USACE stated that it was important to determine the crossing location as soon as possible, as they needed to coordinate the location with their drilling contractor. The USACE could not drill in both locations.

The environmental process was discussed. Mr. Coleman stated that the level of environmental documentation required could not be determined until after the reconnaissance study was completed. At that time WHPacific would update the "Plan

Forward" document, including the environmental requirements. Mr. Williams stated that the USACE anticipated that the road portion would require an Environmental Assessment (EA), but that the lagoon crossing could require an Environmental Impact Statement (EIS).

Rosie Barr, with NANA, stated that obtaining ROW across NANA land will not be a problem, but there was a process that will need to be followed.

Kenny Gallahorn, with the NAB, stated that the Borough has $2.5 million available for the evacuation road project. Part of those funds are being used as a match for the USACE portion of the design. He also stated that they could ask the state legislature for additional money, next year.

Elia Sakeagak and Paul Glavinovich, with NANA, discussed gravel. Ms. Sakeagak is the NANA contact for gravel. Mr. Glavinovich is a geologist and stated that he was very encouraged when he flew over the streams in the area between Kivalina and Kisimigiuqtuq Hill, because he saw plenty of gravel. He believes there is plenty of gravel in the coastal plain.

The official meeting minutes are located in Appendix B.

5.5 November 19, 2013; Meeting of the Joint Councils

A joint meeting with the Kivalina IRA Council and the City Council was held in Kivalina on November 19, 2013. In attendance, besides the council members, were representatives from WHPacific, NAB, NANA, and NWABSD (by telephone). The purpose of the meeting was to present the findings of the evacuation road reconnaissance study to the councils prior to the public meeting scheduled for later that night.

WHPacific project civil engineer, Mr. Steve Coleman, distributed a map showing the two route alternatives that were analyzed as part of the study. They have been identified as the Northern Route and the Southern Route. The map also included the locations of potential material sources and Native Allotments.

Mr. Coleman recapped the field work performed by himself, Stanley Hawley (NVK), and Golder Associates (geotechnical subconsultants). He stated that a considerable amount of gravel was found along the Wulik River. Also, the Southern Route, through the wet area, wasn't as bad as he'd originally expected. The underlying soils are silty sands and the ground was frozen at a relatively shallow depth. The Northern Route, however, was over ice-rich silt material. While being higher was a plus, the soils were definitely less desirable than the Southern Route.

Mr. Coleman also related that the environmental requirements are much clearer than before the study. It appears that an EA-type document will likely be required. The original cost

estimate and schedule (from 2012) assumed that an EIS would be required. The current level of understanding significantly reduces both the cost and schedule to perform the environmental work.

Based on a better understanding of what will be required to bring the project to construction, Mr. Coleman stated that the pre-construction cost estimates have been cut in half; from approximately $6 million down to approximately $3 million.

The construction costs are also better known at this time. The Southern Route will cost approximately $40 million to construct. The Northern Route will be about $70 million. The additional length of road in the lagoon, required on the Northern Route, is the big difference between the two alternatives.

The official meeting minutes are located in Appendix B.

5.6 November 19, 2013; Public Meeting

A public meeting was held in Kivalina on November 19, 2013. Forty people signed the official sign-in sheet, but considerably more were present, if the presenters, out-of-town guests, children, and unregistered attendees are included. The purpose of the meeting was to present the findings of the evacuation road reconnaissance study to the community and to solicit comments and concerns regarding the route alternatives.

Community members raised only a few questions and concerns regarding the project. They were focused mostly on construction activities and the ability to cross the low wet area and not have the road flood. An additional route was suggested: Use the first part of the Northern Route and then connect to the Southern Route at a point east of the low wet area. WHPacific project civil engineer, Mr. Steve Coleman, said that he would include that in the route reconnaissance study report.

The official meeting minutes are located in Appendix B.

5.7 December 6, 2013; Evacuation Road Steering Committee Meeting

The quarterly Evacuation Road Steering Committee meeting was held in Anchorage on December 6, 2013. The meeting was originally scheduled for December 2, 2013, but due to inclement weather, members of the NVK council could not make it into Anchorage. The purpose of the meeting was to update the various agencies on the findings of the evacuation road reconnaissance study and to solicit their feedback and recommendations.

Representatives from NVK, City of Kivalina, WHPacific, NAB, NANA, Maniilaq Association, USACE, ADOT&PF, ADNR, Bureau of Indian Affairs (BIA), and Native American Rights Fund were present, either in person or via telephone. Many agencies that were originally planning to attend were not able to reschedule on such short notice.

Steve Coleman, project engineer with WHPacific, gave the group a summary of the latest details of the field work and reconnaissance study. His presentation was basically a recap of what he gave to the NVK and City councils and the public in Kivalina in November.

Jeff Roach, with ADOT&PF – Northern Region, stated that ADOT&PF funding for construction was unlikely. He thought trying to obtain funding directly from the State legislature was more promising. Mr. Roach preferred the Southern Route, as crossing the airport property would be very problematic. He also stated that an Airport Master Plan could not be started until after the road was constructed.

Nicole Kinsmen, with ADNR-DGGS, stated that the Southern Route would be better from a coastal engineering perspective. The portion of the Northern Route that parallels the runway would create sediment transport issues and could make erosion at the village worse.

Jeff Nelson, with NANA, stated that obtaining ROW across NANA land would not be a problem. He would like to work with the community, and include lands needed for the roads, landfill, airport, etc., in the 14(c) reconveyance efforts.

David Williams, engineer with the USACE, said that he expects to perform the geotechnical work at the causeway/bridge site in March or April of 2014. He would have preferred to have the bathymetric survey prior to the geotechnical program, but will use aerial photos and local knowledge to guide the drilling locations. The bathymetric survey will be performed in summer 2014 and the wave and surge analysis would follow the bathymetric survey. The 35 percent design of the causeway and bridge(s) would then be undertaken.

Greg Smith, with the BIA, stated that gravel could be purchased from ADNR for $0.50/CY, if the BIA was the permit holder. This is substantially cheaper than NANA's royalty of $2.50/CY or the ADNR's normal royalty of $2.00/CY.

The official meeting minutes are located in Appendix B.

5.8 June 11, 2014; Kivalina City Council Meeting

During a June 11, 2014 Kivalina City Council meeting, the City adopted Resolution 14-05: A Resolution of the City of Kivalina Approving the South Route Plan for the Road Construction for the Kivalina Evacuation Road.

A copy of the resolution is located in Appendix B.

6 Field Reconnaissance

6.1 Road Alignments

A field reconnaissance of the various alternative routes identified in the previous efforts was performed by WHPacific senior civil engineer, Steve Coleman, P.E. on August 14 and 15, 2013. Mr. Coleman was accompanied by Golder Associates (Golder) senior geologist, Walt Phillips and NVK tribal administrator and local guide, Stanley Hawley. Because of the long distances and wet ground over much of the routes, the reconnaissance field effort was supported by a Robinson R44 helicopter, chartered from Bering Air.

On August 14, Mr. Coleman, Mr. Phillips, and Mr. Hawley flew along the alternative routes identified in the office study. They flew along portions of the Kivalina and Wulik Rivers, looking for potential gravel sources. Drainages along the north side of Kisimigiuqtuq Hill were also investigated for potential gravel. Brief descriptions of the observations follow. The full Field Reconnaissance Report is located in Appendix C.

6.1.1 Southern Route

The Southern Route begins at the southern end of the runway, crosses the lagoon, and then traverses through lowlands and swampy areas along relict channels of the Wulik River to the east side of the base of Kisimigiuqtuq Hill, generally in a northeasterly direction. This route was across low and wet ground, as was expected. At the lagoon, the ground elevation was very low, approximately five feet or less above the water surface. A route, generally following the mapped route, was found that avoided most of the larger water bodies. However, two minor stream crossings were identified. The ground surface is typically wet with many areas of ponded water.

Vegetation along this route consists of wet tundra and two-foot tall grasses. The topography is very flat, with little relief except at some of the water bodies. The grades increased near Kisimigiuqtuq Hill.

6.1.2 Northern Route

The Northern Route begins at the southern end of the runway, parallels the runway for approximately 1.5 miles, and then crosses the lagoon. On the east side of the lagoon the route follows the higher ground to the west side of the base of Kisimigiuqtuq Hill, generally in a northeasterly direction. This route was across higher and generally drier ground, as was expected. However, polygonal ground was observed along much of the route. Polygonal ground indicates the presence of ice wedges underneath the surface.

Vegetation along this route varied, and consisted of wet tundra and two-foot tall grasses to dry tundra with dwarf birch, willow, and berries. The topography also varied and ranged from flat to gently sloping. No significant water bodies were encountered on this route.

6.1.3 Connector Route

The connector route, located approximately midway between Kivalina and Kisimigiuqtuq Hill, connects the Southern and Northern Routes with a one-mile long section that heads in a generally northerly direction. A route, generally following the mapped route, was found that avoided most of the larger water bodies. However, the alignment crosses a substantial tributary of the Wulik River, approximately midway between the two routes. The ground surface is typically wet with areas of ponded water.

Vegetation along this route consists of wet tundra and two-foot tall grasses. The topography is very flat, with little relief except at some of the water bodies.

6.2 Material Sources

6.2.1 Kivalina River

Gravel bars along the Kivalina River were investigated for use as potential gravel sources. Numerous gravel bars were observed, confirming that gravel was in fact present. Most of the surface material was gravel (less than one-inch in diameter) with sands and silts.

6.2.2 Wulik River

Gravel bars along the Wulik River were also investigated for use as potential gravel sources. In general, the exposed bars were larger in area and contained larger gravel. There were numerous gravel bars observed from the helicopter, but many were located on Native Allotments or were on the east side of the river. Two large gravel bars were identified that were not on allotments and were on the west side of the river. The surface gravel at these locations was larger than found on the Kivalina River (up to two-inch in diameter) and contained almost no silt. It also appears that the gravel material is present under the surface organic layer some distance away from the exposed portions along the river.

6.2.3 Wulik Relict Channels

Sand and gravel deposits were also observed in numerous relict channels to the west of the existing channel of the Wulik River in. While the exposed areas were limited in area, it was thought that sands and gravels may be present at relatively shallow depths below the surface organic soils layer throughout the area.

6.2.4 Kisimigiuqtuq Hill

The peak of Kisimigiuqtuq Hill is at an elevation of approximately 460 feet. Above the vegetated area, the slopes are quite steep, but at the lower elevations, the slopes are generally less than ten percent.

The hill is covered with fractured rock above the vegetated base. The material extends around the entire hill. It looks like material could be excavated from the hill, but may

require blasting below the surface layer. The material will need to be crushed and screened, as the individual pieces are quite large.

6.2.5 Kisimigiuqtuq Hill Drainages

The largest drainage on the backside (north-northwest) of Kisimigiuqtuq Hill was also investigated for potential gravel deposits. This drainage drained to the Kivalina River. No exposed gravel was observed.

6.3 Destination Point

The west, south, and east sides of Kisimigiuqtuq Hill were investigated for potential ending points for the road. An area with gentle slopes and plenty of developable area was looked for. The initial developments would likely be an evacuation facility and a school. Both facilities would be substantial in size.

Mr. Coleman and Mr. Hawley identified a potential destination point that appeared to meet the criteria we were looking for. It is located south-southeast of the hill in an area with slopes in the two to five percent range. There is plenty of room for development.

7 Geotechnical Exploration

7.1 General

To help determine subsurface conditions and locate potential gravel sources, WHPacific retained the services of Golder Associates to perform a preliminary geotechnical investigation of the alternative routes and potential material sources. The geotechnical field exploration was conducted between August 14 and 18, 2013, supported by a Robinson R44 helicopter.

The field program commenced with Golder senior geologist, Walt Phillips, reconnoitering the area to identify potential material sources and any potential issues along the proposed route alternatives. Mr. Phillips was accompanied by WHPacific senior civil engineer, Steve Coleman, and NVK tribal administrator, Stanley Hawley.

The one-day reconnaissance effort was followed by a three-day geotechnical field exploration conducted by Golder geologist, Ryan Campbell, and engineering technician, Matthew Furrer. The Golder field team was accompanied by Mr. Coleman and Mr. Hawley for part of the exploration.

The shallow subsurface exploration focused on the following tasks:

- Determining the depth of the active layer by advancing hand probes along the proposed route alternative alignments
- Determining shallow subsurface conditions along the routes, including soil types and approximate soil and thermal contacts, by advancing shallow boreholes with a hand operated power drill
- Determining the location and quality of potential material borrow sites near the proposed route alignments.

Over 140 probes were advanced in the project area. Ten boreholes were drilled along the alignments. The boreholes were logged and selected samples were collected and tested in the laboratory back in Anchorage. Bulk samples were also collected at potential material source sites.

The complete Geotechnical Report is located in Appendix D.

7.2 Road Alignments

7.2.1 Southern Route

A total of 64 hand probes were completed along the Southern Route. The average depth to probe refusal was 1.5 feet, but ranged from between 0.5 and 5.0 feet. Five boreholes were advance along this alignment. The subsurface conditions along this route consisted

of approximately 0.5 to 1.5 feet of unfrozen organic mat (PT), overlying approximately 2.0 to 4.0 feet of frozen silty sand (SM). Fine gravel was found intermixed with the silty sand in one borehole. Massive ice was found in one borehole.

7.2.2 Northern Route

A total of 54 hand probes were completed along the Northern Route. The average depth to probe refusal was 1.4 feet, but ranged from between 1.0 and 2.0 feet. Three boreholes were advance along this alignment. The subsurface conditions along this route generally consisted of approximately 1.5 feet of unfrozen organic mat (PT), overlying approximately 1.5 to 2.5 feet of frozen ice-rich organic clay and silt (OH/OL), overlying frozen ice-rich mineral silt (ML). Both massive and stratified ice lenses were noted in the clay and silt layers. Massive ice was encountered in one borehole.

7.2.3 Connector Route

A total of six hand probes were advanced along the connector route. The average depth to probe refusal was 1.2 feet, but ranged from between 0.5 and 2.0 feet. One borehole was advance along this alignment, along the northern edge of the tributary crossing. The subsurface conditions encountered in the borehole consisted of 0.5 feet of unfrozen organic mat (PT), overlying 3.0 feet of frozen well-graded gravel with sand (GW).

7.2.4 Tidal Lagoon Area

The tidal lagoon area investigated was approximately two miles wide and was bounded by the Wulik River to the south and the area of relatively higher ground to the north. The area is generally flat and consists of soft, swampy ground. Vegetation consisted of grasses and reeds, unlike the tundra vegetation that was found further inland.

A total of ten hand probes were advanced in the tidal lagoon area. The depth to refusal varied, and was generally deeper than along the other alignments investigated. The average depth to probe refusal was 3.0 feet, but ranged from between 2.0 and 6.0 feet. One borehole was advance in this area, just to the north of the outlet of the Wulik River. The subsurface conditions encountered in the borehole consisted of 1.5 feet of unfrozen organic mat (PT), overlying 4.0 feet of frozen silt with trace sand (ML). Two samples were collected from the bore to measure the pore water salinity, which tested low at less than two parts per thousand.

7.3 Potential Material Sources

7.3.1 Kisimigiuqtuq Hill

Kisimigiuqtuq Hill is characterized by exposed limestone subcrop and rock rubble at the ground surface. While no large outcrops of limestone were observed at the surface, it is anticipated that below the surface larger frost fractured rocks and boulders may exist. The surface rocks have been frost fractured to a depth of approximately three feet.

A bulk material sample was collected from the hill, at a depth of three feet below the surface. The material collected classified as a silty gravel with sand (GM) with approximately 19 percent passing the U.S. No. 200 sieve. The gravel was sub-angular limestone and contained cobbles up to eight inches in diameter. The material found at the hill should be suitable for roadway embankment fill.

7.3.2 Wulik River Deposition Zones

The Wulik River Deposition Zone is characterized by visible gravel bars and beaches along the river banks. Two of these areas were investigated during the field investigation. The fluvial material encountered at these two sites was deposited by flow from the Wulik River.

Two bulk samples were collected at these sites. The material classified as well-graded gravel with sand (GW), with less than one percent passing the U.S. No. 200 sieve. The material found at these areas should be suitable for roadway embankment fill.

Using aerial imagery to interpret topography and geologic features, additional areas of possible fill material was identified within the Wulik River Deposition Zone. These areas were confirmed visually from the helicopter. While no bulk samples were collected at these locations, the areas likely contain very similar material as was sampled in the other areas.

7.3.3 Wulik River Relict Channels

The Wulik River Relict Channel is characterized by visible gravel and sand at the ground surface. The fluvial material in these areas was likely deposited when the Wulik River was located north of its present location.

Two bulk samples were collected from relict channel sites between the southern and northern alignments. One of the material samples classified as well-graded gravel with sand (GW). The other material sample classified as poorly graded sand with silt (SP-SM). The material found at these areas should be suitable for roadway embankment fill.

Using aerial imagery to interpret topography and geologic features, additional areas of possible fill material was identified within the Wulik River Relict Channel. These areas were confirmed visually from the helicopter. While no bulk samples were collected at these locations, the areas likely contain very similar material as was sampled in the other areas.

7.3.4 Material Quantities

Based on the visual boundaries and probe depths of the sites investigated, approximate bank volumes of granular fill material were estimated. The boundaries of these areas were established using hand held GPS units or aerial photos and should be considered approximate. Exploration depth at each investigated site was limited to three feet. This

depth was applied as the vertical extent of the bank volume calculations. The quantities shown in Table 2 will need to be confirmed during the design phase geotechnical investigation when the material source(s) will be proved out with a drilling program.

Table 2. Estimated Potential Gravel Quantities

Area	No. of Samples	Approx. Bank Volume (CY)
Kisimigiuqtuq Hill	1	600,000
Wulik River Depositional Zone - Sampled	2	100,000
Wulik River Depositional Zone - Inferred	0	950,000
Wulik River Relict Channel - Sampled	2	2,500
Wulik River Relict Channel - Inferred	0	480,000
Total Potential Gravel Volume		2,132,500

7.4 Geotechnical Recommendations

Based on the shallow probe and borehole findings, observations of the surface conditions, and their geotechnical experience in the area, Golder recommends the Southern Route as their preferred roadway alignment. This route has better underlying soils and is closer to potential material sources. The Southern Route traverses along the low lying relict channel of the Wulik River and is underlain by frozen silty sand. While perched water is abundant on this alignment and two minor stream crossings are present, these issues can be dealt with by the proper designs.

Golder proposed two roadway embankment options: 1) an elevated roadway constructed entirely of granular fill, and 2) an elevated roadway constructed with a silt core and capped with granular fill. Since it appears that gravel material is available, option one is being considered by WHPacific, at this time.

Golder also pointed out that the peat and organic soil will consolidate under the weight of a roadway. They anticipate compression of between 50 and 75 percent of the initial thickness of the organic layer. The boreholes show that the organic layer is between 1.5 and 2.5 feet thick. Assuming a 2-foot thick layer of organic material, it will be reasonable to expect a settlement of 1.0 to 1.5 feet.

Their report also noted that because the ground is frozen below the organic layer, it is possible that if that material thaws additional consolidation could occur. Measures to mitigate this can be incorporated into the design.

They recommend that the road embankment be constructed to an elevation of four feet above the surrounding ground to help with snow drifting problems. This height is measured after all consolidation has occurred. They also recommend side slopes of 3H:1V (horizontal:vertical).

Due to the limited scope of the geotechnical investigation performed, if the proposed alignment is advanced beyond the conceptual level, Golder recommends a more in-depth geotechnical exploration program be conducted to provide sufficient subsurface data to design a roadway prism and to better determine the extents and quality of potential material sources. Golder estimates that the rough order of magnitude cost to perform this geotechnical work will be between $500,000 and $1,000,000, depending on the final scope of work and the season it is performed in.

8 Alternative Route Alignments

8.1 General

Based on the researched information, field reconnaissance, geotechnical investigation, and comments and input received from the public meetings, three routes have been identified to be analyzed in this route reconnaissance study. These three routes are shown in Figure 3, located at the end of this section.

8.2 Alternative 1: Southern Route

The Southern Route, shown as a dashed red line in Figure 3, begins at the very southeastern end of the airport property (USS 3776), just northwest of the village townsite (USS 5582). The island portion of the route heads northeast approximately 350 linear feet (LF) (0.07 mi.) to the lagoon. The island portion will be located on airport property because existing houses are located at the northwestern edge of the townsite.

The Southern Route then crosses the lagoon over a causeway. The causeway continues northeast for approximately 3,050 LF (0.58 mi.) to the mainland. The causeway will have one or more short bridges, at locations that will be identified later in the design process.

Once across the lagoon, the Southern Route continues northeast across a tidally influenced section, roughly paralleling a small drainage channel for approximately 2,200 LF (0.42 mi.). The alignment then veers to the NNE and continues another 3,500 LF (0.66 mi.). This whole section is very flat, less than 15 feet above the elevation of the lagoon, and much of the existing ground is reported to be underwater during fall storms and spring thaw. This tidally influenced section is approximately 5,700 LF (1.08 mi.) in length.

The next section of the Southern Route is generally above the 15-foot elevation level and will be called “uplands” in this report. The upland section veers to the ENE for approximately 4,550 LF (0.86 mi.), to an area with two drainage crossings. The area around the drainages appears to be underlain with gravel. According to the USGS map, this point is at an elevation of approximately 25 feet. The route then veers to the northeast for approximately 3,650 LF (0.69 mi.) and then veers to NNE for approximately 8,550 LF (1.62 mi.) to a point just west of a Native Allotment. At this point, the route veers to the ENE, to avoid the allotment, for approximately 2,250 LF (0.43 mi.) and then veers back to the NNE, avoiding another allotment, and continues for approximately 8,250 LF (1.56 mi.) to the ending point. The ending elevation is at approximately 80 feet, but most of this section is at an elevation of less than 50 feet. The overall length of the upland portion of the Southern Route is approximately 27,250 LF (5.16 mi.).

The overall length of the Southern Route is approximately 36,350 LF (6.88 mi.). The total elevation difference between the lagoon and the ending point is approximately 80 feet. The average slope is approximately 0.2 percent, but is essentially flat in many areas.

8.3 Alternative 2: Northern Route

The Northern Route, shown as a dashed blue line in Figure 3, begins at the same point as the Southern Route, at the very southeastern end of the airport property (USS 3776). The island portion of the route heads northwest approximately 7,800 LF (1.48 mi.), paralleling the runway east of the island, to a point just past the dump. The route would be located as close to the island as allowed by the FAA, but most of it will likely be in the lagoon. The island portion of the route will be located on airport property, but almost entirely in the lagoon.

The Northern Route then crosses the lagoon over a causeway. The causeway would veer to the northeast for approximately 3,700 LF (0.70 mi.) to the mainland. The causeway will have one or more short bridges, at locations that will be identified later in the design process.

Once across the lagoon, the Northern Route veers to the NNE for approximately 1,450 LF (0.27 mi.) and climbs to the higher "ridge." The route then veers to the northeast and follows the edge of the ridge for approximately 2,850 LF (0.54 mi.). It then heads east for approximately 550 LF (0.10 mi.), ESE for 700 LF (0.14 mi.), east for 1,650 LF (0.31 mi.), and then northeast for 950 LF (0.18 mi.). The route then follows a large curve for approximate 3,400 LF (0.64 mi.) to the northeast and then heads ENE for approximately 2,750 LF (0.52 mi.) to the southern tip of the "hill" labeled with an elevation of 81 feet on the USGS map. This upland section of the Northern Route is approximately 14,300 LF (2.71 mi.) across relatively flat ground with elevations ranging between 15 and 30 feet.

The Northern Route then heads approximately 1,550 LF (0.29 mi.) northeast to the top of the 81-foot high hill. It then continues NNE across the hill for approximately 5,900 LF (1.12 mi.), then north for 2,100 LF (0.40 mi.), and then follows a large curve for approximately 4,150 LF (0.79 mi.) to the northeast. It then follows another large curve approximately 8,450 LF (1.60 mi.) to the east, ending at the same point as the Southern Route. This "higher' upland section is approximately 22,150 LF (4.20 mi.) across ground with elevations ranging between 30 and 80 feet.

The overall length of the Northern Route is approximately 47,950 LF (9.08 mi.).

8.4 Alternative 3: Combined Route

Alternative 3 combines the first part of the Northern Route with the latter part of the Southern Route. These two sections are connected with an approximately 1.66-mile

section between the two. The Combined Route is shown as a dashed green line in Figure 3.

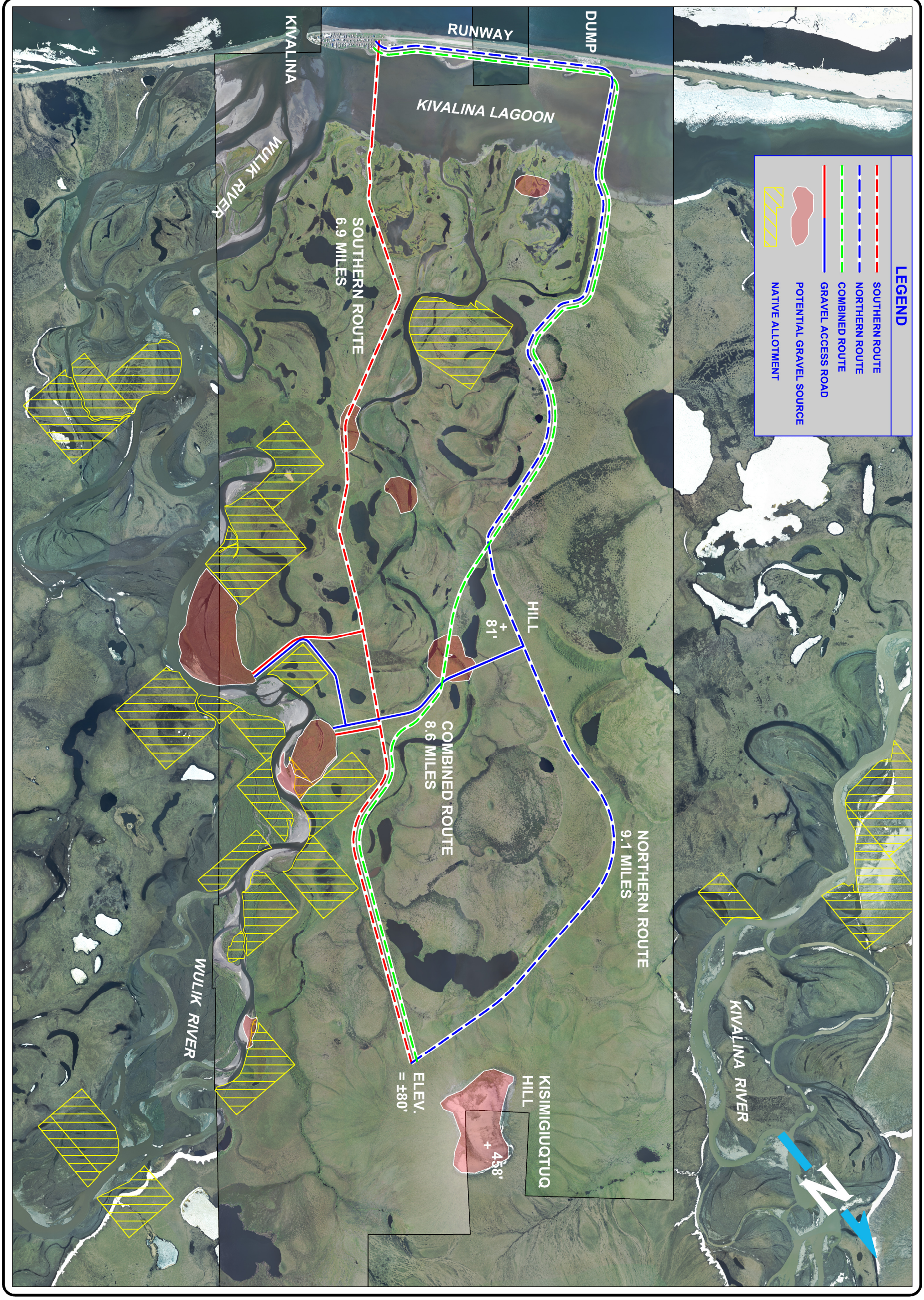
The island and causeway portions of the Combined Route are identical to the Northern Route. The next approximately 14,300 LF (2.71 mi.) is the same as the "lower" upland portion of the Northern Route.

The Combined Route deviates from the Northern Route at the southern tip of the 81-foot high hill. Instead of going up the hill, this route continues northeast for approximately 5,550 LF (1.05 mi.) and then veers ENE for approximately 3,200 LF (0.61 LF) to connect with the Southern Route, just west of the Native Allotment. The connector portion of the route is approximately 8,750 LF (1.66 mi.) across relatively flat ground.

The Combined Route then follows the last 10,900 LF (2.06 mi.) of the Southern Route and ends at the same ending point as the other two alternatives.

The overall length of the upland portion of the Combined Route is approximately 33,950 LF (6.43 mi.). It is between 15 and 80 feet in elevation, but all except the last few hundred feet are at elevations less than 50 feet.

The overall length of the Combined Route is approximately 45,450 LF (8.61 mi.).



Alternative Evacuation Road Routes
Kivalina to Kisimigiuqtuq Hill Scale 1" = 3,000'

Evacuation Road Reconnaissance Study

Native Village of Kivalina

JOB NO.:	5557
DATE:	June 2014
DRAWN BY:	SEC
CHECKED BY:	SEC
FIGURE NO.:	3

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9 Environmental Review

9.1 Environmental Process

The proposed Kivalina Evacuation Road presents significant environmental planning challenges in terms of the data needed to obtain state and federal authorizations to construct the project. Prior to this Route Reconnaissance Study, the planning effort has assumed that an Environmental Impact Statement (EIS) would be the end result of the environmental process. As a result, the earlier environmental cost estimates were significant. Recent conversations with the USACE indicate that they feel the project is commensurate with an Environmental Assessment (EA) level of effort. An EA is appropriate when the lead federal agency believes the project would result in a Finding of No Significant Impact (FONSI). An EA does not require the level and depth of stand-alone environmental studies that an EIS requires.

The funding source(s) and permitting agencies will dictate what type of environmental process is required, based on 40 CFR §1508.18(4). There are two likely funding possibilities: federally-funded or state-funded. Both pathways will require similar levels of effort, in terms of the analysis of impacts and studies required.

If the project is funded by direct federal funding, likely through the Bureau of Indian Affairs (BIA) or Federal Highways Administration (FHWA), then a formal National Environmental Policy Act (NEPA) process will be required.

If the project is funded with state dollars, then environmental permitting will drive the environmental process. While no formal process is required, the project will need to satisfy the permitting requirements demanded by the federal agencies.

9.2 Environmental Documentation

At this point in the project, no lead federal agency has been identified. In the absence of a lead federal agency, it is recommended that a NEPA-style EA-type environmental document be prepared. This type of document can be used by both federal and state permitting agencies to evaluate potential project impacts. A comprehensive, NEPA-style scoping process engaging federal, state, and local stakeholders will help to identify key environmental issues and define the scope of the impacts that should be addressed in the EA.

If future project funding brings on a lead federal agency, the EA-type document could be adopted by the agency and the project moved forward. If a future lead federal agency determined that the project impacts would be substantial, then the EA could be used as the basis for preparing an EIS document.

It is possible that mitigation measures may be necessary to offset project impacts; however, the current opinion is that environmental impacts would not require an EIS-level of document to successfully complete the project and obtain permits.

The environmental document will be used as a process to coordinate public and agency scoping and review. Section 7 consultations, relating to threatened and endangered species, and terrestrial mammal consultations will also be conducted during the development of the environmental document. Preliminary consultations with agencies indicate that two biological assessments will be required: a marine mammal study, focused on ring seals, and an essential fish habitat impact analysis, focused on cod and salmon. It is not anticipated that polar bear or caribou specific biological assessment studies will be required for this project. Instead, existing data and reports, along with interviews with local residents, can be used to analyze and evaluate the effects of the project on their habitat.

Along with the studies and surveys performed as part of this project's environmental process, previously collected environmental studies will also be reviewed and incorporated into the environmental document. The cost and scope of the environmental document is more fully detailed in the *"A Plan Forward"* document included in Appendix F.

9.3 Environmental Studies

Based on conversations with the various agencies, the following studies are anticipated to be required. The costs and scopes of the studies are more fully detailed in the *"A Plan Forward"* document included in Appendix F.

As soon as the preliminary design is complete, coordination with the agencies should begin. Early coordination with the agencies will be key to determining and controlling environmental costs.

9.3.1 Marine Mammal Studies

The lagoon crossing component of the project will require consultation with the National Marine Fisheries Service (NMFS), U.S. Fish and Wildlife Service (USFWS), and National Oceanic and Atmospheric Administration (NOAA) for listed species to determine potential impacts to these species and impacts to other marine mammals that may use the area. Preliminary conversations with these agencies indicate that they will be focused on ring seals that use the lagoon. Impacts to polar bears can be analyzed using existing studies.

The objective of the seal study will be to develop the technical information needed to evaluate the recommended causeway and bridge alternatives, and to provide the design information necessary to satisfy environmental and permit issues. The data requirements should be attempted to be met through the use of existing studies and local knowledge, but agencies may require presence/absence and population information for the lagoon, which may require a field survey.

9.3.2 Essential Fish Habitat Analysis

Preliminary conversations with NMFS, USFWS, and NOAA indicate that an Essential Fish Habitat (EFH) Impact Analysis will be required to determine the presence and movements of cod and salmon in the lagoon. This information will be used to assist in determining the proper design of the bridge and causeway across Kivalina Lagoon and to help prepare applications and acquire permits. The analysis will include research, interviews with residents, consultations with agencies, and a field survey.

9.3.3 Wetland Delineation

The USACE will require that all jurisdictional wetlands be identified along the preferred road alignment. This will require a field survey and preparation of a report that will be provided to the USACE for their concurrence.

9.3.4 Archaeological Survey

An archaeological survey will be required to determine the potential impacts to archaeological resources along the road alignment and at potential material sources. It is anticipated that a pedestrian survey, with limited shovel testing, will be required. The survey will also include consultations with the State Historic Preservation Officer (SHPO), BIA, Village Council, Kivalina Elders, and other parties knowledgeable with the history and prehistory of the project area.

9.4 Permitting

The following permits and determinations are anticipated to be required for this project. Additional permits and/or determinations may be identified during research and communications with regulating agencies. The costs and descriptions of the permits are more fully detailed in the "*A Plan Forward"* document included in Appendix F.

9.4.1 United States Corps of Engineers (USACE)

A Section 404(b) Individual Permit will be required by the USACE to place fill within wetlands. The majority of the proposed road will be through wetlands.

9.4.2 Alaska Department of Environmental Conservation (ADEC)

A Section 401 Water Quality Certification Permit, issued by ADEC, is related to the USACE Section 404 permit. It assures there will be no violations of the Clean Water Act as a result of discharges to Waters of the U.S. Discharges to Waters of the U.S., as related to this project, refers to the placing of fill in wetlands. The Section 401 Certification ensures that materials used as fill will not be contaminated and that placement of fill will be limited to the roadway.

9.4.3 United States Coast Guard (USCG)

A Section 9 Bridge Permit will be required by the USCG. The USCG has authority under the Rivers and Harbors Act to issue permits for construction of bridges over waters of the U.S. A Section 9 permit will be required for construction of a bridge at the lagoon crossing.

9.4.4 Alaska Department of Fish and Game (ADF&G)

A Title 16 Fish Habitat Permit, required by ADF&G, is necessary for any activity that disturbs fish habitat. This includes the construction of culverts and the causeway and bridge over the lagoon. The permit assures that fish habitat will be maintained and protected.

9.4.5 State Historic Preservation Office (SHPO)

If federal funding is involved, then a Section 106 Consultation with SHPO is required by the National Historic Preservation Act. If state funding is involved, then a SHPO review is required by the Alaska Historic Preservation Act. A SHPO review of the project will identify, evaluate, and assess the project's effects to significant cultural resources.

9.4.6 Northwest Arctic Borough (NAB)

A Title 9 Land Use Permit is required for activities within the NAB.

9.4.7 Federal Aviation Administration (FAA)

An Airspace Obstruction Evaluation is required by FAA for all new construction work near airports. This evaluation looks at the potential for structures to impact the airspace needed for safe aircraft operations.

9.4.8 National Marine Fisheries Service (NMFS)

An Incidental Harassment Authorization may be needed from NMFS for construction activities that have the potential to affect marine mammals (seals) that may be present in the lagoon.

10 Project Development Costs

10.1 Pre-Construction Activities

Pre-construction activities include all tasks that occur prior to actual construction activities. These tasks include the initial route reconnaissance and selection, geotechnical investigations, surveys, environmental studies and documentation, design, construction documents (plans and specifications), and permitting. The pre-construction costs, of the different route alternatives, will be very similar, so separate cost estimates have not been prepared for each alternative.

Table 3 outlines the pre-construction tasks and their estimated costs. The costs and scopes of work (SOW) of the pre-construction activities are more fully detailed in the *"A Plan Forward"* document discussed in Section 13.

Table 3. Pre-Construction Tasks and Estimated Costs

Category	Pre-Construction Tasks	Est. Costs
Route Reconnaissance	Aerial Photography	$ 35,000
	Preliminary Geotechnical Investigation	$ 85,000
	Road Reconnaissance Study and Report	$ 150,000
Geotechnical	Geotechnical Investigation (Causeway & Bridge)	$ 320,000
	Geotechnical Investigation (Road and Material Sites)	$ 600,000
Survey	Bathymetric Survey (of Lagoon)	$ 325,000
	Topo Map (from Aerial Photography) and CL Field Verification	$ 80,000
	Right-of-Way Documentation	$ 30,000
Environmental	Environmental Studies (Marine Mammal, EFH, Wetlands, Arch.)	$ 350,000
	Environmental Document (EA)	$ 160,000
Preliminary Design	Hydrologic Study (Lagoon)	$ 145,000
	Preliminary Plans, Sections, Details	$ 270,000
Final Design	Hydrologic and Hydraulic Study (Uplands)	$ 100,000
	Preliminary Engineering Report (Design Study Report)	$ 50,000
	Design / Construction Docs (Road, Causeway, Bridge)	$ 500,000
Permits	Permit Applications	$ 50,000
	Total Pre-Construction Work	**$ 3,250,000**

10.2 Construction

10.2.1 Conceptual-Level Construction Cost Estimate

Table 4 summarizes the conceptual-level construction cost estimates for the alternative routes analyzed. These estimates are based on conceptual designs, only. While not precise, the construction costs of each alternative are based on the same assumptions, so are useful when comparing and evaluating the alternatives. The cost estimates are also accurate enough to be used in preliminary funding discussions. Appendix E contains more detailed breakdowns of the estimates.

Table 4. Summary of Conceptual-Level Construction Costs

Alternative	Cost
Alternative 1: Southern Route	$41 million
Alternative 2: Northern Route	$75 million
Alternative 3: Combined Route	$74 million

10.2.2 Assumptions

While preparing the conceptual-level construction cost estimates, the following assumptions were made:

Road / Causeway Typical Sections

- Surface Elevation
  - Causeway: 15 Feet above lagoon surface
  - Road (Tidal Area): 15 Feet above lagoon surface
  - Road (Upland): 4 Feet above ground surface
- Width at Top
  - Road: 24 Feet
  - Causeway: 30 Feet
- Embankment Thicknesses
  - Road (Upland): 5 Feet
  - Road (Tidal Area): 10 Feet (average)
  - Causeway: 22 Feet
- Sideslopes: 3H:1V
- Surface Course: 6 Inches of Crushed Gravel
- Consolidation: 1.0 to 2.0 Feet (Surface organic layer)
- Geotextile Fabric: Under all above-water sections of road

Bridges

- Two bridges will be required
- Each bridge will be 1,200 SF (24 feet x 50 feet)

Construction

- Gravel material will come from a source(s) along the Wulik River
- Gravel stockpile operation will occur in winter/spring when ground is frozen
- Gravel stockpiling will include placing two feet of material along entire roadway
- The remaining construction activities will occur during summer/fall
- Approximately half of work force will be from Kivalina
- Construction Contractor will mobilize in a construction camp for remaining work force
- Mobilization of equipment and materials will be by barge
- A 20 percent contingency has been included
- Construction engineering and administration costs were estimated using two percent of the construction costs

11 Road Route Analysis

11.1 Alignment Considerations

At an August 12, 2012 meeting in Kivalina, the community selected their preferred lagoon crossing location at a point near the southern end of the airport. This location provided the shortest and quickest route to evacuate the island. The Southern Route utilizes this location to cross the lagoon. The Northern and Combined Routes utilize a more northerly location. While the northern crossing location avoids having to cross the tidally-influenced area directly across from the village, it requires crossing the airport property and traveling 1.5 miles north along the island. Because of this, the Northern and Combined Routes raise serious safety concerns.

The Southern Route will cross the low, wet, tidally-influenced area directly across from the village. A road across this area will require an embankment of sufficient height that it will remain above water during a storm flood event. The elevation of the road through this area will need to be the same as the causeway height.

The road alternatives between Kivalina and Kisimigiuqtuq Hill cross four basic topographical area types: island, lagoon, tidally-influenced, and upland. Table 5 breaks each alternative into its different topographical area types and gives the approximate lengths of each section.

Table 5. Topographical Area Types and Lengths for Each Alternative

Route	Island Section	Causeway Section	Tidal Section	Upland Section	Total
Southern	350 LF (0.07 mi.)	3,050 LF (0.58 mi.)	5,700 LF (1.08 mi.)	27,250 LF (5.16 mi.)	36,350 LF (6.88 mi.)
Northern	7,800 LF (1.48 mi.)	3,700 LF (0.70 mi.)	0 LF (0.00 mi.)	36,450 LF (6.90 mi.)	47,950 LF (9.08 mi.)
Combined	7,800 LF (1.48 mi.)	3,700 LF (0.70 mi.)	0 LF (0.00 mi.)	33,950 LF (6.43 mi.)	45,450 LF (8.61 mi.)

Each of the different topographical areas will require a specific road section. As can be seen in Table 6, the cross-sectional areas of the different sections vary considerably. For the purposes of this analysis, the following road cross-sectional details were assumed.

Table 6. Road Cross-Section Assumptions

Section	Top Width (ft)	Sideslope (H:V)	Consolidation Thickness (ft)	Embankment Thickness (ft)	X-Sectional Area (SF)
Island	24	3:1	2.0	22	1,980
Causeway	30	3:1	2.0	22	2,112
Tidal	24	3:1	1.5	10	540
Upland	24	3:1	1.0	5	195

The volume of gravel required to construct each section of road is the product of the section length and the associated cross-sectional area. The overall volume of gravel required to construct each road is the summation of the gravel volumes of each section of road. The estimated gravel volumes required for each alternative are summarized in Table 7.

Table 7. Summary of Gravel Volumes Required for Each Alternative

Route	Overall Length (LF)	Gravel Volume (CY)
Southern	36,350	575,000
Northern	47,950	1,126,000
Combined	45,450	1,109,000

Gravel volumes are influenced most significantly by road length and cross-sectional areas. As shown in the tables, the Northern and Combined Routes are considerably longer than the Southern Route. Also, the cross-sectional areas required at the island and causeway sections are much larger than for the tidal and upland areas. The Northern and Combined Routes both have considerably longer areas requiring these cross-sections.

All of the alignments will require "fitting" the road through areas of surface water to reduce the amount of fill required to construct the roads. The Southern Route has the most surface water, followed by the Combined Route, and then the Northern Route.

Table 7 shows that a considerable amount of gravel will be required. Based on the geotechnical investigation, it appears that sufficient gravel exists along the Wulik River. If the Wulik River is used as a material source, then the Southern Route will be closest to the material site. This is important because a road must be constructed to access this gravel.

There are numerous Native Allotments in the project area. The Southern Route provides relatively close access to five of these lots that are located along the west side of the Wulik River. The Combined Route is near two of them and the Northern Route is not near any.

11.2 Geotechnical Considerations

Based on the geotechnical investigation, the soils along the Southern Route are better than those along the Northern Route. The Southern Route is underlain with silty sand, while the Northern Route has considerably more ice-rich silt. Roads constructed along the Southern Route will perform better.

The Northern Route is higher and drier, but the surface water encountered along the Southern Route is perched above the permafrost and will not present significant difficulties during design or construction.

Gravel was found in numerous locations throughout the area. The exposed rock observed at Kisimigiuqtuq Hill indicates that it could be used for roadway embankment material, if blasted and crushed. The numerous gravel bars along the Kivalina River contained gravel suitable for construction use, as well.

However, the best gravel was found along the Wulik River. The deposits observed were extensive and the individual particle sizes were larger than those found along the Kivalina River. Native Allotments are situated along the river, but large areas of gravel are located on NANA and State land. Access to the Wulik River will be shortest from the Southern Route and longest from the Northern Route.

It also appears that the Wulik River has meandered through the area traversed by the Southern Route. It is likely that sands and gravels are present at relatively shallow depths along this route, as exposed sands and gravels were observed in many of the relict channels investigated during the field reconnaissance and geotechnical investigation.

Golder, WHPacific's geotechnical subconsultant, recommends the Southern Route as the preferred road alignment.

11.3 Environmental Considerations

The only known environmental factor that favors one alternative over another, is the sediment transport issue raised by ADNR–DGGS. Hardening the island with a road along the lagoon side may create sediment transport issues that could lead to further erosion along the southern end of the island.

Marine mammal and fish habitat issues appear to be equal with either of the causeway locations. Any of the road routes appear to have the same impact on the archaeological survey requirements.

The Southern Route is shorter, and will therefore impact less wetlands.

11.4 Cost Considerations

As was stated above, the two largest factors influencing gravel volumes are road length and cross-sectional area of the road sections. The gravel costs are the single biggest cost items for this project. This is reflected in the construction cost estimates summarized in Section 10.2 and detailed in Appendix E.

The Southern Route is considerably less expensive to construct than the Northern or Combined Routes ($41 million vs. $74-75 million). While cost may not be the most important factor, it will be something that funding agencies will look at very closely. If there are two acceptable alternatives, they will support the most cost effective option.

Pre-construction fees (for survey, geotechnical, environmental, design, permitting, etc.) will be approximately equal, no matter which alternative is selected.

11.5 Local Input from Public Meetings

A vote was not taken on which route was preferred by the community. However, after the November 19, 2013 public meeting, numerous individuals stated that they preferred the Southern Route.

The site of the lagoon crossing was discussed at an August 9, 2012 meeting held in Kivalina. A majority of those present indicated that they preferred a crossing between the village and the airport. This location corresponds to the location of the Southern Route.

11.6 Agency Input

Three agencies responded with feedback on which alternative they would prefer.

ADOT&PF stated that crossing the airport property will be a significant obstacle and that the additional costs of either the Northern or Combined Route would make it more difficult to obtain funding. They prefer the Southern Route.

ADNR-DGGS stated that constructing a road along the lagoon side of the island, armored with riprap or other hardening surface, could increase the erosion potential along the southern end of the island. They prefer the Southern Route.

USACE stated that the most direct route off the island would be best for an evacuation road. They prefer the Southern Route.

11.7 Pros / Cons of Each Alignment

Each alternative presented in this Route Reconnaissance Study has its good points (pros) and bad points (cons). The following subsections summarize the pros and cons of each alternative in a side-by-side format.

11.7.1 Southern Route

Pros	Cons
Quickest evacuation route off the island	Road crosses wetter ground (mostly perched)
Crosses the lagoon at Kivalina	Road passes close to numerous Native Allotments
Lagoon crossing is where the community originally chose it to be (8/9/2012 meeting)	The portion of the road across the flood-prone land area will be up to 12 feet above the ground
Most direct route to Kisimigiuqtuq Hill	Most drainage crossings (culverts)
Shortest overall route (6.9 miles)	Road crosses traditional berry picking areas
Lower community fuel usage (and costs)	Road crosses northward migration route of caribou
Better underlying soils (silty sand)	
Closer to material sources (Wulik River)	
Wulik River has better gravel sources	
Least expensive gravel costs	
Minimal interference with airport property	
Shortest lagoon crossing	
Lowest erosion potential (lagoon-side of island)	
Least expensive (+/- $41 million)	

11.7.2 Northern Route

Pros	Cons
Road follows higher ground	Longest evacuation route off the island (1.5 miles are on island), which defeats the purpose of quickly evacuating the village
Road follows drier ground	Crosses the lagoon 1.5 miles north of Kivalina
Road passes by fewer Native Allotments	Lagoon crossing is not where the community originally chose it to be
Road does not cross flood-prone land area	Most indirect route to Kisimigiuqtuq Hill
Typical road section will be 4 feet above the ground for the whole length (except in lagoon)	Poorer underlying soils (mostly ice-rich silt characterized by the polygonal surface patterns)
Fewest drainage crossings (culverts)	Longest overall route (9.1 miles)
	Higher community fuel usage (and costs)
	Further from material sources (Wulik River)
	Kivalina River has lesser quality material sources
	Most expensive gravel costs
	Road must cross airport property
	Longest lagoon crossing
	Highest erosion potential (lagoon-side of island)
	Most expensive (+/- $75 million)

11.7.3 Combined Route

Pros	Cons
Road follows higher ground	Longest evacuation route off the island (1.5 miles are on island), which defeats the purpose of quickly evacuating the village
Road follows drier ground	Crosses the lagoon 1.5 miles north of Kivalina
Road passes by fewer Native Allotments	Lagoon crossing is not where the community originally chose
Road does not cross flood-prone land area	Not the most direct route to Kisimigiuqtuq Hill
Close to material source on the Wulik River	Second longest overall route (8.6 miles)
Typical road section will be 4 feet above the ground for the whole length (except in lagoon)	Significant areas of poor underlying soils (ice-rich silt characterized by surface polygons)
	Road must cross airport property
	Longest lagoon crossing
	Road passes by two Native Allotments
	Almost the most expensive (+/- $74 million)

12 Recommendations

WHPacific met with the NVK on December 6, 2013, and discussed which route they preferred for the Evacuation Road alignment. The Southern Route was their preferred alignment.

WHPacific agrees with the NVK's decision and also recommends the Southern Route as the preferred Evacuation Road alignment. This recommendation is based on all of the data received to-date, the field work conducted, the analyses performed, and input from the Kivalina community and various agencies. This recommendation is echoed by the City of Kivalina, the geotechnical consultant and the three agencies that responded.

The Southern Route accomplishes the objective of providing a safe and fast evacuation route to Kisimigiuqtuq Hill. It does this with the least environmental impacts, least cost, shortest road, and highest quality road over the best soils.

The following section, entitled "A Plan Forward," has been included to help the NVK navigate the difficult and complicated road ahead. It is recommended that the NVK work with the NAB to expedite the contracting required to bring the appropriate consultants on-board to perform the various pre-construction tasks that have been identified.

13 A Plan Forward

In the spring of 2012, WHPacific developed a report titled, *"Kivalina Evacuation and New School Access Road: A Guide to Required Design and Environmental Studies."* That report summarized the tasks, documents, schedule, and costs needed to complete the evacuation road project. The report was very preliminary, and therefore conservative, in nature. While primitive in its understanding of the project, it was none-the-less very helpful in organizing and directing the efforts of the NVK, NAB, WHPacific, USACE, and others. It was used successfully by the NAB to obtain design funding from the State legislature.

Since that initial effort to understand and grasp the project as a whole, much more detail is now known. As part of this Reconnaissance Study, that earlier report has been updated and improved upon. While still not "perfect," it gives a much clearer and more accurate picture of the steps ahead. The updated report has been renamed *"Kivalina Evacuation and School Access Road Project: A Plan Forward; A Guide to the Required Geotechnical, Survey, Environmental, Design, and Permitting Tasks."* It is included in its entirety in Appendix F.

Tables 8 and 9, below, were taken from the new *"A Plan Forward"* report. Each task listed is described in more detail in the report, so they are not reproduced here. Table 8 shows a summary of the pre-construction activities that have been funded and are completed or underway and their associated costs. Table 9 shows those pre-construction tasks that are currently not under contract and their associated costs. Funds were received from the State of Alaska are being held by the NAB for these tasks.

Table 8. Status of Pre-Construction Tasks (Under Contract) and Associated Costs

Contractor	Pre-Construction Tasks Completed or Under Contract	Status (Start Date)	Actual Costs
WHPacific	Aerial Photography	Completed	$ 35,000
	Preliminary Geotechnical Investigation (Road Alignments and Material Sites)	Completed	$ 85,000
	Road Reconnaissance Study (Report and Recommendations)	Completed	$ 150,000
USACE (w/ NAB)	Geotechnical Investigation (Causeway & Bridge)	March 2015	$ 320,000
	Bathymetric Survey (of Lagoon)	July 2014	$ 325,000
	Hydrologic Study (of Lagoon)	Sept. 2014	$ 145,000
	35% Design (Causeway and Bridge)	January 2015	$ 270,000
	Pre-Construction Work Under Contract		**$ 1,330,000**

Table 9. Pre-Construction Tasks (Not Under Contract) and Estimated Costs

Category	Pre-Construction Tasks to be Completed	Estimated Costs
Geotech.	Geotechnical Investigation (Road Alignment)	$ 300,000
	Geotechnical Investigation (Material Sites)	$ 300,000
Survey	Topo Map from Aerial Photography	$ 50,000
	Centerline Field Verification of Topo Map Data	$ 30,000
	Right-of-Way Documentation	$ 30,000
Environ.	Marine Mammal Study	$ 155,000
	Biological Assessment - Essential Fish Habitat (EFH)	$ 100,000
	Wetlands Delineation	$ 60,000
	Archaeological Survey	$ 35,000
	Environmental Document (Environmental Assessment)	$ 160,000
Pre-Design	Hydrological and Hydraulic Study (Uplands)	$ 100,000
	Preliminary Engineering Report (Design Study Report)	$ 50,000
Design / Construction Documents	Road	$ 250,000
	Causeway	$ 100,000
	Bridge(s)	$ 150,000
Permits	Permit Applications	$ 50,000
	Pre-Construction Work to be Completed	**$ 1,920,000**

Appendices

Project Research Information: A

Public Meeting Minutes: B

Field Reconnaissance Report: C

Geotechnical Report: D

Concept-Level Construction Cost Estimate: E

A Plan Forward: F

Appendix A

Project Research Information

1 Project Research Information

The following information and reference material was used to prepare this Feasibility Study.

1.1 General Information

- *Alaska Regional Profiles, Volume V, Northwest Region*; University of Alaska, Arctic Environmental Information and Data Center.
- *American FactFinder*; U.S. Census Bureau; Website located at http://factfinder2.census.gov/faces/nav/jsf/pages/index.xhtml; Accessed October 2013.
- *Community Database Online - Kivalina*; Alaska Department of Commerce, Community, & Economic Development; Website located at http://www.commerce.state.ak.us/dca/commdb/CF_COMDB.htm; Accessed October 2013.
- *Environmental Atlas of Alaska*; Hartman, Charles W., and Philip R. Johnson; Institute of Water Resources/Engineering Experiment Station, University of Alaska, Fairbanks, Alaska; 1984.

1.2 Reports / Plans

- *Development of Water Surface Elevation Frequency-of-Occurrence Relationships for Kivalina, Alaska*; Scheffner, Norman W., and Martin C. Miller; Department of the Army, Waterways Experiment Station, Corps of Engineers, Vicksburg, Mississippi; January 7, 1998.
- *Evacuation / Relocation Road Feasibility Study, Kivalina, Alaska*; ASCG Incorporated; October 2005.
- *Geotechnical Investigation, Kivalina Borrow Material Exploration*; DOWL/BBFM Engineers Joint Venture; October 1998.
- *Kisimigiuktuk Hill Field Memo*; NANA / Paul Glavinovich; September 12, 2012.
- *Kivalina Airport Layout Plan*; State of Alaska, Department of Transportation and Public Facilities, Northern Region, Aviation; August 29, 2001.
- *Kivalina Evacuation and New School Access Road, A Guide to Required Design and Environmental Studies*; WHPacific Inc.; September 2012.
- *Kivalina Evacuation Road Feasibility Study*; Western Federal Lands Highway Division; February 20, 2008.
- *Kivalina Evacuation Road Project, Preliminary Environmental Report*; WHPacific, Inc.; October 2012.
- *Kivalina Gravel Report (Unpublished)*; U.S. Army Corps of Engineers, Alaska District; 2004.

- *Native Village of Kivalina – Evacuation Route, Significant Biotic Resources Baseline Report and Preliminary Essential Fish Habitat Analysis*; WHPacific, Inc.; September 13, 2012.
- *Reformulation of Water-Surface Elevation Frequency-of-Occurrence Relationships for Kivalina, Alaska – Working Draft Report*; Mark, David J.; U.S. Army Corps of Engineers, Engineer Research and Development Center, Coastal and Hydraulics Laboratory; July 2003.

1.3 Photography

- *Kivalina Orthophoto Mosaics (High Altitude, 2-Foot Pixel Resolution)*; Alaska Department of Commerce, Community, and Economic Development; June 12, 2013 and June 20, 2013.
- *Kivalina Orthophoto Mosaics (Low Altitude, 0.5-Foot Pixel Resolution)*; Alaska Department of Commerce, Community, and Economic Development; August 20, 2013.
- *Kivalina Evacuation Road Non-Orthophoto Mosaics, (2-Foot Pixel Resolution)*; AeroMetric; August 20, 2013.
- *Kivalina Route Reconnaissance Photo Log*; WHPacific, Inc.; September 2013.

1.4 Maps

- *Noatak, Alaska, 1:250,000 Series (Topographic)*; U.S. Geological Survey (USGS); 1955, Minor Revisions 1987.
- *Noatak (C-5) Quadrangle, Alaska, 1:63,360 Series (Topographic)*; U.S. Geological Survey (USGS); 1952, Minor Revisions 1982.
- *Noatak (D-5) Quadrangle, Alaska, 1:63,360 Series (Topographic)*; U.S. Geological Survey (USGS); 1955.
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1.5 Surveys/Plats:

- *Master Title Plat (MTP), Surveyed Township 27 North Range 25 West of the Kateel River Meridian, Alaska, Status of Public Domain Land and Mineral Titles*; April 27, 2010.
- *Master Title Plat (MTP), Surveyed Township 27 North Range 26 West of the Kateel River Meridian, Alaska, Status of Public Domain Land and Mineral Titles*; October 23, 2006.
- *Master Title Plat (MTP), Surveyed Township 27 North Range 26 West of the Kateel River Meridian, Alaska, Suppl Secs 16, 17 & 21, Status of Public Domain Land and Mineral Titles*; June 30, 2004.

- *Master Title Plat (MTP), Surveyed Township 28 North Range 25 West of the Kateel River Meridian, Alaska, Status of Public Domain Land and Mineral Titles*; December 3, 2008.
- *Master Title Plat (MTP), Surveyed Township 28 North Range 25 West of the Kateel River Meridian, Alaska, Suppl Secs 25, 35 & 36, Status of Public Domain Land and Mineral Titles*; December 5, 2006.
- *Master Title Plat (MTP), Surveyed Township 28 North Range 25 West of the Kateel River Meridian, Alaska, Suppl Secs 31 & 32, Status of Public Domain Land and Mineral Titles*; December 5, 2006.
- *Master Title Plat (MTP), Surveyed Township 28 North Range 26 West of the Kateel River Meridian, Alaska, Status of Public Domain Land and Mineral Titles*; November 29, 2006.
- *Status Plat, Township 27N Range 25W of the Kateel River Meridian, Alaska*; Alaska Department of Natural Resources, Land Records Information Section; May 5, 1992.
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- *Land Estate Map, Township 28N Range 26W of the Kateel River Meridian, Alaska*; Alaska Department of Natural Resources, Land Records Information Section; May 5, 1992.
- *Rectangular Survey, Township 27 North, Range 25 West, of the Kateel River Meridian, Alaska*; U.S. Department of Interior, Bureau of Land Management; December 28, 1978.
- *Rectangular Survey, Township 27 North, Range 25 West, of the Kateel River Meridian, Alaska, Segregation Survey*; U.S. Department of Interior, Bureau of Land Management; September 15, 2006.
- *Rectangular Survey, Township 27 North, Range 26 West, of the Kateel River Meridian, Alaska*; U.S. Department of Interior, Bureau of Land Management; December 28, 1978.
- *Rectangular Survey, Township 27 North, Range 26 West, of the Kateel River Meridian, Alaska, Photogrammetric Resurvey and Segregation Survey*; U.S. Department of Interior, Bureau of Land Management; September 15, 2006.
- *Rectangular Survey, Township 28 North, Range 25 West, of the Kateel River Meridian, Alaska*; U.S. Department of Interior, Bureau of Land Management; December 28, 1978.
- *Rectangular Survey, Township 28 North, Range 25 West, of the Kateel River Meridian, Alaska, Photogrammetric Resurvey and Segregation Survey*; U.S. Department of Interior, Bureau of Land Management; October 6, 2006.

- *Rectangular Survey, Township 28 North, Range 26 West, of the Kateel River Meridian, Alaska*; U.S. Department of Interior, Bureau of Land Management; December 28, 1978.
- *Rectangular Survey, Township 28 North, Range 26 West, of the Kateel River Meridian, Alaska, Photogrammetric Resurvey and Segregation Survey*; U.S. Department of Interior, Bureau of Land Management; October 6, 2006.
- *State Historical Index, Township 27 N Range 26 W of the Kateel River Meridian, Alaska*; State of Alaska, Department of Natural resources, Divisions of Lands.
- *U.S. Survey 3776, Alaska*; U.S. Department of Interior, Bureau of Land Management; October 10, 1961.
- *U.S. Survey 5582, Alaska, Townsite of Kivalina*; U.S. Department of Interior, Bureau of Land Management; May 16, 1977.
- *U.S. Survey 6818, Alaska*; U.S. Department of Interior, Bureau of Land Management; October 6, 1982.
- *U.S. Survey 6837, Alaska*; U.S. Department of Interior, Bureau of Land Management; April 22, 1982.
- *U.S. Survey 6848, Alaska*; U.S. Department of Interior, Bureau of Land Management; December 1, 1987.
- *U.S. Survey 6853, Alaska*; U.S. Department of Interior, Bureau of Land Management; May 12, 1982.
- *U.S. Survey 6856, Alaska*; U.S. Department of Interior, Bureau of Land Management; February 15, 1983.
- *Record of Survey ADL 418112, Kivalina Erosion Project*; DOWL HKM; July 25, 2012.
- *Kivalina Airport Property Plan*; State of Alaska, Department of Transportation and Public Facilities, Northern Region, Aviation; August 23, 2001.
- *Kivalina Airport, Kivalina, Alaska, Property Plan, Sheet 4 of 9*; State of Alaska, Department of Aviation; March 15, 1977.
- *Kivalina Airport Layout Plan*; State of Alaska, Department of Transportation and Public Facilities, Northern Region, Aviation; January 10, 1985.

2 Agencies Contacted

Following is a list of agencies and businesses contacted by WHPacific and the information and assistance obtained from them.

AeroMetric: Obtained aerial photography along potential route alignments.

Alaska Department of Community and Economic Development (DCCED): Obtained detailed community information data from their website. Provided aerial photography and topographical mapping.

Alaska Department of Fish & Game (ADF&G): Provided preliminary recommendations on biological assessments required, particularly regarding the Northwest Arctic caribou herd.

Alaska Department of Natural Resources (ADNR), Division of Mining Land and Water: Obtained State Status Plats, State Historical Index, U.S. Master Title Plats, U.S. Rectangular Surveys, and U.S. Surveys.

Alaska Department of Natural Resources (ADNR), Division of Geological and Geophysical Surveys: Provided feedback on the alternative alignments, especially in regards to sediment transport and erosion issues.

Alaska Department of Transportation and Public Facilities (ADOT&PF): Obtained airport layout plans and surveys. Provided feedback on the preferred alternative alignment. Provided information on existing airport operations and development restrictions and about future airport plans.

Bureau of Land Management (BLM): Obtained survey information.

NANA Regional Corporation: Provided GIS data of Native allotments and owners. Provided gravel information and ROW guidance.

National Marine Fisheries Service (NMFS): Provided threatened & endangered species information. Provided preliminary recommendations on biological assessments required, particularly regarding polar bears, ring seals, and essential fish habitat analysis.

Native Village of Kivalina (NVK): Provided general information. Coordinated housing in Kivalina for field crews. Supplied a guide for the field reconnaissance efforts. Organized and ran public meetings in Kivalina and Steering Committee meetings in Anchorage.

U.S. Army Corps of Engineers (USACE): Obtained wetland and flood information. Provided permit requirements. Obtained various reports. Coordinated the bridge/causeway geotechnical investigation, bathymetric survey, hydrological study, and preliminary designs

U.S. Census Bureau: Obtained current population and demographic characteristics.

U.S. Fish and Wildlife Service (USFWS): Provided threatened & endangered species information. Provided preliminary recommendations on the requirements for the essential fish habitat analysis.

U.S. Geological Survey (USGS): Obtained topographical maps.

Appendix B

Public Meeting Minutes

WHPacific

300 West 31st Avenue
Anchorage, Alaska 99503
907.339.6500 ◆ fax 907.339.5327

Meeting Summary

Location: Kivalina **Date:** July 23, 2013

Re: Kivalina Road Reconnaissance Study **Reporter:** Nicole McCullough, WHPacific

Purpose: A joint meeting with Kivalina IRA, City Council, WHPacific, U.S. Army Corps of Engineers, and the NWAB School District was held in Kivalina to discuss the evacuation project.

Millie Hawley, Kivalina IRA
Lucy Swan, Kivalina IRA
Dolly Foster, Kivalina IRA
Oral R Hawley, Kivalina IRA
Austin Swan Sr., City of Kivalilna
Lucy S. Adams, City of Kivalina
Alice A. Adams, City of Kivalina
Rosswell Stalker, Kivalina IRA
Brian Barger, Kivalina IRA
Becky Norton, Kivalina IRA
Isabelle K. Booth, Kivalina IRA
Colleen, City of Kivalina
Charles Ryan Adams, Kivalina IRA
Larraine Adams, Kivalina IRA – ICWA
Shirley Adams, Kivalina IRA
Leroy Adams Sr. Kivalina IRA/City
Dave Williams, US Army Corps of Engineers
Kathy Christy, NWAB School District
Nicole McCullough, WHPacific
Steve Coleman, WHPacific
Jackie Schaeffer, WHPacific

Summary: Millie Hawley called the meeting to order and a roll call was completed. Alice Adams led the invocation and Millie introduced the guests. Everyone approved the agenda and the meeting began with a presentation from WHPacific regarding the evacuation road reconnaissance study.

Steve Coleman presented a map with two possible routes shown and discussed the process for designing the evacuation road. He emphasized the need to find gravel and invited the councils to provide input. Steve explained that a helicopter will be hired to assist with the geotechnical and field reconnaissance work. The helicopter is scheduled for August 14-17. Steve said there is a need to hire someone from the village to help with this effort. Millie said she will post that position and Steve agreed to send a description of the project duties and requirements.

Millie questioned if there were other possible routes for the road. The road off the island is the focus; however only the school site was voted on in 2012, not the road alignment. She said it was important that in the following public meeting it not appear to the public that an alignment was already selected.

Steve explained that a road on high ground is best; it needs to be at least as high as the spit. The routes shown on the map were not the only routes but without detailed topography, appeared to traverse across less wetlands and avoided Native Allotments. An additional route was added to the map that crossed the lagoon north of the runway and avoided the worst of the wet area.

Colleen suggested that we look at the NANA and DOT gravel sites located up the coast to the north and on the Wulik River. There was discussion of the gravel used for the airport.

Dave Williams explained that there is planning assistance from his agency available that could be applied to this project. The funds require a modification to a current agreement that would need to be modified. The agreement is between the Corps of Engineers, the City of Kivalina, the Kivalina IRA and Northwest

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Arctic Borough. Any funds the Corps spends on this project will need a 50% match. Dave distributed a copy of the agreement with the modification language and signature blocks on the last page.

Dave said he received an estimate the day before for the work the Corps could do. The estimate was $800,000. The Corps could determine the best location and design of the lagoon crossing. They would do this by performing a bathymetric survey; completing environmental, hydrology and ice studies; conducting geotechnical work. The Corps can contribute $250,000 this year and next year $150,000. By 2015 they would have a 35% complete design. They estimated at this time that they would need about 250,000 CY of gravel for a 5,000 foot (shortest possible) lagoon crossing. Steve stated a similar amount was likely needed for the road.

Millie asked if there could be a change to the contract modification. She suggested that instead of referring to the relocation that the modification make it clear that the Corps work is for the evacuation road. Dave said yes, he could make that change. He said when the entities all agree he will forward the modification to Washington D.C. for final approval. Until then, no work will start. He suggested that the sooner the better and a proposed date for signature by the Tribe and City was set for July 30th. Dave agreed to modify the language in the agreement and send via email to Millie to distribute to both councils. Colleen asked if July 30th was a deadline and Dave explained that it was not.

Kathy Christy provided background about the Kasayulie agreement that resulted from the *Kasayulie vs. State of Alaska* lawsuit. The agreement led the school district to examine potential improvements to the existing school in Kivalina but they determined the current site was not adequate. Instead, they elected to build a new school off the island. The community met and agreed to the current proposed site at Kisimigiuktuk Hill. She explained that she needed to complete a grant application to the legislature by September 2013. She said that deadline will be met.

The proposed school is 35,000 square feet. For purposes of estimating the funding they used a scaled down version of the Noatak School but the final design will likely be different. Their consultant estimated the school to cost $88 million but she thought this was on the high end and $50 to 60 million was more reasonable. The teachers housing will not be part of the DOE, but maybe AK Housing Finance funds could be used for teacher housing.

Millie said there was no old business and she asked the council for comments and then the meeting was adjourned.

KIVALINA

KISIMIGIUKTUK HILL

KIVALINA RIVER

WULIK RIVER

CHUKCHI SEA

Asikpak Mountain

Kisaymaruktuk Mountain

Asikpak Lagoon

Imnakuk Creek

KIVALINA LAGOON

Kivalik Inlet

Singauk Entrance

IGRUGAVIK CREEK

Kisimigiuktuk Hill

Imikruk

LEGEND

- Potential Road Alignment Route
- Possible Bridge Site
- Native Allotment

N

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Potential Road Alignment Routes
Public Meeting

Kivalina Road Reconnaissance Study
Native Village of Kivalina

JOB NO.:	5557
DATE:	July 2013
DRAWN BY:	SEC
CHECKED BY:	SEC
FIGURE NO.:	1

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Native Village of Kivalina

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"Advocating for our people, land, waters and subsistence way of life"

AGENDA
Joint Meeting
Kivalina IRA & City Council
WH Pacific, U.S. Army Corp of Engineers, NWAB School District
July 23, 2013

1. Call to Order
   A. Roll Call
   B. Invocation
   C. Introduction of Guests
2. Approval of Agenda
3. New Business
   A. Evacuation Road Reconnaissance Study- WH Pacific Steve Coleman
   B. New School Design Update- NWAB School District Kathy Christie
   C. Lagoon Crossing- U.S. Army Corp of Engineers Dave ~~Coleman~~ Williams
4. Old Business
5. Council Comments
6. Adjournment

Kivalina School Access and Evacuation Road Reconnaissance Study

Kivalina, Alaska

Sign In Sheet

July 23, 2013

Name	Organization	Phone	e-mail
JACKIE SCHAEFFER	WHP	339-5323	jschaeffer@whpacific.com
Nicole McCullough	WHPacific	339-6546	nmccullough@whpacific.com
STEVE COLEMAN	WHPACIFIC	339-6527	SCOLEMAN@WHPACIFIC.COM
Lucy M. Swan	Kivalina IRA - Bookkeeper	645-2201	lucy86swan@gmail.com
David W. Williams	U.S. Army Corps of Eng.	753-5621	david.a.williams@usace.army.mil
Millie Hawley	Kivalina IRA	645-2153	millie.hawley@ymail.com
Dolly Foster	Kivalina IRA Council	645-5131	dolly_foster@hotmail.com
Oral R Hawley	Kivalina IRA Council	645-5071	nanenative2002@yahoo.com
Austin Swan Sr	Kivalina City	645-2190	austinswan@kivalina.net
Lacy S. Adams	Kivalina City	645-2136	
Alice A Adams	Kivalina city	645-2433	
ROSS Wall Stalker	Kivalina		
Brian Barger	Kivalina IRA Council	645-5466	
[illegible]	Kivalina City	645-2123	[illegible]@aol.com
Kathy Christy	NWABSD	223-2999	christykj@gci.net
Becky Norton	Kivalina IRA	645-2157/5140	beck.kvk@yahoo.com
Isabelle K. Booth	Kivalina IRA	907-645-2216(H) 306-2587(C)	isabelle.booth@maniilaq.org

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Kivalina School Access and Evacuation Road Reconnaissance Study

Kivalina, Alaska

Sign In Sheet

July 23, 2013

Name	Organization	Phone	e-mail
Charles Ryan adams	IRA	645-2248	NA
Lorraine Adams	IRA - ICWA	645-2256	lorraine.adams@nanacom
Shirley Adams	IRA-Temp.	645-5084	ayaiyaq@yahoo.com
Leroy Adams Sr	IRA/City	645-2249-work	leroyadams@hotmail.com

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Meeting Summary

Location: Kivalina **Date:** July 23, 2013

Re: Kivalina Road Reconnaissance Study **Reporter:** Nicole McCullough, WHPacific

Purpose: A public meeting was held in Kivalina to discuss the Evacuation Road project.

Millie Hawley, Native Village of Kivalina
Lucy Swan, Native Village of Kivalina
Colleen, City of Kivalina
Dave Williams, US Army Corps of Engineers
Kathy Christy, NWAB School District
Nicole McCullough, WHPacific
Steve Coleman, WHPacific
Jackie Schaeffer, WHPacific

Presentation Summary: Nicole McCullough presented an overview of what the Kivalina Road Reconnaissance Study is, Jackie Schaeffer discussed how the public will be involved in this project and why it is important, and Steve Coleman discussed some of the preliminary road design details. Following Steve's discussion was a question and answer session that was open to the entire room. A map showing a couple potential routes was distributed to the participants.

Questions and Answers

Question: Will field work be done when there is a storm (possibly in the fall)?

Answer: Yes, we will study how storms typically affect the study area and if there is a storm we will make observations.

Question: What will be done to prevent the gravel from washing away?
Answer: The causeway will be protected with armor rock. It will be similar to, but smaller than, what is being used on the seaward side of the island.

Question: Will there be a drainage system on the road?
Answer: Yes, a drainage system will be incorporated into the road design.

Comment: There is a lot of gravel in the shallow parts of the Wulik River, but further upstream the rocks get bigger. There might be some land ownership issues.

Comment: Kivalina is located in a shallow spot and there is a lot of gravel in the area.

Question: How much gravel will be needed for the evacuation road?
Answer: At least a half million cubic yards of gravel will be needed for the evacuation road and lagoon crossing.

Question: Is equipment necessary to compact the gravel?
Answer: Normally yes, but the gravel across the lagoon will not be compacted underwater.

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Comment: There have been studies going on for the past 40 years and they are still going. The quickest way to do the project right now would be to take the gravel used during the airport construction from Wulik on my land.

Question: Wouldn't it be easier to work from the hill back to the lagoon?
Answer: Possibly, but the hill may not be the best gravel source, as it will likely require blasting and crushing which would be expensive.

Question: (Liz Hawley) Is there an emergency drill for Kivalina?
Answer: (Millie Hawley) Yes, the City and Northwest Arctic Borough have an evacuation plan, but the only place to go is the school. That is why we are looking at an evacuation road, and trying to see if our Tribal funds could pay for a road. In the event of a disaster, the city has a protocol for flooding evacuation.

Question: Will this road be good for subsistence?
Answer: Yes and no. The road will provide land access to berry picking areas. The road will create some dust, which may cover the areas close to the road. Lucy said that the road could be a concern if there are a lot of berries in the area.

Question: What would excavating gravel out of the river do to it?
Answer: We would need to get a permit prior to excavating any gravel out of the river, which would require an environmental study. We would prefer not to get gravel directly from the river, but from land alongside the river.

Question: The maps show a lot of wetlands, how will water affect the project?
Answer: We would avoid the water where we can. The road might include some culverts and bridges and the design will likely not be a straight road so that bad spots can be avoided. Roads through wet areas will "sink" some, so additional gravel fill will be required.

Question: Are you going to build on top of or below the surface?
Answer: We will probably build on top of the ground to avoid melting any permafrost. Geotechnical studies will help us determine where to build based on the subsistence conditions. There will not likely be excavation for this road project except at the hill.

Question: Will there be buildings at the evacuation site?
Answer: Probably, but for now, we are just looking at the road. Millie stated that based on the December meeting in 2011 with the school district there will probably be buildings at the site.

Comment: Kisimigiuktuk Hill is an old volcano.

Question: Once everything is in place, how long before there is a road?
Answer: Could not answer this as there are many factors. If all the money needed was available right now, it would still take at least a few years.

Comment: Millie Hawley encouraged people to keep asking questions.

Comment: Dave Williams discussed water resources. The road will be 4.0-4.5 meters above the sea level. The causeway will have a 100 foot wide base and be 40 feet across at the surface. Freshly broken

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sharp rocks are best for stabilizing the causeway. We could expect more sand bars once the causeway is built, which may result in bird nesting areas. We are hoping to have the bathymetry survey, drill coring at the crossing and hydrology studies complete by the end of March and a 35% design complete in 2015.

Question: Becky asked how their bridge might be like the Selawik Bridge.

Answer: The Selawik Bridge is not rated for as much weight; it is only weighted for 20,000 pounds. Kivalina will need a stronger bridge.

Question: What about the money?
Answer: This year, the Corps of Engineers will contribute $250,000 and the Northwest Arctic Borough will provide $250,000 and next year they will each contribute an additional $150,000.

Question: Stan asked if someone could explain what IRT is.
Answer: IRT stands for Innovative Readiness Training. It is field training for troops to prepare for wartime missions in American communities. They could build the evacuation road as a training exercise and this would save money.

Comment: Millie submitted an application for IRT assistance at the end of spring for survey and in April and May next year she will submit an application for help with building the bridge and road.

Kathy Christy provided background about the plans for the new school. She explained that she needed to complete a grant application to the legislature by September 2013. She said that deadline will be met. For purposes of estimating the funding they used a scaled down version of the Noatak School but the final design will likely be different. Their consultant estimated the school to cost $88 million but she thought this was on the high end and $50 to 60 million was more reasonable.

Millie asked for final comments. She said the consultants will be around after the meeting was adjourned and will be listening to additional comments.

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Native Village of Kivalina

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e-mail: tribeadmin@kivaliniq.org

"Advocating for our people, land, waters and subsistence way of life"

July 23, 2013
Community Meeting

	NAME	PHONE #	ADDRESS	
1	Russell Adams Sr	645-2144	P.O. BOX 500 12	KIVALINA, AK 99750
2	Ida Swan	[redacted]	P.O. BOX 50068	KIVALINA, AK 99750
3	[illegible]	645 5359	P.O. BOX 500	KIVALINA, AK 99750
4	[illegible]		P.O. BOX 500	KIVALINA, AK 99750
5	[illegible]		P.O. BOX 500	KIVALINA, AK 99750
6	Alan Schwabe		P.O. BOX 500	KIVALINA, AK 99750
7	Hannah Lazarus Martin		P.O. BOX 500	KIVALINA, AK 99750
8	Daniel Fernandez pascual		P.O. BOX 500	KIVALINA, AK 99750
9	Andrea Degnan		P.O. BOX 500	KIVALINA, AK 99750
10	Solomon Basil	6955350	P.O. BOX 500 77	KIVALINA, AK 99750
11	Becky North		P.O. BOX 500	KIVALINA, AK 99750
12	Vendyna North		P.O. BOX 500	KIVALINA, AK 99750
13	Desiree Adams		P.O. BOX 500	KIVALINA, AK 99750
14	Ida Swan		P.O. BOX 500	KIVALINA, AK 99750
~~15~~	[illegible]		P.O. BOX 500	KIVALINA, AK 99750
16	[illegible] R. Koonuk		P.O. BOX 500	KIVALINA, AK 99750
17	Frank Wesley		P.O. BOX 500	KIVALINA, AK 99750
18	Pamela Hoffman		P.O. BOX 500	KIVALINA, AK 99750
19	[illegible] Beasley	645-2216(H)	P.O. BOX 500	KIVALINA, AK 99750
20	[illegible]	645-2648	P.O. BOX 500	KIVALINA, AK 99750
21	Alice A Adams	645-2433	P.O. BOX 500	KIVALINA, AK 99750
22	Oral R Hawley	645-5071	P.O. BOX 500	KIVALINA, AK 99750
23	[illegible]		P.O. BOX 500	KIVALINA, AK 99750
24	Stanley Hawley	645-5499	P.O. BOX 50026	KIVALINA, AK 99750
25	Lorraine Adams	645-2256	P.O. BOX 500	KIVALINA, AK 99750
26	Rosalind Stalker	645-5015	P.O. BOX 50071	KIVALINA, AK 99750
27	MICHAEL GEORGE	9074223221	P.O. BOX 500	KIVALINA, AK 99750
28	Jen Marlow	5034137524	P.O. BOX 500	KIVALINA, AK 99750
29	Nina Almog	5066000684	P.O. BOX 500	KIVALINA, AK 99750

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30	Myra Wesley		P.O. BOX 500	KIVALINA, AK 99750
31	Rhonda Norton		P.O. BOX 50046	KIVALINA, AK 99750
32	Margaret B		P.O. BOX 500	KIVALINA, AK 99750
33	Chris Koenig		P.O. BOX 500	KIVALINA, AK 99750
34	Russell Adams Jr		P.O. BOX 500	KIVALINA, AK 99750
35	Andrea Baldwin		P.O. BOX 500	KIVALINA, AK 99750
36	[illegible]		P.O. BOX 500	KIVALINA, AK 99750
37	[illegible]		P.O. BOX 500	KIVALINA, AK 99750
38	[illegible]		P.O. BOX 500	KIVALINA, AK 99750
39	[illegible]		P.O. BOX 50058	KIVALINA, AK 99750
40	[illegible]		P.O. BOX 50047	KIVALINA, AK 99750
41	Emma Stalker		P.O. BOX 500	KIVALINA, AK 99750
42	Emmanuel Hawley		P.O. BOX 500	KIVALINA, AK 99750
43	Mae Adams		P.O. BOX 50058	KIVALINA, AK 99750
44	JACK KOENIG		P.O. BOX 50005	KIVALINA, AK 99750
45	[illegible]		P.O. BOX 500	KIVALINA, AK 99750
46	Winona Cantor		P.O. BOX 500	KIVALINA, AK 99750
47	Bertha Adams		P.O. BOX 50046	KIVALINA, AK 99750
48	Carlos Hawley		P.O. BOX 500	KIVALINA, AK 99750
49	[illegible]		P.O. BOX 500	KIVALINA, AK 99750
50	Lucy S. Adams		P.O. BOX 500	KIVALINA, AK 99750
51	G Swan		P.O. BOX 50062	KIVALINA, AK 99750
52	Lucy Swan		P.O. BOX 500	KIVALINA, AK 99750
53	Shirley Adams		P.O. BOX 500	KIVALINA, AK 99750
54	Brenda Hawley		P.O. BOX 500	KIVALINA, AK 99750
55	Joanne Wesley		P.O. BOX 500	KIVALINA, AK 99750
56	Leona Adams		P.O. BOX 500	KIVALINA, AK 99750
57	Rhea Barger		P.O. BOX 500	KIVALINA, AK 99750
58	Lora Swan		P.O. BOX 500	KIVALINA, AK 99750
59	Eleanor K Swan		P.O. BOX 500	KIVALINA, AK 99750
60	Hilda Cleary		P.O. BOX 50061	KIVALINA, AK 99750
61	Daley Foster		P.O. BOX 500	KIVALINA, AK 99750
62	Elaine Adams		P.O. BOX 500	KIVALINA, AK 99750
63	Lizzie Hawley		P.O. BOX 500	KIVALINA, AK 99750
64	Lawrence S. Adams		P.O. BOX 50058	KIVALINA, AK 99750
65	Ross Stalker Jr		P.O. BOX 500	KIVALINA, AK 99750
66	Sonya Barger		P.O. BOX 500	KIVALINA, AK 99750
67	Nikki Adams		P.O. BOX 50063	KIVALINA, AK 99750
68	Lucas Sage		P.O. BOX 500	KIVALINA, AK 99750
69	Josie Adams		P.O. BOX 500	KIVALINA, AK 99750
70	Cassie Baker		P.O. BOX 500	KIVALINA, AK 99750

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71	Joe Swan Jr		P.O. BOX 50047	K VALINA, AK 99750
72	Albert Hawley		P.O. BOX 500 66	K VALINA, AK 99750
73	Ella Lemut		P.O. BOX 500	K VALINA, AK 99750
74	Marcia Doring		P.O. BOX 50005	K VALINA, AK 99750
75	Maureen J Norton		P.O. BOX 500 44	K VALINA, AK 99750
76	Billy Stone Jr		P.O. BOX 500	K VALINA, AK 99750
77	Anthony Adams		P.O. BOX 500	K VALINA, AK 99750
78	Emma Swan		P.O. BOX 50047	K VALINA, AK 99750
79	Ellen Hall		P.O. BOX 500	K VALINA, AK 99750
80	Albert Gorton Jr.		P.O. BOX 500 66	K VALINA, AK 99750
81	Willard Adams Jr.		P.O. BOX 500 53	K VALINA, AK 99750
82	Lona Adams		P.O. BOX 500 50	K VALINA, AK 99750
83	Enoch Adams Jr.		P.O. BOX 500 70	K VALINA, AK 99750
84	Robert		P.O. BOX 500	K VALINA, AK 99750
85	Brian Borgo		P.O. BOX 500 20	K VALINA, AK 99750
86	Shirley Adams	5084	P.O. BOX 500 69	K VALINA, AK 99750
87	[illegible]		P.O. BOX 500 22	K VALINA, AK 99750
88	Cecilia Hawley		P.O. BOX 500	K VALINA, AK 99750
89	[illegible]		P.O. BOX 500	K VALINA, AK 99750
90	Danny Joseph	5284	P.O. BOX 500	K VALINA, AK 99750
91	Angelo Hawley	5284	P.O. BOX 50074	K VALINA, AK 99750
92	Mildred Hawley		P.O. BOX 500	K VALINA, AK 99750
93	Charlene Adams		P.O. BOX 500 70	K VALINA, AK 99750
94	Harold Booth	2053	P.O. BOX 50040	K VALINA, AK 99750
95	Caleb Wesley		P.O. BOX 500 48	K VALINA, AK 99750
96	[illegible]		P.O. BOX 500	K VALINA, AK 99750
97	Gerry Swan	2027	P.O. BOX 500	K VALINA, AK 99750
98	Loretta M. Hawley		P.O. BOX 500	K VALINA, AK 99750
99	Loretta G. Adams	5084	P.O. BOX 50061	K VALINA, AK 99750
100			P.O. BOX 500	K VALINA, AK 99750

DOOR PRIZE WINNERS	
*Four 6 gallon gas winners	*Cash prize winners
IDA SWAN	$20 Winona Carter
LARRAINE ADAMS	$30 Becky Norton
WAYNE HAWLEY	$40 CHRIS KOENIG
CALEB WESLEY	$50 Rosswell Stalker

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Meeting Summary

Location: Kivalina **Date:** July 30, 2013

Re: Kivalina Road Reconnaissance Study **Reporter:** Nicole McCullough, WHPacific

Purpose: The quarterly Evacuation Road Coordination meeting took place in Anchorage on July 30, 2013 at the WHPacific office. Members of the Kivalina IRA, City Council, WHPacific, U.S. Army Corps of Engineers, State of Alaska Department of Community and Regional Affairs and the NWAB School District met to discuss the evacuation road project. The following agenda was adopted for the meeting.

1. Call to Order
2. Roll Call
3. Invocation/Introductions
4. Approval of Agenda
5. Approval of previous meeting minutes
6. Business:
    A. IDENTIFY FUNDING SOURCES/PULL RESOURCES TOGETHER
    B. Next Steps
    C. Updates
        i. Corps of Engineers
        ii. July 23, 2013 Meeting- WHPacific
        iii. Kivalina IRA Council
        iv. Northwest Arctic Borough School District
        v. Northwest Arctic Borough
        vi. NANA Lands Dept.
        vii. DCCED
7. Questions and Answers
8. Audience Comments
9. Council Comments
10. Next Meeting
11. Adjournment

Summary: Millie Hawley called the meeting to order and a roll call was completed by the IRA and City Councils. Lucy Adams led the invocation and participants introduced themselves. The sign-in sheet is attached. In addition to those listed, Cathy Christy from the School District and Annette Greene from Department of Education attended via telephone.

Dave Williams from the Corps of Engineers (COE) made a brief presentation about the COE's planning assistance funds available for the evacuation road reconnaissance study. His agency has $250,000 they can spend towards 35% design of the lagoon crossing, which includes a bathymetry survey, hydrology study and geotechnical work. The geotechnical work will likely begin in late winter next year (March/April 2014).

Dave discussed the need to decide on either an amendment to the existing Relocation agreement or a new agreement between the Corps, the City and IRA Councils and the Borough that would allow the

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Corps to receive the funding to do the evacuation road work. He presented a proposed amendment to the existing agreement. The agreement requires a 50% match. Kenny Gallahorn, Northwest Arctic Borough (NAB) said they will provide the match.

Dave said he'd talked to his headquarters and they said an amendment or a new agreement would take about the same amount of time to execute. There followed a discussion of the best approach. It was decided that Dave would prepare a new agreement that used similar language to the amendment he distributed and the Councils, after review, would approve. He said he could get the agreement to the Councils the following day.

There was a brief discussion about the meeting notes from the July 23rd meeting and with one minor correction the meeting summary was approved. Becky suggested, for the benefit of those without computers, that meeting material be delivered in hard copy to those who do not have computer access. Steve Coleman summarized information presented at the July 23 Reconnaissance Study meeting in Kivalina. He emphasized the need to find gravel and explained that a helicopter will be hired to assist with the geotechnical and field reconnaissance work. The helicopter is scheduled for August 14-17. Steve asked about hiring a local guide and Millie said she will post that.

Steve shared a map showing three possible routes, including a route along the island crossing the lagoon two miles from the previously proposed location near the village. This was suggested at the July 23 meeting. There was discussion about how crossing the lagoon at this location had its pros and cons. The land on the other side of the lagoon appears to be better for a road than the location nearer the village. However, the two mile road along the airport may not be acceptable to FAA and Alaska DOT&PF. Dave said it would be important for him to know the proposed lagoon crossing prior to late winter when the drilling will take place. He explained that drilling in both locations would be extremely costly.

We discussed the environmental process. The level of environmental documentation needed can be determined more easily after the reconnaissance study is complete. Dave said that he talked to the COE Regulatory branch and they indicated the road would like require an Environmental Assessment (EA). The lagoon crossing could require a greater environmental effort, an Environmental Impact Statement (EIS).

Austin said that DOT&PF extracted gravel from the Lagoon for the airport. Steve said that this information will be reviewed. The reconnaissance study will include requesting information from a number of sources and interviewing environmental staff from various agencies. There was a discussion about right of way. Rosie Barr said that it will not be a problem but there is a process that will need to be followed.

There was a discussion about the original cost estimate and schedule. Millie asked why it was originally shown as 9 years. Steve explained that was developed as the worst case scenario and assumed that the funding was provided in small amounts, which would be expensive and slow.

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Millie Hawley provided an update on the Kivalina IRA coordination and funding. She said that she submitted an application to Innovative Readiness Training to conduct survey for the Evacuation Road project as a military exercise. Millie said she has been trying to contact Colonel Trueblood who manages the program for the military. Sally Cox, DCRA explained that Colonel Trueblood will be retiring and she provided a name of a contact in Alaska to follow up with. Millie said she would invite him to the next meeting.

Kathy Christy provided background about the Kasayulie agreement in relation to Kivalina. The agreement led the school district to examine potential improvements to the existing school in Kivalina but they determined the current site was not adequate. Instead, they elected to build a new school off the island. The community met and agreed to the current proposed site at Kisimigiuktuk Hill. She explained that she needed to complete a grant application to the legislature by September 2013. She said that deadline will be met. For cost estimating purposes, they used a scaled down version of the Noatak school. Their costs estimate was $85 million. There were questions about what is a normal cost for a school and the likelihood of receiving the funds for the school. Cathy explained that schools in rural Alaska have been built recently from $35-50 million. The cost estimate for the Kivalina school includes a stand-alone, water, sewer and landfill system. It also assumed the rock at the hill will have to be blasted which adds to the foundation costs which is estimated at $12 million. Even before the settlement, Kivalina was a high priority and would not have to compete. It will be up to the legislature whether they will fund or not. If they do not fund it, the school district could reapply.

There was a discussion about the need to consider an emergency shelter along the road. Millie said funding for that could be sought. There was also a discussion about how when the road would be built. Lucy Adams said it is important to get the evacuation road built as soon as possible. Others agreed. Steve said if money was available and there were no problems the road theoretically could be constructed in 2015.

Kenny Gallahorn, NAB said they have $2.5 million for the evacuation road design and environmental documents. He said that the Borough has an emergency y evacuation plan for Kivalina which includes participation from Red Dog, the Military and the Northwest Arctic Borough. Alice mentioned the need to practice the emergency drill. Kenny said that they were going to D.C. the following day to discuss funding opportunities. He also said that they could ask the state legislature again for additional money for next year's budget.

Elia Sakeagak, NANA explained that she is the NANA contact for gravel. She introduced Paul Glavinovich, NANA geologist who prepared a geology report based on his observation on a helicopter flight last spring. He said that the hill rock would need to be blasted. Red Dog does not have gravel and they blast and it is very expensive. He said there is gravel in the lakes and in the rivers. He was very encouraged when flying over the streams in the area between the hill and town because he saw gravel. He said he does not know the extent but he believes there is plenty of gravel in the coastal plain.

Rosie Barr, NANA said that they would like to visit Kivalina to discuss land conveyance. Millie won't be available next week but the rest of the Councils would be, so that week was tentatively selected.

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There was a discussion about the funding and why there was so much money estimated for a polar bear study and why couldn't that be combined with the marine mammal study to save money. Colleen Snow, City of Kivalina said the elders know all about the wildlife and marine life and there is no need to study or spend so much. Steve agreed and said the estimate is likely on the high side but that it is required by the agencies. The work will likely require looking at reports previously prepared and interviewing the locals to get traditional knowledge. Kenny said he would like to see the table of the cost estimates updated and a schedule attached.

Sally Cox, DCRA spoke about her funding. She explained that she is working on a scope of work with the City of Kivalina to pay for a coordinator and for travel to meetings such as this one. There is $120,000 left for this effort. It is state funding.

The state is also managing about $1,000,000 shared between Kivalina, Shishmaref and Newtok. That money is designated to be used for the following:

- *Interagency Collaborative Support Structure:* DCRA will establish an interagency planning work group. Through the working group, collaborative organizational structures will be developed to focus the combined capabilities of local, regional, state, and federal stakeholders on accomplishing the recommended actions.
- *Local Capacity Building:* Grants will be provided to Kivalina to establish a full-time community coordinator (two years) who will work with project staff, representatives of the inter-agency group, and a contractor. The coordinator will also serve as an advocate for funding through grants and other means to implement needed evaluations and action plans.
- *Comprehensive Strategic Management Plan*: A contractor will be hired to develop a strategic management plan which will provide the "blueprint" for how the community and agencies will proceed over the next five years to accomplish the recommended actions the community has decided to take. The contractor will work with project staff and the local project coordinators, and attend inter-agency meetings to develop the strategic management plan.

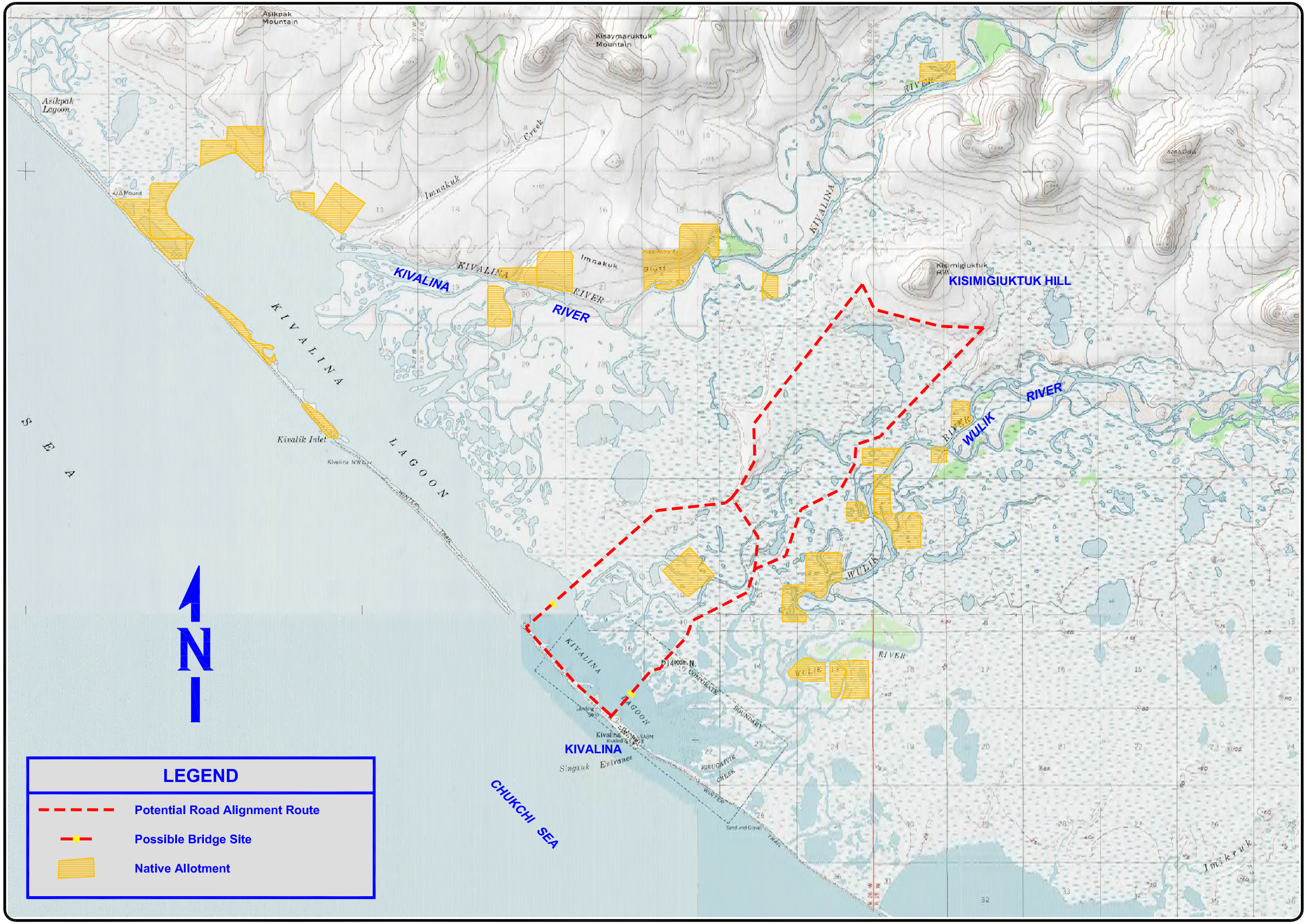
Sally explained that this funding is very flexible and could be used to develop the emergency shelters or to support the road or relocation efforts. It is intended to be used to get the community engaged in the process.

Colleen said that it has been awhile since anyone has talked about relocation and it might be good for the funds to be used for this purpose. Stanley asked a question about the VED funds. Millie suggested that be tabled for another meeting.

Sally said she could come to the village in September.

There was discussion about the need to have more time at the next meeting. Millie agreed. Millie reviewed the proposed upcoming joint meetings to be held in Kivalina:

- NANA Land Conveyance Meeting
- NWALT Meeting



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Potential Evacuation Road Alignment Routes
Joint Meeting w/ Agencies

Kivalina Road Reconnaissance Study
Native Village of Kivalina

JOB NO.:	5557
DATE:	July 30, 2013
DRAWN BY:	SEC
CHECKED BY:	SEC
FIGURE NO.:	1

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- DCRA Meeting

The next quarterly meeting was scheduled for early October.

Table 1. Design and Environmental Requirements for Kivalina Evacuation and New School Access Road

	Study	2012 Estimated Costs
Phase I Preliminary Investigation	Controlled Aerial Photography and Topography	$120,000
	Reconnaissance Report	$175,000
	Preliminary Geotechnical Investigation	$150,000
	Kisimigiuktuk Hill Material Site analysis	$400,000
	SUBTOTAL PHASE I	**$845,000**
Phase II Preliminary Design, Environmental Studies	Marine Mammal Studies	$500,000
	Polar Bear Analysis	$150,000
	Western Arctic Caribou Herd	$150,000
	Bathymetric Survey of Lagoon	$130,000
	Hydrologic Study	$150,000
	SUBTOTAL PHASE II	**$1,080,000**
Phase III Design Phase	Preliminary Engineering Report	$250,000
	Geotechnical (for causeway and bridge)	$2,000,000
	Geotechnical Survey of Preferred Road Alignment	$500,000
	Design Survey of Preferred Road Alignment	$250,000
	Wetlands Delineation	$40,000
	Archaeological Survey	$40,000
	Draft Essential Fish Habitat Analysis	Already Funded
	Final Essential Fish Habitat Analysis	$100,000
	Visual Rendering	$30,000
	T&E Section 7 Analysis	$35,000
	NEPA Document	$500,000
	Design	$350,000
	Environmental Permits	$35,000
	SUBTOTAL PHASE III	**$4,130,000**
	TOTAL All DESIGN AND ENVIRONMENTAL PHASES	**$6,055,000**

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Kivalina School Access and Evacuation Road Coordination Meeting

Anchorage, Alaska

Sign In Sheet

July 30, 2013

Name	Organization	Phone	e-mail
Sally Russell Cox	AK DCCED/DCRA	907-269-4588	Sally.Cox@alaska.gov
Richard T. Sage	Kivalina IRA	907-645-5187	Capt.breeze-KVL@Yahoo.com
Betty Swan	KVL KRPC	301-6558	bmswan@hotmail.com
Lucy I. Adams	KVL Council member	645-2136	
Alice A Adams	Kivalina, Alaska	645-2433	
Stanley Hawley	KIVALINA IRA COUNCIL	907-645-2201	tribeadmin@kivalina.org
Jack Hawley	Kivalina IRA	907645 5071	nanaonative2002@yahoo.com
Leroy T Adams	City of KVL	(907)645-5828	leroy.adams@hotmail
Kenny Gallahorn	NWAB	412-1024	KGallahorn@NWAB.org
Steve Coleman	WHPacific	339-6527	scoleman@whpacific.com
Lorain Baxter	Corps of Engineers	753-2677	Lorain.R.Baxter@usace.army.mil
Noah Naylor	NAB	442-2500	nnaylor@nwab.org
Jimmy C Smith	AK DCCED/DCRA	269 4532	Jimmy.Smith@Alaska.gov
Nisan Almog	Re-locate Project		almognisan@gmail.com
Alan Schwabe	Re-Locate Project		alanschwabe@gmail.com
Jon Marlow	Re-Locate Project	(503)413-9524	jmarlow2@hailmail.net
Colleen Swan	Kwalan Cott.		colleenekc@aol.com

Kivalina School Access and Evacuation Road Coordination Meeting

Anchorage, Alaska

Sign In Sheet

July 30, 2013

Name	Organization	Phone	e-mail
Becky Norton	KVL IRA	645-2157/5146	Becky.KVL@yahoo.com
Nicole McCullough	WHPacific	339-6546	nmccullough@whpacific.com
Elia Sakeagak	NRC-Resources	265-3758	elia.sakeagak2@nana.com
David Williams	Corps of Engineers	753-5621	david.p.williams@usace.army.mil
JACKIE SCHAEFFER	WHPACIFIC	339-5323	jschaeffer@whpacific.com
James Marshall			
Marilyn Swan			
[illegible]			
Rosie Barr	Nana	830-5420	rosie.barr@nana.com
Millie Hawley	KVL IRA	645-2153	millie.hawley@ymail.com

Kivalina IRA/City Councils
Evacuation Road Meeting Summary

Date: Tuesday, November 19, 2013 **Location:** Kivalina, Alaska

Project Name: Kivalina Evacuation Road **Reporter:** Nicole McCullough

Purpose: To review the results of the Kivalina Evacuation Road Reconnaissance Study and discuss the Tribal Transportation Program.

Attendance: The following were present at the joint meeting.

Native Village of Kivalina	City of Kivalina	Others
Millie Hawley, President	Austin Swan, Mayor	Kenny Gallahorn, Northwest Arctic Borough
Dolly Foster , Secretary	Lucy Adams, Council	Noah Naylor, Northwest Arctic Borough
Becky Norton, Council	Colleen Swan, Council	Dean Westlake, NANA Pacific
Stan Hawley, Administrator	Marilyn Swan, City Clerk	Kathy Christie, NWABSD (phone)
Oral Hawley	Janet Mitchell, City Administrator	Jackie Schaeffer, Project Coordinator
	Alice Adams, City Council	Nicole McCullough, Planner, WHPacific
	Charles Adams	Steve Coleman, Engineer, WHP
	Leroy Adams	

Summary: After the invocation by Lucy Adams, Millie discussed the agenda and the purpose of the meeting and explained that there would be a public meeting to review the information regarding the evacuation road that evening. She then turned it over to Steve Coleman to present details of the field work and the reconnaissance study.

Steve distributed a map showing two proposed routes, the northern and southern routes. The northern route was longer, but followed areas of higher and drier ground. The southern route followed a more direct route through areas of lower elevations and wetter ground. The map also indicated potential material sites and locations of Native allotments.

Geotechnical – Steve said that this summer he and Stanley accompanied the geotechnical crew's helicopter-supported investigation. The purpose of the field work was to determine soil types, depth to permafrost, surface conditions, and potential gravel sources. 140 locations were probed to depths of up to 5 feet. The probing was used to determine depths to permafrost and to give an idea of the types of material present. Ten boreholes were also drilled to get a visual look at the near-surface soils. While the entire area had permafrost, the soils along the northern route were primarily ice-rich silt with areas containing massive ice lenses. This condition is not ideal for road building. When the ice melts, there is no structure to the ground and sink holes

can develop. The soils along the southern route, nearer the Wulik River, appear to be sands and silty sands, which are preferable to silt when constructing roads in permafrost areas.

The geotechnical crew found that the areas of standing water along the southern route, were shallow and were perched above the frozen ground (permafrost). Steve said this would not inhibit road construction but would mean that areas off the road would be wet. Steve said that even though the northern route would be along higher ground, the soils were less desirable from a road building perspective.

Steve's map also showed the locations they explored for gravel. He said they avoided the Native Allotments, but still found numerous potential grave sources. Steve was very encouraged by the amount of gravel found in the area. Both the Kivalina and Wulik Rivers were investigated. The gravel along the Kivalina River was finer and was not as suitable for road building as the gravel found along the Wulik River. Samples were taken from some of the Wulik River sites so that laboratory analyses could be used to determine the quality of the material. Visually, the Wulik River gravel looked good.

It will be necessary to complete a more extensive drilling program before designing and constructing the road. While the initial results are very promising, more test holes will be needed to verify the underlying conditions along the selected route and to verify the extents and amounts of available gravel. Colleen asked if there was enough gravel for the road and Steve said that the preliminary work indicated that there was more than enough suitable gravel for the road construction. The geologists stated that it appears that the Wulik River likely meandered through the area in the past, leaving behind gravel deposits.

Environmental - Next, Steve presented information about our current understanding of the environmental process. Colleen asked if the environmental work would follow the NEPA guidelines. Steve said the level of NEPA requirements would depend on the funding source. If Federal funding was used, the environmental work would be required to follow NEPA guidelines. However, if state or private funding was used to construct, then the level of environmental requirements would be less. He has assumed that at a minimum an Environmental Assessment (EA) would be prepared.

Steve explained that the original environmental overview assumed the need for more extensive studies. After further investigation of the available studies and discussions with various agencies, our understanding of the number of required studies has been reduced. There will still be a need to complete an essential fish habitat study, a marine mammal study, an archaeology study, and a wetlands delineation study. Much of the other studies would rely on previous work. Becky Norton said that it is very important to use existing studies and consider traditional knowledge. Steve agreed that the locals should definitely be consulted and said this can save time and money and provide more accurate information about local conditions and archeology.

Cost Estimate – Steve presented cost details. He said the estimate for geotechnical, survey, environmental, and design work (pre-construction efforts) have been refined and reduced from the original estimates. The COE and the NAB have funded the 35% design of the causeway and bridge. The COE plans to complete their drilling program for the crossing in March/April of 2014. Steve discussed the parts of the design that are currently funded versus the parts that remain to be completed. Based on the research conducted as part of this current study, the estimate to complete the pre-construction tasks is now $1,890,000, bringing the total pre-construction cost estimate to $2,960,000. This is roughly half of the original estimate.

Last year, WHPacific worked with Reggie Joule (NAB mayor) to refine the costs which were presented to the state legislature. This year the NAB was awarded $2.5 million to complete the design. This funding should be sufficient to complete the pre-construction (design) phase of the work.

Steve then presented his construction cost estimates for the northern and southern routes. He estimates that the southern route will cost approximately $40 million and the northern route approximately $70 million. He explained that these cost estimates could go up or down, but they were relative to each other and could be used to help select a preferred route. The northern route is longer (9.1 miles versus 6.9 miles), has a significantly longer stretch of road within the lagoon (1.5 miles along the island before crossing the lagoon), and is further away from the gravel sources, all of which drive the costs up considerably.

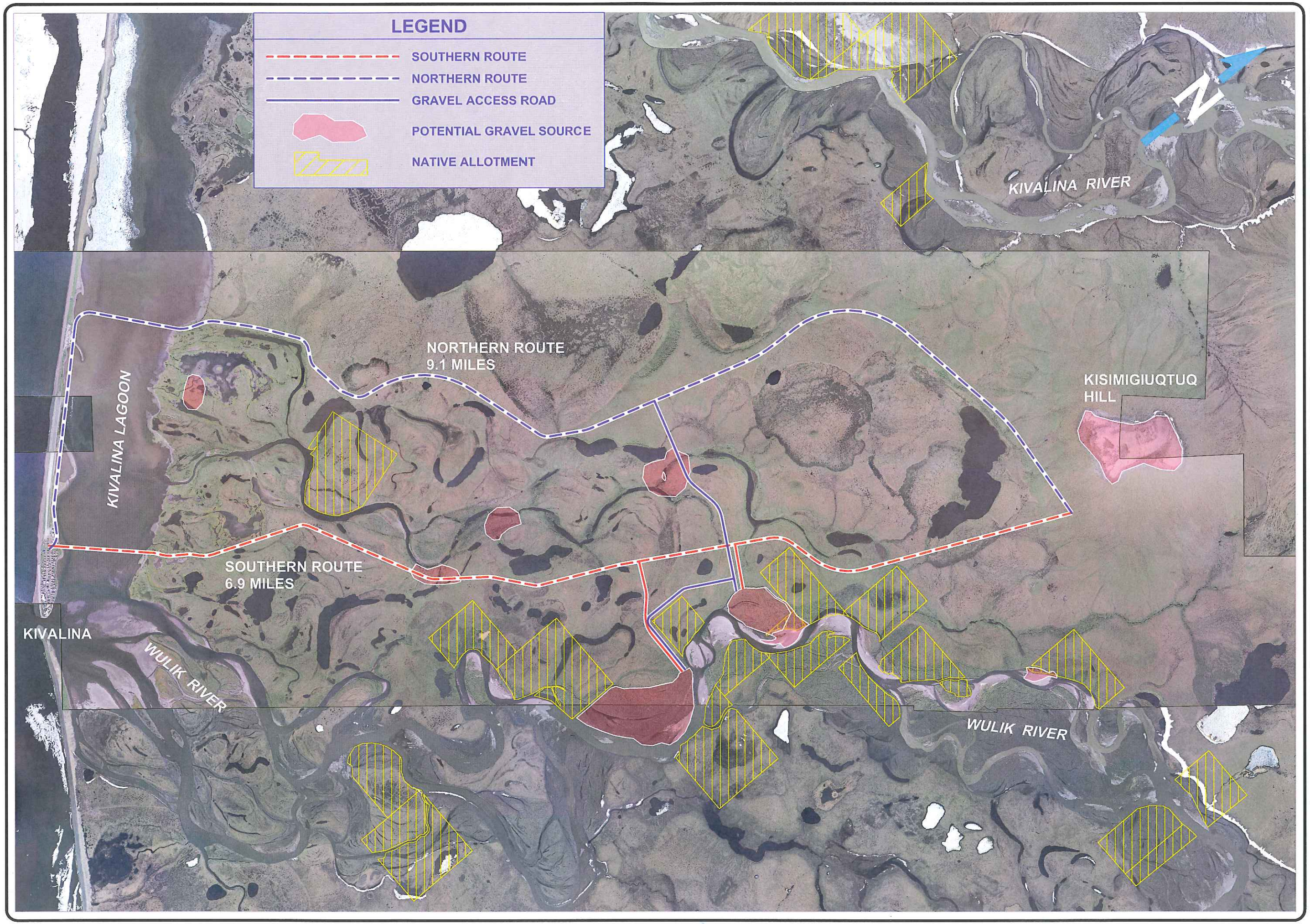
Steve talked about potential for saving funds. One way could be by using the military innovative readiness training. He also said that it might be possible to reduce the road width or consider replacing some of the gravel thickness with insulation. The construction cost estimates will be continually refined during the design phase of the project.

Schedule – A potential schedule for the project was presented. Steve thought that if the design started by January 1, 2014, then the design could be done by the summer of 2015. He anticipates that the bidding process could occur during the summer of 2015 and a contractor selected by August 2015. He said that is when he anticipates a contractor would mobilize his equipment for a winter gravel extraction. The road construction is anticipated to take two to three months and could be completed by the fall of 2016.

Inventory – Nicole discussed the BIA roads program and reviewed details about the federal highway legislation. She explained that the inventory no longer played as significant a role in determining the funding as it had under the previous highway bill. The current formula relied on the previous inventory, NAHASDA population and an average of the BIA funding from previous years. This new formula is eased in, but translates to a net reduction of funds over the next few years. We discussed the need to add the proposed evacuation road alignment into the inventory. A safety grant was applied to for Kivalina and those funds ($12,500) are expected to be available around the first of the year.

Eligible Activities – We discussed various activities that are eligible for funding in the BIA roads program including building expenses such as lighting or electricity, transit and training. We talked about the need to get qualified personnel trained for upcoming construction of the road. Steve said he will supply a list of the positions that will be required for the road construction project. There was concern that a contractor would not hire locally. Steve explained that building the road is a big job and will require about 40 workers. The contractor will have to set up a construction camp and would likely want to hire locally to reduce his costs. Steve estimated that the camp cost per person would be about $500 per day, so they would have the incentive to hire locally to avoid those costs. There was also a discussion on snow fences which is an eligible activity under maintenance. Some analysis would need to be done to determine the proper placement to be the most effective. The BIA funding could also be used as a match for construction of the evacuation road.

Next Steps – The next step will be to present the information to the public in the evening meeting and ask for input. On December 2, there will be a steering committee meeting in Anchorage with the agencies, NAB, Tribe and City represented. By mid-December the City and Tribe will meet again to select a route to proceed to the design phase. Once a road design firm is selected, the design phase can proceed. It is the intention to save



WHPacific
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907-339-6500 Fax 907-339-5327
www.whpacific.com

Alternative Evacuation Road Routes
Kivalina to Kisimigiuqtuq Hill Scale 1" = 3,000'

Kivalina Road Reconnaissance Study

Native Village of Kivalina

JOB NO.:	5557
DATE:	Nov. 2013
DRAWN BY:	SEC
CHECKED BY:	SEC
FIGURE NO.:	4

funding by coordinating the road/gravel source geotechnical investigation and drilling program with the COE who plans to perform their causeway/bridge geotechnical investigation in March 2014.

Kivalina IRA Joint Meeting – Kivalina Evacuation Road
Sign In Sheet
November 19, 2013

Name	Address/City/Zip	Phone	e-mail
Nicole McCullough	WHPacific		nmccullough@whpacific.com
Austin Swan Sr.	Kivalina City		austinswan@inuitek.net
Kenny Gallahorn	NWAB		Kgallahorn@nwabor.org
Becky Norton	KVL IRA		beck_kvl@yahoo.com
Marilyn Swan	City Clerk		
Janet Mitchell	City Admin		
Steve Coleman	WHPacific	442-7901	
Dean Ustelbke	NANA		
JAYME SCHAEFFER	WHPacific		jschaeffer@whpacific.com
Colleen E Swan	Kivalina City Council	645-2123	colleenetc@asl.com
Alice A Adams	Kivalina City Council	645-2433 or 645-3028	
Lucy S. Adams	Kivalina City Council	645-2136, Cell 5042	
Leroy T. Adams	Box 58 KVL AK	645-2005	leroyadams@hotmail.com
Charles Ryan Cales Ashby	Box 15 . KVL, AK.	645-5161	
Noah Naylor	POD 1110, Kotz	442-2500	nnaylor@nwtp.org
Darrell Hawley Nuiqsut	P.B.O. 50061 KVL. AK 99750	645-5071	
Millie Hawley	P.O. Box 50051 KVL AK 99750		millie.hawley@ymail.com
Dolly Foster	P.O.box 50074 Kivalina, AK. 99750	645-5131	dolly-foster@hotmail.com

Kivalina IRA Joint Meeting – Kivalina Evacuation Road
Sign In Sheet
November 19, 2013

Name	Address/City/Zip	Phone	e-mail
STANLEY HAWLEY	P.O Box 50026 KIVALINA, AK. 99750	907-645-2201	tribeadmin@kivalinig.org
Larraine Adams	PO BOX 50014 KIVALINA AK 99750	(907) 645-2256	Ø
Lucy M. Swan	POBox 50040 Kivalina, AK 99750	907-645-5490	lucy86swan@gmail.com
JAYME SCHAEFFER	WHP	359-5323	jschaeffer@whpacific
Richard Sage Sage	PO BOX 50077 Kivalina, AK	907-645-5187	Coolbreeze_KVL@Yahoo.com

Kivalina Public Meeting
Evacuation and School Access Road Meeting Summary

Date: Tuesday, November 19, 2013 **Location:** Kivalina, Alaska

Project Name: Kivalina Evacuation Road **Reporter:** Nicole McCullough

Purpose: To present the results of the Kivalina Evacuation Road Reconnaissance Study and gather input from the public on which potential routes to select as the preferred route.

Summary: After the invocation, Millie explained that this was a public meeting to review the information regarding the evacuation road and encouraged comments. She then turned it over Austin Swan who translated into Inupiaq the purpose of the meeting and the definition of a Reconnaissance Study. Jackie Schaeffer, WHPacific spoke about the importance of speaking out and then turned it over to Steve Coleman, WHPacific to present details of the field work and the reconnaissance study.

Steve distributed a map showing two proposed routes, the northern and southern routes. The northern route was longer, but followed areas of higher and drier ground. The southern route followed a more direct route through areas of lower elevations and wetter ground. The map also indicated potential material sites and locations of Native allotments.

Steve said that this summer there was a helicopter supported geotechnical investigation to determine soil types, depth to permafrost, surface conditions, and potential gravel sources. While the entire area had permafrost, the soils along the northern route were primarily ice-rich silt with areas containing massive ice lenses. This condition is not ideal for road building. When the ice melts, there is no structure to the ground and sink holes can develop. The soils along the southern route, nearer the Wulik River, appear to be sands and silty sands, which are preferable to silt when constructing roads in permafrost areas. Steve also explained that they found numerous potential gravel sources. The gravel along the Kivalina River was finer and was not as desirable for road building as the gravel found along the Wulik River.

Steve presented information about the environmental process. He explained that the original environmental overview assumed the need for more extensive studies. After further investigation of the available studies and discussions with various agencies, it appears that a number of the studies will not be needed.

Steve presented cost details. He said the estimate for geotechnical, survey, environmental, and design work (pre-construction efforts) have been refined and reduced from the original estimates. The COE and the NAB have funded the 35% design of the causeway and bridge. The construction cost estimates for the routes are estimated at approximately $40 million for the southern route and approximately $70 million for the northern route. The northern route is longer (9.1 miles versus 6.9 miles), has a significantly longer stretch of road within the lagoon (1.5 miles along the island before crossing the lagoon), and is further away from the gravel sources, all of which drive the costs up considerably.

A potential schedule for the project was presented. If the design starts by about January 1, 2014 it could be done by the summer of 2015. If funding is available, the road construction could be completed by the fall of 2016. Steve then presented the pros and cons of each alternative.

Public Comments:

- Which end would the project start on?

  Steve explained that the contractor would likely start at the gravel pit along the Wulik River and build 2 foot layer along the entire road. This would occur in the winter. They would also stockpile gravel in a few locations along the route and finish the road in the summer.

- Costs are not as important as saving lives.

  Nicole McCullough, WHPacific agreed, but said with such a huge project it could be hard even to find the funds for the less expensive alternative. Agencies will be less likely to fund an expensive project if there is a safer and much more economical one.

- Can we look at another northern alternative that includes the first half of the northern and half the southern route?

  Steve agreed to look at this option but said the pros and cons would be very similar to the northern route. He agreed it would be slightly cheaper because it would be shorter.

- Will looking at another route delay the project?

  Steve said no, it will be easy to add.

- Now is the time for members of our community to get training for the road project – operators, etc.

- The southern route is very low and that area floods.

  Steve agreed, but explained that the route will be built to around the 13 foot elevation level which is above the flood stage.

- The northern route would go by the dump which is eroding.

- I like the southern route.

- Does the Corps of Engineers have a preference?

  Steve said that they have not talked about a preference but may speak to that next week at the steering committee meeting.

- Do you (Steve) have a preference?

  Steve said he prefers the southern route.

- Will you be doing more studies on the two routes?

  Steve said no. There is not enough money to study both routes. The selected route will be taken to the design stage.

- *We need to hurry up and decide.*

Millie described the next steps. She said the information will be presented to the steering committee meeting in Anchorage next week with the agencies, NAB, Tribe and City represented. By mid-December the City and Tribe will meet again to select a route to proceed to the design phase. Once a road design firm is selected, the design phase can proceed. It is the intention to save funding by coordinating the road/gravel source geotechnical investigation and drilling program with the COE who plans to perform their causeway/bridge geotechnical investigation in March 2014. Millie thanked everyone for attending the meeting and she proceeded to open up the meeting to a raffle.

Kivalina Community Meeting – Kivalina Evacuation Road
Sign In Sheet

November 19, 2013

Name	Address/City/Zip	Phone	e-mail
Miranda Henry	Kivalina, Ak 99750		
Julia Koonook	Kivalina, AK 99750		
George Hawley	Kivalina AK 99750		
Lorraine Adams	KVL AK 99750		
Stan Hawley	P.O. Box 26 KVL, AK. 99750		
Felicia Thomas	Kivalina AK 99750		
Seymour Tuzroyluke	Kivalina, AK 99750		
Beverly Norton	" " "		Beckie_kvl@yahoo.com
Marian J. Norton	" " "		
Joseph Adams	Kivalina, AK 99750		
Leroy J. Adams Jr.	P.O. Box 50012 Kivalina, AK 99750		leroyadamsjr@live.com
Shirley + Ethel Adams	P.O. Box 50069 KVL AK 99750		ayaiyaq@yahoo.com
allen I adams			
Alice a adams	Box 53 KVL 645-2437		
Lucy M. Swan	Box 40 KVL, AK 99750		lucy86swan@gmail.com
Crystal Swan	Box 56 KVL AK 99750		crystalswanDI@hotmail.com
Rhonda Norton	Box 46 KVL AK 99750		rhonda_norton@rocketmail.com

Name	Address/City/Zip	Phone	e-mail
Christopher Koenig	P.O. Box 50 KVL 99750		
Andrea Baldwin	Box 50043 Kivalina, AK 99750	(907) 645-2146	
Myra Wesley	Box 30 Kivalina AK 99750	henry_myra@yahoo.com	
Richard Sage	Box 77 Kivalina, AK 99750	907-645-5197	
Martha Swan	Box 65 KVL AK 99750		
Rosswell Stalker	Box 71 KVL AK 99750		
Albert N. Jr.	66 KVL AK 99750		
Stephie Koonook	80 KVL Ak 99750		
Stephen R. Koenig	80 KVL AK 99750		
Jack Koenig	05 KVL AK 99750		
Rhea Barger	20 KVL AK 99750		
Gilbert Hawley	66 KVL AK 99750		
Kepp Swan	23 KVL AK 99750		
Doug Swan	P.O. Box 50023 Kivalina AK 99750	645-5118	
Delia Hawley	P.O. Box 59 KVL AK 99750	645-5355	
Joe Swan Jr.	P.O. Box 50042 KVL AK 99750	907 645 5105	

Name	Address/City/Zip	Phone	e-mail
Brenda Hawley			
Dolly Foster			
Jolene Wesley			
Janette D. Adams			

Kivalina Evacuation and School Access Road
Steering Committee Meeting Summary

Date: Friday, December 6, 2013 **Location:** Anchorage, Alaska

Project Name: Kivalina Evacuation Road **Reporter:** Nicole McCullough

Purpose: To present the results of the Kivalina Evacuation Road Reconnaissance Study and gather input from the agencies on which potential route to select as the preferred route.

Summary: After the invocation by Becky Norton, Millie Hawley explained that this was a steering committee meeting to review the information regarding the evacuation road.

Millie Hawley, IRA President	Barbara Janitschek, Maniilaq	David Williams, USACE
Isabelle Booth, IRA	Noah Naylor, NW Arctic Borough	Tina McMaster-Goering, USACE
Becky Norton, IRA	Jeff Nelson, NANA	Loran Baxter, USACE
Stan Hawley, IRA	Tristen Pattee, NANA	Jeff Roach, ADOT&PF
Richard Sage, IRA	Jackie Schaeffer, WHPacific	Nicole Kinsman, ADNR
Loraine Adams, IRA	Nicole McCullough, WHPacific	Erin Dougherty, NARF
Leroy Adams, City	Steve Coleman, WHPacific	Greg Smith, BIA
Rhonda Norton, City	Elia Sakeagak, NANA	

Participants were introduced. The following agenda was adopted for the meeting:

1. Call to order
2. Roll Call
3. Invocation/Introductions
4. Approval of Previous Minutes
5. Approval of Agenda
6. New Business (9:15-12 noon)
    - A. Update on August 2013 Kivalina Evacuation Road Reconnaissance Study WHPacific
    - B. Update on November 19, 2013 Community Meeting
    - C. Update from Northwest Arctic Borough School District
    - D. Update from Military Readiness Training (invited)
    - E. Next Steps –Where do we go from here?

Lunch – (Will be provided)

7. Resume New Business (1:30pm-4pm)
    - David Williams, Army Corp of Engineers – Bridge/Cause way update (1:30-2pm)
    - Alexa Greene/Jeff Roach – DOT&PF (2- 2:30pm)
    - Sally Cox, SOA DCCED (2:30- 3pm)
    - Rosie Barr/Jeff Nelson, NANA (3-3:30 pm)
8. Next Meeting dates
9. Closing Comments
10. Adjournment

It was noted that the Military Innovative Readiness Training (IRT) was contacted, but no response was received yet. No one was available from the Alaska Department of Commerce, Community, and Economic Development (DCCED) or from the Northwest Arctic Borough School District (NWABSD).

The meeting minutes from the previous steering committee meeting were reviewed along with the Joint committee meeting and public meeting notes. Leroy Adams noted that he was shown as representing the Native Village but he was with the City and his name was duplicated in the "Others" column. Charles Adams was listed as Charles Ashby and should also be shown as with the City. These changes were approved by the committee. Jackie Schaeffer requested a list of current City Council members.

WHPacific - Steve Coleman, from WHPacific, presented the latest details of the field work and the reconnaissance study. He distributed a map showing two proposed routes, the northern and southern routes. The northern route was longer, but followed areas of higher and drier ground. The southern route followed a more direct route through areas of lower elevations and wetter ground. The map also indicated potential material sites and locations of Native allotments.

Steve said that this summer there was a helicopter supported geotechnical investigation to determine soil types, depth to permafrost, surface conditions, and potential gravel sources. While the entire area had permafrost, the soils along the northern route were primarily ice-rich silt with areas containing massive ice wedges and lenses. This condition is not ideal for road building. When the ice melts, there is no structure to the ground and sink holes can develop. The soils along the southern route, nearer the Wulik River, appear to be sands and silty sands, which are preferable to silt when constructing roads in permafrost areas. Steve also explained that they found numerous potential gravel sources. The gravel along the Kivalina River was finer and was not as desirable for road building as the gravel found along the Wulik River.

Steve presented information about the environmental process. He explained that the original environmental overview assumed the need for more extensive studies. After further investigation of the available studies and discussions with various agencies, it appears that a number of the studies will not be needed.

Steve presented cost details. He said the estimate for geotechnical, survey, environmental, and design work (pre-construction efforts) have been refined and reduced from the original estimates. (The original estimate was approximately $6 million and the current estimate is approximately $3 million.) The U.S. Army Corps of Engineers (COE) and the Northwest Arctic Borough (NAB) have funded the 35% design of the causeway and bridge. The construction cost estimates for the routes are estimated at approximately $40 million for the southern route and approximately $70 million for the northern route. The northern route is longer (9.1 miles versus 6.9 miles), has a significantly longer stretch of road within the lagoon (1.5 miles along the island before crossing the lagoon), and is further away from the gravel sources, all of which drive the costs up considerably.

Steve presented a potential schedule for the project. If the design starts by about January 1, 2014, and everything goes as planned, it could be done by the summer of 2015. If construction funding is available, the road construction could be completed by the fall of 2016.

Steve then presented the pros and cons of each alternative.

ADOT&PF - Jeff Roach, from the Alaska Department of Transportation & Public Facilities (ADOT&PF) – Northern Region, presented information about funding. He said that the federal earmarks are greatly reduced and

funding for specific projects is not likely. He explained that the new highway legislation (MAP-21) reduced the amount of STP funding previously used for rural projects. MAP-21 expires in 2014 and funding allocations could change with the passage of new highway legislation. However, he thought it very possible that the current highway bill would remain in effect for a couple years or more with continuing resolutions. If this happens, it is unlikely that there would be funding for the Kivalina Evacuation Road construction. He felt that obtaining funding directly from the State legislature was the most promising.

Jeff then discussed his concerns with the northern route. He said that when the State accepted Federal funding for the airport, they agreed to protect the investment and protect the safety of the airport and flying public. If the northern route was selected, they would have to evaluate it very closely, because of the potential for penetrations into the Runway Object Free area. A road next to the runway would not be desirable from a safety perspective. The State may require the road to be off airport property, which extends into the lagoon. The State would also like to see the landfill relocated at least one mile away from the airport because of the potential for bird strikes. There was discussion about the erosion at the dump and along the lagoon side of the island. The state is monitoring the erosion carefully.

Jeff said that the State considered other airport locations on the mainland during the relocation study that would line up better with the wind. Steve pointed to areas near the southern route that could be developed for a new runway. Jeff said that an Airport Master Plan would not begin until after the road was constructed.

ADNR - Nicole Kinsman, with the Alaska Department of Natural Resources (ADNR), Division of Geological & Geophysical Surveys discussed the erosion on the lagoon-side of the island. She stated that from a coastal engineering perspective the southern route would be more desirable. She explained that 'hardening' or armoring the island for a mile and a half where the northern route would be located would create sediment transport issues and could make erosion worse in the village.

Loran Baxter, with the USACE, agreed with her assessment and explained that there is a Phase II to the seawall project that includes armoring the lagoon side of the southern portion of the island.

NANA – Jeff Nelson, with NANA Lands, would like to work with the community on the 14 (C) reconveyance for the road, future landfill, and airport. He would like to set up a meeting in Kivalina to discuss this in the near future. He discussed a potential workshop to discuss the 14 (C) reconveyance to the city in mid-February.

There was a discussion about the Native Allotment owners along the routes. Steve asked if they had been notified of the potential routes. Millie Hawley said they had not been contacted and she was unsure of the owners. Steve said that WHPacific will get a list of the Native Allotment owners. Becky Norton asked if the southern route could be moved away from the Native Allotments and Steve said there was room to move them a bit further away, if desired.

Millie asked about the land where the bridge and road would be located. We discussed the need for a long term lease. Jeff Roach, with ADOT&PF, said that no residential structures would be allowed on airport property.

Maniilaq Association – Barbara Janitschek congratulated the staff and governments for all the progress that had been made and said she believed that faith and prayer were helping to guide the process. She suggested that the group meet again to select a route. Millie Hawley agreed and a tentative date of December 17th was

set. Millie said she needed to consult with the City officials before finalizing the date. She also said that she would like the agencies to be available if there are any questions, but it was not necessary for them to attend the meeting.

USACE – David Williams, with the U.S. Army Corps of Engineers (USACE), introduced Tina McMaster-Goering who will be taking over the project. Dave said that he has funding to complete the 35% design of the causeway and bridge with a match from the Borough. The total cost is estimated to be $1.1m. He said he still needs the agreement signed from all parties. The Borough's agreement includes their responsibilities to provide the match funding. For the city and tribe, their agreements indicated they will provide information and coordination. He would like the agreement back by the end of the month.

The Corps had hoped to have the bathymetric survey done before the geotechnical investigation, but because they weren't able to get that done last fall, they will rely on air photos and local knowledge to guide the drilling program. His cost estimate was based on drilling at the southern route, not the northern route. To drill the northern route would cost more. The plan is to drill in the March/April time frame. The bathymetric survey will be done in the summer. That information will be used to complete a wave and surge analysis that will be used to determine the height of the bridge and causeway. Dave explained that he plans to start the project asking for estimates for two pieces of work – the geotechnical work and the survey. The geotechnical work will help to determine the quality and quantity of gravel needed for the lagoon crossing.

Dave also discussed the funding he had available for protecting the lagoon side of the island. To access those funds and get that project started the City will have to agree to proceed and to seek funding for the required match which would likely be about $1.75m. If they want they can turn over the agreement to another entity such as the Tribe or the Northwest Arctic Borough. Dave would like to hear by January if the community is interested in pursuing this work. It is not necessary to have the funding in place by this date, but a commitment to proceed is needed. If the decision to move forward is made he can help locate the needed funds. He suggested that rather than trying to go back and forth with signatures on the agreement, a signing ceremony could take place with the Colonel, Borough, City, and Tribal officials.

BIA - Greg Smith, with the Bureau of Indian Affairs (BIA), said that there is a C-133 aircraft operating in Alaska that has about the twice the capacity of the C-130 so can save money. He said that the C-133 pilot indicated the plane was designed to be able to land on the same runway as the C-130 airplane

Greg also stated that ADNR recognizes the BIA as a governmental permit holder. If they are used, ADNR would not charge for the first 5,000 CY of gravel. After that, the cost would be $0.50/CY. Elia Sakeagak, with NANA, stated that the NANA royalty for gravel is $2.50/CY for gravel taken from NANA lands.

There was a discussion about getting assistance with grant writing. Stan Hawley asked if WHPacific could assist with writing a USDA grant. Nicole said yes.

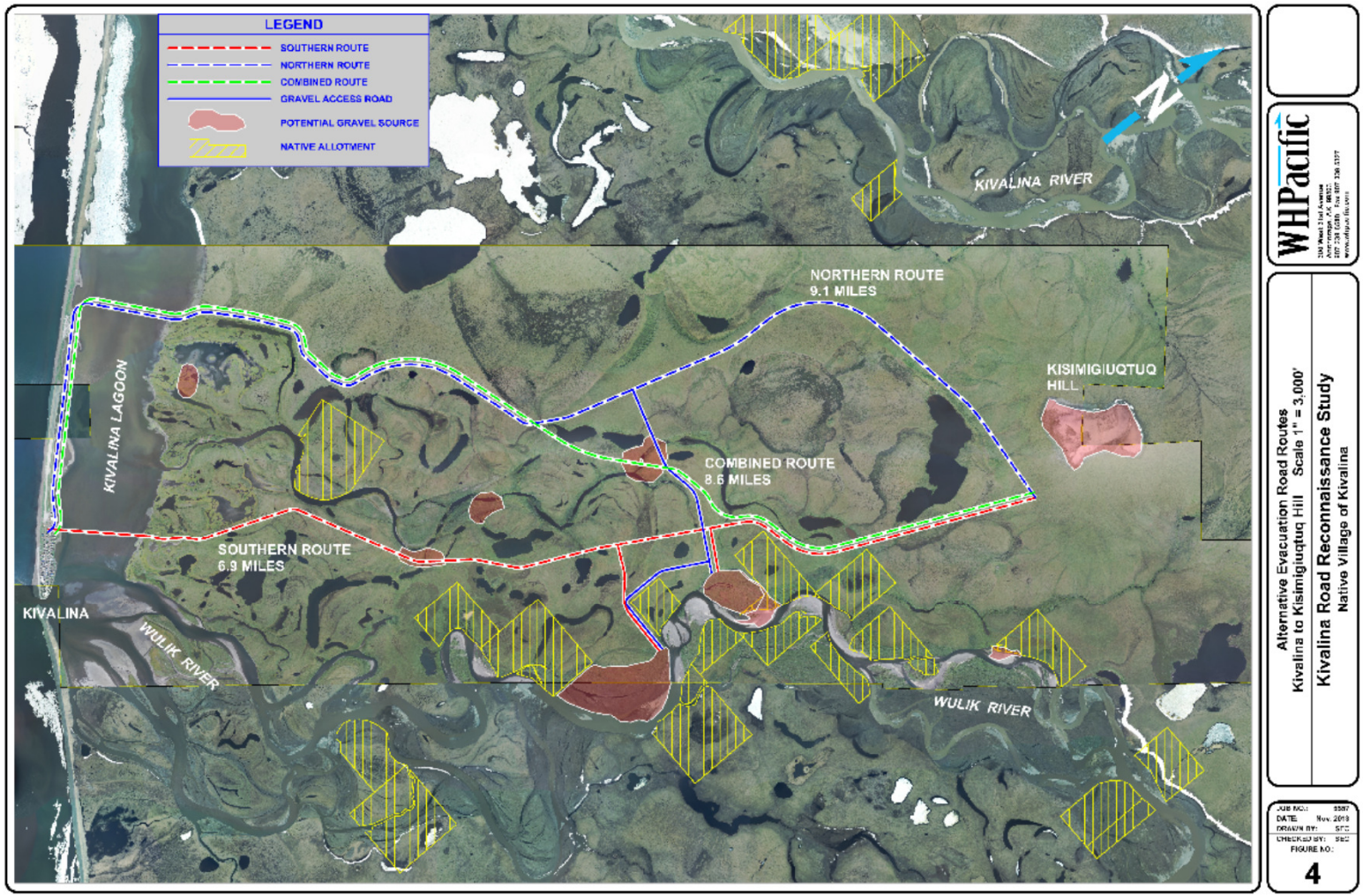
Next Meeting –The next meeting was tentatively set up for the first week in February.

Kivalina Evacuation and School Access Road

WHPacific

December 2, 2013

Alternative Alignments



Pros and Cons

Southern Route

Pros	Cons
Quickest evacuation route off the island	Road will cross wetter ground (mostly perched)
Crosses the lagoon directly from Kivalina	Road passes close to numerous Native Allotments
Lagoon crossing is where the community chose	The portion of the road across the tidal area will be up to 12 feet above the ground
Most direct route to Kisimigiuqtuq Hill	
Shortest overall route (6.9 miles)	
Better underlying soils (Silty Sand)	
Closer to material sources (gravel)	
Wulik River has better gravel sources	
Gravel costs will be less expensive	
Road does not cross airport property	
Shortest lagoon crossing	
Least expensive (+/- $40,000,000)	

Northern Route

Pros	Cons
Road follows higher ground	Not the quickest evacuation route off the island. (The first 1.5 miles are on the island.)
Road follows drier ground	Crosses the lagoon 1.5 miles north of Kivalina
Passes by fewer Native Allotments	Lagoon crossing is not where the community chose
Road does not cross tidal area	Most indirect route to Kisimigiuqtuq Hill
Typical road section will be approx. 4 feet above the ground for the whole alignment (except at the lagoon crossing)	Longest overall route (9.1 miles)
	Underlying soils are predominately ice-rich silt (characterized by the polygonal surface patterns)
	Further from material sources (gravel)
	Kivalina River has less quality material sources
	Gravel costs will be more expensive
	Road must cross airport property
	Longest lagoon crossing
	Most expensive (+/- $70,000,000)

KIVALINA CITY COUNCIL

P.O. Box 50079
Kivalina, Alaska 99750

Phone: 907-645-2137
Fax: 907-645-2175

email: kivalinacity@aol.com

RESOLUTION 14-05

A RESOLUTION OF THE CITY OF KIVALINA APPROVING THE SOUTH ROUTE PLAN FOR THE ROAD CONSTRUCTION FOR THE KIVALINA EVACUATION ROAD.

WHEREAS, The City of Kivalina is the municipal governing body for the City of Kivalina; and

WHEREAS, The City of Kivalina recognizes the need to develop an evacuation route to ensure the safety of its residents during time of extreme storm events and flooding, and

WHEREAS, the City of Kivalina wishes to further the Kivalina Evacuation Road Project, and

NOW THEREFORE BE IT RESOLVED, that the Kivalina City Council selects the South Route for the evacuation road.

CERTIFICATION:
This resolution was duly considered and adopted at a meeting of the Kivalina City Council in Kivalina, Alaska on June 11, 2014 with 6 for and 0 against and 0 abstained.

Attest:

City Mayor — Date: 6/11/14

City Clerk — Date: 6/11/14

Appendix C

Field Reconnaissance Report

Field Reconnaissance Trip Report
Kivalina Evacuation Road Reconnaissance Study

Date:	August 13 - 16, 2013	**Location:**	Kivalina, Alaska
Project:	Evacuation Road Reconnaissance Study	**Reporter:**	Steve Coleman, P.E.
No.:	209.005557		

Purpose: Steve Coleman, WHPacific Sr. Civil Engineer traveled to Kivalina to conduct a Field Reconnaissance of potential road routes between Kivalina and Kisimigiuqtuq Hill and to investigate potential material sources. While there, Steve met with the geotechnical engineers from Golder Associates and outlined the geotechnical field work required of them.

Time and Events Summary:

Tuesday, August 13, 2013

9:30 AM: Arrived at Anchorage International Airport and checked in for Alaska Airlines Flight 152 to Kotzebue.

10:45 AM: Departed Anchorage for Kotzebue.

1:45 PM: Arrived in Kotzebue, via Nome.

3:30 PM: Depart Kotzebue for Kivalina on Bering Air, Flight 662.

4:15 PM: Arrived in Kivalina and was met by Leroy Adams and transported to the school.

4:45 PM: Checked in with the principal's husband and settled in at the school. The school was without water, so hauled 5-gallon buckets of water from the lagoon to flush the toilets with.

6:00 PM: Prepared and ate dinner.

Kivalina Weather: 45 - 50°F; 10 - 15 mph winds; Overcast skies.

Wednesday, August 14, 2013

8:00 AM: Met Stanley Hawley at the Native Village of Kivalina office.

9:00 AM: Met Walt Phillips (Geologist, Golder Associates) and Jeffrey (Pilot, Bering Air) at the airport. Walt and Jeffrey flew from Kotzebue in Bering Air's Robinson R44 helicopter. WHPacific chartered the four-seat helicopter for four days, from August 14 through August 17.

9:45 AM: Steve, Stanley, Walt, and Jeffrey toured the routes and potential material sites along the rivers by helicopter.

First, we flew from the airport to Kisimigiuqtuq Hill along the southern route. We checked out the surficial rock at the hill while Jeffrey unloaded five-gallon fuel jugs at his fuel depot.

We then flew from Kisimigiuqtuq Hill to the Kivalina River and looked at the gravel bars up and down the river. Also noted the limestone hills along the north side of the river. We stopped at a couple of gravel bars to get a good look at the size and gradation of the gravel.

Next, we explored the drainages along the north and northwest slopes of Kisimigiuqtuq Hill, looking for gravel deposits. We stopped at one creek area, but were not able to see any exposed banks, so could not discern if gravels were present.

We then flew over to the Wulik River, going around the back side of Kisimigiuqtuq Hill. At the Wulik River, we looked at the gravel bars and cut banks along the stretch near Kisimigiuqtuq Hill. We stopped at one of the river cut banks so Walt could get a good look at the soil profile from the water surface up to the tundra surface. At the water line there was a good seam of gravel that extended two to three feet above the water surface. Above that, was a layer of sand, and then silt and organics to the surface.

We then flew to the prominent high spot, roughly half-way between Kivalina and Kisimigiuqtuq Hill. Walt probed the ground trying to determine if sand and/or gravels were present below the surface. He couldn't tell for sure, but it did not "feel" like sands or gravels.

2:00 PM: We returned to the Kivalina Airport and ate lunch. During lunch we strategized how the geotechnical fieldwork should be accomplished during the next three days.

Walt was going to fly back to Kotzebue with Jeffrey, that afternoon, in time to meet with his two geotechnical people that were heading out to Kivalina later that evening. He would discuss his findings with them and give them directions.

Walt felt that there was plenty of gravel available along the two rivers, but felt that the deposits along the Wulik River were better than those along the Kivalina River, and that we should focus more on them. Walt also thought it would be wise to explore a little more at the high ground mid-way between Kivalina and Kisimigiuqtuq Hill. He also saw a couple of areas along the southern alignment that appeared to be exposed gravels and he wanted his crew to look at them.

Walt also thought that the northern route would be more likely to contain massive ice, due to all of the polygonal surface features we observed.

Steve reiterated that it was critical that we identify sufficient gravel sources to construct the project, and requested that Walt direct his crew to spend sufficient time locating potential material sources.

3:00 PM: Walt and Jeffrey returned to Kotzebue in the helicopter. Walt met with Ryan Campbell (Geologist, Golder) and Matthew Furrer (Technician, Golder) in Kotzebue and discussed the day and the plan forward with them.

4:30 PM: Steve arranged to move from the main school into the classroom building next to the school. Steve then moved his gear there.

5:45 PM: Ryan and Matthew arrived from Kotzebue on a Bering Air charter. Steve helped them move into the classroom building at the school.

6:45 PM: During dinner, Steve reviewed the previous days' activities with Ryan and Matthew and planned the next days' field activities.

Kivalina Weather: 40 - 60°F; 5 - 15 mph winds; Partly cloudy skies.

Thursday, August 15, 2013

8:00 AM: Planned the day with Ryan and Matthew and prepared to meet Stanley and Jeffrey.

8:45 AM: Met Stanley at the NVK office.

9:00 AM: Met Jeffrey at the airport.

9:15 AM: Jeffrey, Steve, Ryan, and Matthew flew to Kisimigiuqtuq Hill. (The helicopter only holds four people, so Stanley waited at the airport.) We flew to the hill along the southern route, with a quick detour to the Kivalina River. Steve got out at the "fuel depot" at the hill, while the rest flew back to the airport along the northern route.

Steve explored Kisimigiuqtuq Hill, looking at the area for development potential, such as a possible school site, housing, etc. In particular, he looked at slopes, vegetation, soils, views, relationship of site with respect to the hill and wind direction, etc. He walked and photographed the hill at the higher elevation along the west, south and east sides and then descended to the base of the hill and walked along the base to a point below the southwest ridge.

10:45 AM: Jeffrey brought Stanley to where Steve was. Steve wanted to get Stanley's thoughts on where he thought potential development areas (school, housing, etc.) should be. Steve had Jeffrey fly them to the gentle sloping area southeast of the hill. From there they walked along the east side of the hill to the north side of the hill.

Jeffrey then picked them up and flew them along the south face of the hill to the west side, where there was another potential development area. Steve and Stanley walked around this area.

Steve and Stanley were then dropped off at an area between the base of the south side of the hill and the lake. They looked at this area.

After looking at the three areas, Stanley and Steve both thought the east side of the hill would be best for development and that the southeast area would be best for a

school – it was gently sloping and closest to Kivalina. Other development could occur upslope from the school. The area south of the hill was attractive, but Steve had concerns about snow drifting. Steve asked Stanley if he could come out here during the winter and check the drifting conditions.

12:45 PM: Jeffrey took Steve and Stanley to a large gravel bar on the Wulik River and met up with Ryan and Matthew and ate lunch.

After lunch, Ryan delineated the extents of the exposed gravel with his GPS. Matthew took some grab samples of the material. We then hiked away from the river, probing and further delineating the extents of the gravel.

2:45 PM: We then went to explore some exposed gravel areas along some remnant channels of the Wulik River that were observed during the earlier flying. Gravel was observed in numerous areas along these remnant channels.

4:15 PM: We then went to the high ground between Kivalina and Kisimigiuqtuq Hill. Ryan and Matthew probed in numerous areas. They also looked for any exposed areas along the banks. No exposed areas were found and probing indicated frozen silty material. Ryan said they would come back and drill here.

5:00 PM: Jeffrey dropped Steve and Stanley off at the school. Jeffrey returned to pick up Ryan and Matthew. Steve packed and prepared to leave with Jeffrey back to Kotzebue.

5:45 PM: Steve and Jeffrey departed Kivalina for Kotzebue. Ryan and Matthew will remain in Kivalina until Sunday to complete their geotechnical investigation.

6:30 PM: Arrived in Kotzebue.

7:00 PM: Checked in at Bibber's Bed & Breakfast.

Kivalina Weather: 45 - 65°F; 5 - 10 mph winds; Clear skies.

Friday, August 16, 2013

7:00 AM: Arrived at Kotzebue airport. Checked in at Alaska Airlines

8:15 AM: Departed Kotzebue on Alaska Airlines Flight 151.

11:15 AM: Arrived in Anchorage, via Nome.

Kotzebue Weather: 55°F; 0 - 5 mph winds; Clear skies.

Observations:

Northern Road Route

- Definitely higher ground
- Drier, but wet in areas
- Quite a bit of areas had polygonal surface features, indicating ice wedges and ice lenses
- No areas of gravel were observed along this route

Southern Road Route

- Definitely lower ground
- Definitely wetter ground
- Polygonal surface features were minimal
- Areas of gravel were observed along this route
- Shortest route to preferred school site

Kivalina River Material Sources

- Gravel was observed along the river bars
- Gravel sources are further from the alternative road routes
- Gravel material is finer than the Wulik River

Wulik River Material Sources

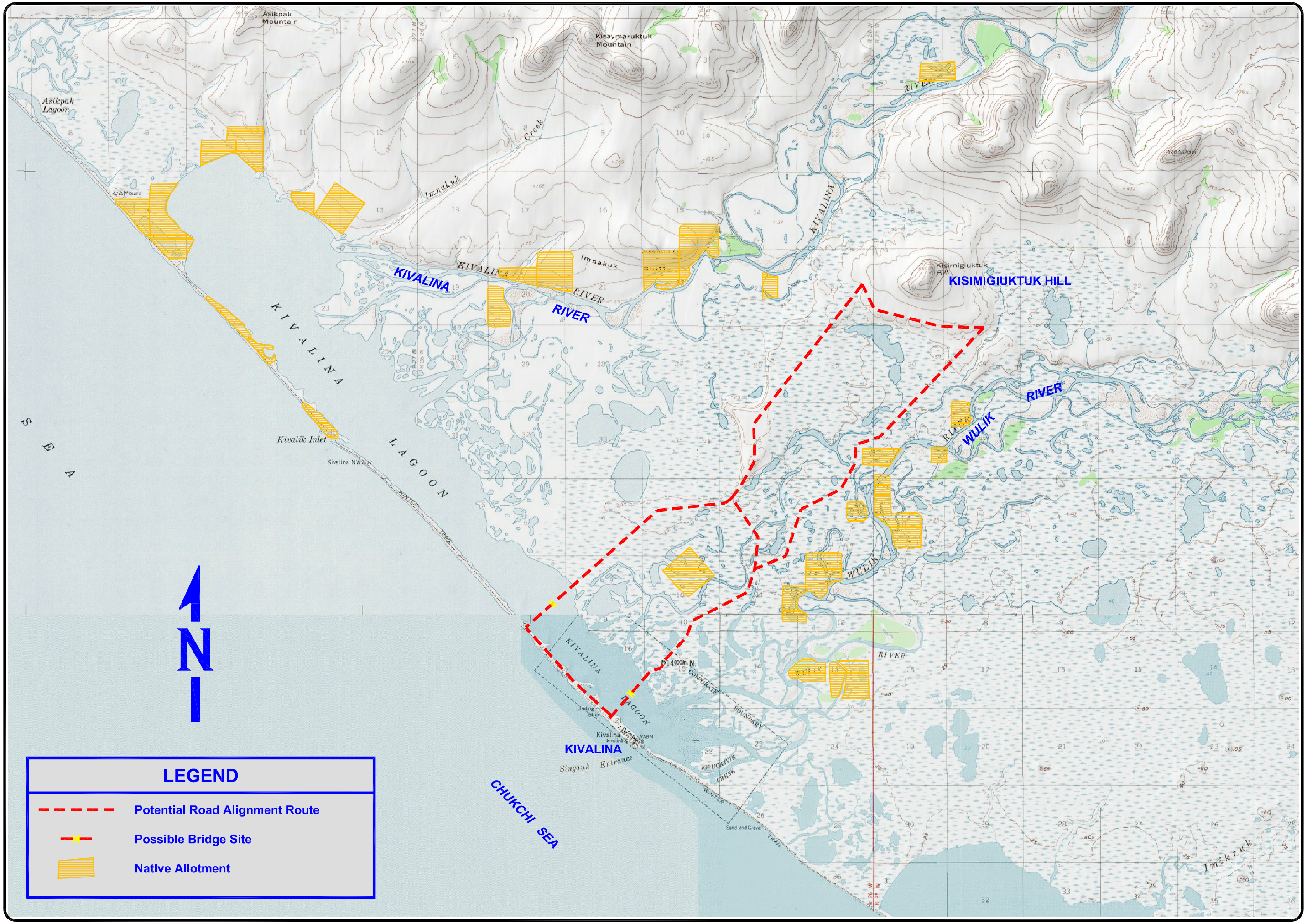
- Gravel was observed along the river bars
- Gravel sources are closer to the alternative road routes, especially the southern route
- Gravel material is coarser than the Kivalina River
- Appears that there may be gravel along the remnant channels, as well

Kisimigiuqtuq Hill Area

- Exposed fractured rock was observed at the upper elevations
- While much rock was present, it will take processing (blasting, crushing, screening, etc.) to use for road construction
- Area southeast of Hill looks best for school site

Kivalina Lagoon / Causeway Area

- The depth of the lagoon was not measured, but it appears to be very shallow
- The northern route would not have to go through the low flood-prone area
- The southern route goes through a flood-prone area that appears to extend a considerable distance inland



LEGEND

- Potential Road Alignment Route
- Possible Bridge Site
- Native Allotment

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Potential Evacuation Road Alignment Routes
Joint Meeting w/ Agencies

Kivalina Road Reconnaissance Study

Native Village of Kivalina

JOB NO.:	5557
DATE:	July 30, 2013
DRAWN BY:	SEC
CHECKED BY:	SEC
FIGURE NO.:	1

Appendix D

Geotechnical Report

December 11, 2013 133-95034

Mr. Steve Coleman, PE
WHPacific, Inc.
300 W 31st Ave
Anchorage, AK 99503

RE: GEOTECHNICAL FINDINGS AND CONCEPTUAL RECOMMENDATIONS, KIVALINA EVACUATION ROAD, KIVALINA, ALASKA

Dear Steve:

1.0 INTRODUCTION

Golder Associates Inc. (Golder) is pleased to present our geotechnical findings and conceptual-level engineering recommendations and considerations for the Kivalina evacuation roadway project. It is our understanding that the proposed road is intended to provide an emergency evacuation route from the community of Kivalina. The objective of our geotechnical field effort was to determine the general shallow depth soil and thermal conditions along several proposed routes, developed by WHPacific, Inc. (WHPacific) and provided to Golder prior to the field work. Additionally, Golder was tasked with identifying and characterizing potential granular material sources near the proposed routes.

To support our geotechnical effort, a series of shallow hand probes and hand augers were advanced along the proposed roadway alignments and potential material sources. Our scope of services was performed in general accordance with our proposal to WHPacific dated August 1, 2013. Throughout the investigation Golder coordinated with Mr. Steve Coleman, PE and the village of Kivalina's IRA representative.

2.0 PROJECT UNDERSTANDTING

WHPacific was contracted to provide planning and engineering support services for an evacuation road extending from the village of Kivalina to Kisimigiuktuk Hill. Kisimigiuktuk Hill is located approximately seven miles northeast of the village of Kivalina, as shown in Figure 1. Preliminary road designs include an elevated embankment section constructed with granular fill and an elevated road section utilizing mineral silt for fill and geosynthetics for stability. The area along the proposed routes is currently undeveloped and existing fill roads or trails were not observed along the proposed alignments.

Golder was subcontracted by WHPacific to perform a geotechnical field exploration and provide conceptual-level geotechnical recommendations and considerations for a light-duty, double lane unpaved roadway. Golder's recommendations and considerations will support additional engineering design, permitting, and construction cost estimates. The recommendations and considerations presented in this report were developed in conjunction with WHPacific's design team. Our scope of services did not include developing final engineering designs or bid-ready construction documents.

3.0 REVIEW OF EXISTING GEOTEHCNICAL DATA

In 2007 Duane Miller Associates (DMA) issued a desktop investigation report on potential material targets in and around the Kivalina area. Sandy gravel and sand deposits were identified within the modern floodplains of the Wulik drainage as potential areas for aggregate material assessments. Old beach lines and associated back beach sand dunes were also identified as potential targets for unclassified granular

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material areas. Finally rock and rock rubble deposits from bedrock ridges were identified as potential sources for crushed material.

4.0 FIELD EXPLORATION PROGRAM

4.1 Route Selection

Two road alignments and a short route connecting both alignments were selected by WHPacific as possible routes to connect the existing village with an area of higher ground on Kisimigiuktuk Hill. For the purpose of this report and communication, Golder has given the following names to the three routes: Northern Alignment, Southern Alignment, and the Connector Alignment, as shown in Figure 1. Additionally, the approximately two mile wide area on the east side of the tidal lagoon was investigated to help identify a potential causeway crossing point.

The proposed routes were not survey located or marked in the field at the time of our field effort. Hand-held GPS instruments were used to field locate the routes and our test probe locations based on the project imagery provided by WHPacific. We generally consider hand-held GPS instrument accuracy to be about ±10 feet, but depending on a variety of factors, accuracy of ±30 feet, or more, should be expected.

4.2 Shallow Subsurface Field Exploration

The field exploration was conducted between August 14 and 18, 2013. The field program commenced with Golder geologist Walt Phillips reconnoitering the area to identify potential material sources and issues along the proposed route that warranted further investigation. Mr. Phillips was accompanied by WHPacific civil engineer Steve Coleman and the Native Village of Kivalina tribal administrator, Stanley Hawley. The reconnaissance effort was followed by the geotechnical field exploration conducted by Golder geologist Ryan Campbell and engineering technician Matthew Furrer. The Golder field team was accompanied by Mr. Coleman and Mr. Hawley for part of the exploration.

The shallow subsurface exploration program focused of the following tasks:

- Determining the depth of the active layer by advancing hand probes along the proposed road alignments
- Determining shallow subsurface conditions along the proposed road alignments, including soil types and approximate soil and thermal contacts, by advancing shallow boreholes with a hand operated power drill
- Determining the location and quality of potential material borrow sites near the proposed road alignments

The hand probes consisted of advancing a slender steel rod, approximately ½ inch in diameter, into the ground surface, typically until refusal. The hand probes were advanced in late summer, when probe depths generally indicate the near-maximum depth of seasonal thaw. Probe resistance was inferred to represent the approximate depth of seasonal thaw. Hand probe refusal may have occurred in relict seasonally frozen ground or possibly the top of the underling permafrost generally encountered in the Kivalina area. Without a more detailed geotechnical drilling effort, it is not possible to distinguish between relict seasonal frost and permafrost. Additionally, the actual thaw depth will vary between years and the time of the season. Over 140 thaw probes were advanced in the project area, as identified in Figures 3 through 5. Each probe location was recorded using a handheld GPS.

The shallow subsurface soil conditions were investigated using a Hilti TE 70-ATC Combi-hammer drill with a 1.5-inch diameter bit. The drill bit was advanced to the safe working limits of the equipment depending on the subsurface conditions, generally between five to eight feet below ground surface. The maximum exploration depth was eight feet below ground surface. As each exploration was advanced, a Golder representative visually logged the surface and subsurface soil and thermal conditions. Borehole locations are identified in Figure 6. Select disturbed, but representative, samples were collected for

further assessment and geotechnical laboratory testing. A summary of the laboratory testing can be found in Appendix A.

Bulk samples from potential granular material source sites were collected from shallow hand dug tests pits. The test pits were typically dug to a depth of three feet and representative bulk samples were collected.

4.3 Potential Material Sources

The potential granular material sources presented in Figure 2 were identified during the initial reconnaissance effort and were further explored by Golder during the field exploration as discussed in Section 4.3. At these select sites, shallow depth bulk samples of the material were collected for further geotechnical laboratory testing and evaluation. The approximate locations of the bulk samples are identified as G01 and G04 through G08 in Figure 2. Sample numbers G02 and G03 were not collected during this investigation.

Additional areas are presented in Figure 2 as possible potential material sources. These areas were encountered while probing the road alignments and identified using the topography and geologic features interpreted on imagery provided to Golder by WHPacific. While no bulk samples were taken, these areas either have similar topographies and surficial characteristics as the confirmed material sources or are close in proximity to a confirmed material source.

4.4 Laboratory Testing

Representative portions of the recovered soil samples were retained in double-sealed, polyethylene bags and shipped to Golder's laboratory in Anchorage for further analysis. In the laboratory, the soil samples were reviewed to confirm field visual classifications and select samples were tested for soil index properties. Laboratory tests were conducted following the American Society for Testing and Materials (ASTM) recommended laboratory testing procedures. Laboratory testing included:

- Soil moisture content
- Particle size distribution
- Organic content
- Atterberg Limits
- Salinity

All laboratory data are summarized in Appendix A. A Golder adapted ASTM soil classification reference sheet is also provided in Appendix A.

5.0 GENERALIZED SITE AND SUBSURFACE CONDITIONS

5.1 Regional Setting

Kivalina is within the Arctic Foothills Physiographic Province, which is generally characterized by rolling hills and gentle slopes. The Community of Kivalina, however, is located on the southern end of Kivalina Island, a barrier island that separates Kivalina Lagoon on the east from the Chukchi Sea on the west. Kivalina River and Wulik River both flow into Kivalina Lagoon which in turn discharges into the open sea through Kivalik Inlet and Sinauk Entrance.

The island is generally less than 20 feet above sea level, is almost flat and consists of geologically modern beach-sand deposits. Some gravel is present at each end of the island, but historically most granular construction material has been brought in from the Wulik River floodplain. We understand that the only significant source of locally available granular material is from the floodplains and deltas of the two major drainages east of Kivalina Lagoon.

The Chukchi Sea has a major weather impact on the area but because it is frozen for over half the year, Kivalina has a climate that is transitional between Maritime and Continental. The mean annual temperature is about 20°F with an average precipitation rate of less than 10 inches per year. Snowfall is on the order of three feet per year and persistent winter winds can result in significant drifting. Permafrost is present throughout the mainland area east of Kivalina Lagoon.

5.2 Climate

General historical and current design climate data including average thawing and freezing indices are presented in Table 1 for the Kivalina area (localized climate parameters). The indices are derived from public data available from the University of Alaska Fairbanks (UAF) Scenarios Network for Alaska and Arctic Planning (SNAP[1]). Climate indices were calculated from SNAP data and accessed online from a database created by Mr. Matthew Dillon[2]. Design indices are based on an average of the three coldest winters (freezing index) or warmest summers (thawing index) observed during the analysis period.

By down scaling data, SNAP estimates historical and future climate conditions in regions of Alaska that do not have consistent climate records. It is important to note that these data are estimates, and are not necessarily based on direct temperature measurements at the site. SNAP downscaled data is a product derived from several global climate model outputs. Additional information is available at the SNAP group's website.

Table 1: Engineering Climate Indices for Kivalina, Alaska

	SNAP 1948 – 1978	SNAP 1979 – 2009	SNAP 2013 – 2043 (estimated)[1]
Average Air Temperature[2]	20.7 °F	22.3 °F	23.9 °F
Average Freezing Index	5710 °F-days	5240 °F-days	4620 °F-days
Average Thawing Index	1660 °F-days	1840 °F-days	1800 °F-days
Design Freezing Index	6750 °F-days	6370 °F-days	5670 °F-days
Design Thawing Index	2040 °F-days	2280 °F-days	2070 °F-days

Notes: 1) Projected by UAF SNAP, Composite of 5 Global Climate Models, Emission Scenario A1B
2) Air temperatures are estimates prepared by UAF SNAP

This report utilized data over two historical time spans (1948–1978 and 1979–2009) to provide comparison of SNAP-derived climate parameters over the last half-century. Similarly, a 30-year span was reviewed from the five-model composite of SNAP global climate model (mid-range emission scenario A1B) output to provide estimated future climate projections. Average air temperatures have increased over the past 60 years and are modeled to continue increasing at approximately the same rate over the next 30 years. The SNAP-derived average and design freezing indices both exhibit a historical decreasing trend. SNAP models a decreasing average and design freezing indices, however the average thawing index is anticipated to remain approximately constant. This indicates potentially warmer winters and cooler summers. This condition of cooler summers and warmer winters has been predicted by UAF SNAP across a significant portion of Alaska.

[1] Scenarios Network for Alaska and Arctic Planning (SNAP) (2012). Online: http://snap.uaf.edu (accessed April 2012).
[2] Dillon, Matthew (2013). Online: http://akindices.akdillon.net (accessed September 30, 2013).

5.3 Regional Geology

Bedrock is seldom exposed in the project area except in isolated hills, especially those northwest of the Kivalina floodplain. These hills are topped with rock rubble and outcrops of limestone have been reported. Kisimigiuktuk Hill, the only hill in or near the project area, is rubble covered.

Although Pleistocene glaciation did not extend to the coast, it has had a major impact on the surficial geology in the Kivalina area. Sea level fluctuation has resulted in the accumulation of sandy beach deposits at various locations both offshore and inland from the presently established coastline. These deposits are similar in composition to present beach deposits, but in many cases they have been partially or totally eroded away or buried by newer fine grained material.

The drainage patterns of the Wulik and Kivalina Rivers have controlled much of the post-glacial deposition of local sediments. Glacial deposits in the headwaters have been reworked by stream and river action and are the source of gravelly sand and sandy gravel deposits in the modern floodplains. Wind-blown silt and sand is often present as a near-surface veneer which, with surface vegetation, forms the present tundra cover. Along the eastern edge of Kivalina Lagoon, between the two rivers, a vegetation covered tidal influenced zone extends as much as two miles inland.

Beneath one to two feet of seasonally thawed material, the mainland east of the lagoon is almost universally underlain by permafrost. Horizontally layered ice masses are common and near vertical ice wedges that have developed in soil contraction cracks often result in a surficial feature known as polygonal patterned ground. This segregated ice is generally confined to the fine-grained, organic-rich surface material, but under some conditions ice wedges have penetrated into the underlying granular material.

5.4 Roadway Alignments

In general, the topography is consistent along the alignments. The topography is relatively flat near the tidal wetlands, and rises to an elevation of approximately 50 feet. Localized topography ranges from flat to gently sloping hills. The surface vegetation ranged from damp tundra with tussocks and two foot tall grass, to dry tundra with dwarf birch and willow. Polygonal ground was noted in some areas of elevation indicating the presence of wedges of ice underneath the subsurface. Shallow water ponds were noted along the base of slopes, and in areas with sufficient gradient, water could be seen flowing between ponds. Representative site photographs are presented in Appendix B.

5.4.1 Southern Alignment

The southern alignment begins near the southern end of the tidal lagoon area directly across from Kivalina, and traverses through the lowlands and swampy areas along a relict stream channel (Figure 3). The total length of the alignment is approximately seven miles. The ground surface along the alignment was typically wet, and there were many areas with ponded water at the surface. The alignment crosses two minor streams near the western edge of the alignment, as shown in Figure 3.

A total of 64 hand probes were completed along the southern alignment. The location and depth to refusal for each probe is presented in Figure 3. The average depth to probe refusal was 1.5 feet, with a minimum probe depth of 0.5 feet, and a maximum probe depth of 5 feet. The probe which encountered refusal at 5 feet was near the start of the alignment in the tidal lagoon area.

Five shallow boreholes (BH01 and BH04 through BH07) were advanced by the hand drill along the southern alignment at the locations presented in Figure 6. The subsurface conditions along the alignment generally consisted of approximately 0.5 to 1.5 feet of unfrozen organic mat (PT) overlying approximately 2 to 4 feet of frozen silty sand (SM). Fine gravel was encountered intermixed with the silty sand in borehole BH06. Massive ice was encountered in borehole BH01 and extended from 5 feet to the depth of exploration, approximately 8 feet.

5.4.2 Northern Alignment

The northern alignment begins on the northern end of the tidal lagoon area. The alignment generally traverses through the higher elevation ground, estimated at an elevation of ±50 feet. This alignment is often undulating with elevation variations in the ±30 feet range. The total length of the alignment is approximately 6.5 miles. Polygonal ground was observed along the alignment as well as standing water in a low-lying area near the eastern edge. No major stream crossings were encountered on this alignment.

A total of 54 hand probes were advanced along this alignment. The depth to probe refusal was typically consistent at each probe location. The location and depth to refusal for each probe is presented in Figure 4. The average depth to probe refusal was 1.4 feet, with a minimum probe depth of 1 foot, and a maximum probe depth of 2 feet.

Three shallow boreholes (BH03, BH08 and BH09) were advanced by the hand drill along the northern alignment at the locations presented in Figure 4. The subsurface conditions along the alignment generally consisted of approximately 1.5 feet of unfrozen organic mat (PT), overlying 1.5 to 2.5 feet of frozen, ice rich organic clay and silt (OH/OL), overlying frozen, ice-rich mineral silt (ML). Both massive and stratified ice lenses were noted in the clay and silt layers. Massive ice was encountered in borehole BH03 from 4 feet below ground surface (bgs) to the hole termination depth of 8 feet bgs. Surface water up to 2 feet in depth over an area approximately 40 feet wide was encountered between boreholes BH03 and BH09.

5.4.3 Connector Alignment

The connector alignment connects the northern and southern alignments, approximately one mile to the east of the tidal lagoon area. The alignment crosses a major tributary of the Wulik River and is approximately one mile in length.

A total of six probes were advanced along this alignment. The location and depth to refusal for each probe is presented in Figure 5. The average depth to probe refusal was 1.2 feet, with a minimum probe depth of 0.5 feet, and a maximum probe depth of 2 feet. One borehole (BH10) was advanced by the hand drill along the northern edge of the tributary crossing. The subsurface conditions encountered in the borehole consisted of 0.5 feet of unfrozen organic mat (PT) overlying 3 feet of frozen, well graded gravel with sand (GW). The gravel was rounded to subrounded and up to 3 inches in diameter.

5.4.4 Tidal Lagoon Area

The tidal lagoon area investigated is approximately two miles wide and is bounded by the Wulik to the south and the area of relatively higher ground to the north. The area is generally flat and consists of soft, swampy ground. Grasses and reeds exist at ground surface, unlike the tundra vegetation which exists further inland to the east.

A total of ten hand probes were advanced in the tidal lagoon area. The location and depth to refusal for each probe is presented in Figure 5. Probe depths varied across the area, and the depth to probe refusal was generally deeper than along other alignments investigated. The average depth to probe refusal was 3 feet, with a minimum probe depth of 2 feet, and a maximum probe depth of over 6 feet, which was the extent of the hand probe.

One shallow subsurface borehole (BH07) was advanced by the hand drill near southern edge of the area, just to the north of the outlet of the Wulik River, as presented in Figure 6. The subsurface conditions encountered in the borehole consisted of approximately 1.5 feet of unfrozen organic mat (PT) overlying 4 feet of frozen silt with trace sand (ML). Two samples were collected from the borehole to measure the pore water salinity. The results from both samples were low, with the pore water salinity measured at less than 2 parts per thousand for each sample.

5.5 Potential Material Sources

Five bulk material samples were taken from the potential material sources identified during the initial reconnaissance, as presented in Figure 2. Laboratory results on the bulk samples are presented in Appendix A. Each potential material source is discussed in detail in the following sections.

5.5.1 Kisimigiuktuk Hill

Kisimigiuktuk Hill is characterized by exposed limestone subcrop and rock rubble at ground surface. While no large outcrops of limestone were observed at the surface, it is anticipated that below surface larger frost fractured rocks and boulders may exist. Further exploration will be required to identify the potential rock size and quantity of the underlying bedrock. The surface rocks have been frost fractured to a depth of approximately three feet based on the hand dug test pit advanced at the site. A bulk material sample (G01) was collected from Kisimigiuktuk Hill at a depth of 3 feet bgs. The material collected classified as silty gravel with sand (GM) with approximately 19 percent passing the U.S. number 200 sieve. The gravel was sub-angular limestone and contained cobbles up to eight inches in diameter. The material encountered at this deposit should be suitable for use as roadway embankment fill. However, the material may need processing to remove oversized and organic material.

5.5.2 Wulik River Deposition Zones

The Wulik River deposition zone is characterized by visible gravel bars and beaches along the river bank. Two of these areas were identified during the field exploration. The fluvial material encountered at these sites was most likely deposited by flow from the Wulik River. Two bulk samples (G04 and G08) were collected at these sites. The material collected classified as well-graded gravel with sand (GW), with less than one percent passing the U.S. number 200 sieve. The material encountered at this deposit should be suitable for use as roadway embankment fill. However, the material may need processing to remove oversized and organic material.

Using aerial imagery to interpret topography and geologic features, additional areas of possible fill material were identified within the Wulik River Deposition Zone. These areas are identified on Figure 2 as possible fill material. While no bulk samples were collected at these locations, the areas either have similar topographies and surficial characteristics as the confirmed material sources, or are close in proximity to a confirmed material source.

5.5.3 Wulik River Relict Channel

The Wulik River relict channel is characterized by visible gravel and sand at ground surface. The fluvial material in these sites was likely deposited when the Wulik River was north of its present location. Two bulk samples (G05 and G06) were collected from the relict channel between the north and south alignments. The material from bulk sample G05 classified as well-graded gravel with sand (GW) and was collected from the middle of the potential material source. This material is considered representative of the majority of the material in the area. The material from bulk sample G06 classified as poorly graded sand with silt (SP-SM) and was collected from a lightly vegetated area surrounding the gravel deposit. The material encountered at this deposit should be suitable for use as roadway embankment fill. However, the material may need processing to remove oversized and organic material.

Using aerial imagery to interpret topography and geologic features, additional areas of possible fill material were identified within the Wulik River Relict Channel. These areas are identified on Figure 2 as possible fill material. While no bulk samples were collected at these locations, the areas either have similar topographies and surficial characteristics as the confirmed material sources, or are close in proximity to a confirmed material source.

5.5.4 Material Quantities

Based on the visual boundaries and probe depths of the sites investigated in the Wulik Relict Channel, Wulik Depositional Zone, and Kisimigiuktuk Hill areas, approximate bank volumes of granular fill material

were estimated in Table 2. The boundaries of these areas were established using a hand held GPS and walking the visual extents of the deposit and should be considered approximate. It should be noted the exploration depth at each investigated site was limited to three feet. This depth was applied as the vertical extent in our bank volume calculations. In each area, our geologic interpretation infers that granular material may be present below the three foot exploration depth, however this was not confirmed.

Table 2: Approximate Bank Volumes from Investigated Granular Fill Areas

Investigated Area	Sample Number of Collected Material	Approximate Bank Volume (Cubic Yards)
Wulik River Relict Channel	G05 and G06	2,500
Wulik River Depositional Zone	G08 and G04	100,000
Kisimigiuktuk Hill	G01	600,000

Based on aerial imagery and topography we have estimated material bank volumes from the areas identified as containing possible fill material (Table 3). The bank volumes presented in Table 3 should be considered very rough estimates because they were not confirmed by field samples or site visits. For the bank volume estimates, boundaries were interpreted from aerial imagery and topography, and a material depth of three feet was assumed.

Table 3: Estimated Bank Volumes from Possible Granular Material Fill Areas

Area	Approximate Bank Volume (Cubic Yards)
Wulik River Relict Channel	480,000
Wulik River Depositional Zone	950,000

Notes: Possible granular material fill areas were not investigated. Bank volume estimates are based on interpretation from aerial photographs and a material depth of three feet.

A 30 percent reduction of the bank volume for mine site slopes and ramps and appropriate swell, shrinkage, and thaw consolidation factors will need to be considered when calculating the bank volume estimates. In addition, an appropriate volume contingency for anticipated deleterious material should be applied, resulting in adjustment of the anticipated mineable quantity of useable granular fill material.

6.0 DISCUSSION

Each of the alignments traverses wet, organic-rich soil that will impact the performance of the roadway. Topography along the proposed alignments is generally flat, but includes some gently sloping hills. Ponded water was encountered, particularly in the low lying areas and in drained surface ponds. Generalized subsurface conditions encountered consisted of a surficial fibrous peat mat overlying silty sand and mineral silt. Frozen soil was encountered in all but one of the hand probes. Depths to frozen soil are summarized in Table 2 below.

Table 4: Summary of Hand Probes

Alignment	Number of Hand Probes Performed	Depth to Probe Refusal	
		Range (feet)	Average (feet)
Northern	49	1 to 2	1.4
Southern	65	0.5 to 5	1.5
Connector	6	0.5 to 2	1.2
Tidal Area	10	2 to 6+	3

All alignments explored during our field effort will have design, construction, and maintenance challenges due to the subsurface conditions. Based on the shallow probe findings, our observations of the surface conditions, and our geotechnical experience in the area, the Southern Alignment is considered the preferred roadway alignment. The southern alignment appears to be better suited for the proposed roadway due to the slightly better underlying soils, and the proximity to material sources.

The Southern Alignment traverses along the low lying relict channel of the Wulik River and is underlain by frozen silty sand. However, perched water is abundant on this alignment and two minor stream crossings are present that may require culverts.

7.0 RECOMMENDATIONS AND CONSIDERATIONS

We understand the desired roadway to be a double lane road constructed from locally available fill material. Light trucks and ATV's will be the intended traffic loads. Heavier loads, such as earth moving equipment, are expected to be temporary during the construction of the road and potentially for seasonal maintenance. If heavier loads are anticipated during future use, the roadway design will need to be adjusted accordingly to accommodate the heavier loads.

Based on discussions with the WHPacific permitting and engineering team, two roadway options are proposed at the conceptual design phase:

- Elevated roadway embankment/prism constructed entirely of granular fill
- Elevated roadway embankment/prism with a local mineral silt core stabilized with a geosynthetic material and a granular fill cap

There are advantages and disadvantages to both roadway options. Both options will experience settlement and should be expected to require long-term maintenance. We have assumed that due to cost constraints, the organic material encountered along the alignment will not be removed prior to embankment construction. Thus, operational issues that both roadway options may experience include:

- **Consolidation settlement of organic material:** The peat and organic soil are expected to consolidate under sustained loads, such as roadway alignments. The hand augurs advanced along the alignments show 1.5 to 2.5 feet of organics. We estimate that the compression of the organic layer under the weight of the embankment will be about 50 to 75 percent of the initial thickness of the organic layer, depending on the organic content and the surcharge load. We estimate most of the consolidation occurring in the first year. Assuming a two-foot thick layer of organic material, reasonable settlement of the subsurface organic material may be 1 to 1.5 feet. Settlement is expected to occur differentially throughout the embankment.
- **Side slope instability:** As the ice rich soils thaw and the organics under the embankment consolidate, the toe of the side slope will settle with progressive slope failure along the axis of the embankment. Side slope failure can be both local and global.
- **Thaw settlement of frozen soil below the surficial organic material:** By changing the surface characteristics of the ground, it is possible that the seasonal depth of thaw will increase. If permitted to thaw, the icier soils underlying the roadway prism, particularly along the toe of the side slopes, will subside and the roadway prism fill will likely settle. In addition, the fill material may become saturated and possibly weaken during wheel loading.

The problems above are not considered inclusive, and are presented to highlight some of the potential issues that the roadway may experience. There are additional roadway options which may help mitigate some of the potential problems, such as placing ground insulation in the fill section and soil grid reinforcement. However, they are not being considered at this preliminary design phase.

Geotechnical considerations for each road option are summarized below. Additional geotechnical investigation and engineering is required to advance any of the conceptual designs. For both options we have assumed excavation and removal of the underlying organic material will not occur.

7.1 Elevated Roadway with Imported Fill

If sufficient quantities of acceptable granular fill are available, an elevated roadway prism using granular fill is considered the lower maintenance road option for this project. Site preparation should include hand removal of brush, but the organic mat should remain intact under and adjacent to the prism section. A woven geotextile is recommended under the prism section that extends at least several feet outside the prism footprint. Embankment fill should be sand and gravel with approximately 10 to 15 percent silt as a binder material. The embankment prism section should extend at least four feet above the existing grade after thaw settlement of the fill material and the consolidation settlement of the organic mat.

Side slopes of 3H:1V (horizontal: vertical) should be considered for the road prism. If the recommended side slopes are not feasible, steeper slopes can be achieved by mechanically stabilizing the slopes. Slope stability can be achieved using geogrid reinforcement or retaining walls. Additional slope protection measures are advised along culverts and water crossings, including armor rock and inlet/outlet erosion protection.

7.2 Elevated Roadway with Local Prism Core Material and an Imported Cap

In the event that locally available granular fill is not available or deemed too costly, local mineral silt can be used for a prism core with a granular fill cap for side slopes and a trafficking surface. Site preparation should be similar to methods discussed above for the granular fill embankment option. A local mineral silt can be placed and wrapped in a non-woven geotextile pillow to develop shear stability within the mineral silt. Ideally, the mineral silt should be obtained outside the roadway alignment area, mined and allowed to drain for at least one year prior to use as embankment material. The mineral silt may be placed in a frozen state for a winter construction program, but thaw strain on the order of 30 to 50 percent can be expected depending on a number of material preparation and placement conditions. The mineral silt should be allowed to thaw and drain prior to granular cap placement.

Geotextile reinforced sections have been used for embankments throughout Alaska for many years with success, but the systems will experience large settlements and seasonal frost movement throughout their design life. The quality of the mineral core behavior strongly depends on the quality and preparation of the mineral silt borrow, the quality and timing of the material placement, and the quality of the geotextile wrap. The granular fill cap should be well graded sand and gravel with 10 to 15 percent silt as a binder material. The granular cap should be 12-inches thick over the mineral silt core with 4H:1V side slope.

7.3 Construction Considerations

Based on field observations and laboratory data, all of the soil encountered in our hand probes is considered moisture sensitive. As such, if summer construction is anticipated, the in-place soil may experience a significant loss in shear strength if the soil fabric is disturbed during construction. Additionally, construction equipment access during winter conditions may also be limited due to the weak soil underlying the seasonal frost if the soil profile is not fully frozen. Once the seasonal frost is damaged, the underlying organic soil may rut and loose shear strength.

Roadway embankments subject to cyclic or repeated loads may also weaken the underlying soil with potential ‘pumping’ and other shear strength loss issues. Once damaged, the underlying organic and mineral soil may require engineered stabilization methods for rehabilitation and trafficking.

8.0 RECOMMENDATIONS FOR FURTHER STUDY

Due to the limited scope of this geotechnical investigation, if the proposed alignment is advanced beyond a conceptual level we recommend a more in-depth geotechnical exploration program be conducted. We

recommend that geotechnical boreholes are conducted to better characterize and classify the project area. The purpose of the additional geotechnical work would be twofold and include:

- Roadway alignment exploration to provide sufficient subsurface data to design a roadway prism
- Material site exploration to better determine the extent and quality of the potential material sources

Due to the remote location and lack of infrastructure along the proposed alignments the geotechnical exploration would require a large amount of logistics and support. Based on similar remote work, if the exploration is to be conducted during the winter we suggest the mobilization of a track mounted geotechnical drill rig suited to remote work and snow covered tundra travel. Based on similar remote work, if the work is to be completed during the summer season we suggest the mobilization of a skid mounted geotechnical drill rig that is customized for helicopter sling operations at remote sites. The geotechnical drill and drilling equipment will need to be mobilized between sites using a heavy lift helicopter such as a Bell 204. A smaller helicopter such as a Hughes 500 or Robinson 44 can be used for crew transport and support.

8.1 Roadway Alignment Exploration

In order to move the roadway alignment design past the conceptual phase we suggest drilling a series of 20 to 30 shallow boreholes laid out based on the terrain, geology, vegetative cover, water ways, and anticipated conditions along the route. Borehole spacing could be set at between 1,000 to 2,000 feet apart with plans to infill where large discrepancies are noted. A program with fewer boreholes could be developed as a preliminary exploration, however sufficient data may not be obtained and the associated risks of development or potential for the need to complete additional exploration would be increased.

8.2 Material Site Investigation

We recommend that the material sites identified during the initial field program be explored in conjunction with the roadway alignment exploration program stated above. The exploration program would identify and delineate deposits of granular material that can serve as a material source. To delineate the extents of each material site, it is expected that 5 to 15 holes would be drilled at each target location before a “Go or No Go” decision is made. The delineation drilling program would further define any area of interest and serve to collect the quantitative data needed for permit applications and mine site planning. Borehole depths will likely vary from 15 to 30 feet, depending on the materials encountered and the anticipated amount of granular fill required for the proposed construction.

8.3 Rough Order of Magnitude Cost

The estimated cost for the above will range between $500,000 and $1,000,000 depending on the final scope of work. These costs include fees for the geotechnical drilling contractor, helicopters, cargo aircrafts, and Golder professional labor and expenses. This cost should serve as a reference and may change significantly depending on the final scope of work. There are potential savings opportunities if the work can be paired with other projects, such as the lagoon causeway and bridge geotechnical investigation.

9.0 USE OF REPORT

This report has been prepared for the use of WHPacific in conceptual-level design for the proposed Kivalina evacuation roadway project outside of Kivalina, Alaska. If there are significant changes in the routes, or design we should be notified so that we may review our conclusions and recommendations in light of the proposed changes and provide a written modification or verification of the changes.

There are possible variations in subsurface conditions between explorations and also with time. Therefore, inspection and testing by a qualified geotechnical engineer should be included during construction to provide corrective recommendations adapted to the conditions revealed during the work.

Unanticipated soil conditions are commonly encountered and cannot fully be determined by a limited number of explorations or soil samples. Such unexpected conditions frequently result in additional project costs in order to build the project as designed. Therefore, a contingency for unanticipated conditions should be included in the construction budget and schedule.

The work program followed the standard of care expected of professionals undertaking similar work in Alaska under similar conditions. No warranty expressed or implied is made.

10.0 CLOSING

It has been a pleasure to work with you on this project. Please feel free to contact us with any further questions.

GOLDER ASSOCIATES INC.

Peter A. Calvin, PE
Staff Engineer

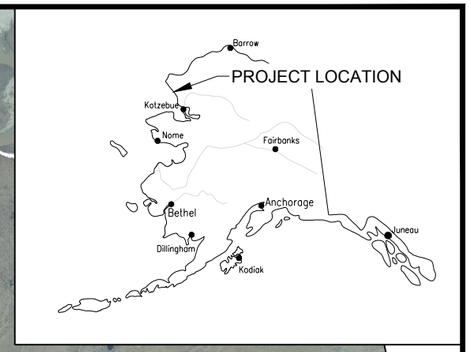
Richard A. Mitchells, PE
Associate and Manager Alaska Operations

Ryan L. Campbell
Engineering Geologist

Attachments:
Figure 1: Project Location Map
Figure 2: Potential Material Sources
Figure 3: Southern Alignment Probe Data
Figure 4: Northern Alignment Probe Data
Figure 5: Supplementary Probe Data
Figure 6: Borehole Location Map
Appendix A: Laboratory Data
Appendix B: Site Photographs

PAC/RAM/RLC/mlp

FIGURES



NORTHERN ALIGNMENT

KISIMIGIUKTUK HILL

APPROXIMATE AREA
80,000 SQ YARDS

APPROXIMATE AREA
200,000 SQ YARDS

APPROXIMATE AREA
2,500 SQ YARDS

APPROXIMATE AREA
600,000 SQ YARDS

TIDAL LAGOON AREA

CONNECTOR ALIGNMENT

SOUTHERN ALIGNMENT

APPROXIMATE AREA
100,000 SQ YARDS

APPROXIMATE AREA
260,000 SQ YARDS

APPROXIMATE AREA
100,000 SQ YARDS

APPROXIMATE AREA
65,000 SQ YARDS

APPROXIMATE AREA
37,000 SQ YARDS

KIVALINA

APPROXIMATE AREA
700,000 SQ YARDS

LEGEND

NATIVE ALLOTMENT AS PROVIDED BY WHPACIFIC

2013 GOLDER PROBE ROUTE

REFERENCE

1. BACKGROUND IMAGERY PROVIDED BY WHPACIFIC, DATED JUNE 12, 2013

0 1500 3000 4500

SCALE 1"=3000' FEET

PROJECT
WHPACIFIC
KIVALINA ACCESS ROAD
KIVALINA, ALASKA

TITLE
PROJECT LOCATION MAP

Golder Associates

PROJECT No.		133-95034	FILE No.	3395034-Recon_Maps
DESIGN	MSF	2013-08-22	SCALE	SCALE
CADD	MSF	2013-11-27	FIGURE	
CHECK	RLC	2013-11-27		1
REVIEW	RAM	2013-11-27		

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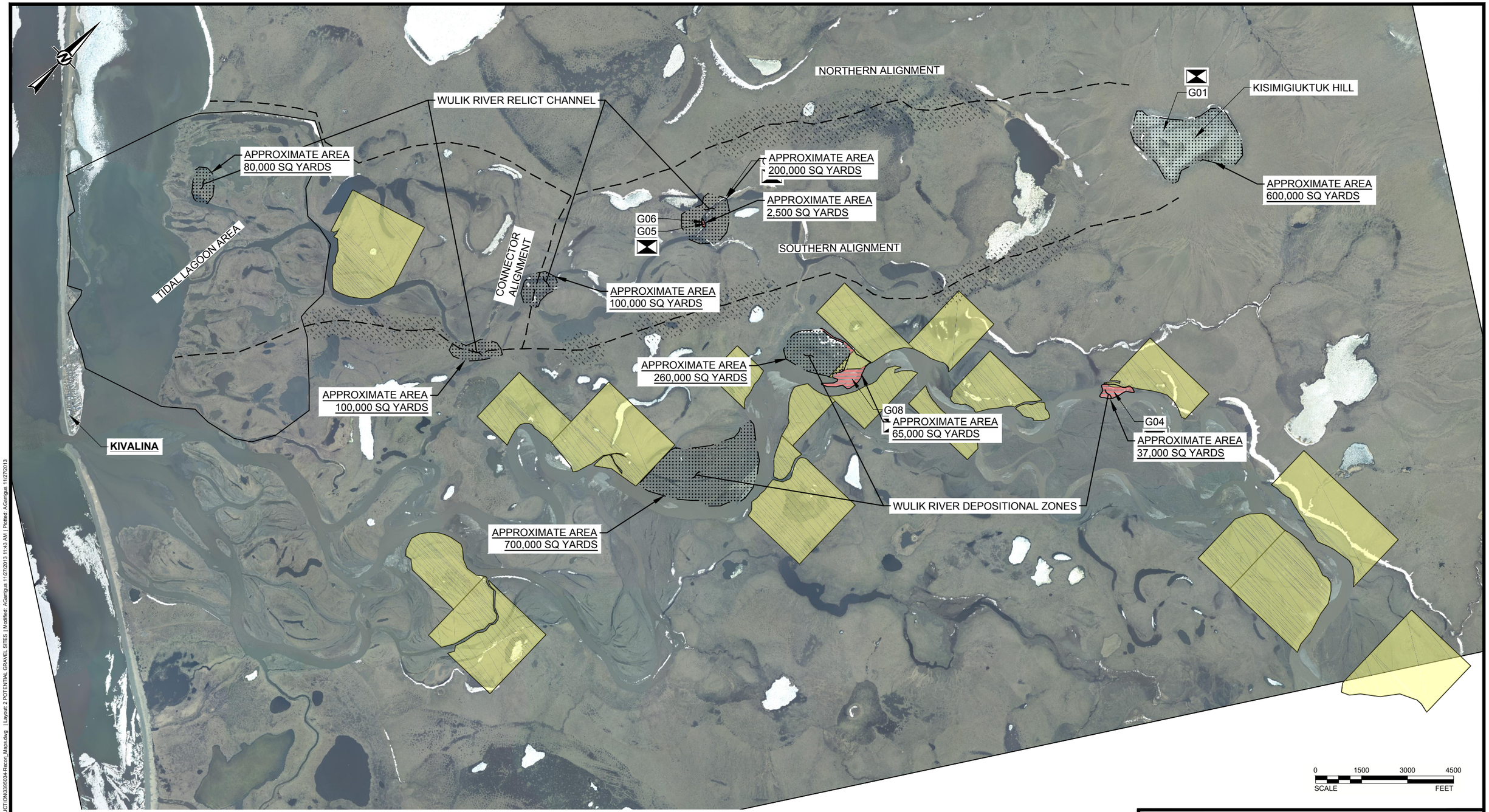

LEGEND

- INVESTIGATED FILL MATERIAL AREA
- POSSIBLE FILL MATERIAL AREA
- NATIVE ALLOTMENT AS PROVIDED BY WHPACIFIC
- 2013 GOLDER PROBE ROUTE
- G00 — 2013 GOLDER CONSTRUCTION MATERIAL GRAB SAMPLES

LEGEND (CONT.)

- PERCHED WATER ZONE

REFERENCES / SPECIFICATIONS

1. BACKGROUND IMAGERY PROVIDED BY WHPACIFIC, DATED JUNE 12, 2013

PROJECT
WHPACIFIC
KIVALINA ACCESS ROAD
KIVALINA, ALASKA

TITLE
POTENTIAL MATERIAL SOURCES

Golder Associates

PROJECT No.		133-95034	FILE No.	3395034-Recon_Maps
DESIGN	MSF	2013-08-22	SCALE	SCALE
CADD	MSF	2013-11-27	FIGURE	2
CHECK	RLC	2013-11-27		
REVIEW	RAM	2013-11-27		

LEGEND

- INVESTIGATED FILL MATERIAL AREA
- POSSIBLE FILL MATERIAL AREA
- NATIVE ALLOTMENT AS PROVIDED BY WHPACIFIC
- 2013 GOLDER PROBE ROUTE
- 94 (1.5') 2013 GOLDER PROBE LOCATION. DEPTH TO REFUSAL SHOWN IN PARENTHESES.

LEGEND (CONT.)

- PERCHED WATER ZONE

REFERENCES / SPECIFICATIONS

1. BACKGROUND IMAGERY PROVIDED BY WHPACIFIC, DATED JUNE 12, 2013

PROJECT

WHPACIFIC
KIVALINA ACCESS ROAD
KIVALINA, ALASKA

TITLE

SOUTHERN ALIGNMENT PROBE DATA

Golder Associates

PROJECT No.		133-95034	FILE No.	3395034-Recon_Maps
DESIGN	MSF	2013-08-22	SCALE	SCALE
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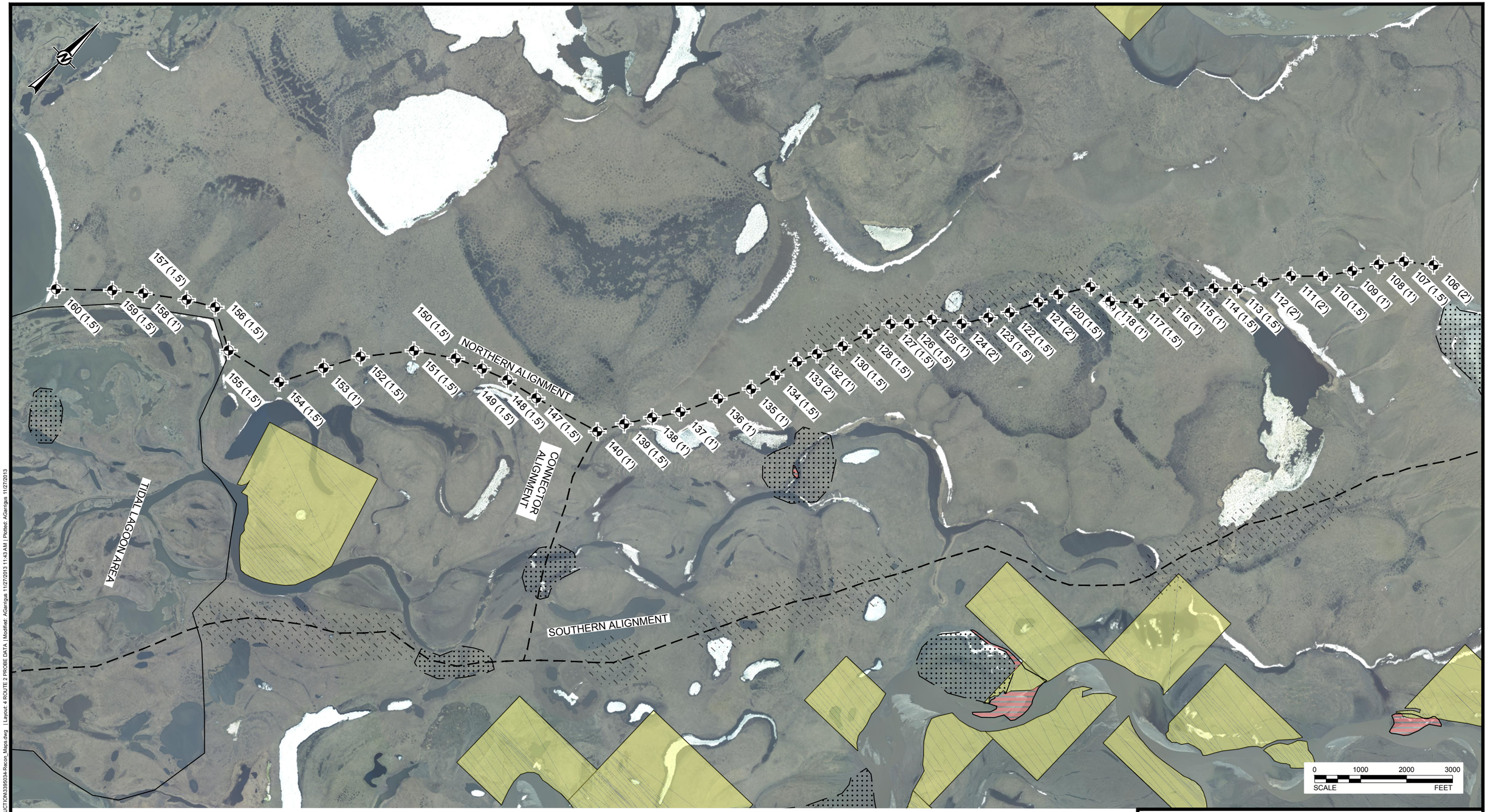
REVIEW	RAM	2013-11-27		



LEGEND

- INVESTIGATED FILL MATERIAL AREA
- POSSIBLE FILL MATERIAL AREA
- NATIVE ALLOTMENT AS PROVIDED BY WHPACIFIC
- 2013 GOLDER PROBE ROUTE
- 94 (1.5') 2013 GOLDER PROBE LOCATION. DEPTH TO REFUSAL SHOWN IN PARENTHASES.

LEGEND (CONT.)

- PERCHED WATER ZONE

REFERENCES / SPECIFICATIONS

1. BACKGROUND IMAGERY PROVIDED BY WHPACIFIC, DATED JUNE 12, 2013

PROJECT

WHPACIFIC
KIVALINA ACCESS ROAD
KIVALINA, ALASKA

TITLE

NORTHERN ALIGNMENT PROBE DATA

Golder Associates

PROJECT No.		133-95034	FILE No.	3395034-Recon_Maps
DESIGN	MSF	2013-08-22	SCALE	SCALE
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CHECK	RLC	2013-11-27		4
REVIEW	RAM	2013-11-27		

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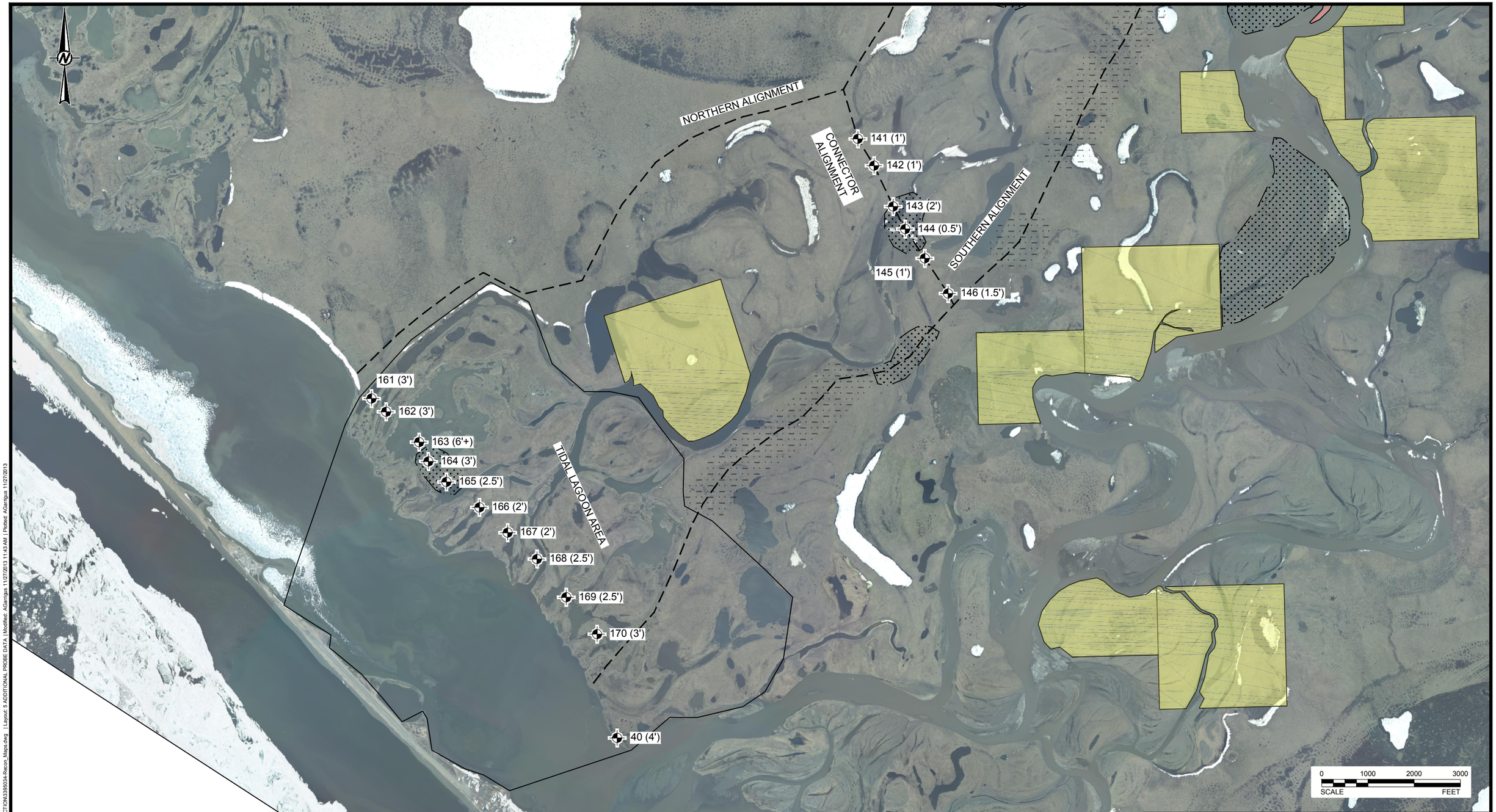

LEGEND

- INVESTIGATED FILL MATERIAL AREA
- POSSIBLE FILL MATERIAL AREA
- NATIVE ALLOTMENT AS PROVIDED BY WHPACIFIC
- 2013 GOLDER PROBE ROUTE
- 94 (1.5') 2013 GOLDER PROBE LOCATION. DEPTH TO REFUSAL SHOWN IN PARENTHASES.

LEGEND (CONT.)

- PERCHED WATER ZONE

REFERENCES / SPECIFICATIONS

1. BACKGROUND IMAGERY PROVIDED BY WHPACIFIC, DATED JUNE 12, 2013

PROJECT
WHPACIFIC
KIVALINA ACCESS ROAD
KIVALINA, ALASKA

TITLE
SUPPLIMENTARY PROBE DATA

Golder Associates

PROJECT No.		133-95034	FILE No.	3395034-Recon_Maps
DESIGN	MSF	2013-08-22	SCALE	SCALE
CADD	MSF	2013-11-27	FIGURE	
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REVIEW	RAM	2013-11-27		

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LEGEND

- INVESTIGATED FILL MATERIAL AREA
- POSSIBLE FILL MATERIAL AREA
- NATIVE ALLOTMENT AS PROVIDED BY WHPACIFIC
- 2013 GOLDER PROBE ROUTE
- BH00 2013 GOLDER HAND AUGER SAMPLE LOCATION

LEGEND (CONT.)

- PERCHED WATER ZONE

REFERENCES / SPECIFICATIONS

1. BACKGROUND IMAGERY PROVIDED BY WHPACIFIC, DATED JUNE 12, 2013

PROJECT

WHPACIFIC
KIVALINA ACCESS ROAD
KIVALINA, ALASKA

TITLE

BOREHOLE DATA

Golder Associates

PROJECT No.		133-95034	FILE No.	3395034-Recon_Maps
DESIGN	MSF	2013-08-22	SCALE	SCALE
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CHECK	RLC	2013-11-27		6
REVIEW	RAM	2013-11-27		

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LEGEND

- INVESTIGATED FILL MATERIAL AREA
- POSSIBLE FILL MATERIAL AREA
- NATIVE ALLOTMENT AS PROVIDED BY WHPACIFIC
- 2013 GOLDER PROBE ROUTE

NOTES

1. AREA CALCULATIONS ARE APPROXIMATE, BASED ON BOTH DESKTOP AND FIELD STUDY

REFERENCES / SPECIFICATIONS

1. BACKGROUND IMAGERY PROVIDED BY WHPACIFIC, DATED JUNE 12, 2013

PROJECT

WHPACIFIC
KIVALINA ACCESS ROAD
KIVALINA, ALASKA

TITLE

APPROXIMATE AREA OF POTENTIAL MATERIAL SOURCES

Golder Associates

PROJECT No.		133-95034	FILE No.	3395034-Recon_Maps
DESIGN	MSF	2013-08-22	SCALE	SCALE
CADD	MSF	2013-11-27	FIGURE	
CHECK	RLC	2013-11-27		7
REVIEW	RAM	2013-11-27		

APPENDIX A
LABORATORY DATA

TABLE A-1: SAMPLE SUMMARY

Client:	WHPacific	**Project No.:**	133-95034
Project:	Kivalina Access Road	**QA/QC By:** J. Randazzo	**Date:** 9/7/2013
Location:	Kivalina, Alaska	**Reviewed By:** M. Hess	**Date:** 9/4/2013

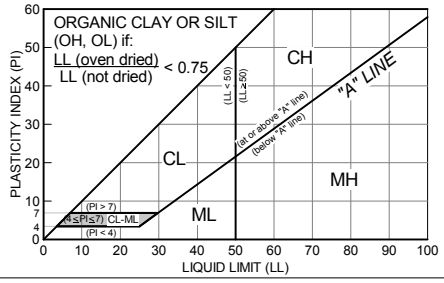
SAMPLING DATA						CLASSIFICATION AND INDEX TEST RESULTS											
		DEPTH (ft)								GRADATION (%)							
SAMPLE LOCATION	SAMPLE NUMBER	TOP	BOTTOM	RECOVERY (%)	SAMPLE TYPE	NATURAL MOISTURE CONTENT (%)	LIQUID LIMIT (LL) (%)	PLASTIC LIMIT (PL) (%)	PLASTICITY INDEX (PI) (%)	GRAVEL	SAND	FINES (SILT & CLAY)	ORGANIC CONTENT (%)	DESCRIPTION (USCS)	SALINITY (ppt) [(d) is directly meas.]	TESTS / OTHER TESTS	SAMPLE NOTES
BH-01		4.0	5.0			124	62	51	11					OH		PI	Kisimigiuktuk Hill
BH-02		3.0	4.0			249							43.3				Northwest of study area
BH-03		1.5	2.5			277	56	51	5				23.0	OH		PI	Northern Alignment
BH-04		4.5	5.0			59											Southern Alignment
BH-05		1.5	2.0			30				0.0	85.2	14.8		SM			Southern Alignment
BH-06		4.5	5.0			12											Southern Alignment
BH-07	1	1.5	2.5			111									0		Tidal Lagoon Area
BH-07	2	4.5	5.5			241									2(d)		Tidal Lagoon Area
BH-08		5.5	6.0			245											Tidal Lagoon Area
BH-09	1	1.5	2.5			162											Northern Alignment
BH-09	2	4.0	4.5			165											Northern Alignment
BH-10		0.5	1.0			7				48.4	47.2	4.4		GW		SA	Connector Alignment
G-01		0.0	2.0			6				60.5	20.5	18.9		GM		MA	Kisimigiuktuk Hill
G-04		0.0	1.0			2				77.2	22.0	0.7		GP		SA	Wulik River Depositional Zone
G-05		0.0	1.0			8				62.9	35.6	1.6		GW		SA	Wulik River Relict Channel
G-06		0.0	1.0			6				0.1	91.9	8.0		SP-SM			Wulik River Relict Channel
G-08		0.0	1.0			2				66.3	33.0	0.7		GW		SA	Wulik River Depositional Zone

KIVALINA ACCESS ROAD.GPJ LIBRARY-ANC(12-3-13).GLB [ANC_SAMPLE_SUMMARY] PCalvin 12/3/13

Golder Associates Inc.
2121 Abbott Road, Suite 100, Anchorage, AK
Tel: (907) 344-6001 Fax: (907) 344-6011 www.golder.com

UNIFIED SOIL CLASSIFICATION (adapted from ASTM D2487)

MATERIAL TYPES	CRITERIA FOR ASSIGNING SOIL GROUP NAMES AND GROUP SYMBOLS USING LABORATORY TESTS			GROUP SYMBOL	SOIL GROUP NAMES & LEGEND	
COARSE-GRAINED SOILS >50% RETAINED ON NO. 200 SIEVE	GRAVELS >50% OF COARSE FRACTION RETAINED ON NO 4. SIEVE	CLEAN GRAVELS <5% FINES	$C_U \geq 4$ AND $1 \leq C_C \leq 3$	GW	WELL-GRADED GRAVEL	If soil contains ≥15% sand, add "with sand"
			$C_U < 4$ AND/OR [$C_C < 1$ OR $C_C > 3$]	GP	POORLY GRADED GRAVEL	
		GRAVELS WITH FINES >12% FINES	FINES CLASSIFY AS ML OR MH	GM	SILTY GRAVEL	
			FINES CLASSIFY AS CL OR CH	GC	CLAYEY GRAVEL	
	SANDS ≥50% OF COARSE FRACTION PASSES ON NO 4. SIEVE	CLEAN SANDS <5% FINES	$C_U \geq 6$ AND $1 \leq C_C \leq 3$	SW	WELL-GRADED SAND	If soil contains ≥15% gravel, add "with gravel"
			$C_U < 6$ AND/OR [$C_C < 1$ OR $C_C > 3$]	SP	POORLY GRADED SAND	
		SANDS AND FINES >12% FINES	FINES CLASSIFY AS ML OR MH	SM	SILTY SAND	
			FINES CLASSIFY AS CL OR CH	SC	CLAYEY SAND	
FINE-GRAINED SOILS >50% PASSES NO. 200 SIEVE	SILTS AND CLAYS LIQUID LIMIT <50	PLASTICITY CHART		CL	LEAN CLAY	If soil contains coarse-grained soil from 15% to 29%, add "with sand" or "with gravel" for whichever type is prominent, or for ≥30%, add "sandy" or "gravelly"
				ML	SILT	
				OL	ORGANIC CLAY OR SILT	
	SILTS AND CLAYS LIQUID LIMIT ≥50			CH	FAT CLAY	
				MH	ELASTIC SILT	
				OH	ORGANIC CLAY OR SILT	
HIGHLY ORGANIC SOILS		PRIMARILY ORGANIC MATTER, DARK IN COLOR, AND ORGANIC ODOR		PT	PEAT	



NOTES:
$C_U = \frac{D_{60}}{D_{10}}$ $C_C = \frac{(D_{30})^2}{D_{10} \times D_{60}}$

Gravels or sands with 5% to 12% fines require dual symbols (GW-GM, GW-GC, GP-GM, GP-GC, SW-SM, SW-SC, SP-SM, SP-SC) and add "with clay" or "with silt" to group name. If fines classify as CL-ML for GM or SM, use dual symbol GC-GM or SC-SM. $D_{(X\%)}$ is soil particle diameter where X% is % finer. *Optional Abbeviations:* Lower case "s" after USCS group symbol denotes either "sandy" or "with sand" while "g" denotes either "gravelly" or "with gravel"

CRITERIA FOR DESCRIBING MOISTURE CONDITION (adapted from ASTM D2488)

DRY	ABSENCE OF MOISTURE, DUSTY, DRY TO THE TOUCH
MOIST	DAMP BUT NO VISIBLE WATER
WET	VISIBLE FREE WATER, USUALLY SOIL IS BELOW WATER TABLE

COMPONENT DEFINITIONS BY GRADATION

COMPONENT	SIZE RANGE
BOULDERS	GREATER THAN 12 in.
COBBLES	12 in. to 3 in.
GRAVEL	3 in. to #4 Sieve (4.76 mm)
COARSE GRAVEL	3 in. to 3/4 in.
FINE GRAVEL	3/4 in. to #4 (4.76 mm)
SAND	#4 (4.76 mm) to #200 (0.074 mm)
COARSE SAND	#4 (4.76 mm) to #10 (2.0 mm)
MEDIUM SAND	#10 (2.0 mm) to #40 (0.42 mm)
FINE SAND	#40 (0.42 mm) to #200 (0.074 mm)
SILT & CLAY (FINES)	SMALLER THAN #200 (0.074 mm)

DESCRIPTIVE TERMINOLOGY FOR PERCENTAGES (ASTM D2488)

DESCRIPTIVE TERMS	RANGE OF PROPORTION
TRACE	0 - 5%
FEW	5 - 10%
LITTLE	10 - 25%
SOME	30 - 45%
MOSTLY	50 - 100%

RELATIVE DENSITY / CONSISTENCY ESTIMATE USING STANDARD PENETRATION TEST (SPT) VALUES (adapted from Terzaghi and Peck 1967)

COHESIONLESS SOILS [a]		COHESIVE SOILS [b]		
RELATIVE DENSITY	$(N_1)_{60}$ (blows/ft) [c]	CONSISTENCY	$(N_1)_{60}$ (blows/ft) [c]	UNCONFINED COMPRESSIVE STRENGTH (TSF) [d]
VERY LOOSE	0 - 4	VERY SOFT	0 - 2	0 - 0.25
LOOSE	4 - 10	SOFT	2 - 4	0.25 - 0.50
COMPACT	10 - 30	FIRM	4 - 8	0.50 - 1.0
DENSE	30 - 50	STIFF	8 - 15	1.0 - 2.0
VERY DENSE	OVER 50	VERY STIFF	15 - 30	2.0 - 4.0
		HARD	OVER 30	OVER 4.0

(a) Soils consisting of gravel, sand, and silt, either separately or in combination possessing no characteristics of plasticity, and exhibiting drained behavior.
(b) Soils possessing the characteristics of plasticity, and exhibiting undrained behavior.
(c) Refer to ASTM D1586 for a definition of N value. $(N_1)_{60}$ is the N value corrected for hammer energy and overburden pressure, and is detailed in ASTM D6066. N values may be affected by a number of factors including: material size, sampler size, hammer weight and type, depth, drilling method, and borehole disturbance. **N values are only an approximate guide for frozen soil or cohesive soil.**
(d) Undrained shear strength, s_u= 1/2 unconfined compression strength, U_c. Note that Torvane (TV) measures s_u and pocket penetrometer (PP) measures U_c

SAMPLER ABBREVIATIONS

SS	SPT Sampler (2 in. OD, 140 lb hammer)	**C**	Core (Diamond Bit)
HD	Heavy Duty Split Spoon (3 in. OD, 340 lb hammer)	**TW**	Thin Wall (Shelby Tube)
-BL	Brass Liners used in Split Spoon	**TP**	Thin Wall Piston Sampler
CA	Continous Core (Soil in Hollow-Stem Auger)	**MS**	Modified Shelby
GS	Grab Sample from Surface / Testpit	**GP**	Geoprobe
AC	Auger Charge	**RC**	Air Rotary Cuttings
AW	Auger Wash	**AG**	Auger Cuttings

LABORATORY TEST ABBREVIATIONS

Con	Consolidation	**PID**	Photoionization Detector	**TXCD**	Triaxial, Consolidated Drained
Dd	Dry Density	**PM**	Modified Proctor (D1557)	**TXCU**	Triaxial, Consolidated Undrained
K	Thermal Conductivity	**PP**	Pocket Penetrometer	**TXUU**	Triaxial, Unconsolidated Undrained
MA	Sieve and Hydrometer	**PTLD**	Point Load	**W_C**	Liquid Limit (LL)
NP	Non-plastic	**SA**	Sieve Analysis	**W_P**	Plastic Limit (PL)
OLI	Organic Loss	**SpG**	Specific Gravity	**Ω**	Soil Resistivity (Res.)
P200	Passing #200 Sieve (D1140)	**TC**	Thaw Consolidation/Strain		
pH	Soil pH	**TV**	Torvane		

Golder Associates

SOIL CLASSIFICATION / LEGEND

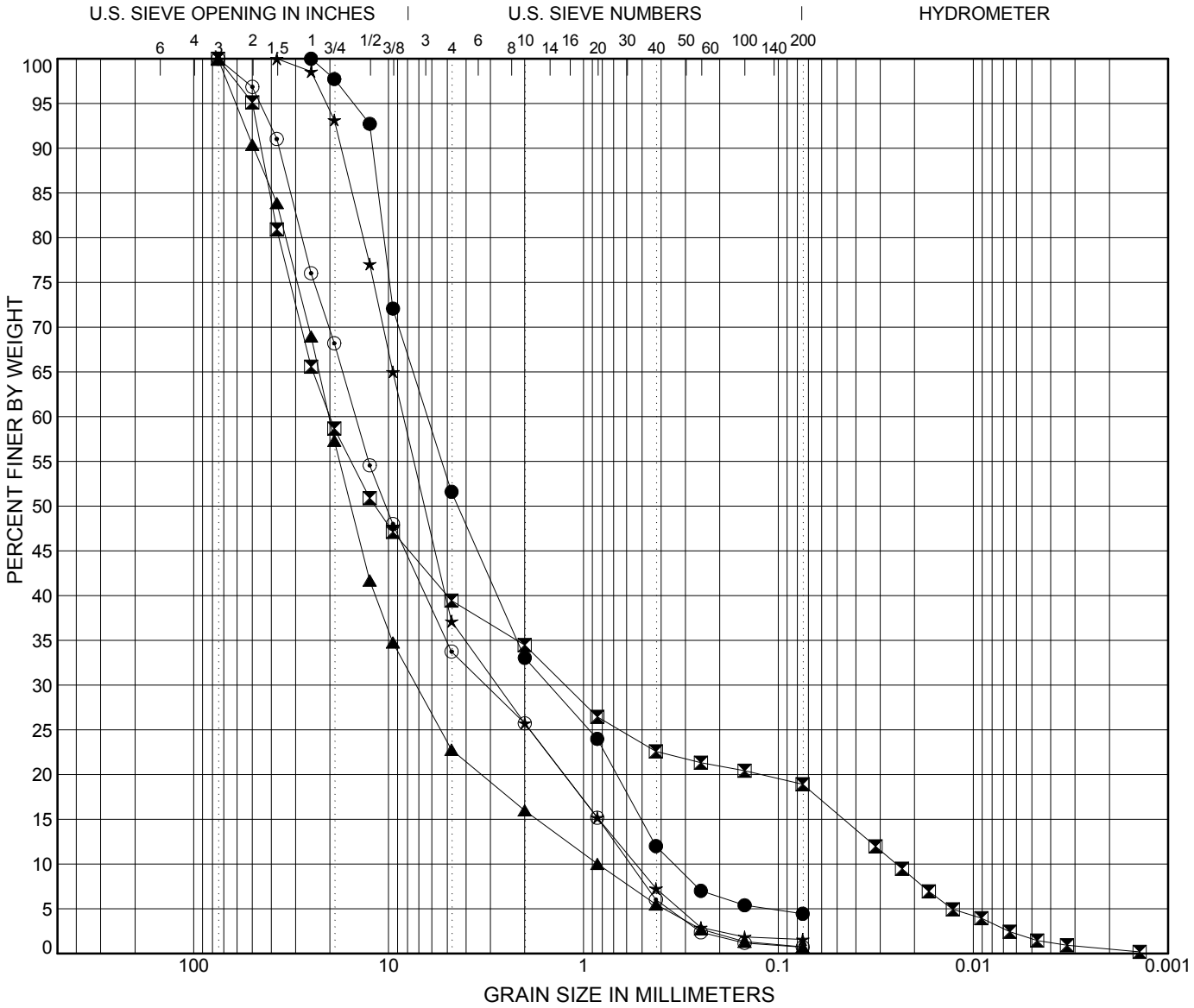
Figure A-1

Golder Associates

FIGURE A-2: SUMMARY OF PARTICLE SIZE DISTRIBUTION RESULTS

Reference(s)
ASTM D 422

Client:	WHPacific	**Project No.:**	133-95034	
Project:	Kivalina Access Road	**QA/QC By:**	J. Randazzo	**Date:** 9/7/2013
Location:	Kivalina, Alaska	**Reviewed By:**	M. Hess	**Date:** 9/4/2013

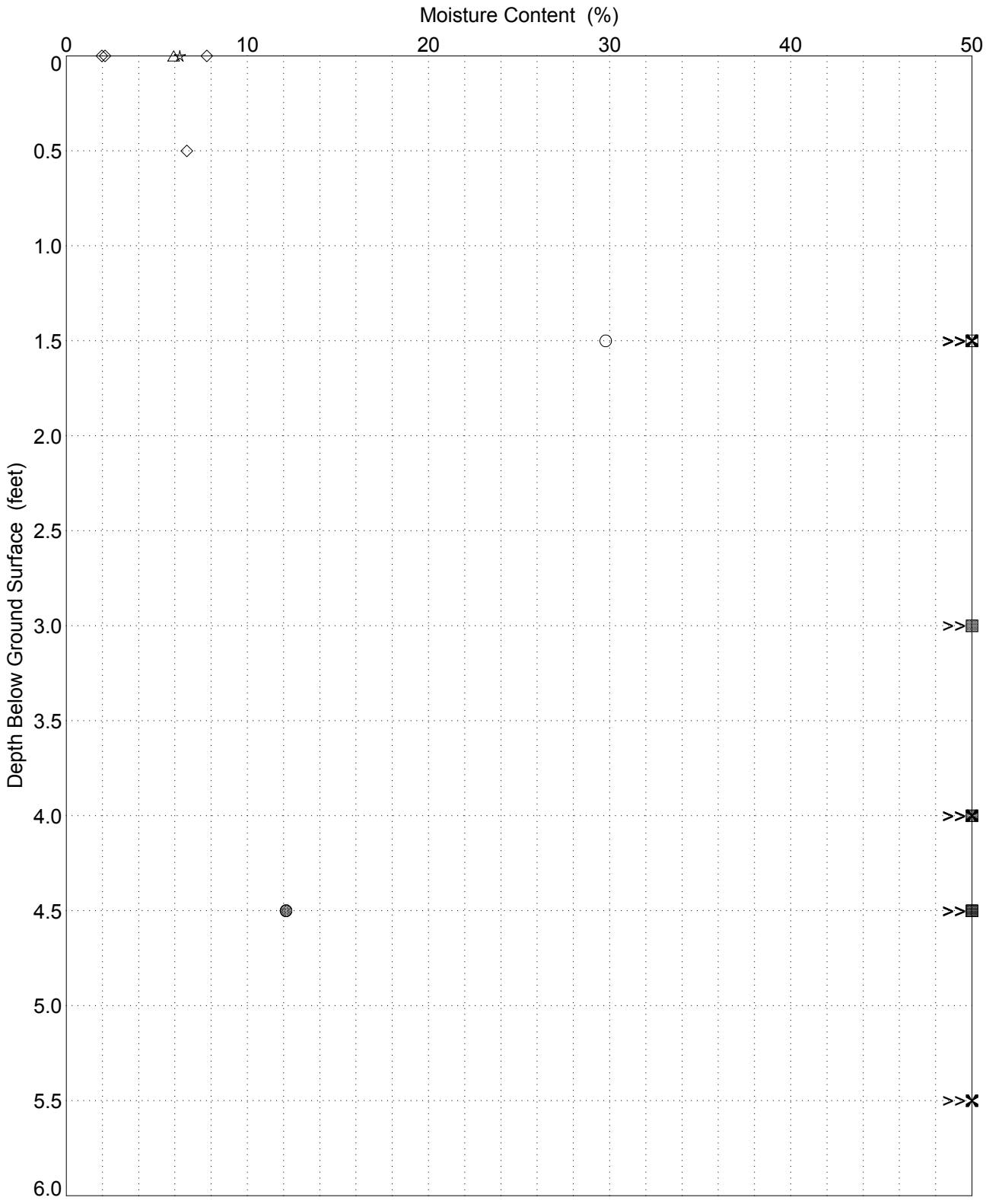


COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Sample Location	Sample Number	Depth (ft)	USCS Classification	Cc	Cu	% Gravel	% Sand	% Fines	% < 0.02 mm
●	BH-10		0.5	well-graded gravel with sand (GW)	1.0	18.4	48.4	47.2	4.4	
⊠	G-01		0.0	silty gravel with sand (GM)	3.1	807.9	60.5	20.5	18.9	8.3
▲	G-04		0.0	poorly graded gravel with sand (GP)	3.0	23.9	77.2	22.0	0.7	
★	G-05		0.0	well-graded gravel with sand (GW)	1.7	15.5	62.9	35.6	1.6	
⊙	G-08		0.0	well-graded gravel with sand (GW)	1.2	25.7	66.3	33.0	0.7	

KIVALINA ACCESS ROAD.GPJ LIBRARY-ANC(12-3-13).GLB [ANC LAB GRAIN SIZE] PCalvin 12/3/13

Golder Associates Inc.
2121 Abbott Road, Suite 100, Anchorage, AK
Tel: (907) 344-6001 Fax: (907) 344-6011 www.golder.com



NOTE: FILLED SOIL SYMBOL INDICATES FROZEN / BONDED CONDITION

Golder Associates

SCALE	NOT TO SCALE	
DESIGN	N/A	
CADD	PAC	12/03/13
CHECK	BBS	12/03/13
REVIEW	RAM	12/03/13
REV.	0	

FILE No. KIVALINA ACCESS ROAD.GPJ

PROJECT No. 133-95034

TITLE

MOISTURE CONTENT VS. DEPTH

KIVALINA ACCESS ROAD
KIVALINA, ALASKA

WHPACIFIC / KIVALINA ACCESS ROAD / AK

FIG. A-3

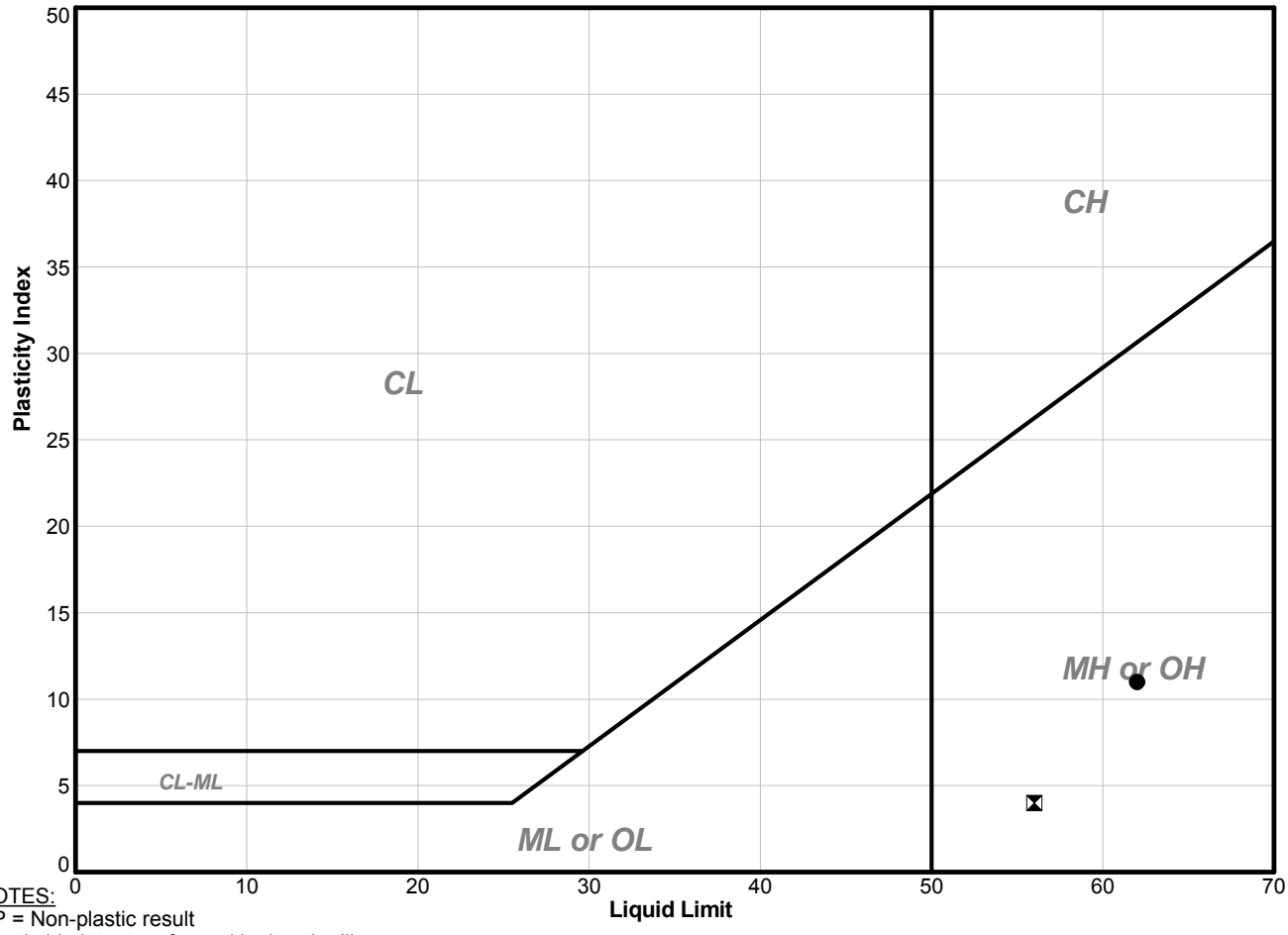
KIVALINA ACCESS ROAD.GPJ LIBRARY-ANC(12-3-13).GLB [ANC WATER CONTENT] PCalvin 12/3/13

FIGURE A-4: LIQUID LIMIT, PLASTIC LIMIT AND PLASTICITY INDEX

Reference(s)
ASTM D 4318

Client:	WHPacific	**Project No.:**	133-95034	
Project:	Kivalina Access Road	**QA/QC By:**	J. Randazzo	**Date:** 9/7/2013
Location:	Kivalina, Alaska	**Reviewed By:**	M. Hess	**Date:** 9/4/2013

PLASTICITY CHART



NOTES:
NP = Non-plastic result
Plastic Limit test performed by hand rolling
Liquid Limit test performed using mechanical device

	Sample Location	Sample Number	Depth (ft)	Bottom (ft)	Passing #40 Sieve (%)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index	USCS	Natural Moisture Content (%)
●	BH-01		4.0	5.0	100	62	51	11	OH	124
⧓	BH-03		1.5	2.5	100	56	51	5	OH	277

KIVALINA ACCESS ROAD.GPJ LIBRARY-ANC(12-3-13).GLB [ANC LAB ATTERBERG CASAGRANDE MULTI (10)] PCalvin 12/3/13

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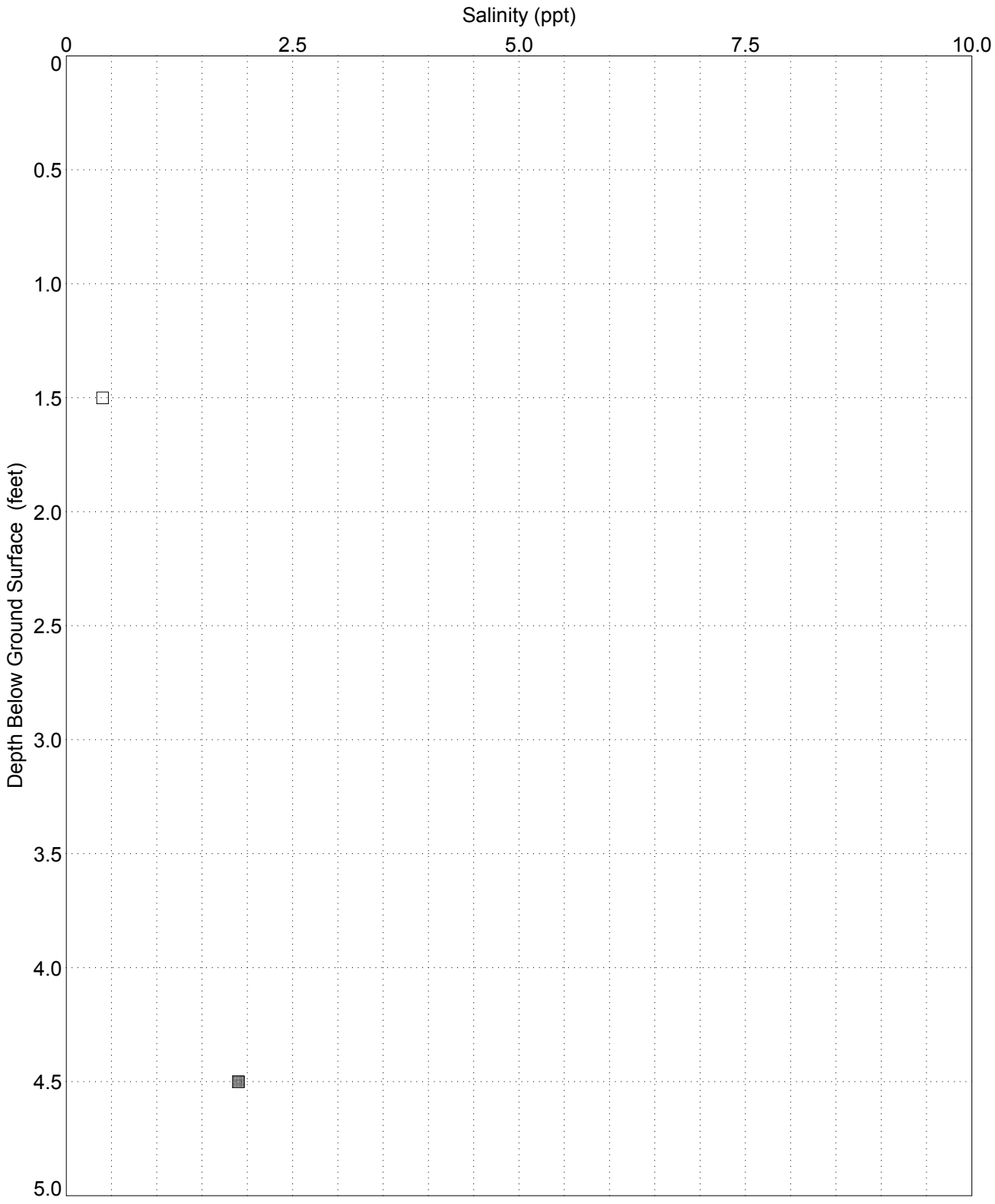
2121 Abbott Road, Suite 100, Anchorage, AK
Tel: (907) 344-6001 Fax: (907) 344-6011 www.golder.com



□ CL,CH,ML,CL-ML ○ SM,SC △ SP,SW,SP-SM ◇ GP,GW,GP-GM ☆ GM,GC ✕ PT,OL,OH ⛄ ICE,ICE+soil

NOTE: FILLED SOIL SYMBOL INDICATES FROZEN / BONDED CONDITION

Golder Associates

SCALE	NOT TO SCALE	
DESIGN	N/A	
CADD	PAC	12/03/13
CHECK	BBS	12/03/13
REVIEW	RAM	12/03/13
REV.	0	

FILE No. KIVALINA ACCESS ROAD.GPJ

PROJECT No. 133-95034

TITLE

SALINITY VS. DEPTH

KIVALINA ACCESS ROAD
KIVALINA, ALASKA

WHPACIFIC / KIVALINA ACCESS ROAD / AK

FIG. **A-5**

KIVALINA ACCESS ROAD.GPJ LIBRARY-ANC(12-3-13).GLB [ANC SALINITY] PCalvin 12/3/13

APPENDIX B
SITE PHOTOGRAPHS

Kivalina Road – Representative Site Photographs

PHOTO 1

Massive ice in BH03

PHOTO 2

Drilling on the North Alignment.

PHOTO 3 Typical conditions on North Alignment: a thin organic mat overlying frozen silt.	
PHOTO 4 Typical minor stream crossing. Minor stream is flowing into the Wulik river.	

PHOTO 5 Bulk sample from G01	
PHOTO 6 Gravel deposition zones at G04 and G08	

PHOTO 7 Sand deposition zone from G06	
PHOTO 8 Perched water backfilling drill hole on South Alignment	

PHOTO 9 Inferred gravel deposit	
PHOTO 10 Looking east along the South Alignment	

Appendix E

Conceptual-Level Construction Cost Estimate

Southern Route

Item No.	Item Description	Unit	Unit Cost	Quantity	Extended Cost
201(1A)	Clearing	ACRE	$2,000	54.0	$ 108,000
203(5A)	Borrow, Type A	CY	$20	445,000	$ 8,900,000
301(4)	Aggregate Surface Course, Grading E-1	CY	$75	17,500	$ 1,312,500
305(1)	Stockpiled Material, Type A	CY	$17.50	575,000	$ 10,062,500
515(1)	Bridge, Complete	EA	$1,200,000	2	$ 2,400,000
602(3)	Structural Plate Arch	LF	$1,000	200	$ 200,000
603(1-36)	36-inch CSP	LF	$350	2,400	$ 840,000
611(1)	Riprap, Class I	CY	$200	31,000	$ 6,200,000
630(1)	Geotextile, Separation	SY	$1.50	260,000	$ 390,000
631(2)	Geotextile, Erosion Control	SY	$2.50	111,000	$ 277,500
640(1)	Mobilization and Demobilization	LS	$1,500,000	1	$ 1,500,000
640(4)	Worker Meals and Lodging	LS	$1,000,000	1	$ 1,000,000
641(1)	Erosion and Pollution Control Administration	LS	$50,000	1	$ 50,000
641(3)	Temporary Erosion and Pollution Control	LS	$100,000	1	$ 100,000
642(1)	Construction Surveying	LS	$150,000	1	$ 150,000
	Subtotal				**$ 33,490,500**
	Contingency		20%		$ 6,698,100
	Construction Work Subtotal				**$ 40,188,600**
	Construction Engineering (@ 2% of Above)	LS	2%		$ 803,772
	Subtotal w/ Construction Engineering				**$ 40,992,372**

Northern Route

Item No.	Item Description	Unit	Unit Cost	Quantity	Extended Cost
201(1A)	Clearing	ACRE	$2,000	54.0	$ 108,000
203(5A)	Borrow, Type A	CY	$20	996,000	$ 19,920,000
301(4)	Aggregate Surface Course, Grading E-1	CY	$75	23,000	$ 1,725,000
305(1)	Stockpiled Material, Type A	CY	$17.50	1,126,000	$ 19,705,000
515(1)	Bridge, Complete	EA	$1,200,000	2	$ 2,400,000
602(3)	Structural Plate Arch	LF	$1,000	100	$ 100,000
603(1-36)	36-inch CSP	LF	$350	2,000	$ 700,000
611(1)	Riprap, Class I	CY	$200	59,000	$ 11,800,000
630(1)	Geotextile, Separation	SY	$1.50	262,000	$ 393,000
631(2)	Geotextile, Erosion Control	SY	$2.50	214,000	$ 535,000
640(1)	Mobilization and Demobilization	LS	$1,500,000	1	$ 1,500,000
640(4)	Worker Meals and Lodging	LS	$2,000,000	1	$ 2,000,000
641(1)	Erosion and Pollution Control Administration	LS	$50,000	1	$ 50,000
641(3)	Temporary Erosion and Pollution Control	LS	$100,000	1	$ 100,000
642(1)	Construction Surveying	LS	$150,000	1	$ 150,000
	Subtotal				**$ 61,186,000**
	Contingency		20%		$ 12,237,200
	Construction Work Subtotal				**$ 73,423,200**
	Construction Engineering (@ 2% of Above)	LS	2%		$ 1,468,464
	Subtotal w/ Construction Engineering				**$ 74,891,664**

Combined Route

Item No.	Item Description	Unit	Unit Cost	Quantity	Extended Cost
201(1A)	Clearing	ACRE	$2,000	51.0	$ 102,000
203(5A)	Borrow, Type A	CY	$20	987,000	$ 19,740,000
301(4)	Aggregate Surface Course, Grading E-1	CY	$75	22,000	$ 1,650,000
305(1)	Stockpiled Material, Type A	CY	$17.50	1,105,000	$ 19,337,500
515(1)	Bridge, Complete	EA	$1,200,000	2	$ 2,400,000
602(3)	Structural Plate Arch	LF	$1,000	150	$ 150,000
603(1-36)	36-inch CSP	LF	$350	1,800	$ 630,000
611(1)	Riprap, Class I	CY	$200	59,000	$ 11,800,000
630(1)	Geotextile, Separation	SY	$1.50	245,000	$ 367,500
631(2)	Geotextile, Erosion Control	SY	$2.50	214,000	$ 535,000
640(1)	Mobilization and Demobilization	LS	$1,500,000	1	$ 1,500,000
640(4)	Worker Meals and Lodging	LS	$2,000,000	1	$ 2,000,000
641(1)	Erosion and Pollution Control Administration	LS	$50,000	1	$ 50,000
641(3)	Temporary Erosion and Pollution Control	LS	$100,000	1	$ 100,000
642(1)	Construction Surveying	LS	$150,000	1	$ 150,000
	Subtotal				**$ 60,512,000**
	Contingency		20%		$ 12,102,400
	Construction Work Subtotal				**$ 72,614,400**
	Construction Engineering (@ 2% of Above)	LS	2%		$ 1,452,288
	Subtotal w/ Construction Engineering				**$ 74,066,688**

Section Type / Length (ft)

Route	1	2	3	4	Total	
Southern	27,246	5,690	3,054	342	36,332	6.88 Mi.
Northern	36,442	0	3,721	7,791	47,954	9.08 Mi.
Combined	34,052	0	3,721	7,791	45,564	8.63 Mi.

1	Upland Area
2	Flood-Prone Area
3	Causeway
4	Island Area

Section	Top Width (ft)	Thickness (ft)	Sideslope (H:1)	Btm Width (ft)	X-Section (sf)	D-1 Thick. (ft)	D-1 Btm (ft)	D-1 Area (sf)	Riprap Thick (ft)	Sideslope (ft)	Riprap X-Sect Area (sf)	Btm 2' X-Sect (sf)
1	24	5	3	54.00	195.00	0.5	27	12.75	0	15.81	0.00	96.00
2	24	10	3	84.00	540.00	0.5	27	12.75	1	31.62	63.25	156.00
3	30	22	3	162.00	2,112.00	0.5	33	15.75	1	69.57	139.14	
4	24	22	3	156.00	1,980.00	0.5	27	12.75	1	69.57	139.14	

Total Embankment Fill Volume / Section (CY)

Route	1	2	3	4	**Total**	**Road**	**Causeway**	**Island**
Southern	196,777	113,800	238,891	25,080	**574,547**	**310,577**	**238,891**	**25,080**
Northern	263,192	0	291,065	571,340	**1,125,597**	**263,192**	**291,065**	**571,340**
Combined	245,931	0	291,065	571,340	**1,108,336**	**245,931**	**291,065**	**571,340**

Embankment Fill Volume Less 2-Ft Thick Stockpile (CY)

Total
444,797
996,026
987,262

Surfacing Course Volume / Section (CY)

Route	1	2	3	4	**Total**	**Road**	**Causeway**	**Island**
Southern	12,866	2,687	1,782	162	**17,496**	**15,553**	**1,782**	**162**
Northern	17,209	0	2,171	3,679	**23,058**	**17,209**	**2,171**	**3,679**
Combined	16,080	0	2,171	3,679	**21,930**	**16,080**	**2,171**	**3,679**

Geotextile Area / Section (SY)

Route	1	2	3	4	**Total**	**Road**	**Causeway**	**Island**
Southern	196,171	63,728			**259,899**	**259,899**	**0**	**0**
Northern	262,382	0			**262,382**	**262,382**	**0**	**0**
Combined	245,174	0			**245,174**	**245,174**	**0**	**0**

36-Inch Dia. Culvert Lengths / Section (LF)

Route	1	2	3	4	**Total**	**Road**	**Causeway**	**Island**
Southern	1,471	956			**2,427**	**2,427**	**0**	**0**
Northern	1,968	0			**1,968**	**1,968**	**0**	**0**
Combined	1,839	0			**1,839**	**1,839**	**0**	**0**

Sideslope Riprap Volume / Section (CY)

Route	1	2	3	4	**Total**	**Road**	**Causeway**	**Island**
Southern	0	13,328	15,738	1,762	**30,829**	**13,328**	**15,738**	**1,762**
Northern	0	0	19,176	40,150	**59,325**	**0**	**19,176**	**40,150**
Combined	0	0	19,176	40,150	**59,325**	**0**	**19,176**	**40,150**

Lower 2-Ft Embankment Volume / Section (CY) - Construction Stockpile Along Road

Route	1	2	3	4	**Total**	**Road**	**Causeway**	**Island**
Southern	96,875	32,876	0	0	**129,750**	**129,750**	**0**	**0**
Northern	129,572	0	0	0	**129,572**	**129,572**	**0**	**0**
Combined	121,074	0	0	0	**121,074**	**121,074**	**0**	**0**

Appendix F

A Plan Forward

Kivalina Evacuation and School Access Road Project

This paper describes the field and office tasks required to complete the pre-construction portion of the project so it can be bid for construction.

This is an update of the original paper titled, "Kivalina Evacuation and New School Access Road; A guide to the required Design and Environmental studies," dated October 2012.

A PLAN FORWARD

A Guide to the Required Geotechnical, Survey, Environmental, Design, and Permitting Tasks

Updated May 2014

WHPacific

Kivalina Evacuation and School Access Road Project

A PLAN FORWARD:
A Guide to the Required Geotechnical, Survey, Environmental, Design and Permitting Tasks

Prepared for:

Native Village of Kivalina

Prepared by:

WHPacific

May 2014

Table of Contents

Kivalina and Kisimigiuqtuq Hill

Vicinity Map

Kivalina Evacuation Road Background

Kivalina is a traditional Inupiat Eskimo village located in northwest Alaska. Its precarious position on a low-lying barrier island, between the Chukchi Sea and Kivalina Lagoon, and the persistence and severity of storm events have put the village at serious risk of being inundated by an ocean storm event. Currently, there is no way for community residents to escape the island by foot or wheeled vehicles; the only way to leave is by plane or boat. During a storm event both of these means of escape would be extremely dangerous, if not impossible. If a storm surge reaches a level where evacuation of the village is necessary, the residents need a route they can use to evacuate to higher ground.

The Northwest Arctic Borough School District has plans to build a new school and, in January 2012, they asked the community where they would want it located. The residents chose a site near Kisimigiuqtuq Hill. That location is approximately 8 miles inland from the community and would require a road. A road to Kisimigiuqtuq Hill could serve as an evacuation road and provide access to the new school.

In the spring of 2012, the Native Village of Kivalina and Maniilaq, with funds from the Bureau of Indian Affairs Tribal Transportation program, hired WHPacific to develop a draft Preliminary Environmental Report for the Evacuation Road project. The original version of this paper, which was part of that report, summarized the documents needed to complete the design and environmental phases of the evacuation road project. That paper grouped the studies into three phases: Phase I (0-3 years), Phase II (3-6 years) and Phase III (6-9 years). It pointed out that to save funds and time, some of the project studies could be performed together. It also noted that by combining the road studies with similar studies required for the school design, additional cost savings could be attained. At that time, the estimate for the construction phase of the road was $45 million.

This paper has refined the list of required tasks, the descriptions of those tasks, and the estimated costs to perform them. This paper has also reorganized the required tasks into those completed or under contract and those tasks that still need to be completed. Tasks that need to be completed have been further grouped into categories.

At the end of this paper, a schedule has been included that shows a possible timetable to construction of the road in 2017.

Table 1, below, provides a summary of the pre-construction activities that have been funded and are completed or underway and their associated costs. Table 2 shows those pre-construction tasks that are currently not under contract and their associated estimated costs. The total cost to complete all tasks is estimated to be $3,250,000.

Table 1. Status of Pre-Construction Tasks (Under Contract) and Associated Costs

Contractor	Pre-Construction Tasks Completed or Under Contract	Status (Start Date)	Actual Costs	Subtotals
WHPacific	Aerial Photography	Completed	$ 35,000	$ 270,000
	Preliminary Geotechnical Investigation (Road Alignments and Material Sites)	Completed	$ 85,000	
	Road Reconnaissance Study (Report and Recommendations)	Completed	$ 150,000	
USACE (w/ NAB)	Geotechnical Investigation (Causeway & Bridge)	March 2015	$ 320,000	$1,060,000
	Bathymetric Survey (of Lagoon)	July 2014	$ 325,000	
	Hydrologic Study (of Lagoon)	Sept. 2014	$ 145,000	
	35% Design (Causeway and Bridge)	January 2015	$ 270,000	
	Pre-Construction Work Under Contract		**$ 1,330,000**	

Table 2. Pre-Construction Tasks (Not Under Contract) and Associated Estimated Costs to Complete

Category	Pre-Construction Tasks to be Completed	Estimated Costs	Subtotals
Geotech.	Geotechnical Investigation (Road Alignment)	$ 300,000	$ 600,000
	Geotechnical Investigation (Material Sites)	$ 300,000	
Survey	Topo Map from Aerial Photography	$ 50,000	$ 110,000
	Centerline Field Verification of Topo Map Data	$ 30,000	
	Right-of-Way Documentation	$ 30,000	
Environ.	Marine Mammal Study	$ 155,000	$ 510,000
	Biological Assessment - Essential Fish Habitat (EFH)	$ 100,000	
	Wetlands Delineation	$ 60,000	
	Archaeological Survey	$ 35,000	
	Environmental Document (Environmental Assessment)	$ 160,000	
Pre-Design	Hydrological and Hydraulic Study (Uplands)	$ 100,000	$ 150,000
	Preliminary Engineering Report (Design Study Report)	$ 50,000	
Design / Construction Documents	Road	$ 250,000	$ 500,000
	Causeway	$ 100,000	
	Bridge(s)	$ 150,000	
Permits	Permit Applications	$ 50,000	$ 50,000
	Pre-Construction Work to be Completed	**$ 1,920,000**	
	Total Pre-Construction Costs	**$ 3,250,000**	

Tasks Completed or Under Contract

Controlled Aerial Photography

Purpose: Obtain aerial photos along the alternative Evacuation and School Access Road alignments. These photos will be used in evaluating the various alignment alternatives. When an alignment is selected, this photography will be used to produce a topographical map for design.

Scope of Work: Procure aerial photography from AeroMetric that covers the alternative route corridors between Kivalina and Kisimigiuqtuq Hill, extending roughly to the Kivalina and Wulik Rivers. The digital color photos must be ground controlled by field survey and have a 1-foot pixel resolution and suitable for making a topographical map with 2-foot contours.

Actual Cost: $35,000

Status: Completed

Preliminary Geotechnical Investigation (Road Alignments and Material Sources)

Purpose: Determine the general shallow subsurface conditions along the alternative Evacuation and School Access Road alignments. Identify and characterize potential gravel material sources near the proposed routes.

Scope of Work: Perform a geotechnical field exploration and provide conceptual-level geotechnical recommendations for a roadway between Kivalina and Kisimigiuqtuq Hill. A geotechnical drilling program at the bridge location(s) is not included in this preliminary geotechnical report.

The shallow subsurface exploration program will be supported by helicopter and will focus on the following:

- Determine the depth of the active layer by advancing hand probes along the proposed alignments
- Determine shallow subsurface conditions along the proposed alignments by advancing shallow boreholes with a hand-operated power drill
- Determine the location and quality of potential material borrow sources near the proposed alignments.

Representative samples will be collected for analysis. The location of each probe and borehole will be recorded using hand-held GPS instruments.

Prepare a geotechnical report summarizing the field work and results of the laboratory testing. The report will also include conceptual-level geotechnical engineering considerations for road embankment design and material sources. Recommendations and estimated costs for further geotechnical work will be included.

Actual Cost: $85,000

Status: Completed

Road Reconnaissance Study (Report and Recommendations)

Purpose: Evaluate Evacuation and School Access Road alignment alternatives and recommend a preferred alignment for further study.

Scope of Work: Coordinate with the community and gather available agency documents from prior, ongoing, and proposed projects in the immediate area. Hold a public meeting to gather local input. Propose alternative road alignments and then investigate them in the field. Coordinate the work of the geotechnical investigation, described above.

The Reconnaissance Report will summarize the findings of the office research, field work, and the analysis of the alternatives. It will include the following:

- Executive Summary
- General description of terrain, visible hydrologic, geologic and geographic features, and natural hazards
- Records of meetings with the Native Village of Kivalina, governments, agencies, stakeholders, and the general public
- Descriptions of alternatives investigated
- Analysis of desirability and feasibility of each alternative, including environmental impact considerations, ROW impacts, functionality, cost, constructability, and safety
- Conceptual level construction cost estimates for each alternative

Actual Cost: $150,000

Status: Completed

Geotechnical Investigation (Causeway and Bridge Site)

Purpose: Obtain geotechnical information sufficient to design the causeway and bridge foundations across Kivalina Lagoon.

Scope of Work: Prepare a geotechnical drilling program based on the lagoon crossing location determined in the Road Reconnaissance Study, available soils and geologic maps, reports, publications, aerial photographs, and other available reference material. Boring locations, spacing, and depths shall be determined by a geotechnical engineer based on the topography, geologic conditions, visible soil conditions, design considerations, and in accordance with the standard practices needed to determine foundation information.

Prepare a geotechnical report summarizing the field work and results of the laboratory testing. The report will also include geotechnical design information that can be used by the bridge engineers to select and design the appropriate bridge foundations. The report will also include soils information that can be used for the causeway design and construction.

Actual Cost: $320,000

Status: Under contract w/ USACE. Scheduled to begin in March 2015.

Bathymetric Survey

Purpose: Determine the underwater topography (bathymetry) in Kivalina Lagoon, near the causeway and bridge locations. This information will be used to prepare a hydrology report and to assist in the causeway and bridge designs.

Scope of Work: The bathymetric survey will be detailed enough to allow the design of a bridge and causeway that will not trap marine mammals, interfere with fish passage, or adversely disrupt the

flow of water in Kivalina Lagoon. The underwater topography of the lagoon will be depicted as a bathymetric contour map.

Actual Cost: $325,000

Status: Under contract w/ USACE. Scheduled to begin in July 2014.

Hydrologic Study

Purpose: Analyze the currents and water and sediment movement in Kivalina Lagoon. This information will be used to assist in the design of the causeway and bridge(s).

Scope of Work: Review all available documents and conduct the field and office studies necessary to determine the hydrologic characteristics in Kivalina Lagoon. The study will include examining the current hydrology, flood inundation information, basin characteristics, and tidal impacts. Water resource investigations will be conducted, as needed, to prepare a detailed Hydrologic Study Report that can be used to determine the appropriate causeway and bridge designs, as well as bridge location(s).

Estimated Cost: $145,000

Status: Under contract w/ USACE. Scheduled to begin in September 2014.

Preliminary Causeway and Bridge Design

Purpose: Prepare preliminary designs of the causeway and bridge(s) across Kivalina Lagoon.

Scope of Work: Use the information obtained in the geotechnical investigation, bathymetric survey, and hydrology study to prepare 35% complete design drawings of the causeway and bridge(s). The designs will be completed to a level that major details are known. These details will include height and width of causeway embankment; side slope protection; bridge abutment foundations; bridge type, member sizes, and spans; and estimated construction costs.

Documentation, including calculations and AutoCAD drawings, will be assembled into a Preliminary Lagoon Crossing Design Report. This report will be used by consulting engineers to complete the causeway and bridge designs.

Estimated Cost: $270,000

Status: Under contract w/ USACE. Scheduled to begin in January 2015.

Geotechnical Tasks to be Completed

Geotechnical Investigation (Road Alignment)

Purpose: Characterize and classify the geotechnical conditions along the selected Evacuation and School Access Road alignment to a greater extent than was done during the preliminary geotechnical investigation. The roadway geotechnical investigation will provide sufficient subsurface data to design the roadway prisms.

Scope of Work: Explore subsurface conditions along the selected alignment. An experienced engineer or geologist will be present during the field work to locate the test holes, observe the excavation work,

collect samples, and prepare a descriptive log for each hole. It is anticipated that 20 – 30 shallow boreholes, spaced 1,000 to 2,000 feet apart, will be drilled along the route.

Perform laboratory tests on selected soil samples to evaluate the behavior characteristics of the soil encountered. Selected samples will be tested for natural water content, grain-size distribution, and possibly Atterberg Limits, as appropriate. The types of tests and the testing program will be adjusted based on the actual conditions encountered.

Based on the results of the field explorations and laboratory testing, conduct engineering design analyses to evaluate the foundation parameters and provide recommendations needed for the final design of the proposed roadway prisms. Prepare a geotechnical report that presents conclusions and recommendations concerning drainage, road design, suitability of local materials as borrow, and other factors, as appropriate.

Along with the engineering recommendations, the report will also include a site description, summarize field explorations, laboratory test procedures and results, and present narrative description of the subsurface conditions encountered. This description will be supported by tabulated logs of all test holes.

Estimated Cost: $300,000.

Geotechnical Investigation (Material Sources)

Purpose: Characterize, classify, and delineate the granular material deposits identified as potential material sources during the preliminary geotechnical investigation. The material source geotechnical investigation will provide sufficient subsurface data to determine the extent and quality of potential material sources.

Scope of Work: Explore subsurface conditions at the potential material source locations. An experienced engineer or geologist will be present during the field work to locate the test holes, observe the excavation work, collect samples, and prepare a descriptive log for each hole. It is anticipated that 5 – 15 boreholes will be drilled at each potential material source location before a "Go or No Go" decision is made. If a site proves promising, additional boreholes will be drilled to more fully delineate the gravel available.

Perform laboratory tests on selected material samples to evaluate their behavior characteristics. Selected samples will be tested for natural water content, grain-size distribution, hardness, and durability.

Based on the results of the field explorations and laboratory testing, provide recommendations on a preferred material source. Prepare a geotechnical report that presents conclusions and recommendations concerning the quality, quantity, suitability of material for road and causeway construction, mine site planning, and other pertinent design information.

Along with the engineering recommendations, the report will also include site descriptions, summarize field explorations, laboratory test procedures and results, and present narrative description of the subsurface conditions encountered. This description will be supported by tabulated logs of all test holes.

Estimated Cost: $300,000.

Survey Tasks to be Completed

Topographical Mapping from Aerial Photography

Purpose: Prepare a topographical map, with two foot contours, along the selected Evacuation and School Access Road alignment. This data will be used for the design of the road.

Scope of Work: Generate 2-foot contours from the aerial photography obtained as part of the earlier aerial photography task. The mapping extents will be limited to a corridor approximately 500 feet wide centered along the selected alignment.

Estimated Cost: $50,000

Design Survey of Selected Road Alignment

Purpose: Field verify the topographical mapping produced from the aerial photography. Obtain sufficient data and set appropriate monumentation to control the design and construction work and to prepare right-of-way or easement documents.

Scope of Work: Complete a thorough records Investigation that includes all existing survey work and maintain copies of all pertinent survey plats and land ownership documents in the project file. Field survey the centerline of the alignment and compare it to the topographic mapping prepared in the above task. Make adjustments, as necessary, to the aerial mapping data.

Estimated Cost: $30,000.

Right-of-Way Documentation

Purpose: Prepare the appropriate right-of-way (ROW) documents.

Scope of Work: Utilize the information obtained in the above design survey task to prepare the appropriate ROW document(s). Consult with the land owner(s) and funding agencies to determine what the ROW document will look like.

Estimated Cost: $30,000.

Environmental Tasks to be Completed

Marine Mammal Studies

Purpose: Identify and understand the distribution and behavior of the marine mammals that inhabit Kivalina Lagoon. This information will be used to assist in the proper design of the bridge and causeway across the lagoon.

Scope of Work: The focus will be on ring seals. Conduct the study through analysis of previous reports, interviews with agency staff, shore-based observation, and collection of traditional knowledge from local residents. The study will include available data on the distribution (distance to shore, travel path) and behavior (travel speed, migration timing) of marine mammals in the area in and around Kivalina Lagoon. The objective is to develop the technical information to fully evaluate causeway and bridge alternatives, and to provide the design information necessary to satisfy environmental and

permit compliance. Consultation with the National Marine Fisheries Service (NMFS) during project scoping will determine potential impacts and data needs.

Data requirements for the project will be met utilizing existing studies and local knowledge, as much as possible, before completing a field survey. The cost estimate reflects a one-month field survey to determine the presence/absence of marine mammals in Kivalina Lagoon.

Estimated Cost: $155,000

Biological Assessment - Essential Fish Habitat

Purpose: Identify and understand the distribution and behavior of the fish that inhabit Kivalina Lagoon. This information will be used to assist in determining potential adverse effects the causeway and bridge(s) may have and the proposed measures to minimize or mitigate the adverse effects.

Scope of Work: Conduct an Essential Fish Habitat Impact Analysis in the waters and substrate within Kivalina Lagoon important to fish for spawning, breeding, feeding, or growing to maturity. Document resources used, conduct interviews with residents in Kivalina, and consult with appropriate state and federal agency personnel. Determine potential adverse effects of the project and propose causeway and bridge design measures that can be implemented to minimize or mitigate any adverse effects identified.

Estimated Cost: $100,000

Wetlands Delineation

Purpose: Identify the locations of all jurisdictional wetlands along the Evacuation and School Access Road alignment.

Scope of Work: Delineate and report on wetlands within a corridor approximately 500 feet wide centered along the selected alignment, using the methodology in the 1987 Corps of Engineers Wetland Delineation Manual and the Alaska Regional Supplement. Prepare a report in accordance with Corps of Engineers Anchorage District Special Public Notice 2010-45. Provide the wetland delineation report to the Corps of Engineers and coordinate and facilitate their concurrence.

Estimated Cost: $60,000

Archaeological Survey

Purpose: Determine potential impacts to archaeological resources along the Evacuation and School Access Road alignment.

Scope of Work: Research, gather, and review existing information and published literature. Consult with the State Historic Preservation Officer (SHPO), BIA, the Village Council, and other parties knowledgeable with the history and prehistory of the project area. Review available literature and previous archaeological work in the project area, if applicable. Perform a pedestrian survey, within a corridor approximately 500 feet wide centered along the road alignment, with periodic shovel testing along the length of the project. Report the findings in accordance with the Alaska SHPO Standards.

Estimated Cost: $35,000

Polar Bear Analysis

Purpose: Obtain information on polar bear use within the project area. This information will be used to assist in the Threatened and Endangered Species Section 7 consultation.

Scope of Work: Review existing reports that have surveyed the presence of polar bears in the coastal area around Kivalina. Analyze reports for current and forecasted movement of polar bears in the study area including denning, refuge from human disturbances, access to maternal dens and feeding habitat, and travel along the coast. Ensure that actions associated with the development of the Evacuation and School Access Road do not adversely modify or destroy designated critical habitat.

Estimated Cost: This cost is included in the cost to prepare the Environmental Document, discussed below.

Western Arctic Caribou Herd Analysis

Purpose: Obtain information on the Western Arctic Caribou Herd. This information will be used to determine the probable impacts the Evacuation and School Access Road will have on caribou migration.

Scope of Work: The Western Arctic Caribou Herd is a valuable local subsistence resource. It is anticipated that additional field studies will not be needed, but that existing data can be utilized. Gather existing data by conducting Interviews with local hunters and scientists, and by reviewing existing research from the Kivalina area, the Northwest Arctic Borough, and the North Slope Borough. Develop design criteria based on research and discuss cumulative impacts to the herd from the Red Dog Mine Road, the Ambler Mine Road, etc. Consider impact of snow fences, if those are anticipated, to the migration of the caribou.

Estimated Cost: This cost is included in the cost to prepare the Environmental Document, discussed below.

Threatened and Endangered Section 7 Analysis

Purpose: Analyze potential impacts to threatened and endangered species. This information will be used to assist in the Threatened and Endangered Species Section 7 consultation.

Scope of Work: Review engineering road design plans and various resources to analyze and evaluate potential impacts to listed species. Conduct presence/absence surveys for threatened and endangered species and habitats when required. Conduct field work to delineate and document the preliminary assessment of impacts by evaluating habitats, soil morphology and characteristics, landscape features, wildlife, and any other characteristics contributing to the presence of threatened and endangered species. Use GPS, Geographic Information Systems (GIS), and/or CADD to document field findings.

Prepare a report detailing field reviews, life history, habitats, or other technical requirements for threatened and endangered species. Prepare a Determinations of Effect, documenting the potential effects of the Evacuation and School Access Road project on threatened or endangered species. Prepare Biological Assessments or other documents as required under Section 7 of the Endangered Species Act. Use GIS data and other remote sensing tools to locate and investigate potential threatened and endangered species mitigation sites. Write site specific mitigation management plans.

Estimated Cost: This cost is included in the cost to prepare the Environmental Document, discussed below.

Visual Rendering

Purpose: Develop a computer-generated display that shows the visual impacts of the bridge and causeway. This rendering will be used to determine the finding of significance and effect.

Scope of Work: Prepare a computer-generated rendering showing the view of the bridge/causeway from the village. The rendering will contain enough information about the visual characteristics of the project for the residents to view the bridge and causeway. An evaluation of the visual impact will be supported by factual descriptions of proposed improvements and representative photographs of the area.

Estimated Cost: This cost is included in the cost to prepare the Environmental Document, discussed below.

Environmental Documentation

Purpose: Develop an appropriate environmental document to analyze and address the impacts of the Evacuation and School Access Road project.

Scope of Work: Funding sources have not been identified at this time. If Federal funding is utilized, then the project will be required to complete a NEPA document through a Federal lead agency. If State or private funding is utilized, then preparation of an Environmental Assessment (EA) style document is recommended as part of the environmental planning effort.

The cost estimate reflects the preparation of an EA-style document. If Federal funding becomes available after an EA has been prepared, the EA document could be used as the basis of a continued environmental process, if required by a Federal agency.

The environmental document will also be used as a process to coordinate public and agency scoping. Agency consultations relating to threatened and endangered (T&E) species that may be impacted during the project will also be conducted during the development of the environmental document. As stated above, it is not anticipated that polar bear or caribou specific biological assessment studies will be required for this project. Instead, existing data and reports, along with interviews with local residents, can be used to analyze and evaluate the effects of the project on their habitat. Along with the studies and surveys performed as part of this project's environmental process, previously collected environmental studies will also be reviewed and incorporated into the environmental document.

Estimated Costs: $160,000

Pre-Design Tasks to be Completed

Preliminary Engineering Report (Design Study Report)

Purpose: Evaluate and recommend design criteria and alternatives for the Evacuation and School Access Road. This document will be used by the engineers to perform the road, causeway, and bridge designs and to prepare the construction documents.

Scope of Work: Gather all investigations, studies, and reports that have been performed for the Evacuation Road project to-date and summarize the critical components of each. Perform the following additional studies: hydrologic and hydraulic study, traffic study, utility conflict study, and

right-of-way analysis. Determine the appropriate design criteria and parameters for the road, causeway, and bridge(s). Design parameters will include design speed, final road alignment, road prism geometry (width, thickness, sideslopes, etc.), bridge type, causeway openings, etc.

Provide draft and final Preliminary Engineering Reports that recommend proposed road design parameters based on the geotechnical reports, environmental studies, and all other applicable studies or assessments that have been completed.

Conduct a meeting with the IRA Council and present the draft Preliminary Engineering Report. Incorporate Council comments into the final Preliminary Engineering Report.

Estimated Cost: $150,000

Design Tasks to be Completed

Road Design

Purpose: Prepare complete bid-ready plans and specifications documents for construction of the road portion of the Evacuation and School Access Road project.

Scope of Work: Utilize the information contained in the Preliminary Engineering Report to design the road portion of the Evacuation and School Access Road project. Prepare plans for Council and agency reviews at the 35%, 65%, 95%, and 100% stages of completion. Respond to all questions and comments and record any changes required in the plans, specifications, or other deliverable items.

Use the ADOT&PF's *Standard Specifications for Highway Construction 2004 (English)* as the reference specifications.

Determine the pay items and estimate the quantities and unit costs. Provide documentation of detailed calculations and references used in preparing the Engineer's Estimate.

Estimated Costs: $250,000

Causeway Design

Purpose: Prepare complete bid-ready plans and specifications documents for construction of the causeway portion of the Evacuation and School Access Road project.

Scope of Work: Utilize the preliminary (35%) causeway design, prepared by the USACE, to complete the design of the causeway portion of the Evacuation and School Access Road project. Prepare plans for Council and agency reviews at the 65%, 95%, and 100% stages of completion. Respond to all questions and comments and record any changes required in the plans, specifications, or other deliverable items.

Use the ADOT&PF's *Standard Specifications for Highway Construction 2004 (English)* as the reference specifications.

Determine the pay items and estimate the quantities and unit costs. Provide documentation of detailed calculations and references used in preparing the Engineer's Estimate.

Estimated Costs: $100,000

Bridge Design

Purpose: Prepare complete bid-ready plans and specifications documents for construction of the bridge portion of the Evacuation and School Access Road project.

Scope of Work: Utilize the preliminary (35%) bridge and abutment design, prepared by the USACE, to complete the design of the bridge portion of the Evacuation and School Access Road project. Prepare plans for Council and agency reviews at the 65%, 95%, and 100% stages of completion. Respond to all questions and comments and record any changes required in the plans, specifications, or other deliverable items.

Use the ADOT&PF's *Standard Specifications for Highway Construction 2004 (English)* as the reference specifications.

Determine the pay items and estimate the quantities and unit costs. Provide documentation of detailed calculations and references used in preparing the Engineer's Estimate.

Estimated Costs: $150,000

Permitting Tasks to be Completed

Permitting

Purpose: Prepare applications and acquire the required permits for the construction of the Evacuation and School Access Road project.

Scope of Work: Prepare permit applications. Provide support to the lead agency and other regulatory agencies during the permit/determination review process. Anticipated permits and determinations include:

- U.S. Army Corps of Engineers (USACE) Section 404 Wetlands permit
- Alaska Department of Environmental Conservation (ADEC) Section 401 Water Quality Certification permit
- U.S. Coast Guard (USCG) Section 9 Bridge permit
- Alaska Department of Fish and Game (ADF&G) Title 16 Fish Habitat permit
- Alaska State Historic Preservation Office (SHPO) Section 106 consultation
- Northwest Arctic Borough (NAB) Title 9 Land Use permit
- Federal Aviation Administration (FAA) Airspace Obstruction Evaluation
- National Marine Fisheries Service (NMFS) incidental Harassment Authorization

Additional permits and/or determinations may be identified during research and communications with regulating agencies.

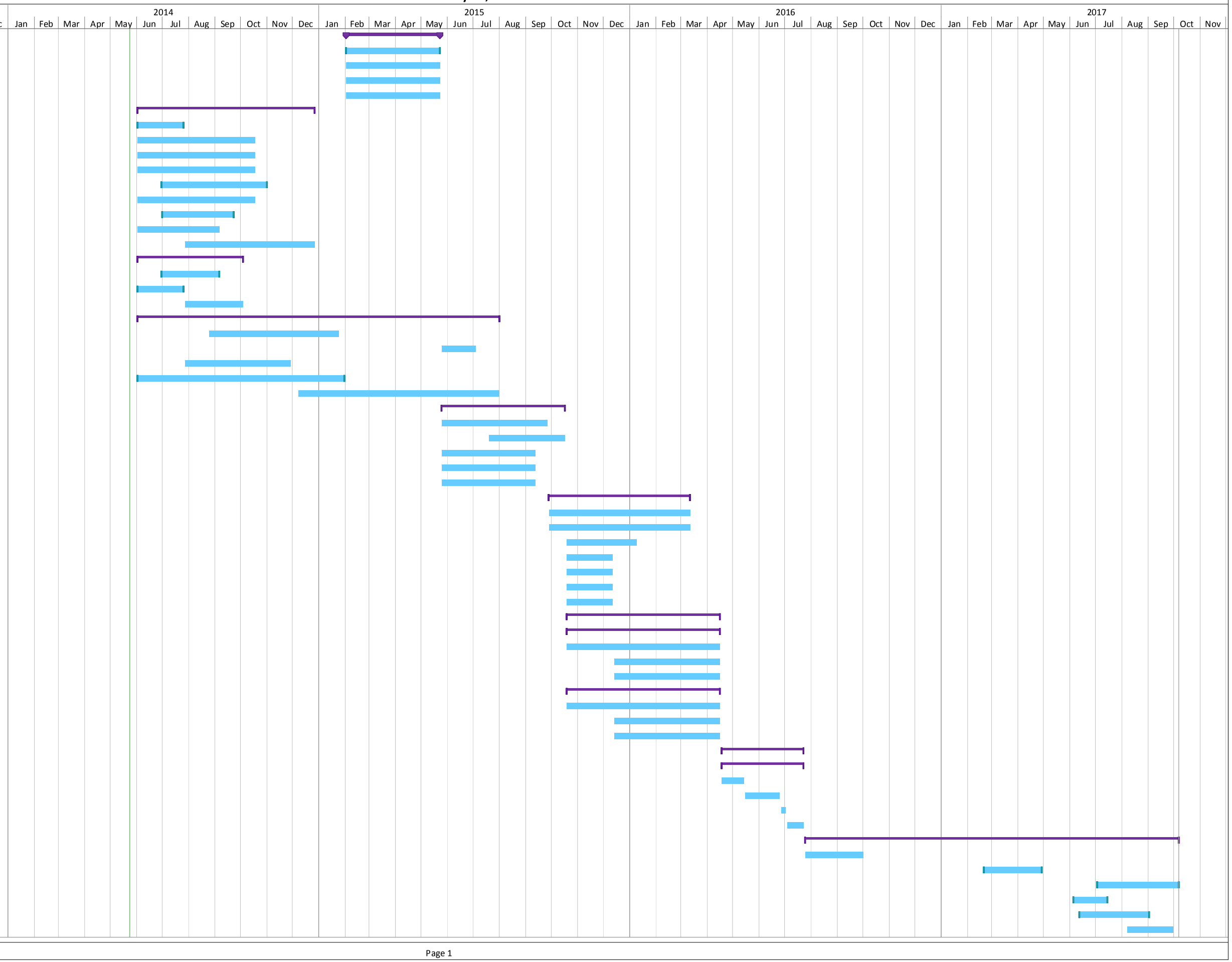
Estimated Costs: $50,000

Schedule

The following schedule shows a possible timetable for the design and construction of the Evacuation and School Access Road project. This schedule assumes no delays or unanticipated problems. It also assumes that funding is available and that contracting with consultants and contractors is not prolonged. The schedule shows completion of the project in 2017.

Kivalina Evacuation and School Access Road
Estimated Schedule through Construction
Revision Date: May 23, 2014

ID	Task Name	Duration	Start
1	**Geotechnical Investigations**	**16 wks**	**Mon 2/2/15**
2	Causeway Across Lagoon (USACE)	16 wks	Mon 2/2/15
3	Bridge Abutments (USACE)	16 wks	Mon 2/2/15
4	Road	16 wks	Mon 2/2/15
5	Material Source(s)	16 wks	Mon 2/2/15
6	**Environmental Studies / Documentation**	**30 wks**	**Mon 6/2/14**
7	Environmental Scoping	8 wks	Mon 6/2/14
8	Marine Mammal Studies	20 wks	Mon 6/2/14
9	Polar Bear Analysis	20 wks	Mon 6/2/14
10	Western Arctic Caribou Herd	20 wks	Mon 6/2/14
11	Essential Fish Habitat Analysis	18 wks	Mon 6/30/14
12	Threatened and Endangered Species	20 wks	Mon 6/2/14
13	Wetlands Delineation Study	12 wks	Tue 7/1/14
14	Archaeological Survey	14 wks	Mon 6/2/14
15	NEPA-Type Document	22 wks	Mon 7/28/14
16	**Surveys**	**18 wks**	**Mon 6/2/14**
17	Bathymetric (at Lagoon Crossing) (USACE)	10 wks	Mon 6/30/14
18	Topographic (from Aerial Photos)	8 wks	Mon 6/2/14
19	Topographic (Field Verification)	10 wks	Mon 7/28/14
20	**Design Studies**	**61 wks**	**Mon 6/2/14**
21	Hydrologic and Hydraulic (Lagoon	22 wks	Mon
22	Bridge Type Analysis and Selection	6 wks	Mon
23	Hydrologic and Hydraulic (Upland Area)	18 wks	Mon 7/28/14
24	Design Study Report - Road	35 wks	Mon 6/2/14
25	Design Study Report - Lagoon Crossing	34 wks	Mon 12/8/14
26	**Preliminary Design (35%)**	**21 wks**	**Mon 5/25/15**
27	Causeway (USACE)	18 wks	Mon 5/25/15
28	Bridge(s) (USACE)	13 wks	Mon 7/20/15
29	Road	16 wks	Mon 5/25/15
30	Stream Crossings / Culverts	16 wks	Mon 5/25/15
31	Material Sites	16 wks	Mon 5/25/15
32	**Permits / Determinations**	**24 wks**	**Mon 9/28/15**
33	USACE Section 404 Wetlands	24 wks	Mon 9/28/15
34	ADEC Section 401 Water Quality	24 wks	Mon 9/28/15
35	ADF&G Title 16 Fish Habitat	12 wks	Mon 10/19/15
36	NAB Land Use	8 wks	Mon 10/19/15
37	SHPO No Historical Prporties Affected	8 wks	Mon 10/19/15
38	NMFS Incidental Harrassment Auth.	8 wks	Mon 10/19/15
39	FAA Obstruction Evaluation	8 wks	Mon 10/19/15
40	**Construction Documents (Final Design)**	**26 wks**	**Mon 10/19/15**
41	**Road**	**26 wks**	**Mon 10/19/15**
42	Plans (Road)	26 wks	Mon 10/19/15
43	Specifications	18 wks	Mon 12/14/15
44	Engineer's Construction Cost Estimate	18 wks	Mon 12/14/15
45	**Lagoon Crossing**	**26 wks**	**Mon 10/19/15**
46	Plans (Causeway & Bridge)	26 wks	Mon 10/19/15
47	Specifications	18 wks	Mon 12/14/15
48	Engineer's Construction Cost Estimate	18 wks	Mon 12/14/15
49	**Bidding Process**	**14 wks**	**Mon 4/18/16**
50	**Road**	**14 wks**	**Mon 4/18/16**
51	Prepare Bid Documents (Road)	4 wks	Mon 4/18/16
52	Advertise Road Project	6 wks	Mon 5/16/16
53	Select Road Contractor	1 wk	Mon 6/27/16
54	Award Road Project / Construction NTP	3 wks	Mon 7/4/16
55	**Construction**	**63 wks**	**Mon 7/25/16**
56	Mobilize Equipment	10 wks	Mon 7/25/16
57	Gravel Excavation / Stockpile	10 wks	Mon 2/20/17
58	Road Construction	14 wks	Mon 7/3/17
59	Mobilize Bridge Materials	6 wks	Mon 6/5/17
60	Causeway Construction	12 wks	Mon 6/12/17
61	Bridge Construction	8 wks	Mon 8/7/17

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