2 PLANNING AREA

2.1 PLANNING AREA PHYSICAL SETTING

2.1.1 Planning Area Location

The community of Kivalina is located 80 miles north of the Arctic Circle and 80 miles northwest of Kotzebue at 67° 44′ N latitude, 164° 33′ W longitude. The 700-foot wide, five-mile long barrier island on which the village sits borders the Chukchi Sea on the west and the Kivalina Lagoon on the east, encompassing approximately 1.9 square miles of land. The highest elevation point on the island is ten feet above sea level. The community itself is located at the southeast end of the island at the Singauk Entrance to Kivalina Lagoon, where the Wulik River flows into the Chukchi Sea. Northwest end of the island is bound by the Kivalik Inlet, which has been formed by the flow of the Kivalina River.

2.1.2 Planning Area Climate

Kivalina has long cold winters and relatively cool summers. Temperatures range from 58° F in the summer to -17° F in the winter. The Chukchi Sea is generally ice-free in the summer and open to boat traffic from mid-June to the first of November. Ice starts forming on the open ocean during the fall, and becomes shorefast as the temperature drops. Areas of open water may occur during the winter depending on changes in wind, currents, and temperature.

2.1.2.1 Wind – Planning Area

Prevailing winds at Kivalina are from the northeast, according to preliminary data collected by the Alaska Department of Transportation & Public Facilities (ADOT&PF) and the National Weather Service. However, the highest wind velocities are from the southeast, with the highest recorded wind speed of 54 mph.

Whale bone near Kivalina airport (TNH/URS, 2001)

Strong northerly winds have also been recorded at Kivalina.

2.1.2.2 Storms

Kivalina is subject to storms at any time of year. During summer and fall months, sea storms bring high winds of 40 to 70 knots from the southwest. Winter storms usually bring winds from the northeast. Storm surges, ice override, and coastal flooding can occur in Kivalina due to storms. Drifting snow during winter storms is a common problem in the area as well (see also section 2.1.2.3). Additional information on the implications of storm characteristics on community location is presented in further detail under the sections addressing snowfall and oceanography.

2.1.2.3 Snowfall and Drifting

The mean annual snowfall for the Kivalina area is 50 inches (Environmental Atlas of Alaska). Snow is possible in Kivalina throughout the year, but is most common from October through April. During the winter months, blowing snow from the prevailing northeasterly winds creates large snowdrifts across the community, resulting in transportation and housing access problems. Because the airstrip is perpendicular to the prevailing winds, it is subject to heavy drifting during storms. A snowstorm in April of 2001 resulted in 20-ft snowdrifts throughout the community, trapping some residents in their homes until neighbors were able to rescue them. Drifting also creates hazards to the residents when snow accumulates near windows and doors that can provide emergency egress, and covers fuel tanks and other above ground facilities.

2.1.3 Geology

Kivalina is located in a coastal area of low topographic relief, consisting of gentle sloping, rubble-covered hills, separated by broad expanses of tundra. Test holes indicate that the soils appear to be gravel and sands at the beach, with ice-rich frozen silts farther inland. The areas around Kivalina have an elevation near sea level, while the hills located to the northeast rise to an elevation of a few hundred feet. Bedrock of limestone and dolomite is found in outcrops along river-cut bluffs of the Kivalina River. Marine deposits lie over bedrock near the mouth of the Kivalina River. Pleistocene glaciers originating in the mountains of the western Brooks Range covered the upper reaches of the Wulik and Kivalina Rivers, but did not advance into the lower elevations. Low-lying portions of land surrounding Kivalina are covered with unconsolidated quarternary deposits of unknown thickness, ranging in size from clay to gravel. The floodplains of both rivers are broad and braided. The region has continuous permafrost, which may be found within a few feet below the ground surface. Permafrost may be as thick as 600 feet, with the potential for thaw bulbs in the vicinity of the Wulik and Kivalina Rivers. (U.S. Army Corps of Engineers 1998 Community Improvement Feasibility Study).

Limited soils investigations were conducted as part of this study. The geology of Igrugaivik, Kiniktuuraq, Kuugruaq, Simiq, Imnakuk Bluff, and Tatchim Isua is described in the geotechnical report included in Appendix B.

2.1.4 Oceanography

Ocean waters adjacent to Kivalina are subject to the complex dynamics associated with Bering Strait flows between the Chukchi and Bering Seas. While the net oceanic flow along the Chukchi Sea's southeastern coast is generally northward, it is subject to short-term temporal fluctuations of both oceanographic and atmospheric origin, as well as localized spatial variations due to the presence of headlands, straits, and the influence of major rivers.

Of greater oceanographic relevance to the present Kivalina village site, however, is its exposure to wind-generated waves. Winds from the south to southwest generate waves that expend their full energy directly onto Kivalina's beaches, resulting in accelerated erosion and a redistribution of beach sediments approximately perpendicular to the coastline. While these storm waves can be destructive, the sediments that are moved offshore remain available to re-build the beach under the action of smaller waves that occur under lighter winds from the southwest.

Waves produced by south to southeasterly winds are not as high or long as those from

Kivalina community facing south (TNH/URS, 2001)

the southwest, because of the shorter fetch. However, these waves are more destructive to Kivalina beaches because they may ride atop a storm surge that can raise sea level by several feet along Kivalina's barrier island Also, due to their oblique assault on the shoreline, these waves provide the energy for longshore currents that sweep the sediment away to the north. The effects of this combination of destructive forces is illustrated by the storm of 18-20 October 2004 which flooded the community in several locations, significantly eroded the shoreline, and damaged property at the school site. Forty-knot southeasterly winds (gusting to nearly 60 knots) produced a 4-ft storm surge, as measured at the Red Dog Mine dock a few miles to the southeast of Kivalina (National Ocean Survey 2004).

Although less common than waves from the southerly quadrant, waves from the northwest can potentially be higher, longer, and more destructive than waves from other directions. Patterns of sediment transport near Singauk Entrance provide evidence of the influence of these waves on local beach dynamics. Although sea level would be depressed slightly (i.e. "negative" storm surge) due to northwest winds along the southeast Chukchi Sea coastline, waves generated over the much longer fetch could be much more destructive than those that occur under the more frequent southerly winds.

2.1.5 Floods, Erosion and Seismic Activity

The statistics and analyses employed by Wise et al. (1981) utilized weather data from the previous several decades. Since then, there have been marked changes in weather patterns that appear to have caused such weather events described below to occur even more frequently, (Easterling et al. 1999).

2.1.5.1 Flooding

Flood hazards in Kivalina result almost exclusively from storm surges from south to southeasterly winds. Storm flooding has historically occurred in early fall, before the formation of shorefast or sea ice. Shorefast ice creates a barrier of grounded ice along the shore; waves break against the ice or are reduced in energy, rather than striking directly against the shore where erosion occurs. Local observations indicate that in recent years, shorefast ice has formed later in the year than usual, leaving the village without protection from fall sea storm flooding.

Kivalina beach erosion in 1983 facing south (left) and facing north (right) (Colonell, 1983)

Singauk Entrance (Colonell, 1983)

The extent of sea ice cover reduces the effective fetch by "dampening" the ocean surface and limiting the formation of wind generated waves. According to the storm surge climatology assessment produced by Wise et al. (1981), the 4-ft surge that occurred on 20 October 2004 and caused flooding in Kivalina has a statistical probability of occurrence, also called "recurrence interval," of about one year. That is, a storm surge of this magnitude should be expected to occur annually. However, prior to October 2004, there had been only two recorded storms to date that have overtopped portions of the island since the establishment of the current Kivalina town site in 1905.

It is possible that observed trends related to delays in formation of shorefast ice and sea ice are resulting in fall storms that 1) have more wave energy, and 2) cause damage later in the fall because the period of open water is greater. Recent beach erosion and sediment deposition patterns may also allow storm generated waves and surges to reach the community, resulting in a higher potential for flooding.

2.1.5.2 Erosion

Fall storms and storm surges can result in beach and shoreline erosion. Soils at the existing town site are permanently frozen except in the active layer and at the active beach zones, which allows beach erosion

Erosion near teacher housing (TNH/URS 2003)

where tides and ocean waves can affect unfrozen ground. The erosion stability of the Kivalina spit relies on the integrity of the vegetative mat that keeps surface soil from washing away and insulates the underlying permafrost beneath the active layer. The absence of sea ice during recent fall storms has left the beaches vulnerable to erosion in the form of undercutting of the vegetative mat, which in turn creates a small bluff on the ocean side that exposes the vegetative mat to further undercutting and increasingly severe erosion. This process is further accelerated by destablization of the underlying permafrost due to climate change.

Significant beach erosion resulted from the October 18, 2004 storm, causing a loss of shoreline and damage to some structures along the beach. The teacher housing building had to be relocated due to storm surge erosion that turned the once slow-sloping beach into a drop-off. It is reasonable to deduce that beach erosion events, such as the one in October 2004, are occurring more frequently for reasons similar to those discussed under the flooding section. The marked reduction of beach width adjacent to Kivalina since the early 1980s attests to the greater frequency and severity of these erosion events. Storms in the fall of 2005 also resulted in severe erosion, undercutting a portion of the school and other structures.

2.1.5.3 Seismic

Earthquakes with the magnitude of 6.0 or greater have occurred four times in both the Chukchi Sea and Western Alaska. The largest earthquake on record for this region occurred in 1958, approximately 210 miles southeast of Kivalina near Huslia with the magnitude of 7.3, followed by two 6.0 aftershocks. During this earthquake, extensive failure in unconsolidated surface soils within an elongated northeast zone were observed. The Kaltag Fault System passes south of Huslia, but no significant seismic activity has been associated with this fault.

A magnitude 6.0 earthquake occurred on the Seward Peninsula in 1950; however, there is little information available about this earthquake. In 1928, a M6.9 earthquake and three M6.0 aftershocks occurred in the western Chukchi Sea approximately 155 miles west of Kivalina an earthquake. The Kobuk Fault, east-west trending fault that displaces Quaternary deposits, triggered a series of moderate M4.6 earthquakes approximately 225 miles west of Kotzebue.

A geologic map of the area prepared by the Geological Society of America, (Neotectonic Map of Alaska, Plafker, Gilpin, and Lahr 1993), does not show faults or linements with evidence of Holocene (0 to 11,000 years) or Quaternary (11,000 to 500,000 years) displacement within approximately 140 miles of the Kivalina site.

Earthquake-induced geologic hazards that may affect the site include landslides, fault rupture, settlement, liquefaction, and associated effects (loss of shear strength, bearing capacity failures, loss of lateral support, ground oscillation, lateral spreading, etc.). Liquefaction occurs when

Cold winter storage, Kivalina, Alaska (TNH/URS, 2001)

excess pore pressures develop during untrained cyclic loading of uncohesive soils, causing a reduction in effective stress and strength. The presence of generally continuous permafrost precludes a liquefaction hazard at undeveloped sites, except within the thaw bulbs of rivers and lakes. Ground thawing induced by site development could result in a liquefaction hazard. The sites most prone to liquefaction upon thawing would be those in low-lying areas with a high water table.

Fault rupture on the seafloor can produce tsunamis, a hazard in coastal areas. There were no reported tsunamis associated with the 1928 submarine earthquakes in the Chukchi Sea. The closest recorded submarine earthquake that produced a tsunami occurred in 1991 in the Bearing Sea southwest of St. Matthew Island, (West Coast & Alaska Tsunami Warning databases). This M6.1 earthquake occurred near the edge of the continental shelf.

2.2 LIVING RESOURCES

2.2.1 Subsistence Resources

Subsistence contributes significantly to the culture and economy of Kivalina, and it is an important consideration in planning for the new town site. Subsistence resources harvested by Kivalina residents include fish, sea animals (including bowhead whale, beluga whale, and seal), waterfowl, and caribou. Resource sharing between households is common in Kivalina.

Specific subsistence activities vary with the seasons. In the spring, residents focus on hunting and trapping of species such as bowhead whales, seals, furbearing animals, and waterfowl. Residents fish through holes in the ice until spring breakup. Summer is usually dedicated to marine harvests of char, salmon, and other fish, as well as beluga whales. Summertime is also the season for berry harvests.

Caribou, waterfowl, and other game are harvested during their fall migrations. Residents also hunt other large game, such as bears and moose, during the fall. Winter is devoted to hunting seal along the coast, ice fishing on the Kivalina and Wulik Rivers and the lagoon, and small game hunting.

Data on subsistence harvest of fish and wildlife is available for six specific years (between 1964 and 1992) through the Alaska Department of Fish and Game. After initial declines in total harvest that may be attributable to the decline in use of dog teams, the total subsistence harvest poundage has stayed relatively stable, although the per capita consumption has dropped with the increase community population. Between years, harvest by species shows variation in the percentage of contribution to total harvest. Dolly varden, seal, caribou and have historically been among the top species harvested, although beluga whales have periodically made up a substantial portion of the subsistence harvest. Given this variability in harvest, different potential relocation sites will have advantages and disadvantages over the years. Coastal sites will be more advantageous for marine mammals, river sites (particularly the Wulik River) more advantageous for freshwater fish, and inland sites more advantageous for caribou.

Resource	Harvest Time	Peak Harvest Time	Harvest Area Relative to Portsite	Access Methods	Harvest Methods	Factors Affecting Harvest
Marine Mammals						
Ringed seal	November to early July	February to June	North and south of Portsite on shorefast ice or on drifting floes after breakup.	Access is by snowmachine over the ice during winter or by boat after breakup	Seals are shot with a rifle on the ice or in the water. If they are shot in the water, they retrieved with seal hooks and pulled into a boat or on the ice. They are butchered on the ice or back in the village.	Ice conditions (thickness, roughness), show depth, presence and size of leads and cracks, wind direction and speed, and abundance of animals.
Bearded seal	November to August	June	Same as above	Same as above	Same as above	Same as above
Beluga whale (spring)	Late April to June	Late May and early June	In leads up to 10 miles offshore, north and south of Portsite.	Same as above	Belugas are shot with rifles and recovered with seal hooks. They are pulled onto the ice or towed back the village and butchered.	Presence of and size of leads, wind direction and speed, abundance of animals.

Beluga Whale (summer)	June to August	July	In nearshore water north and south of Portsite.	Summer belugas are hunted from boats among drifting floes or in open water	Summer belugas are shot with rifles and recovered with seal hooks. Belugas are towed to the village or to shore and butchered.	Floating ice, wind, Portsite activity (possibly), abundance of animals.
Bowhead Whale	Late April to June	May	In leads up to 10 miles offshore north and south of Portsite.	Snowmachines are used to tow boats on sleds across the ice to open leads where bowheads migrate.	Bowheads are sot with harpoon bombs and speared with harpoons. They are pulled onto the ice with block and tackle, and butchered.	Presence of and size of leads, wind direction and speed, distance of migration route from shore.
Polar bear	December to May	March to May	On shorefast and pack ice north and south of Portsite	Snowmachines are used to follow tracks to the bear. Native hunters often shoot polar bears incidentally while hunting seals, walrus or whales.	Polar bears are shot with rifles and skinned on the ice or back in the village.	Ice conditions (thickness, roughness), snow depth, availability and size of leads and cracks, wind direction and speed, abundance of animals.
Walrus	June and July	June and July	Along the edge of pack ice up to 30 or more miles offshore.	Boats are used to hunt walrus hauled out along the edge of retreating pack ice.	Walrus are shot with rifles from boats. Because they are hunted far from the village, they are butchered on the ice where they are shot.	Distance offshore, wind, currents, weather, visibility (fog), and economics.
Birds						
Ducks	May to October	May to June	In and around lagoons along the beach, and around inland ponds.	Snowmachines, ATV'S, or boats are used to access the hunting area.	Ducks are shot with rifles and shotguns and brought back to the village or hunting camp.	Wind, visibility
Brant/geese	May to October	May and June	Same as above	Same as above	Same as above	Same as above
Ptarmigan	February to November	March and October	On the tundra north, south, and east of Portsite.	Snowmachines, ATV's, or boats are used to access the hunting area.	Same as above	Tundra conditions, weather, abundance of animals.
Fish						
Char	Year round	June, August, September	In Kivalina Lagoon, and the Kivalina, Noatak, Wulik, and other rivers of the region.	Snowmachines are used during winter and boats are sued during summer.	Char are caught in gill nets, in seines, and by hook and line. They are cached on site or brought back to the village.	Ice and water conditions, size of run, good fish-preserving weather, freeze-up timing,

						presence of grizzly bears and wolverines.
Grayling	Year round	June, August, September	Same as above, in lagoons, rivers of the region.	Same as above	Same as above	Ice and water conditions, size of run, good fish-preserving weather, freeze-up timing.
Salmon	June to August	July and August	Same as above	Same as above	Same as above	Water conditions, run size, preference for char.
Whitefish	June to September	August, September	Same as above	Same as above	Same as above	Ice and water conditions, size of run, good fish-preserving weather, freeze-up timing.
Cod	October to December, and July (rarely)	November, December	Kivalina Lagoon	Snowmachines during winter and boats during July.	Cod are mostly caught with hook and line through holes chopped in the ice.	Same as above

Given the emphasis on marine and river subsistence activities and fish, the community location and layout needs to consider areas for boat haulout and storage, drying racks for subsistence harvests and other resource processing needs, subsistence related activities (such as whaling festivals) and access to traditional subsistence areas.

The cost of access is also an important consideration in the location of a new community town site. Kivalina residents typically access hunting and fishing areas and traditional camps by boat during the open water season, and by snowmobile after snow and ice formation allow it. The current town site is strategically located to allow easy boat access to the Chukchi Sea and to the Kivalina and Wulik rivers. Some potential town sites on the northern end of the study area are either located adjacent to shallow areas of the lagoons or rivers, requiring an access road to deeper water, boats with shallower drafts, or a combination of the two. Such sites may result in more fuel usage or gear changes, resulting in higher costs associated with subsistence.

2.2.2 Wetlands and Other Waters of the United States

Kivalina's barrier island is narrow strip of upland and tidally influenced estuarine unconsolidated shore (USFWS, 1978). According to the U.S. Fish and Wildlife Service (USFWS) National Wetlands Inventory (NWI) maps, extensive salt marsh habitat is found along this narrow strip of land (USFWS, 1978). Salt marsh wetlands (estuarine emergent wetlands) are vegetated with grasses, sedges, and broad-leaved, salt-tolerant emergents, which are present for most of the growing season. Vegetation along the coastal lagoons tends to be abundant because of the high accumulation of nutrients in shallow waters (NPS, 1986). Estuarine emergent wetlands are valued for their excellent wildlife habitat functions and high ecological diversity (Adamus 1987).

Diverse wetland habitats surround the Kivalina Lagoon, including large salt marshes, palustrine scrub-shrub and emergent wetlands, and open water ponds. The southern wetlands adjacent to the lagoon are salt-water influenced with freshwater intrusions derived from the Kivalina and Wulik rivers flowing into the lagoon. This mixture of salt and freshwater influences provides for rich ecological diversity. Even upland areas may include areas that are classified as wetlands, requiring placement of fill and associated permits in order to develop a new town site.

The marine intertidal waters of the Chukchi Sea adjacent to Kivalina include unconsolidated shores composed of unknown substrates (USFWS 1978). Marine habitats are exposed to water and currents of the ocean where salinities exceed 30 percent, and support marine biota (Cowardin et al. 1979).

2.2.3 Wildlife and Wildlife Habitats

Kivalina's barrier island provides unique habitat for migratory birds, including white-fronted geese, cackling and lesser Canada geese, black Brant, mallards, and common and king eiders. The lagoon also provides important nesting, breeding and feeding habitat for large numbers of migratory birds (NPS, 2004). Approximately 21 species of terrestrial mammals, and 21 species of marine mammals are also found in this area (NPS, 1986). Terrestrial mammals in the region include: caribou, grizzly bear, musk ox, wolf, arctic fox, weasel, and wolverine. Marine mammals include spotted, ribbon, ringed, and bearded seals; Pacific walrus; and bowhead, gray, and beluga (belukha) whales. The Kivalina area is important caribou winter habitat and summer musk ox habitat, as well as arctic fox range (NPS, 1986).

2.2.4 Threatened and Endangered Species and Species of Concern

2.2.4.1 Humpback Whale (*Megaptera novaeangliae*)

The humpback whale, a federally listed endangered species under the Endangered Species Act (ESA) of 1973, migrates to the southern Chukchi Sea during the summer months. Their population decline is largely attributed to historic commercial whaling, which has since been banned. Scientists estimate the current population to be between 1,000 and 2,000 animals (Faris, 2003).

2.2.4.2 Bowhead Whale (*Balaena mysticuetus*)

The bowhead whale is currently listed as "endangered" under the ESA and as "depleted" under the Marine Mammal Protection Act of 1972. The bowhead whale population was seriously depleted following heavy exploitation by the commercial whaling industry. The Bering Sea stock of bowhead whale migrate north and east following the leads in the sea ice in the eastern Chukchi Sea (Shelden and Rugh 1995). Kivalina subsistence hunters are given a strike quota of one bowhead whale per year by the International Whaling Commission and the Alaska Eskimo Whaling Commission (Burch 1985).

2.2.4.3 Arctic Peregrine Falcon (*Falco peregrinus tundrius*)

In 1982, the Arctic peregrine falcon was on the threatened and endangered species list. At that time, three peregrine falcon nests were located in the Wulik and Kivalina drainages; however, these falcon nests were not found during a 1983 study. The Arctic peregrine falcon has since been delisted from the threatened and endangered species list (50 FR 17, 1999) (NPS, 1986), but the Arctic peregrine falcon is still considered an

Alaska species of special concern (Swem, 2003).

2.2.5 Fish and Essential Fish Habitat

Both the Kivalina and Wulik rivers are listed as anadromous streams in the Alaska Department of Fish and Game (ADF&G) Fish Distribution Database. The Kivalina River supports pink (*Oncorhynchus gorbuscha*), chum (*O. keta*), king (*O. tshawytscha*) and coho salmon (*O. kisutch*); and arctic char (Dolly Varden). The Wulik River and its tributaries support all five species of salmon; pink, chum, King, coho, and sockeye (*O. nerka)*; arctic char; and whitefish species (ADF&G 1998). Arctic char, or Kivalina char as it is called locally, is a mainstay of the Kivalina subsistence lifestyle (Burch, 1985).

Coastal and inland waters support four species of whitefish important to subsistence, including the humpback whitefish (*Coreganus pidschian*), least cisco (*C. sardinella*), Bering cisco (*C. laurettae*) and round whitefish (*C. cylindraceum*). Only the Bering and humpback whitefish are regularly harvested by Kivalina subsistence fishermen. Arctic cod (*Boreogadus saida*) and saffron cod (*Eleginus gracilis*) appear in the Kivalina Lagoon twice a year after freeze-up and in early July. They are harvested mainly in the fall. Other fish found in coastal waters that are occasionally harvested by Kivalina fishermen include grayling, sculpin, burbot, and smelt (Burch 1985).

2.3 COMMUNITY PROFILE

2.3.1 Culture and History

Kivalina is a traditional Inupiat Eskimo village located in the Northwest Arctic Borough of Alaska. Because residents depend on fish and wildlife for survival, their long-lived traditions are attributable to cultural connections with the ocean, rivers, and the land.

This coastal area of Alaska has been inhabited for thousands of years. It has long been a stopping-off place for seasonal travelers between Arctic coastal areas and Kotzebue Sound communities. In 1847 the village of Kivalina was reported as "Kivualinagmut" by Lt. Zagoskin of the Imperial Russian Navy. At that time, Kivalina was located at the north end of the Kivalina Lagoon. The community was founded at its present location when the Federal Government constructed a school on the island in 1905. A post office was set up in 1940 and an airstrip built in 1960. Kivalina was incorporated as a 2nd Class City of the Northwest Arctic Borough in 1969. New houses, a new school and electricity followed.

2.3.2 Demography

Demography addresses the existing and projected population characteristics of the community. The population projection forecast is an educated guess of future events that may have an affect on the community of Kivalina. Because conditions can change dramatically over a short period of time, the forecast should be reviewed and updated periodically.

2.3.2.1 Population Data

The population of Kivalina was first recorded in the 1920 census at 87 residents. Kivalina had a population of 377 in the year 2000, and the State of Alaska estimate for 2004 is 388. The population of Kivalina is predominantly Alaskan Native (96 percent), and relatively young with a median age of 20.8. The male and female composition is approximately 51 and 49 percent, respectively. Representatives of the City and IRA have indicated that families leave Kivalina due to a lack of housing, infrastructure, and potential for expansion.

It should be noted that the actual growth rate since the 2000 population census has been closer to 1 percent. A 3.5 percent growth rate would require a selection of a relocation site with room for community expansion.

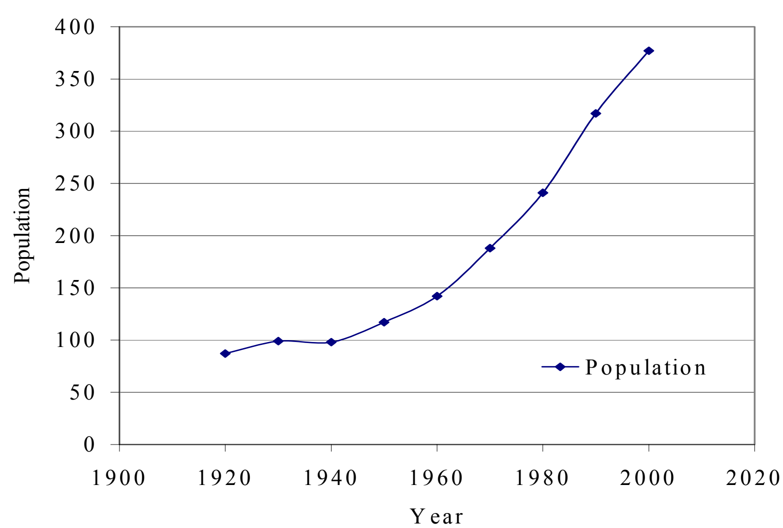
The table below shows the historic population for Kivalina. This report projects over a 30-year period through 2030. The best estimate projection was derived by projecting the data into the future at a growth rate of 3.5 percent. The forecast is based on the Northwest Arctic School District's recent projected expected growth for the area.

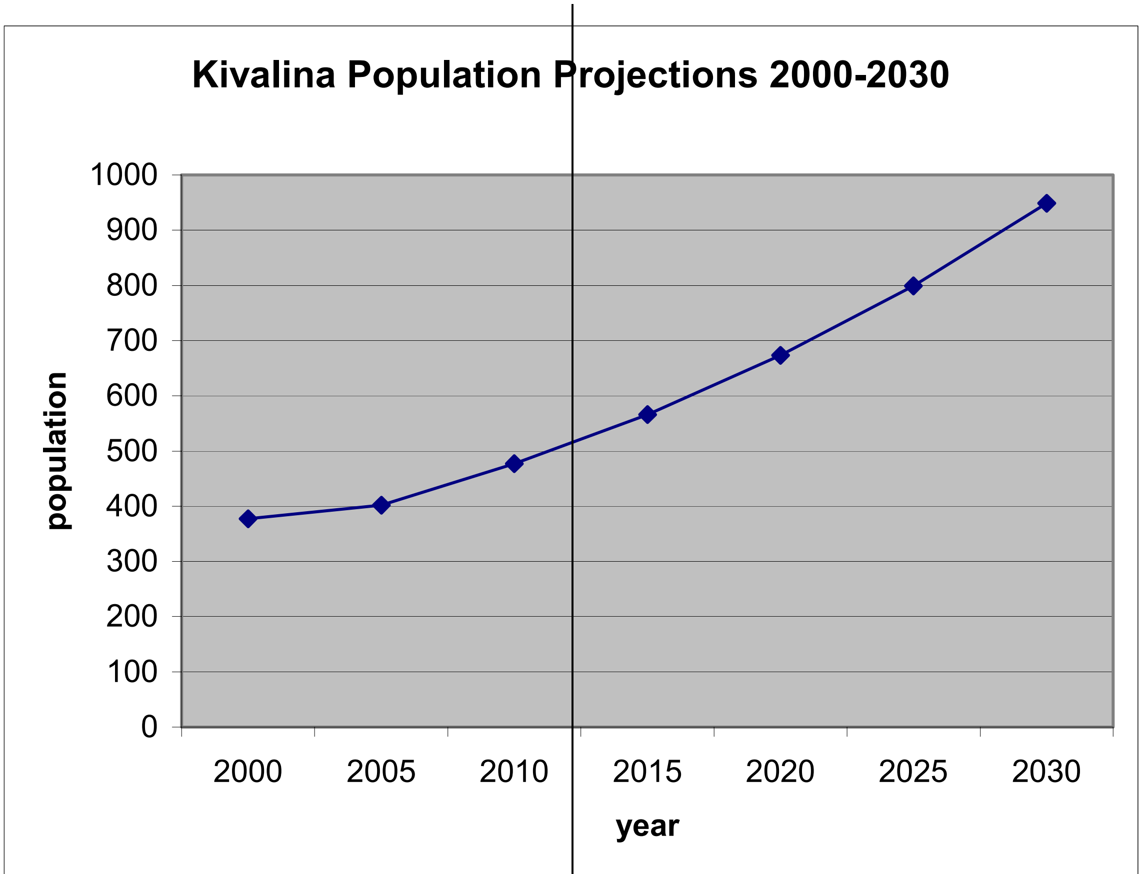
Year	Pop. With 3.5% Growth Rate
2000	377
2005	402
2010	477
2020	673
2030	949

When dealing with small population numbers, the addition or subtraction of a small number of people (for example one family) can radically affect the estimated growth rate. This is particularly true if the growth rate is already small. Consequently, significant changes to the growth rate can occur from year to year. After a new town site is constructed, families who have moved away from Kivalina may choose to return, which may dramatically increase the population growth rate.

The best estimate projection would require revenue and employment to continue to expand, but would not require major resource development. Under this scenario, the population of Kivalina would double in about twenty years. The population growth between 2020 and 2030 is more uncertain because of the changes that would have to occur in order to support that number of people. Factors ranging from infrastructure, housing, and local economic growth, to federal, state, and local revenue levels may most likely influence Kivalina's actual population growth.

Historic Population Data for Kivalina





2.3.3 Local Government

Kivalina is a 2nd class city organized under Alaska Statute 29, and maintains a 2% sales tax. A 2nd class city is incorporated under the rules and laws of Alaska and defined as having 400 or less permanent residents. Kivalina has two separate local governments: the Native Village of Kivalina (NVA), a federally recognized tribe; and the city of Kivalina, established under the state of Alaska. There is a seven-member city council, out of which a mayor and a city administrator are elected.

2.3.4 Regional Government

Kivalina is within the Northwest Arctic Borough, a home rule borough, formed in 1986. The Northwest Arctic Borough is 83% Alaska Native. The Borough provides programs and services to encourage development, coordination within and outside the region, and to improve employment and education. Kotzebue is the seat of the Borough government (NWAB, 2001). The Borough is also responsible for the Northwest Arctic School district, which provide education in Kivalina and other communities within the Borough.

2.3.5 Native Organizations

There are three Alaska Native organizations in Kivalina; the Native Village of Kivalina (NVA), the NANA Corporation, Inc.(NANA), and the Maniilaq Association. The Native Village of Kivalina is a federally recognized tribe, which has several active, federally funded programs.

Kivalina is located within the NANA Corporation Region. ThNANA Corporation, Inc. is a for-profit corporation established by the 1971 Alaska Native Claims Settlement Act (ANSCA) (ADCCED, 2004). NANA is a regional corporation acting on social and cultural needs of the Inupiat people of Northwest, Alaska (NANA, 2004). NANA businesses include management services, oil industry support, mining support and hospitality. There are approximately 10,000 shareholders and 3,085,532 acres of ANCSA land conveyed. Total revenues in 2000 were $176.2 million (DCED, 2004). NANA Corporation also merged with all of the ANCSA village corporations in the NANA region except Kotzebue. Therefore, NANA owns surface and subsurface lands in the Kivalina area, and is responsible for conveying ANCSA 14(c)3 lands to the city of Kivalina. NANA will be a major stakeholder in the potential sites for community relocation.

The third native organization, the Maniilaq Association, is a non-profit regional corporation representing twelve federally recognized tribes located in Northwest Alaska. The Maniilaq Association is a social, tribal and health service provider, servicing about 6,500 people and employing a 500 person workforce, and is the region's largest employer (Maniilaq, 2003). Maniilaq manages a hospital in Kotzebue as well as health clinics in all the villages.

2.3.6 Public Facilities

Figure 3 shows the key map of buildings in Kivalina. Structures in Kivalina fall under the following categories:

- Facilities, including the school, churches, store, community center, clinic, landfill, city office, airport, IRA office, barge landing, post office, fire hall, jail, National Guard Armory, and heavy equipment building;
- Utilities, including fuel tanks, washeteria, power plant, water tanks, septic fields, water treatment facilities, and telephone building, and
- Residential and General structures, including residential housing, teacher housing, drying racks, boat storage, cold storage, and other storage.

The school, school storage, store, and store storage area are on the south side of the island. The Army National Guard, clinic, city offices, two churches, community center, post office, jail and the fire hall are centrally located. Residential structures are generally scattered throughout the community. The airport and airstrip are on the north end of the island

The McQueen School is operated by the Northwest Arctic School District. Built in 1970, it has 117 students and, due to its age and condition, would be considered a candidate for replacement.

The community presently has a National Guard facility. The National Guard is a popular organization in many communities in rural Alaska. The residents would like to keep the presence of the Guard, and would like a facility at the new site.

The existing clinic is too small to adequately serve the community of Kivalina (Appendix A). It consists of a reception area, two examining rooms, a room that serves as an office, communications, and storage room, and a boiler room. The current design and layout of the clinic creates impediments for working physicians.

The city building houses the City Administration, the IRA Administration, and space for meetings.

The Kivalina public utilities and infrastructure, located towards the center portion of the island, consist of a water system and treatment plant, power generation, and bulk fuel utilities.

Currently, the community receives barged fuel oil deliveries once per year, usually in the fall. Delivery quantities are between

50,000-60,000 gallons. Fuel oil is stored in vertical cylindrical steel storage tanks of approximately 6,000 gallons each.

The power plant is operated by AVEC. It has four diesel fuel fired generators.

2.3.6.1 Water Supply

Kivalina's primary water source is a point approximately two miles upriver from the mouth of the Wulik River. The river is frozen for about 7 months. Freeze up generally occurs in October with break up coming in late May/June. Although the Wulik River is ice free in May/June, water is normally not pumped until July due to the high silt content of the river water after break up. Water is also pumped in October, prior to the freeze up of the Wulik River.

When the tide is low, 14,000 feet of 4-inch diameter fire hose is temporarily installed between the river and the raw water storage tank (RWST). A 15-20 horsepower (Hp) engine driven, palette mounted pump is transported to the collection point upriver by boat. The pump is capable of delivering approximately 85 gallons per minute (gpm) to the 692,000 gallon RWST, and runs 24 hours a day until the tank is filled, over approximately five to six days (TNH/URS, 2003).

Kivalina water storage tank (TNH/URS, 2003)

Treatment involves purifying the raw water through a small water treatment plant (WTP) located in the water treatment building attached to the north end of the washeteria. The WTP equipment is capable of treating 80 gpm. Treated water is pumped from the plant into a 500,000-gallon Treated Water Storage Tank (TWST). Treatment of the raw water involves the use of a 54" pressure sand filter and a *Giardia* barrier microfilter. When the 500,000-gallon storage tank is filled with treated water, the RWST is refilled and the pumping and transmission equipment is disassembled and stored.

Kivalina has no community piped water distribution system. The only buildings with piped water are the washeteria, school, and clinic. The public school complex is fully plumbed and has its own distribution system that serves the school building, shop, and teacher housing. A 1,965-gallon storage tank is used to buffer the school system from operational failure in the WTP. The storage tank, equipped with a level sensor, is filled automatically from the TWST as needed. The school system has a single canister filter, changed once a month, for additional treatment. Two 350-gallon pressure tanks maintain pressure for the cold water system and two 100-gallon pressure tanks operate the hot water system.

Sanitary facilities for the clinic are simple. The clinic contains two sinks, but no flush toilets. All wastewater effluent from the clinic to its lift station is graywater. Human waste is collected in honey buckets, as is typical in the village.

Residents obtain treated water from the watering point at the washeteria. They collect water in containers, such as 30-gallon garbage cans, and self-haul to their homes. Water is pumped into personal containers at a rate of $0.50 for 30 gallons through a paybox located on the east side of the washeteria. The individual collecting the water must keep a flow switch depressed until the 30 gallons has been pumped. Water is transported to homes by the individual using a small trailer towed by an all-terrain vehicle (ATV) or snow-machine. Information from the State of Alaska Department of Community and Economic Development (DCED) indicates only about one-third of residents have water tanks in their homes to provide running water for the kitchen. Many of the newest U.S. Department of Housing and Urban Development (HUD) homes have 30-gallon storage tanks and are fully plumbed, ready for connection to a piped water service. The storage tank is filled manually and feeds the plumbing by gravity.

Attempts to install a piped water distribution system are evident in Kivalina. An arctic pipe water system was installed in the village around 1978. Looped arctic pipes, remnants of this old distribution system, are still attached to some houses. This system was intended to be used as a summer distribution system for residences and not as a year-round piped system.

2.3.6.2 Waste Disposal

2.3.6.2.1 Wastewater

The only facilities served by on-site wastewater disposal systems are the school

Kivalina washeteria watering point (TNH/URS, 2003)

buildings and washeteria/clinic. Residents dispose of non-septic wastewater and graywater by dumping it on the ground outside their houses. Kivalina residents currently rely on self-haul honey buckets for septic waste collection and a honey bucket bunker for disposal of most human waste. Honey buckets are 5-gallon buckets lined with plastic garbage bags. The bags are tied off and removed when full, and hauled to the honey bucket bunker. The honey bucket bunker is north of the airstrip, approximately a mile and a half from the community of Kivalina. The bunker is a 60'x 60'x 8' galvanized H-pile and corrugated sheet steel containment basin with a capacity of approximately 215,000 gallons.

Kivalina honey bucket containment bunker at landfill (TNH/URS, 2003)

A potentially unsanitary condition arises in the village when the filled plastic garbage bags are not taken the full distance from the village to the landfill bunker. Bags deposited at the hatch of the already full wood bunkers in the village and along the way to the landfill bunker are potential sites of pathogen transfer to the community.

The washeteria and clinic each have a lift station that receives effluent by gravity, which pumps into a shared 4,000-gallon septic tank that has a pumped force main discharge going into a drainfield located on the western beach. The washeteria/clinic drainfield measured about 93 feet by 18 feet before it was destroyed by erosion during the October 2004 storm. The drainfield was not rebuilt after the storm because of feasibility issues. Due to the permanent loss of the drainfield, the washeteria is presently used as a graywater only facility, with no use of the toilets.

The McQueen School wastewater treatment system was installed in 1992. It consists of a gravity fed sump and duplex pump lift station, aeration tank, settling tank, chlorine contact tank, and a slow sand filter. Wastewater travels through an aeration chamber, clarifying tank, sand filters, and a chlorine contact chamber. A mound drainfield at the school is inoperable. Treated wastewater is discharged through an insulated 2” piped outfall onto the beach of the Chukchi Sea. The school wastewater treatment plant is, however, currently hydraulically and organically overloaded and does not meet discharge requirements.

A new septic tank for the school and a new wastewater treatment plant to serve the washeteria, clinic, and school is designed and funded by Village Safe Water (VSW) for construction; however construction has been delayed by VSW because the village does not meet certain grant conditions regarding essential capacity indicators under the Rural Utility Business Advisor (RUBA) program. Once the city meets the grant conditions, construction of the new wastewater treatment plant will be re-scheduled. The wastewater treatment plant project also includes separate funding designated for purchase and installation of equipment for a small scale community ATV honeybucket haul system at the existing town site.

The new wastewater treatment plant will use septic tanks for primary treatment, re-circulating aerobic fixed-film bioreactors for secondary treatment, ozone for final disinfection, and will discharge at the beach surface.

2.3.6.2.2 Solid Waste

Based on site photographs, Kivalina residents disposed of solid waste randomly at an old dump located in a two-acre area on the proposed Kiniktuuraq relocation site prior to 1996. Site photographs show minimal solid waste accumulation. The dumpsite appears to be abandoned, but was not covered due to lack of cover soil.

Built in 1996, the existing Kivalina landfill is located on a 3.4-acre parcel, 1.1 miles north of the village in Section 26, T.28 N., R.27W. This unpermitted Class III municipal solid waste landfill is a few hundred yards adjacent to the north end of the runway, and is bounded by water with the Chukchi Sea to the west and the lagoon to the east. The landfill was designed with a 20-year design life for a population of 373 people. Landfill capacity was calculated with assumptions that solid waste would be generated at a rate of 154 pounds per day, and that the waste would be compacted to a landfill density of 18-pounds/cubic foot. The landfill was to be operated as a trench and cover type facility according to a 1995 City of Kivalina Solid Waste Management Plan. Solid waste was to be processed by open burning, compaction by a bulldozer, and covered with soil.

Individual members of households haul waste to the landfill in small trailers (ANTHC March 2003). Residents deposit solid waste randomly on the ground surface, mainly toward the east side. Solid waste is uncontained and not segregated. The City of Kivalina maintained the landfill in the beginning of its operation. Cover soil was used until the initial stockpile was depleted. Unorganized burning around the landfill was noted during a July 2003 site visit (TNH/URS, 2003). Site containment berms and a fence were not noted at the landfill. Landfill and solid waste maintenance does not appear to occur. No cover soil was observed.

The size of the landfill was estimated to be

View of Kivalina solid waste facility and access trail (TNH/URS, 2003)

500 by 200 yards during a July 2003 site visit. The values are approximate because the waste was spread over a wide area and uncompacted. The depth of the debris was estimated to range from six inches to four feet. These dimensions average to approximately 75,000 cubic yards for uncompacted/unburned waste (TNH/URS, 2003).

Because total community refuse volume information is not available, Cold Regions Utilities Monograph (CRUM), 1996, was used to obtain the existing volume estimate using residential volume and population. For the average Kivalina residential refuse volume in cubic yards, a value of 0.018 cubic yards per day was used, which CRUM proposes for residential or municipal waste in northern communities. The existing uncompacted solid waste generated per year in Kivalina is therefore estimated at 2,786 cubic yards for a population of 383 people.

Kivalina is presently working on a grant to obtain a burn box (ANTHC 2004).

2.3.6.3 Fuel

Bulk fuel storage (BFS) tanks in Kivalina are owned and managed by McQueen School, the Kivalina Native Store, Alaska Village Electric Cooperative, Inc. (AVEC), the National Guard, and the Alaska Department of Transportation and Public Facilities (DOT&PF). The tanks consist of above ground steel tanks in a variety of sizes.

Kivalina washeteria/clinic drainfield before the October 2004 storm (TNH/URS, 2003)

BFS facilities are typically located near the owner's point of use. The school and Native Store tank farms are located at the south end of the spit, the AVEC tank is on the west side of the spit, and the additional tanks are distributed throughout the village. See Table A for tank volumes.

Kivalina currently has fuel delivered by Crowley Marine Services once a year. The existing storage volume is adequate to serve the unplumbed community of 383 people.

The Washeteria has two Burnham fuel oil fired boilers; each rated at a gross output of 404 thousand BTU's per hour with fuel consumption listed at 3.5 gallons per hour (gph). McQueen School uses approximately 33,000 gallons per year (gpy) and has a 1,467 gallon day tank (refilled twice weekly) to supply the school's boilers. The Native Store sells fuel oil for home heating; gasoline for ATV's, boats, and snowmobiles; and propane for home cooking needs.

2.3.6.4 Electricity

AVEC supplies all electric power to the village of Kivalina with diesel driven generators. The number and configuration of on-line generators at any given time is affected largely by season, time of day, storms, and Washeteria usage. Generally, winter electric generation requirements are higher than summer because school is in session. Conservative estimates indicate annual fuel usage of approximately 85,000 gallons.

Additional emergency electric generation for the Washeteria can be supplied by a local backup generator.

2.3.6.5 Housing

Housing in Kivalina is crowded and inadequate. According to the 1990 U.S. Census, Kivalina had 71 single-family residences. There is no multi-family housing in Kivalina. The residences have one to three bedrooms and house as many as five to 15 occupants. The 1990 average number of people per household in Kivalina is 4.70, which is nearly 50 percent higher than the United States average and about 40 percent higher than the state average. A state survey summarized several characteristics of homes in the Northwest Arctic Borough. The houses are among the smallest of all regions in the state, averaging just 731 square feet.

Housing conditions vary from older dwellings to new housing, with the newer homes being built by the Northwest Inupiat Housing Authority. The lack of utilities supplying water and sewer, the lack of flooding and erosion control, and the lack of available real estate for expansion have hindered development of new housing.

2.3.6.6 Public School

Kivalina houses the McQueen School, of the Northwest Arctic School District (NWABSD), which is operated by the Borough. As stated on the NWABSD web site, the NWABSD prides itself on "providing a well-rounded quality education that includes a working knowledge of traditional Inupiaq life skills including language, cultural customs and culturally practical skills."

The school has nine classrooms, a wood shop, darkroom, gymnasium, library, and modern computer and video equipment.

There are approximately 117 students attending grades K through 12 with approximately 9 certified staff. The school, as in most rural Alaska Native communities, acts as a focal point of activity for the community. It draws not only the students that attend the school, but hosts after-hours events associated with holidays and festivals as well. The school acts as the Chukchi Campus of the University of Alaska Fairbanks, and also provides recreational opportunities to the community, such as basketball and other sports.

2.3.6.7 Transportation

Transportation within Kivalina is primarily by foot, small boat, all terrain vehicle, and snow machine. There are no roads into or out of Kivalina. The major means of transportation into and out of the community are the state owned 3,000 ft by 60 ft gravel airstrip, and the Crowley Marine Services barge. Crowley makes two annual trips to Kivalina, usually taking place in July or August. Barges set sail to Kivalina from Kotzebue, and Crowley attempts to run the trips back-to-back to take advantage of good weather. The actual trip dates are weather dependent, due to wind, swells, and general weather conditions (ADCCED, 2004).

2.3.6.8 Economy and Employment

Kivalina has a mixed wage-subsistence economy. Wage income for the Kivalina residents is limited and includes year round and part-time employment through the McQueen School, City of Kivalina, Maniilaq Association, the Kivalina IRA Council, Alaska Village Electric Cooperative (AVEC), airlines, and local stores. The development of the Red Dog Mine, which is located 18 miles South of Kivalina at the headwaters of the Wulik River, has had a substantial economic impact on the NANA region through creation of employment and revenues to the NANA Corporation and Northwest Arctic Borough. Some Kivalina residents are employed at the mine.

There are several talented artists in Kivalina that produce traditional and contemporary carvings and jewelry from ivory, baleen, bone, and animal skins and furs. The native craft industry has recently expanded and the community is strongly committed to keeping arts and crafts as an important part of its culture and traditional heritage.

2.3.6.9 Land Ownership

A combination of several entities – the Northwest Inupiat Housing Authority, NANA Corporation, State of Alaska, and individuals in the form of native allotments – own the land in the vicinity of Kivalina. The State of Alaska owns a portion of land at the site of the airstrip that extends from the edge of the community. Because of its dedication to transportation needs, it is unavailable for community expansion. The NANA Corporation owns surface and subsurface land on the potential town sites. In addition, the state owns the land under the Kivalina lagoon, which is a potential source of gravel for the new town site pad. The City of Kivalina is entitled to select up to 1,280 acres of land for municipal purposes under Section 14 c (3) of ANCSA, although they have yet to make a selection. There are a number of Native allotments in the project area, including several in the vicinity of alternative relocation sites (Figure 2). The Bureau of Indian Affairs acts as trustee for Native Allotments and their approval is needed prior to lease or sale of allotments.