3.6 IMNAKUK BLUFF

3.6.1 Location and Site Description – Imnakuk Bluff

The Imnakuk Bluff site lies on the north side of the Kivalina River, approximately 1.5 miles east of the river's mouth. The west end of the site is 2.6 miles northeast of the Chukchi Sea and the southeast corner of the site is situated about 5.5 miles north-northeast of the existing village. It is a parcel of land 1.5 miles long by ½ mile wide, with its long axis lying parallel to the river, and its south boundary at the river.

A steep, 50 ft high bluff face that drops off to the river below characterizes the site. From the shoulder of the bluff, the site slopes upward to the north between 5-8% grade along a distance over a mile.

The soils near the shoulder of the bluff are more dry and stable than those 200+ ft north of the slope where wet, muskeg soils begin and extend beyond the north limits of the site. Reference the Geotechnical Report for a more in-depth description of the site soils.

Muskeg plants and other low arctic flora such as arctic cotton; moss, sedges, berries and grasses make up the bulk of the ground cover to within 200+ ft of the bluff. From the bluff to the north, the drier, more gravelly soils support a sparser growth of ground cover of predominantly Arctic Willow. Few scrub alder and willow bushes grow in protected depressions in the terrain.

The USACE (1998) report indicates that local residents knowledgeable about the Imnakuk Bluff site indicate winter winds can be a severe constraint to community comfort.

A stream cuts through the site, flowing north-south, about 1/3 the distance from the east boundary. This stream may provide an outlet for sewage provided it can be treated sufficiently to meet ADEC discharge standards and a permit can be obtained.

One characteristic of Imnakuk Bluff that raises safety concerns are the bluffs dropping off to the Kivalina River on the south side of the site. This presents a hazard to both vehicle and pedestrian traffic. Any design for a village at this site should require safety fencing along the top of the bluffs.

3.6.2 Site Development – Imnakuk Bluff

Reference the geotechnical report regarding the depth of gravel recommended for maintaining the thermal regime of the site after development. The depth of fill applied to the site is determined by maintenance of the existing frozen thermal regime.

The fill depth over this site will vary depending on the type of subgrade soil it is placed on. Test holes showed permafrost at the surface at this site, therefore we anticipate that fill will be a minimum of 9 ft.

Grading should maximize the utilization of swales and roadside ditching as much as possible. Where lengths of grade and slopes combine to make swales and ditches too deep, drainage structures such as culverts, manholes, catch basins and subsurface piping shall be employed.

General site grades should be kept to the minimum of 2% on undeveloped (soil) surfaces as much as practicable, and less than the minimum slopes that promote scour and erosion for the soils used. Pipe grades should be a minimum of 1%. Storm drainage outfalls should be rock lined to prevent erosion and heated to maintain open flows during the colder spring nights.

Imnakuk Bluffs has native allotments on the site. The presence of native allotments presents site control issues that must be resolved prior to selection of development of this site.

3.6.2.1 Construction Considerations – Imnakuk Bluff

S&W (2005) states that soils consist of ice-rich permafrost. Residential structures could be founded on post-and-pad or pile foundations.

3.6.3 Infrastructure Development – Imnakuk Bluff

3.6.3.1 Water – Imnakuk Bluff

Based upon the water resource study (Appendix H), a surface water source is proposed for Imnakuk Bluff. For the purposes of this study, the Kivalina River is assumed to be the water source. Geotechnical investigations in 2005 (S&W 2005) showed that Imnakuk is underlain by ice lenses and has ice rich permafrost. Only above ground water and sewer systems can be considered for Imnakuk. Circulation in series among homes and buildings should be considered as a means of applying building heat to keep the system thawed in winter.

3.6.3.2 Wastewater – Imnakuk Bluff

Imnakuk Bluff has a slope between 3% to 7%, and ice-rich permafrost. A gravity collection system and aboveground utilidor would work best at this site.

A sewage lagoon system, located ½ miles south, is proposed for this site. See Section 3.2.4.2.1 on page 43 for details of a 3 cell lagoon system.

S&W (2005) states that sewer utilities would likely be above grade, as the existing solid conditions do not support buried utilities. The sewer mains would need to be constructed with arctic pipe.

Instability related to lagoon construction is an issue. On-site wastewater disposal with a leach field would not be appropriate due to shallow bedrock and frozen ground (S&W, 2004).

3.6.3.3 Solid Waste – Imnakuk Bluff

The site is situated at an elevation approximately 50 ft above the Kivalina River. At this elevation, it is not in any floodplain and the potential for surface water to enter the solid waste site does not appear to be a concern. Any solid waste site located north or east of the village site would be at a higher elevation than the village, and therefore be less susceptible to flooding. The river itself appears to be a flood plain.

Based on the September 2005 site visit, a possible solid waste disposal site could be located 1 to 1 ½ miles east of the site in the land on top of the bluff. The site appears to be high enough in elevation to avoid any flooding and may have natural soils that can be used to build a berm around the site. Additional fill may be required but could likely be obtained from the islands between the braids of the Kivalina River. Permitting of the solid waste site may be difficult as disturbance of anadromous fish habitat may occur during landfill construction and operation (August 2004 site visit).

3.6.3.4 Fuel – Imnakuk Bluff

Except for the location of marine headers and fill pipeline routings, the information in 3.2.6 Fuel applies to all potential sites equally.

3.6.3.5 Heating – Imnakuk Bluff

The information in 3.2.7 Heating applies equally to all sites.

3.6.3.6 Electricity – Imnakuk Bluff

The information in 3.2.8 Electricity applies equally to all sites. However, due to the site's exposure to high winds, it may be possible to utilize wind power generation.

3.6.4 Access – Imnakuk Bluff

Road access from the Imnakuk Bluff site to the lagoon may have to extend about 1.8 miles west of the site and cross Imnakuk Creek to access an area where a landing can

be constructed. This road should terminate at the east side of the lagoon, making it necessary for a boat trip across the lagoon in order to reach the barrier spit. If a road were to be constructed to the Chukchi Sea beach, it would have to extend approximately 1 more mile across the lagoon.

Access to the Bluffs site by boat may be difficult. During the August site visit, we traveled to the site via a small boat piloted by Joe Swan. Finding a channel to reach the Kivalina River was difficult, and the boat grounded on a sand bar before we were able to locate a landing point. The nearest landing point was about a ½ mile upstream of the portion of the site cut by a small stream.

No barge access up the Kivalina River will be possible without dredging. The high bluffs at the river make landing and unloading a barge nearly impossible. Grades of an access road from the West are also a concern. The slope rises quickly from the lagoon to the top of the site. Road grades should have to be kept to a reasonable slope to ensure winter use is not dangerous. Slopes should be kept to less than 12%.

3.6.4.1 Access for Subsistence Activities – Imnakuk Bluff

Access to the Chukchi Sea for hunting sea mammals and fishing should be through the lagoon or from the Chukchi Sea beach.

The location of the Bluff site, inland from the lagoon, places it far enough away from the Chukchi Sea so that watching for whales from the site will not be possible, in spite of the elevation above the surrounding terrain.

The site provides direct access to the Kivalina River via a couple of foot trails from the site. Access to the village from the Kivalina River may be difficult for most of the length of the site. The high, steep bluffs make moving any game from the river to the new village site complicated. The best river access may be from the village to the lagoon, and from the lagoon to the river via boat.

The Wulik River is at the southern end of the lagoon. Access to this river should be by boat from the boat-staging pad at the end of the road from the new village to the lagoon.

Beach access from the Imnakuk Bluff site should be by boat or road across the lagoon.

Gravel roads from the new village site at Imnakuk Bluffs may be expensive to construct and maintain. The terrain to the west and east is muskeg, wet, ice-rich and poor support for roads. The terrain to the South, across the braided channels of the Kivalina River, is made up of good gravels, but the river channels impose barriers to pedestrian and four-wheeler traffic.

There are two proposed access roads from the village. One is routed 0.7 miles to the northwest to access the proposed runway, the other access road runs East to the proposed barge landing north of the Imnakuk Creek.

3.6.4.2 Goods & Supplies – Imnakuk Bluff

At the barge access site, a 1 acre staging area should be constructed for loading and unloading the barge. This staging area should allow the community to stage the materials and ferry them to the new village.

The exact location for the airstrip is unknown at this time. Additional information will be gathered during the Stage II study to determine the best location and design considerations for a new airstrip. For the purposes of this report and the cost estimate, we have shown the airstrip runway located 0.7 miles northwest of the site as described in the USACE (1998) report.

3.6.4.3 Air Transportation – Imnakuk Bluff

The USACE (1998) report indicates that a 4,000 ft runway could be constructed approximately 0.7 miles west of the proposed community and connected to the new village by a gravel road.

The December 1997 letter from ADOT&PF indicates that ADOT&PF feels that the Imnakuk Bluff site, as described in the 1997 Corps Draft Feasibility Study, would be a good site for a new runway. ADOT&PF several available locations, good elevation and foundation condition options, no flood hazard, reduced potential for foundation degradation and upland and alluvial options for foundation material.

Additional information will be gathered during the Stage II study to determine the best location and design considerations for a new airstrip. Refer to Section 2.1 for general recommendations.

3.6.4.4 Roads & Streets within Community – Imnakuk Bluff

The road layout within the community is expected to closely reflect the plan in Appendix G for the Phase I study report. Roads should be designed on a grid system to maximize flow of traffic and access to all portions of the new community.

The soil conditions of the Imnakuk Bluff site require road prism to be a minimum of 9 feet thick.

It is important to note that the bluff poses a hazard. For the safety of the community, a protective fence along the top of the bluff on the south side of the new village is recommended.

3.6.4.5 Roads Outside the Community – Imnakuk Bluff

The location of the Imnakuk Bluff site and the soil conditions of the surrounding terrain make road construction difficult and expensive. It is anticipated that there will be as few roads as possible outside the village to access the new airstrip, the solid waste facility, sewage lagoons and the lagoon boat moorage area. To reduce the amount of road development necessary, two or more of these facilities should be located along the same road.

3.6.5 Native Allotments

There are two Native allotments in the immediate vicinity of the Imnakuk Bluffs site that constrain the layout of a new townsite (see Figure 9). These townsites are located along the eastern half of the proposed townsite. Relocation at this site would likely require resolution of the use of these Native allotments and are a potential constraint to use of this site for relocation. In addition, two additional Native allotments are located to the east of the potential landfill site. These sites can probably be avoided, however if native allotments pose site constraints, the village location could be shifted west to avoid site control issues.

3.6.6 Relocation Costs – Imnakuk Bluff

Design and construction administration are not included in the construction cost estimate below. The cost estimate to build a new village site at Imnakuk Bluffs is **$248.7 million.** Detailed costs are included in Appendix A. A summary is included below:

Site Work and Airport Construction	$165,900,000
Erosion Protection	$231,000
Construction Camp	$606,000
Power and Fuel	$5,292,000
Move Buildings	$1,125,000
New Buildings	$52,690,000

Water/Sewer System and Landfill	$19,844,807
Transportation System	$3,056,000
Total Cost	**$248,700,000**

3.6.7 Recommended Plan for Imnakuk Bluff

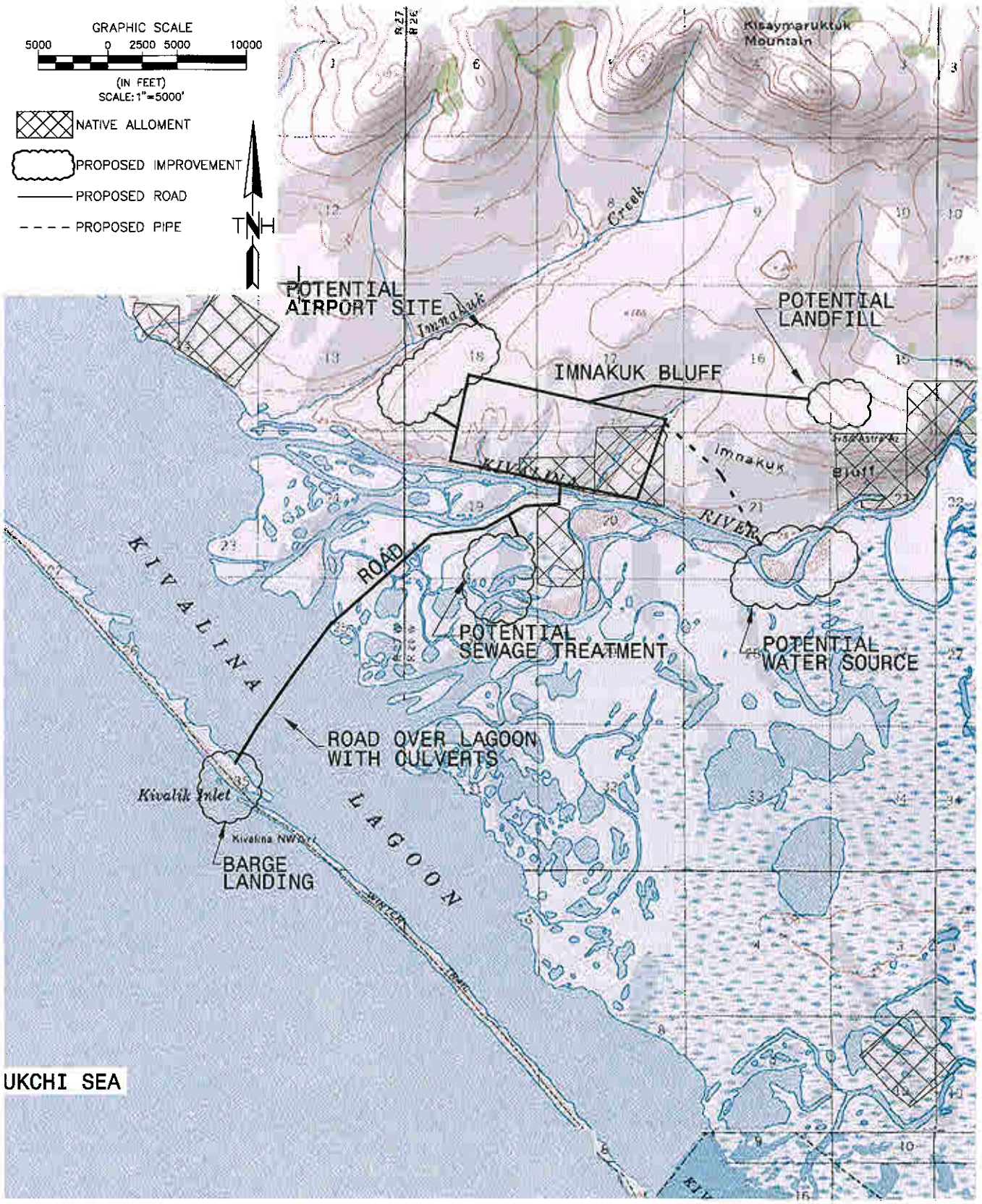
The Imnakuk Bluffs Site is situated approximately 6.3 miles north-northeast of the existing town site on the north side of the Kivalina River.

The area to be investigated for the runway to serve the Imnakuk Bluffs Site is located approximately 2/3 miles northwest of the town site at the lower slopes of the hills north of the site. It is anticipated that this area should provide a better subgrade on which to base the 150 ft X 4,000 ft runway. The landfill should be sited east of the site to maintain the required 10,000 feet from the runway.

The raw water source for the Imnakuk Bluffs Site has not yet been determined. Two possible raw water sources for this village option are the Kivalina River and Imnakuk Creek. Both of these potential sources are being investigated in the current water resource investigation project (2006-2007).

The landfill should be located along the access road from the barge landing to facilitate ease of transporting recyclable materials and the barge landing for shipping.

The sewage lagoon should be located below the town site on the south side, along the road to Kivalina Lagoon.



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TNH
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TRYCK NYMAN HAYES, INC.
911 W. 8TH AVENUE, SUITE 300
ANCHORAGE, AK 99501-3497
TEL: (907)279-0543 • FAX: (907)276-7679

FIGURE 9

IMNAKUK BLUFF CONCEPTUAL LAYOUT

DESIGN BY: MEW	DATE: 6/16/06
DRAWN BY: JT	PROJECT No: 03003.007
SCALE: 1" = 5000'	REV. –
CAD DWG FILE:	
FIELD BOOK: –	SHEET 1 OF 1
GRID: –	

Imnakuk Bluff, Photo 1

View S showing stream channel emptying into River

Imnakuk Bluff, Photo 2

View N showing pond in stream channel

Imnakuk Bluff, Photo 3

View downstream from Imnakuk Bluff at landing site, note shallow water depth

Imnakuk Bluff, Photo 4

Limestone gravel at face at stream channel

Imnakuk Bluff, Photo 5

View N on Imnakuk Bluff

Imnakuk Bluff, Photo 6

Aerial view of Imnakuk Bluff area

KIVALINA VILLAGE
RELOCATION PROJECT

FIGURE 8 IMNAKUK BLUFF

PHOTOS BY TRYCK NYMAN HAYES, INC., AUGUST 25, 2004
KIVALINA, ALASKA

SHEET 1 of 1

FILE NAME KIVALINA_IMNAKUK_BLUFF.DWG

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