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STATE OF ALASKA
VILLAGE SAFE WATER

TUNTUTULIAK, ALASKA COMMUNITY WATER AND SEWER FEASIBILITY STUDY FINAL REPORT

DECEMBER 1993

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INTRODUCTION

In February of 1993, the village of Tuntutuliak, through the Tuntutuliak Community Services Association (TCSA) was offered a combination grant of State and Federal EPA funds to improve sanitation facilities in the village. The first step in this process is the feasibility study of options related to wastewater disposal, water supply and solid waste disposal. Eagle River Engineering Services (ERES) was selected as the engineering consultant to perform this study, and after a period of collecting background data, an initial site visit and public meeting were held in March 1993. A follow-up public meeting was held June 15, 1993 to discuss and narrow the choice of options. During both visits house to house community surveys were conducted to determine resident's input and expectations. A working relationship was established with the Traditional Council and Mr. Robert Enoch of TCSA. Options were identified and explored. The following basic information was determined:

- The existing honey bucket self haul system is not a desirable system for most residents. The bunkers in most cases are full and overflowing. The community would like a higher level of service.
- The capability of the individuals in the community to pay for O&M costs averages $27 for water service and $30 for sewer service on a monthly basis.
- The existing dumpsite is entirely inadequate and must be relocated and improved.
- A full piped system is the most desired option, but most residents do not want high maintenance costs.
- There is a wide range of economic capabilities when it comes to sanitation services. Some residents will pay large amounts, others do not want service or can only pay dependent on a variable job status.
- A new boardwalk system is needed and is a desired side benefit of any type of system improvement. It is preferred that BIA ISTEA funds be spent on boardwalk improvements so that VSW funds can be fully utilized for sanitation improvements.

SUMMARY

Due to site conditions in Tuntutuliak, all options studied have considerable O&M costs. It is recommended that a phased implementation of sanitation facilities be initiated according to need and economic capability. After discussing all the options, the following course of action is recommended.

- Participation of other funding sources should be aggressively pursued to provide boardwalk and waste heat funding to allow expanded sanitation facilities.
- Washeteria improvements should be implemented immediately to improve the water quality and increase its acceptance by residents.
- The summer water distribution system should be implemented to increase use of treated well water.
- If it is found to be acceptable, the new lagoon site should be activated along with an adjacent, fenced, solid waste site.
- A phased plan should be developed to implement a flush tank and haul system to be eventually converted into a pressurized or vacuum sewer system.
- The LKSD should be required to participate in the water and sewer service. The school can provide an equitable portion of maintenance and construction costs for a pump station force main to the lagoon site. This would eliminate the location of the now existing, poorly operated sewage lagoon in the center of the village.
- It is recommended that the existing honey bucket bunkers be abandoned and possibly new bunkers constructed as a short term overall service improvement with limited capital and O&M costs.

As O&M costs are a large consideration of any plan, it is recommended that the flush tank and haul system, for both water and sewage, be initiated as a phased demonstration project in sections of the village. This would provide an immediate improvement in service, and allow the level of service to be adjusted to the ability of the homeowner to pay for service. A section of the village should be outfitted with the Flush Tank Haul system as a demonstration project.

I. DESCRIPTION OF PLANNING AREA

A. Location

Tuntutuliak is located 440 miles west of Anchorage and 40 miles southwest of Bethel in southwest Alaska, Latitude 60°20'N, Longitude 162°40'W. The community is situated adjacent to the Kinak River approximately three miles from its confluence with the Kuskokwim River and about 40 miles from the Bering Sea coast. The village lies in the Bethel Census District, and is in the area of the Association of Village Council Presidents.

B. Climate

Daily maximum average temperatures range from 59° to 62° Fahrenheit in the summer, and from 11° to 19° Fahrenheit in the winter. Daily minimums range from -2 to +2 degrees Fahrenheit in the winter and from 42° to 47° Fahrenheit in the summer. Extreme temperatures recorded over a 50 year span range from a high of 86° to a low of -46° Fahrenheit. Annual heating degree days for Tuntutuliak is estimated at 13,334; the freezing index is 3,000 degree days. Available data is from nearby Bethel records. A slightly greater marine influence can be expected at Tuntutuliak as it is nearer the coast.

The average total precipitation for Tuntutuliak is approximately 16 inches per year with the majority falling as rain during the period from July to October. Most snowfall occurs during the period from November to March with an average annual accumulation of more than 50 inches. The reoccurrence interval for ground snow loads in Tuntutuliak are: 25 years - 61 psf; 50 years - 73 psf; 100 years - 88 psf.

Prevailing winds in Tuntutuliak come from the south-southwest during summer months, becoming predominately north-northeasterly winds from October to March. Winds during the spring are variable. Wind load building design criteria are: 25 years - 66.7 mph; 50 years - 73 mph; 100 years - 80 mph.

C. Soil Conditions

Tuntutuliak is located on the Yukon-Kuskokwim Coastal Lowland, a delta complex characterized by low-lying treeless tundra underlain by shallow discontinuous permafrost. Relief is low; elevations near the village are less than 20 feet above sea level. Soils of the delta are formed from a mixture of riverine, marine, organic, and wind deposits. They typically consist of fine-grained, ice rich material which vary in thickness from tens to hundreds of feet.

The village is situated on the old floodplain deposits of the Kinak River. Soils consist of interlaced silts and organic material with lenses of massive ice. The layer that actively thaws in the summer is estimated to average three feet. Water lies on the top of the permafrost and drainage is impeded locally due to low relief. Local soils exhibit very low strength and are subject to severe settlement should the underlying permafrost melt. Most large buildings are constructed upon freeze back pile type foundations; drilled to depths of 20 - 30 feet.

Soils information is available from exploration reports accomplished for the high school, washeteria, DOT airport survey, and ACVP housing units. These reports indicate an average one foot thick organic layer underlain by a dark grey ice rich silt soil (ML) with some organic inclusions. Visible ice varies in content from 20-60 percent with large ice lenses encountered. Soil bearing capacity is considered low with a high susceptibility for settlement if thawed, due to high ice content and fine grained and organic materials. Soil temperature average is approximately 30.5° Fahrenheit. The soil is considered not suitable for conventional septic system disposal. Permafrost may be absent in isolated areas within the thaw bulb of the Kinak River and large bodies of water.

D. Flood/Hazard/Seismic

Erosion of the riverbank has been occurring at a fairly rapid rate east of the grade school, and in general along the east side of the village on the left bank of the Kinak River. This erosion is the result of several factors. Waves generated from storms and boat traffic can undermine and erode the base of slopes. Melting and degradation of the underlying permafrost also contribute to bank instability by creating saturated soil conditions which allow slumping. Erosion is further accelerated by the removal of vegetation along the top of the riverbank and ice gouging during break-up. Most erosion occurs during river break-up in the spring and during the late summer storm season. An erosion control project funded by AK DOT-PF was completed in 1985. Riprap was laid over a geotextile fabric along several hundred feet of the river bank to help contain the erosion.

Flooding is a persistent problem in many areas of the lowlying, flat Kuskokwim River delta. Flooding occurs when strong southeast winds drive in the tide and a subsequent high tide comes in on top of it, flooding the village. Residents call this phenomena "full moon, south winds floods." High tides usually occur in late spring. Usually once in June or in early July, there are high tides with winds out of the south causing some flooding. If a storm occurs in the Bering Sea during the fall,there can also be exceptionally high tides with flooding. Flooding also occurs as a result of ice jams and overflows. The US Corps of Engineers rates the flood hazard as high in Tuntutuliak with a flood frequency of five to 20 years. The eastern part of the village, known locally as "Lower Tuntutuliak," is most affected by flooding and has been inundated to a depth of two feet. The washeteria and water supply well are located in this area.

Tuntutuliak is located in seismic zone one (1989 UBC), which is defined as only minor structural damage from seismic activity. An earthquake of 3.0 to 4.5 on the Richter scale is possible.

E. Economy

The economy of the village includes a mix of subsistence and cash generating activities. Local employment opportunities consist of the following (1990):

Lower Kuskokwim School District	25
Village corporation	10
TCSA (electric utility)	6
Airline agents	5
Health Clinic	3
Family owned General Stores	3
DHHS	2
Airport Maintenance	2
Post Office	1
ACVP	1
United Utilities Telephone	1
National Guard (part-time)	20

Seasonal jobs are available in commercial fishing, fish processing plants, and construction. Village residents estimate that about 30 residents fish commercially and 35-40 people are crew helpers (1990).

Women in the village are involved in craft making and make skin sewn products such as hats, slippers, parkas, gloves, mukluks, and smaller items like Eskimo yo-yos, pincushions, masks, dance fans, and beaded necklaces and earrings. These crafts are sold locally, in Bethel, and in Anchorage.

Incomes as per 1990 census data for 1989 are:

Median household income	$14,444
Median family income	15,000
Median non-family household income	11,250

Residents rely heavily on subsistence activities such as hunting, fishing, trapping, and berry picking. Approximately 50 percent of the typical diet in the village is obtained through subsistence activities. Seal and salmon are most important. Moose is occasionally taken upriver. Waterfowl, snowshoe hare, and ptarmigan are also hunted. All families engage in either commercial or subsistence fishing, and about one half of the families go to fish camps. Local fish used for human or canine consumption include: salmon, whitefish, sheefish, pike, blackfish, and burbot. Tomcod are sometimes taken along the coast.

Residents also trap mink, beaver, otter, and muskrat. Village residents estimate that 10 to 15 residents engage in trapping. Berries are gathered in late summer and fall, as are grasses for basket making. Driftwood is gathered for steam baths and for some home heating.

Native residents of Tuntutuliak are shareholders in Qinarmiut Corporation, which is the local Native corporation established in accordance with the terms of ANCSA. Qinarmiut Corporation owns a housing rental, operates a store, and sells fuel, outboard motors, and snowmachines. The corporation employs two land managers. Other businesses in the community include three small family owned general stores. The electric utility company (TCSA) is a non-profit association, and is designated as the future operator of improved water and sewer facilities.

F. Public Facilities

The health clinic is operated jointly by the traditional council and the Yukon-Kuskokwim Health Corporation (YKHC), a regional consumer controlled health care organization incorporated in 1969. The corporation, funded by a variety of state, federal and private sources, provides a wide range of preventative and primary health and social services to the community. Two health aides trained in village health surveillance and preventative health care staff the clinic.

The Lewis Angapak Memorial School is under the jurisdiction of the Lower Kuskokwim School District (LKSD), based in Bethel. In the spring of 1990, eight certified teachers, seven associate teachers and two teacher aides taught 94 students in preschool through grade 12. In addition to the teaching staff, the school employs a principal (one of the certified teachers mentioned above), two maintenance employees, two secretaries, two cooks, and two janitors. In 1988 an elementary school addition was added to the high school. The school is open to community use for basketball, volleyball, meetings, and community dinners. The library is open to the public as are the woodworking and electric workshops.

Other structures include the community hall, washeteria, the village corporation store, three privately owned general stores, the electric utility office, an armory, and the Russian Orthodox and Moravian churches. The old elementary school is presently unused.

Government land is limited to land withdrawn for two school sites and the National Guard Armory, the State airstrip is leased from the BLM.

Land ownership status in the community is mixed. The majority of the village improvements in the older part of town are patented to the Federal Townsite Trustee. Remaining land is owned by the Qinarmiut Corporation, Native Allotees, or the State of Alaska. One section of town is still not conveyed by the Federal Government. All of these factors must be considered in the feasibility of a sewage disposal system.

G. Public Administration

Tuntutuliak is an unincorporated village. The Traditional Council is the active tribal governing body of the community. The council has a president who is the presiding officer and four members who hold office for three years. The council operates the health clinic with the YKHC. The council also maintains the new community hall which was built in 1986. The traditional council is concerned with community needs, and has expressed a desire to improve the washeteria and landfill operations and to provide either a road or boardwalk renovation.

The Tuntutuliak Traditional Council (TTC) has authorized the Tuntutuliak Community Services Association (TCSA), a non-profit public utility authority, to represent the community in the initiation of the VSW study. TCSA presently operates the electric utility system and the village washeteria. TTC is recognized as the Appropriate Village Entity formed under state law to oversee decisions concerning lands to be conveyed for community expansion purposed under ANCSA Section 14(c)(3).

H. Population Trends and Predictions

Tuntutuliak's population grew from 216 persons in 1980 to 300 persons by 1990 (US Bureau of the Census), an average annual growth rate of 3.3 percent. According to the 1990 census, 97 percent of Tuntutuliak's population was Alaska Native.

In 1990, the median age of Tuntutuliak residents was 23.4 years, compared with 25.1 years for the Bethel Census Area (BCA) in which Tuntutuliak is located. In 1980, the median age for Tuntutuliak's Alaska Native population was only 17.8 years. The rise in median age between 1980 and 1990 suggests that the population growth has declined. The Alaska Department of Labor (ADOL) anticipates that this trend will continue in the BCA, but at a modest rate that will not significantly alter the region's population composition.

ADOL projects that the population of the BCA will grow at an average annual rate of 2.7 percent for the period 1990-2000. In its demographic traits, Tuntutuliak closely resembles the BCA as a whole. Therefore, Tuntutuliak's population is projected to grow at an average annual rate of 2.7 percent through the forecast period 1993-2003. Tuntutuliak's projected population for the years 2003, 2013 and 2023 are shown in the table below.

Table I-1
Historic and Projected Population
Tuntutuliak Alaska, 1960-2023

Year	1970	1980	1990	1993	2003	2013	2023
	(Actual Population)			(Projected Population)			
Population	158	216	300	325	425	550	725

Source: US Census Bureau (1960-1990 actual population); Kevin Waring Associates (1993-2023 projected population).

In 1990, there were 76 housing units in Tuntutuliak of which 70 were occupied. The average number of persons per household for Tuntutuliak was 4.29 persons compared to 3.72 persons for BCA as a whole (US Bureau of Census). For the purpose of projecting the number of households, it is assumed that local household size will gradually drop to four persons by 2023 and stabilize at that size hereafter. On this assumption, the number of Tuntutuliak households is estimated at 77 in 1993, 106 by 2003, 138 by 2013, and 181 by 2023.

I. Transportation/Access

Tuntutuliak relies heavily on air for transportation of passengers, mail, and cargo services. The runway, located approximately one mile south of the main village, is 1,800 feet long and 50 feet wide. The actual usable width is about 30 to 40 feet. The airstrip can accommodate Twin Otter and light cargo aircraft. The airstrip access road is scheduled for gravel improvement in 1993. There is also a seaplane base on the Kinak River. Scheduled flights arrive in the village daily, with service provided by Alaska/Era Airlines, MarkAir Express, Yute Air, Arctic Air, and Camai from Bethel. Charter services which fly to and from Tuntutuliak include Hageland's Aviation Services, Kusko Aviation, Bush Air, Craig Air, Rob Air, MarkAir, and Camai. Air freight reaches Tuntutuliak via the scheduled air carriers who pick up freight in Bethel.

Boats are also an important means of transportation. Residents use their boats for fishing, hunting, wood gathering, and visiting. Barges deliver freight at least six times a year with fuel, building materials, and supplies for the school district. No formal dock exists; the barge lands on the bank of the Kinak River either near the main village or near the high school. Access from the barge unloading area to building sites for material transport is difficult.

There are no roads in Tuntutuliak, or the heavy equipment to build and maintain the roads. The state DOT/PF has a grader for the airstrip. Between 1977 and 1983, the DOT/PF built 1.6 miles of boardwalks varying in width from two and one half to three and one half feet. Boardwalks are particularly important during the summer months when the ground is very wet. DOT/PF also funded winter trail markers to delineate 24 miles of trail. Snowmachines are the principal means of transportation in town during the winter. In summer residents generally walk and use wheel barrows. Residents would like to have a road in the village which connects the airport, old village and new homes, as the distance from one end of the village to the other is formidable (actual distance = 6,285′). The local boardwalks are in need of repair and would have to be upgraded to allow any type of sewage haul system.

A connecting road is considered a village priority. There is no gravel source in Tuntutuliak and gravel would have to be hauled to the site at considerable expense. Possible sources of sand and gravel are Quinhagak, Goodnews Bay, and a borrow pit at Birch Tree Crossing near Akiak. Gravel delivered to Tuntutuliak is expected to average $180 per yard. Ground in the area is underlain with permafrost and drainage is impeded due to low relief complicating the design and construction of new roads.

J. Power

66 residential and 11 commercial consumers (1990) purchase electric service from TCSA. The service is a three-phase overhead system with a voltage rating of 477 volts carried on lines. There are three generators: two 125 kw, and one 150 kw. Rates are $0.46 per kwh for

residential and commercial use and the school district pays $0.38 per kwh. The association employs six employees: a manager, a bookkeeper, a janitor, and three generator operators.

Most homes use propane for cooking, but stove oil and electric stoves are also used. Stove oil is used predominately for home heating. The average home uses roughly 1,000 gallons of oil per year for heating, 850 gallons for cooking (if stove oil is used), and 580 gallons of gas per year for vehicles. Stove oil sells at $90 for a 55 gallon drum, and gasoline averages $2.50 per gallon (1993).

K. Receiving Waters

Tuntutuliak is bordered to the south and west by the Kinak River. There are no USGS records available for the Kinak River. There are a series of interconnected lakes and sloughs that drain into the Kinak River. The Kinak River drains to the Kuskokwim which empties into the Bering Sea. The lagoon site is located above the flood water area of the Kinak, and is assumed to be isolated from the lake network. Lagoon discharge would be from percolation or through a controlled outfall to adjacent lakes or the Kinak River. Existing sewage bunkers drain below the ground surface into adjacent wetland areas and tundra ponds.

L. Surface and Groundwater Characteristics

Surface water consists of scattered tundra ponds and small meandering streams. Little is known of the water quality, however some residents utilize the lakes for a water supply. It is speculated by PHS reports that the dissolved iron content ranges from one to several parts per million in local surface water. The Kinak River is tidally influenced, and the chloride level would vary.

Groundwater is available at recorded depths of approximately 90′ and 197′ in fine sand aquifers. Well log data is available from four wells drilled by PHS in 1964 and 1979. The water quality from the wells drilled to a depth of 107′ showed a high iron content and because of this a new well was drilled to 201′ (1979) with a better quality water, but a limited quantity of 10 gpm. The LKSD well located at the high school was drilled in 1980, and partially logged by Dowl Engineers to 220 feet where drilling stopped in a saturated fine grey silt/sand formation, however there is no complete well log available. This well also has a high mineral content and arsenic level. It is speculated that producing wells are located in the area of the Kinak River thaw bulb and are recharged by the Kinak River. Residents indicated that the old well (1961), which was abandoned due to the river encroachment, had an acceptable water quality. Groundwater is expected to be available, but only at levels of +200′ and at limited quantity. Water typically requires treatment to make it acceptable to the local residents.

M. Wildlife

Small mammals such as shrews, voles, muskrat, beaver, mink, weasel, river otter, arctic and red fox are common in the area. Mink found in the upland tundra are important in the region due to the large size and high quality of the pelts. Musk ox in a herd of 10 to 15 animals have been spotted periodically. This group is part of the Nelson Island herd established by State and Federal agencies approximately 15 years ago.

The coastal waters support four species of seals, walruses, and sea lions. The seals migrate north following the receding edge of sea ice in spring. Many species of whales also occur seasonally along the coast, including Beluga and Gray whales.

Numerous species of both marine and freshwater fish inhabit the local waters. Currently Pacific herring is a very important marine fish for subsistence use. Also available for subsistence, commercial and recreational use are boreal smelt, arctic cisco, and all five species of salmon, which migrate from the sea through the rivers to clear upland spawning areas. Other freshwater fish found in the rivers and lakes are northern pike, sheefish, burbot, five species of white fish, stickleback, and blackfish. Upland streams support populations of trout, char and grayling.

The tundra wetlands accommodate a profusion of birds between May and November. It is both a resting area for migrating birds as well as a nesting habitat for many. Over 80 percent of all Cackling Canada geese and Emperor geese nest here. Other species of geese include White Fronted and Brants. Many of our ducks reside here through the summer including all four species of eiders: Spectacled, King, Steller's and Common. Tundra swans, Sandhill cranes, loons, gulls, and millions of shorebirds also make extensive use of this habitat.

The are around Tuntutuliak is not considered a critical habitat and is at the southern end of what is considered the core area. There are no critical species of issue and is labeled as a "low profile" area.

N. Wetlands

Being such a distinct waterfowl area is obviously an indication of wetlands. Scattered amongst the nearly continual mat of tundra are rivers, sloughs, lakes and ponds. Approximately one third of the entire delta is covered with water. Vegetation consists primarily of wet and moist tundra types. Mosses and lichens create a mat in which other species take root. On slightly dryer, raised ground dwarf shrubs occur. Many shrubs have overwintered berries which provide important spring nutrition for the birds which migrate here.

Tuntutuliak and the area within this project scope lies within the Yukon National Wildlife Refuge and is classified as Native land, conveyed surface and subsurface. This refuge, the Nation's largest, was created for the purposes of conservation of the diversity of species, preservation of habitat and water resources, as well as ensuring the opportunity for a continued lifestyle of subsistence by local residents, chiefly Yu'pik eskimos.

Tuntutuliak is within a wetlands area, however, and consideration of the project's effect on wetlands in the area will be required according the US Army Corps of Engineers Regulatory Section. An application has to be made to the US Army Corps of Engineers to request a jurisdictional determination of wetlands status.

II. EXISTING SANITATION FACILITIES

A. History of Sanitation Facilities

Tuntutuliak received a PHS sanitation facilities construction project in 1961. An initial project proposal, dated March 1, 1960, requested assistance in developing a watering point; providing kitchen sinks and water storage facilities for each home; a waste disposal facility for each home; and a refuse disposal area for the village. The Indian Health Service (IHS) responded in 1961 with project number AN-61-423. It provided a community watering point consisting of a 240 square foot insulated wood frame building, four inch steel cased well 97′ deep, with submersible pump, two water storage tanks, a 1,000 gallon and 459 gallon, with lime batch treatment iron removal equipment, generator, and oil stove; kitchen sinks, water storage cans and water carrying cans for 26 dwellings with a population for 145 people; grey water seepage pits, privies, and garbage cans for 26 dwellings; and a fenced community refuse disposal area. Project number AN-61-423 was completed in August 1965 and transferred to the village of Tuntutuliak on April 1, 1966. Total cost of the project was $20,000 or $770 per house served.

The BIA well crews drilled two wells in Tuntutuliak for the BIA school, one drilled in 1964. The December 1964 well was drilled through 97 feet of muck (probably organic silts) and tightly packed sands. The well produced a good yield at 35 GPM, but quality was poor due to iron concentrations in excess of 17 ppm and hardness as $CaCO_3$ of 189 mg/L. The November 1965 well was drilled through a similar formation to a depth of 90 feet. The water quality was poor with iron concentrations in excess of 17 ppm. These wells are not in use as the old BIA school site is abandoned.

Through the interest and desire of village leaders to maintain the watering point, the system, installed in 1965, functioned for over 10 years with few problems. A PHS inspection trip made in August 1977 noted that river bank erosion was threatening the Tuntutuliak water facility and the condition of the wellhouse was very poor. Village leaders requested emergency assistance at this time to relocate or rebuild the village watering point. The PHS sanitation engineer making the inspection suggested that the villagers allow the watering point to remain in service at least until the fall of 1978. The engineer also suggested that the village rotate the wellhouse building 180° around the well to allow for an approximate eight to 10 feet of erosion to occur before the watering point could no longer be of service.

A follow-up inspection in August 1978 noted that the wellhouse building had been rotated around the well as suggested; the interior and exterior of the building repainted; a damaged door and broken window replaced; the well thawed; interior of the watering point was clean; and a supply of lime was on hand for water treatment. In a meeting with the village council during the follow-up inspection the council stated that during the summer rainwater was collected for drinking, however, during the remainder of the year the watering point served as the main water source. It was also pointed out that the BIA school purchased water from the village owned watering point.

At this time, the village council again made a verbal request for a new watering point, with a larger water storage capacity to be constructed 300 feet from the river adjacent to the BIA school property.

The PHS report #AN-78-625F conclusions pointed out the efforts of the village towards operation and maintenance of the existing watering point and that the sale of water to the BIA was a basis for good operation and maintenance practices; and that the eroding river bank was currently within five feet of the corner of the building. PHS recommended that Tuntutuliak receive consideration for emergency funding to replace the watering point and also that provisions be made to drill another well during the 1978-1979 winter season.

EHB drilling crews began drilling in Tuntutuliak January 11, 1979. Drillers Henry Horner and Jim Appleton encountered mud and clay down to a depth of 80 feet and sands from 80 to 105 feet where water was encountered in an aquifer of fine sand. This well turned out to be unsatisfactory as a water supply. The water is of poor quality (50 ppm iron and 0.2 ppm arsenic) and the pumping test indicated a limited aquifer with a low long term yield. This well, located by the church, was abandoned.

A second well was drilled during July of 1979. This well was drilled through permafrost to a depth of 201 feet. The water at this source was considerably higher in quality than previous sources. Arsenic was less than 0.1 and iron concentrations were 2.4 ppm.

Completed project facilities including both wells and one well pump were transferred to the village on September 21, 1979. Total cost of the project was $63,419. This project was to provide a water source for 36 homes at an average cost per house of $1,762.

In 1980 the original 1965 well succumbed to the eroding riverbank and the well house was salvaged and placed over the BIA school well to provide a community watering point. The 201′ well drilled by PHS in 1979 was not in use at this point. It is noted in a PHS project summary dated December 1981 that pit privies and seepage pits provided by IHS have been filled to capacity or have deteriorated to unusable condition. A fenced landfill was located on the south end of the airstrip, however, there was no passable road to the site. It was determined that due to village expansion plans of 25 new houses an improvement of the sanitation facilities was imperative. A haul system and community circulating water system were considered, but because of high O&M costs, they were unacceptable to the community in 1981.

A central watering point/washeteria complex was the next alternative. O&M costs were estimated by PHS at $30 per house per month plus the cost to operate washing machines, dryers, and showers on an individual basis. The village council selected the watering point/washeteria as the preferred alternative.

In 1982 construction began on the washeteria which included a watering point, four showers, two toilets, and a laundry with four washers and three dryers. In addition, a summer only distribution system serving several watering points was provided. Water was supplied from the

IHS well drilled in 1979, with the washeteria being located adjacent to the well. Treatment for removal of iron from the well water was required, and two 10,000 gallon storage tanks were constructed. Water hauling buckets and storage containers were provided to each household.

Washeteria wastewater was to be discharged to a designated lake approximately 400 feet from the river. The lake provided approximately nine months of detention, after which discharge through a system of meandering channels to the river occurred. Home honey bucket waste was disposed of in eight sewage disposal bunkers located throughout the village.

No additional solid waste disposal facilities were planned under this project.

In 1983 the washeteria project scope was amended to include the use of an electrical generator waste heat recovery system to provide pre-heating of the water for the washeteria.

The cost of improvements were $1,421,000 designated to serve a total of 36 existing and 25 new homes. O&M costs were estimated at $40,620 annually in 1987 with a per household cost of $30/month after subtracting revenue generated by coin-op receipts.

No further improvements have been made to the main sanitation facilities to date. Additional bunkers have been constructed by residents over the years as capacity of existing bunkers is exceeded. Old bunkers have not been properly closed out.

B. History of O&M Capacities

Based on PHS records, it appears that between 1965 and 1977 the single well watering point was adequately maintained by village personnel. Recommended upgrades to the wellhouse building made in 1977 by PHS inspection report were implemented by 1978. The PHS sanitary engineer pointed out the good efforts of the village towards operation and maintenance of the watering point as a basis for drilling a new well.

After construction of the new washeteria, PHS field reports dated July 21, 1983 indicated difficulty in maintaining the well from freezing. This was corrected by proper maintenance of the heat tape and is no longer a problem. The waste heat system was not successfully implemented and subsequently disconnected and discarded. It is claimed by village personnel that the system was poorly designed and never operated properly. The summer water point system was discontinued after one year due to lack of maintenance, and eventual deterioration of the system. In 1989 the washeteria was closed down due to lack of funds to pay for its operation and maintenance. The washeteria was reopened in 1991 with PHS-Yukon Kuskokwim Health Service (YKHS) assistance utilizing a $15,000 grant, and is presently run by TCSA.

The TCSA organization has a good record of maintenance of the existing water system and washeteria over the last year. The system maintenance man and operator is Mr. Jacob Daniels who is considered to be conscientious and thorough in his duties. The washeteria has a full time attendant system. The attendant cleans the facility, sells laundry supplies, and dispenses tokens for the washing machines and dryers. A breakdown of 1992 washeteria expenses is presented in Appendix C. At the time of our visit, the facility was fully operational and is utilized by residents for laundry. It appears that TCSA is capable of facility operation and management and has the capacity to provide billing services through an established utility billing system.

C. Adequacy of Existing Facilities

1. Water

The washeteria provides the only controlled method of water supply to the village utilizing a six inch drilled and cased well with 10,000 gallon pre-treatment tank and 10,000 gallon storage tank facility. The water is treated with the addition of potassium permanganate, utilizing a green sand filter for iron removal. Water is provided by a watering point at the washeteria facility only, at a charge of $0.15 per gallon. Washeteria water is considered by most residents to be only suitable for washing, and steam bath use. Drinking the washeteria water is considered objectionable due to the film it leaves in teas and coffee and the "chemical taste" associated with treated water. This, in combination with the fact that there is a charge for water and it is only available at the washeteria, leads to a general reluctance to utilize the water except for when there is no other available option. Preferred sources of water, as determined by community survey, are lake and river ice in winter, and rainwater in summer. River water is occasionally used when the season allows its use due to water clarity. The present water system is not considered adequate due to the length of haul distance which encourages use of unprotected water sources. The existing washeteria is utilized almost entirely as a laundry facility.

It is not expected that residents will pay for water unless it is provided to the home. It would be difficult to maintain and charge for usage if uncontrolled watering points are provided throughout the community. The facility has lost money last year ($2,500) and it is expected that the attendants' hours will be reduced to make up the deficit. It has been indicated that the school facility would purchase water if this was made available.

The well serving the washeteria has a utilized yield of 10 gpm or 14,000 gpd. The well yield test completed in 1979 showed a static water level of eight feet, compared to a present static water level of 4.4 feet. The existing water system utilizes a pump placed at 80 foot depth in the well. A well flow test was conducted on June 15-16, 1993 with the results presented in Appendix E. The well flow test indicated that the present well can support long term pumping at a 20 gpm rate, however, this must be monitored to prevent the possibility of salt water intrusion. The present storage tank capacity is 20,000 gallons if both tanks are utilized for storage by pre-heating the raw water to make iron treatment more effective. Well log data and 1979 flow test data are also presented in Appendix E.

2. Wastewater

Wastewater disposal is by pit privy and honey bucket self haul to bunkers placed throughout the community. Grey water wastes are disposed of outside of the home in any convenient area.

The bunkers are wood framed holes excavated six feet into the permafrost with wooden covers equipped with hatches to dispose of honey bucket waste. The LKSD school facility has a wastewater lagoon system, which is in close proximity to residential home clusters. Odor from the lagoon is objectionable due to its location. This lagoon is emptied by pumping annually into the Kinak River or into the solid waste disposal area. This disposal practice is objected to by the Village Traditional Council. Wastewater disposal is considered inadequate due to the fact that bunkers are full and overflowing, and the residents request a more convenient method of waste disposal. The school system requires secondary treatment, if utilizing the present area for lagoon effluent disposal, and ideally should transport all waste to a more distant retention site. It is suggested that a cooperative effort can be realized, which would incorporate the school wastewater needs with the village disposal system at shared cost.

3. Solid Waste

The present solid waste facility consists of a designated boardwalk access which terminates into an open tundra area subject to flooding, animals, winds and uncontrolled waste disposal. Solid waste is disposed of in a haphazard manner and is subsequently scattered over a large area and onto a native allotment adjacent to the designated disposal site. Some of the residents burn their combustibles in 55 gallon drums around the village. There are complaints that the burn debris contaminates rain water collection systems. For these reasons, we believe the solid waste site is completely inadequate and requires relocation and improvement.

D. Unmet Needs

The community requires an improvement of the basic sanitation facilities presently in place. The honey bucket waste disposal methods are poor at best and have the potential to become a health hazard. The school sewage lagoon is in close proximity to the residences and is operated in a manner that is a health hazard. Existing sewage bunkers are full to capacity, and require proper abandonment to remove contaminant potential. Preferred drinking water sources are subject to contamination at the source or during transport to the community. The washeteria water system requires an improved water treatment system or increased level of maintenance to make the water more palatable to the residents and then a method of distribution and fee schedule implemented so that residents will utilize the water. It is recommended that the system operator receive advanced State training certification, that the well seal be improved to prevent flooding contamination, and that the standby generator be repaired to prevent washeteria damage in the event of power failure. The washeteria waste outfall line requires repair where it is separated. A public information campaign will be necessary to develop residents' confidence in the water supply. A new dumpsite is required in a more suitable location with proper fencing, a burn box or incinerator, and provision for an operator to attend to the facility.

III. SANITATION FACILITY ALTERNATIVES / CAPITAL AND O&M COSTS

A. General

There are several physical site restrictions that limit the available options for sanitation facilities in Tuntutuliak. These site conditions must be considered in the overall evaluation of alternatives, and are listed below prior to a discussion of specific solutions.

1. Tuntutuliak is subject to annual flooding events which severely restrict the land area available for waste disposal.
2. The village is spread out over a large area in small home clusters which makes any collection system more extensive and complicated.
3. There are no roads in Tuntutuliak and existing boardwalks are narrow and not capable of supporting vehicle loading. Repair or replacement of existing boardwalks throughout the length of the village would be a large portion of the capital cost of any project, estimated cost $968,000-1,150,000.
4. Construction equipment is limited to a DOT airport grader and TCSA Bobcat with backhoe and drill attachments.
5. There is no local source of gravel for construction of conventional roads or lagoon diking. Imported gravel material is very expensive. Estimated gravel cost = $180 per cubic yard.
6. The only suitable land area for a sewage disposal lagoon is located north of the village at a distance of 0.6 mile. This distance increases the costs of both access and transportation of wastes.

B. Major Scheduled Capital Projects

There are indications through the BIA Division of Transportation, in conjunction with the Federal Highway Administration, that funding may be available for an improved road system in Tuntutuliak. This is through a program titled, "Intermodal Surface Transportation Efficiency Act (ISTEA). If this is realized, then costs associated with access road construction can be applied to sanitation improvements.

A new electrical generating facility is proposed with assistance from the Alaska Energy Authority (AEA). Contact with the AEA has determined that implementation of the project is "highly possible." The facility would be located adjacent to the washeteria and would include consolidation of fuel tanks away from the well site, and provision for a waste heat recovery system. This is considered an important improvement as the existing washeteria utilizes one of two 10,000 gallon storage tanks for pre-treatment water storage to provide more effective iron removal. The well water is allowed to warm slowly in the storage tank. Pre-heating of the water before treatment would allow more effective utilization of the storage capacity of the tanks, as they would normally be full or nearly full of water. Pre-heat is also desirable as chemical treatment becomes much more effective and efficient. Pre-heating the raw water utilizing generator waste heat would allow for full use of the existing storage tanks exclusively for water storage. This is an important consideration due to the limited yield of the existing well supplying these tanks.

Relocation of the airstrip is being considered. This relocation would be to an area to the north of the village where planes typically landed prior to the existing airstrip development. Reasoning for relocation of the airstrip are continued erosion of the riverbank encroaching on the airstrip surface and flooding conditions experienced at certain times of the year. Relocation would require importing gravel and developing an access road.

The school facility is considering installation of a package treatment plant (Biopure) relocated from the old BIA school and refurbished. This plant would provide secondary treatment to the school waste prior to discharge into the existing lagoon. It is estimated by district personnel that this would cost approximately $30,000 to accomplish.

C. Feasibility Study O&M Cost Estimate Assumptions

The present population of Tuntutuliak is approximately 300 to 325 residents based on 1990 census and projection. Population projections show an estimated growth of two percent per year for a projected population of approximately 425 in 2003, and approximately 5503 in 2013 if continued growth follows established patterns. Current school population is 96 students including pre-school or approximately one third of the population. This study is based on present population.

The number of occupied homes in Tuntutuliak is approximately 70 (1990 census). Homes are situated in small clusters in the old and new village. There is one home outside the immediate village area that does not desire water or sewer facilities and is not included in this study. The washeteria wastewater is disposed into a small tundra pond lagoon, and this is considered satisfactory for this study, based on village comments. System connections are considered for four stores, the clinic, and community hall in this study.

Any housing expansion would be to the north of the village on higher ground. The area of the lower village is not fully occupied at this time and would possibly be abandoned in favor of a higher ground location.

From recommended design water demand values Table 5-2 Cold Climate Utilities Manual (CCUM), water demand for a typical self haul system is 2.6 gpd/capita. A piped utility system can be expected to utilize 38-69 gpd/capita, average figure of 54 gpd/capita was utilized. The COWATER system, or flush tank and haul, is estimated at 3.0 gpd/capita. This is based on the figure of 2.7 gpd/capita for Mekoryuk and the assumption of increased usage due to expanded grey water disposal. School usage is based on gpd/capita as per EPA On-site Wastewater Design Manual reference as 21.1 gpd/student. Average number of people per home is 5.0 based on community survey. Tuntutuliak is a traditional village and it is customary to utilize steam baths for bathing purposes, which reduces water usage. Commercial uses are not considered separately as it is assumed that waste generation is by per capita village population. Service connections are considered for the four stores, Community Hall, and clinic, in all options. The above water usage figures are tabulated in Table III-1 and utilized in the capital and O&M cost estimates for various options.

It is assumed that construction will be by force account system and that local labor is available at an average rate of $12.00 per hour. Superintendents are estimated at $35-40 per hour depending on the level of skill required. Maintenance personnel are assumed to have an average burdened rate of $12.00 per hour.

On all water service options the cost of water treatment is estimated based on actual 1992 TCSA figures for the annual O&M costs required to treat 358,439 gallons of water in 1992 and presented in Appendix C. The 1992 cost for water production for the washeteria was reduced to a unit cost of $0.14 per gallon. This rate per gallon will decrease as usage is expanded and inefficiency is removed and that is reflected in the $0.11-0.12 per gallon rate utilized in cost projections. The school water system is not metered and must be estimated which affects cost projections for the school water and wastewater contribution.

Electrical power cost is applied at the utility rate of $0.38 per KWH, which is the wholesale rate applied to large users, such as the school. Project capital cost, and operation and maintenance costs include a eight percent fee for local administration. More detailed breakdowns of capital cost, and O&M cost estimates are included in Appendix A. Projected usage rates may vary considerable from actual usage rates once the facilities are put into operation. Therefore, the projected revenues may or may not cover projected costs. It will be the village's responsibility to monitor actual usage rates closely to determine whether actual revenues derived are sufficient to meet costs. In the event that revenues are not sufficient to meet costs, the village will have to either increase the rates or institute a user charge system to generate sufficient revenues to meet costs. The TCSA can develop a user charge system based on the availability of more reliable data after the system has been in operation for several months.

Table III-1
Projected Water Usage
Total Gallons, Residential - School

	HBH System (2.6 gpd)	Piped Water & Sewer (54 gpd)	FTH COWATER System (3.0 gpd)	School System Only (21.1 gpd)
1993	**845**	**17,550**	**975**	**1,983**
2003	1,105	22,950	1,275	2,810
2013	1,430	29,700	1,650	3,636
2023	1,885	39,150	2,175	4,793

D. Washeteria Improvements

In order to facilitate use of the existing water system by residents, treatment processes must be improved and the water must be made more readily available.

We recommend renovation of the existing treatment plant to include: pre-heating of well water by oil-fired boiler to improve and expedite the treatment process, improvement of the green sand filter system, repair of outfall line, sealing of the well, and State certification training for the water system operator.

Table III-2
Washeteria Improvements

ESTIMATED CAPITAL COST	$36,408

E. All Weather Watering Point & School Service Connect

An all weather watering point would provide greater accessibility and a shorter haul time for residents of the new village, reducing the haul distance by one half mile. The LKSD school facility presently obtains water from an on-site well located on school property. Reports prepared by RoEn Design Associates, Inc. in 1989 for the LKSD show the water to require extensive treatment to be potable. If this all weather watering point is incorporated into a supply service line to the school facility, the O&M cost can be partially absorbed by school usage fees. It is proposed that a three inch recirculating and heat traced water line be installed in an above ground, insulated utilidor that is located in an area not frequently traveled to avoid conflicts with snowmachine routes. This route is detailed on Figure 1, Appendix I. The watering point would be in the vicinity of the school property, and would be an all weather coin operated facility. The location would be convenient to the new village housing area, reducing haul distance.

Table III-3
All Weather Watering Point & School Service Connect

ESTIMATED CAPITAL COST	$507,535

O&M cost would be for heating and delivery of water to the watering point, repair of water collection station, collection of money from facility, estimated at $8,413 a month for the school at 2,600 gpd, and $68 per month for a residence at 3 gpd.

F. Summer Distribution System

A summer distribution system is considered as one further option to expand use of the washeteria water in lieu of a full, all weather, piped system with water provided to each home. Water is more difficult to haul in the summer versus winter when snow machine travel is relatively easy. The summer distribution system would provide a central watering point to each residential home cluster. O&M cost is reduced due to the fact that the system is only operated during the time when weather conditions are above freezing. Maintenance cost is considerable due to the fact that the line should be drained prior to freezing and that the line is above ground and is subject to breakage by vehicles and vandalism. Watering points will have to be coin operated to allow collection of revenue for water treatment and have a timed water release to prevent indiscriminate use of the water.

Table III-4
Summer Distribution System

ESTIMATED CAPITAL COST	$120,028

O&M costs are expected to be for pump power supply and maintenance, maintenance of the water line and watering points, and revenue collection. Estimated O&M costs are $69 per month per residence for five months a year.

G. Waste Disposal Tundra Pond Lagoon

Sewage is presently disposed of in individual honey bucket bunkers located adjacent to housing clusters. The school has an individual lagoon which is considered inadequate. The washeteria has a small tundra pond lagoon which absorbs largely grey water and treatment process water and has received no complaints from the residents. While the legal status of this lagoon is indeterminate for the purpose of this study, it is considered adequate. The old BIA school lagoon is inactive and should not be re-activated due to its location near residences.

There is no adequate central disposal facility in Tuntutuliak and one will have to be constructed regardless of what option is considered for collection and delivery of the wastewater. Due to site conditions of permafrost soils and seasonal flooding, lack of construction equipment and gravel availability, it was determined that a tundra pond lagoon would be the most appropriate option for a disposal site.

The site selection criteria was to locate a natural depression requiring minimal site work for containment in an area that does not flood, and is a sufficient distance from the village location. There are two lagoon sites, a primary and an alternate, that were considered after investigation of the area around Tuntutuliak with the assistance of Mr. Robert Enoch of TCSA.

These site locations are detailed in the full size base map. Lagoon cross section for the primary site are detailed in Appendix J. The primary site is considered the preferred location and was accepted at the Traditional Council meeting March 26, 1993. Survey volume calculation have been conducted, but no soils or geotechnical work has been performed under this scope of work. Tundra pond lagoon volume is estimated at 2.05 million gallons, including ice volume. This lagoon volume can be expanded by diking at the indicated outlet. The primary site has three to four foot high banks on three sides with a lower bank and overflow outlet to the east. If the lagoon were to overflow, discharge would be to a second, smaller tundra pond a short distance to the southeast. The drainage pattern from this point is not well defined, but any remaining effluent would likely be dispersed through a series of large shallow tundra ponds where dilution of the effluent would be effected. If the overflow becomes a problem, effluent could be pumped to an area of connected tundra ponds flowing to the Kinak River a short distance to the northwest. Sand bag dikes also may be placed to effectively control overflow in the future. Lagoon site preparation is limited to fencing of the lagoon boundary to control access, preparing an access route to the lagoon and a dump platform if needed. Costs for lagoon site preparation only are estimated in Table III-5. Lagoon costs, detailed in this section, are the capital costs associated with the level of effort necessary for treatment of low water use options of sewage delivery. An additional amount of capital cost is included in fully piped system options to reflect the increased waste volume associated with these systems.

Table III-5
Waste Disposal Tundra Pond Lagoon

ESTIMATED CAPITAL COST	$73,677

O&M costs would be minimal and limited to general cleanup at the site and repair of fencing if needed. These are incidental to the sewage delivery service, and are included in the delivery system O&M costs. Estimated cost $100 per month total in the village.

H. Pressurized Water and Pressurized or Vacuum Sewer Systems

A piped water and sewer system would require an above ground Utilidor system and force or vacuum mains due to the topography and soil conditions. Utilidors would be kept from freezing by utilizing recirculating flow with electric heat trace, the heat trace to be used only as a back-up when needed. It is envisioned that a combination of delivery systems with individual home pumps or gravity collection stations and a force or vacuum main, would be utilized. As the school facility is the major single point user, a force main pump station would be established in the low elevation area near the school that several housing clusters can gravity feed. This site would require a waiver of horizontal separation distance from ADEC for approximately 40' to surface water. The wastewater would then be pumped to the lagoon site as required. Various sections of the village can be served by mains with collection stations routed to the main pumping facility near the school. It is expected that the O&M costs of such a system would be high due to the required maintenance and the expanded use of water such a system realizes. The lagoon area will have to be expanded beyond the tundra pond natural elevation to accommodate the full water usage of 17,550 gpd. The washeteria would require expansion to provide for increased water usage. However, this type of system would not require a haul vehicle and associated costs.

The cost estimate in Table III-6 is for providing hookups to 70 homes in all areas of the village, and to the school, clinic, community hall and stores.

Table III-6a
Piped and Pressurized Water and Sewer Systems

Pressurized water distribution	$2,255,894
Pressurized sewer	$2,223,147
ESTIMATED CAPITAL COST	$4,479,041

O&M cost was estimated at approximately $201 per month per family.

Table III-6b
Pressurized Water and Vacuum Sewer Systems

Pressurized water	$2,255,894
Vacuum sewer	$2,395,104
ESTIMATED CAPITAL COST	$4,650,998

Total O&M cost was estimated at approximately $216 per month per family.

I. Sewage Force Main School Location to Lagoon

The phased option of providing a force main station from an area behind the school to the lagoon site was explored as a separate cost item. This would provide a means of removing the school waste out of the village, and would provide a haul system deposit point reducing haul time and therefore haul cost if a haul system is implemented. This pump station is also required for a fully pressurized water and sewer system and is not included in the capital cost for those options.

Table III-7
Sewage Force Main School Location to Lagoon

ESTIMATED CAPITAL COST	$790,829

Total O&M expenses are estimated at $27,582 annually, or $1,263 per month for the school, and $15 per family per month if utilized as a collection point.

J. Honey Bucket Haul (HBH) System

A HBH system would provide for collection of honey bucket wastes from central collection stations located in a convenient area of each residential home cluster and at the community hall, clinic and store facilities. The collection stations would consist of elevated polyethylene bins which are collected by an operator with a four wheeler or snowmachine (dependent on season) and hauled to the sewage lagoon for disposal. Residents would be required to deposit their own honey bucket wastes into the collection container, and a monthly charge would be levied for collection service. Collection containers would have to be designed to eliminate or minimize spillage as reportedly occurs with the Napakiak and Kongiganak systems. One major capital cost item associated with this option is the provision of new roads or boardwalks to provide access for the haul vehicle. The present boardwalk system in Tuntutuliak is inadequate to provide sewage haul vehicle access. The ISTEA program described in Section III.B. may provide funding for the access routes freeing up money for the sanitation facility. Boardwalk improvements are not included in the HBH capital cost estimate, and would be less extensive than for the COWATER FTH system where access to each home is required. While HBH system is not the most modern or popular method, it does provide for removal of wastes to a proper lagoon site, and should be considered in the overall feasibility study.

Table III-8
HBH System

ESTIMATED CAPITAL COST	$145,632

O&M costs are expected to be for replacement of vehicles and upgrade collection containers, labor for collection duties and cleaning and maintenance of vehicles, and fuel. Estimated cost $18 per 80 gallon sewage haul trip, or $88 per residence per month for five people in a residence.

K. COWATER (*FTH*) System

The COWATER flush tank haul (*FTH*) System is a system that provides a flush toilet with wastewater holding tank and water supply holding tank. The system requires a haul vehicle which is typically a 4-wheeler or Alpine snowmachine with a 120 gallon haul tank. The COWATER system toilet utilizes a one pint flush, reducing water usage and resultant haul volume requirements. The system appearance is that of a standard flush toilet when utilized with a tank external to the home.

The system is very flexible in that it can be phased or scaled to meet the owner's needs and financial capabilities. The basic system includes a toilet with 100 gallon sewage tank and separate 100 gallon water storage tank. The sewage tank can be either inside or outside of the home. This basic system can be expanded to include a sink either at the toilet or in the kitchen. Grey water can be discharged to the holding tank through use of selective valves. The water storage tank can be filled by the owner or through use of a water delivery tank. The sewage tank is pumped as required with the owners use determining frequency of pumping. The homeowner would notify the operator (TCSA) and pay based on frequency of pumping and water haul. This system can be phased into the community and can also be connected to a fully piped system in the future if necessary. The COWATER system is currently being demonstrated in Mekoryuk and is proposed for Tununak and Napakiak, Alaska. This system has a low initial capital cost with maintenance cost similar to HBH system. Spillage would not be a problem due to the collection tank being sealed. If a section of the system breaks down, the whole system is not effected, and the low anticipated water usage created would not require a large expansion of the WTP, or a large lagoon. Haul equipment maintenance is familiar to the residents. The system can be phased into the village. Water usage for this system is estimated at 3.0 gpd/capita based on an expansion in use over the Mekoryuk estimate of 2.7 gpd/capita. The school could not participate in this system due to volume of waste discharged by the school.

Table III-9
COWATER (*FTH*) System

ESTIMATED CAPITAL COST	$869,820

O&M costs are expected to be for replacement of vehicles and upgrade collection containers, labor for collection duties and cleaning and maintenance of vehicles, and fuel. Estimated cost of $112 water, $72 sewage, per month per residence for four haul trips per month average.

L. Gravity Collection System

It may be possible to place 12 residences, the community hall, clinic and store on a gravity sewer main to the proposed lift station located north of the school site. This option was explored and while it does reduce O&M costs slightly, there is a high capital cost associated with the improvement. It is recommended only if a fully piped or pressurized system is put into place as a phased system improvement.

Table III-10
Gravity Collection System

ESTIMATED CAPITAL COST	$557,959

O&M costs are expected to be for line repair and maintenance of pipe grade and heat trace usage if glaciation of the line results. Estimated monthly cost per unit of $74.

M. Solid Waste

Due to site conditions in Tuntutuliak, that is, permafrost soil conditions and lack of sand or gravel sources, the only practical method of solid waste disposal is the open dump method. A site was selected adjacent to the proposed sewage lagoon that accomplishes several objectives. The site will be located a sufficient distance from the village housing to minimize odors, the location is in an area that receives minimal flood occurrence, and the site can share an access route with the lagoon to minimize expensive boardwalk or road building.

The dumpsite is located on high ground and will not impact any water supply sources. A 1.9 acre land area is available with allowance for expansion of the dump if needed. Based on a 4.0 lb/capita waste generation rate the expected volume of waste is 1,300 lb/day of which 50% is combustible, with a compaction density of 500 lb/yd^3 the yearly volume would be 475 yd^3 or one third acre, one foot depth. Initially it is proposed that a one third acre area be completely fenced and a burn box type incinerator be installed to allow for burning of combustibles.

Self haul is the preferred method of disposal as determined by community survey. The majority of residents will not pay for solid waste collection. Many residents indicate they will separate combustible from non-combustible items. Judging from past experience it will be necessary to hire an attendant to maintain the burn box and police the area as part of the O&M costs associated with solid waste disposal.

Table III-11
Solid Waste Site

ESTIMATED CAPITAL COST	$114,108

O&M costs are expected to be a flat rate of $13 per month per resident. This is reduced to $5 per month if a dozer is not utilized to compact and cover waste.

N. Abandonment Procedure for Honey Bucket Bunkers

Bunkers should be abandoned by the following procedure:

1. Bunker lids and side walls shall be removed to ground level, and hauled to the solid waste disposal site for burning.
2. Any material to a level of two feet below grade is to be transported to the sewage lagoon site for disposal in a covered haul trailer.
3. The remaining bunker contents should be treated with lime utilizing approximately 250 lbs of lime per bunker which is to be mixed into the upper portion, breaking up plastic bags as much as possible using a small backhoe.

4. A filter fabric material is to be placed over the remaining contents, extending filter fabric up the sides two feet and overlapping all joints two feet.
5. An earth cap is to be placed over filter fabric material utilizing sand fill to ground level, compacted by hand tamping in six inch lifts to approximately 80% standard proctor.
6. A cap of organic material is to be placed over the sand fill to a level of 1' above ground surface and graded to create an earth dome over the bunker.

All workers are to be properly versed in safety procedure and to wear protective clothing during operation. Equipment is to be decontaminated after each work phase is accomplished.

Table III-12
Abandon 20 Bunkers

ESTIMATED PROJECT COST	$64,108

IV. RECOMMENDED SANITATION FACILITIES

A. Access

A complete boardwalk system to access all areas of the village should be constructed to facilitate a phased haul/piped system. Boardwalk costs are estimated at $44-52 per lineal foot. This phase can be constructed utilizing VSW or other transportation funding.

B. Water Supply and Distribution

The present water supply source and treatment method with suggested improvements is adequate for village use unless a full piped system is realized. If a full pipe system is installed, additional well producing capacity and/or expanded storage tank capacity will be required. Residents indicated through community survey that they are willing to pay an average of $26 per month for water which can only support a limited distribution system in combination with self haul.

<u>Study Recommendation:</u>

Water treatment system be improved as per Section III-D.

The water distribution system should be expanded through the construction of an all weather watering point to the new village and school and a summer distribution line installed. A water haul system similar to the COWATER system should be provided for those willing to pay the expected O&M costs. Other residents may continue to self haul water.

C. Sewage Disposal

Sewage disposal recommendations are based on several factors. The most convenient option is a fully piped system, however, there are several disadvantages to seriously consider. A piped system requires a higher degree of operation and maintenance skill level than a haul system. If maintenance is not performed adequately, and the system fails, it fails for the entire village. The utilidors are above ground and become an obstacle to travel. A boardwalk is not necessarily required for a piped system, and therefore is not a side benefit.

A honey bucket haul system would have the side benefit of a completed boardwalk system, however, there is problem with spillage and it is not as convenient.

A piped system must be provided to transport school sewage from the village site to the new lagoon site.

The flush tank haul system or COWATER system provides a flush toilet, however, wastes must be hauled to the lagoon. A new boardwalk is again a side benefit. There is not a spillage problem with the sealed haul tank, and the equipment is familiar to residents. The system can be phased to the degree of service desired by the homeowner, therefore the homeowner has control over their monthly expense.

The villagers have indicated through a community survey that they are willing to pay $30 per month for sewage service with a range of response from $10-80+. All systems come with an O&M cost in excess of $30 per month. For this reason we believe the COWATER (*FTH*) system would be the preferred option to meet a wide range of levels of service.

Study Recommendation:

A force main and pump station be constructed behind the school that would provide waste disposal for the school. The remainder of the community should be phased in with a *FTH* system utilizing external holding tanks. Selection of homes for the *FTH* system should be based on level of interest in the system and may be initiated as a demonstration project. All existing honey bucket bunkers should be abandoned, as the systems are phased into service.

D. Solid Waste

The solid waste site improvement should be a top priority. A fenced open dump with burn box, part-time operator and tractor is proposed as the best option. There are not many alternatives for solid waste disposal due to site conditions. Self haul is the preferred option for delivery of solid waste to the dumpsite.

Study Recommendation:

A new fenced dumpsite with operator, burn box and small dozer.

E. Recommended Options Capital and O&M Cost Estimate Summary

Table IV-1
Recommended Capital and O&M Costs (per residence per month)

ITEM	CAPITAL	O&M COST
Boardwalk improvements	$ 968,000	
Washeteria improvements	$ 36,408	$ *
All weather watering point & school water service connect	$ 507,535	$ 68
Summer water distribution system	$ 120,028	$ 69 **
Tundra pond lagoon	$ 73,677	$ *
Sewage force main, school and limited community use only	$ 790,829	$ 1,263 *****
COWATER flush tank haul system	$ 1,017,184	$48-192 ***
Solid waste site	$ 114,108	$ 13/5 ****
Abandon honey bucket bunkers (20)	$ 64,108	$ N/A

* Not estimated separately for this improvement, included in distribution options.
** For months of service operation only.
*** Water and sewage service combined.
**** Cost with dozer option/cost without dozer option.
***** School & 15 residential

F. Sanitation Project Schedule

o Final draft incorporating review comments	October 1, 1993
o Final feasibility study report	December 1993
o Design phase	February 1993-July 1994
o Phased construction	September 1993-September 1994

APPENDIX A
CAPITAL AND O&M CALCULATIONS

Elevated Boardwalk
Capital Costs

Item No.	Item	Unit	Unit Cost	No. Units	Sub Total
1	Lumber, Materials	LF	$24.25	N/A	$24.25
2	Freight	LF	$12.60	N/A	$12.60
3	Labor	LF	$5.12	N/A	$5.12
4	Superintendent	LF	$2.24	N/A	$2.24
	SubTotal (Cost/LF)				$44.21
	Contingency/LF	%	0.10		$4.42
	Local administration/LF	%	0.08		$3.54
	TOTAL COST/LF =				$52.17

Assumptions:
8 man crew capable of installing an average of 125 LF per day
22,000 LF covers majority of Village paths with platted easement.

Capital Cost Estimate
Washeterla Improvements

Item No.	Item	Unit	Unit Cost	No. Units	Sub Total
1	Prepare operators manual	LS	$3,000.00	1	$3,000
2	Operator training	LS	$1,600.00	1	$1,600
3	Refurbish green sand filter	LS	$5,000.00	1	$5,000
4	Seal well head	LS	$500.00	1	$500
5	Repair outfall line	LS	$2,500.00	1	$2,500
6	Install boiler raw water preheating system	LS	$12,000.00	1	$12,000
	Sub Total				$24,600
	Design engineering	%	0.15		$3,690
	Contingency	%	0.25		$6,150
	Local administration	%	0.08		$1,968
	TOTAL				$36,408

O&M Costs not estimated separately for this improvement as they are included in distribution options.

All Weather Watering Point & School Service Connect
Capital Cost Estimate

Item No.	Item	Unit	Unit Cost	No. Units	Sub Total
1	3" Arctic piping w/ht trace & return 1"	LF	$43.00	2,400	$103,200
2	Pipe accessories & bends	Ea	$600.00	5	$3,000
3	Valves and misc.	Ea	$300.00	6	$1,800
4	Joint kits	Ea	$25.00	120	$3,000
5	Pipe piling supports	Ea	$368.00	129	$47,472
6	Pipe hangers	Ea	$60.00	120	$7,200
7	Boiler units, main & backup	Ea	$8,000.00	2	$16,000
8	Construction equipment	Hr	$150.00	240	$36,000
9	Water point building	Ea	$6,000.00	1	$6,000
10	Electrical services	Ea	$4,800.00	3	$14,400
11	School service line	LF	$20.00	240	$4,800
12	Modifications to washeteria, mechanical & electrical	LS	$52,000.00	1	$52,000
13	Labor	Hr	$12.00	855	$10,260
14	Superintendent	Hr	$35.00	438	$15,330
15	Freight cost	LS	$24,800.00	1	$24,800
	Sub Total				$345,262
	Design engineering	%	0.10		$34,526
	Project Administration	%	0.12		$41,431
	Contingency	%	0.25		$86,316
	TOTAL				**$507,535**

All Weather Watering Point & School Service Connect
O&M Cost Estimate
Annual

Item No.	Item	Unit	Unit Cost	No. Units	Sub Total
1	WTP maintenance, water treatment	Gal	$0.11	681,525	$74,968
2	Replacement parts for water line	LS	$1,000.00	1	$1,000
3	Pump electrical cost	Kw	$0.38	758	$288
4	Fuel for water point, recirculating heat	Gal	$1.75	1,050	$1,838
5	Labor for watering point maintenance	Hr	$12.00	192	$2,304
6	**Sub Total**				$80,397
	Contingency	%	0.20		$16,079
	Local Administration	%	0.08		$6,432
	TOTAL				$102,909
	Cost per gallon of water at watering point =				$0.15
	Average monthly cost/residence =				$67.95
	Average cost to school/month (9 months/year) =				$8,412.67

Assumptions:
Actual water cost 1992 at WTP = $0.14/gallon assume incr. useage reduces unit cost.
School usage 2,600 gpd - 9 months of year, 5 days/week
New village usage = 39 homes x 5 people/home x 3.0 gpd = 585 gpd
Utility self-power electricity rate

Summer Distribution System
Capital Cost

Item No.	Item	Unit	Unit Cost	No. Units	Sub Total
1	3" HDPE pipe and fittings	LF	$3.75	4,000	$15,000
2	Flow meters and valves	LS	$10,500.00	1	$10,500
3	Freight and equipment rental	LS	$7,000.00	1	$7,000
4	Water supply points	Ea	$2,000.00	4	$8,000
5	Labor	Hr	$12.00	800	$9,600
6	Superintendent	Hr	$35.00	200	$7,000
7	WTP modification	LS	$24,000.00	1	$24,000
	Sub Total				$81,100
	Design engineering	%	0.15		$12,165
	Contingency	%	0.25		$20,275
	Local administration	%	0.08		$6,488
	TOTAL				$120,028

Summer Distribution System
O&M Cost
Annual

Item No.	Item	Unit	Unit Cost	No. Units	Sub Total
1	Line maintenance	Hr	$12.00	156	$1,872
2	WTP water costs	Gal	$0.11	146,250	$16,088
3	Repair & replacement parts & equipment	LS	$1,000.00	1	$1,000
4	Electrical power	Kw	$0.38	52	$20
	Sub Total				$18,979
	Contingency	%	0.20		$3,796
	Local administration	%	0.08		$1,518
	TOTAL				$24,293
	Cost per residence (monthly for 5 mos/yr) =				$69

Assumptions:
3.0 gpd/capita consumption rate
New village utilizes extension of all weather watering point, and is included in above calculation
$0.166 per gallon treated and delivered water cost
Average use per home = 405 gallons per month

Waste Disposal Tundra Pond Lagoon
Capital Cost

Item No.	Item	Unit	Unit Cost	No. Units	Sub Total
1	Fence materials	LF	$20.00	1,860	$37,200
2	Platform	LS	$3,500.00	1	$3,500
3	Labor	Hr	$12.00	240	$2,880
4	Superintendent	Hr	$35.00	80	$2,800
5	Freight	LF	$3.10	1,860	$5,766
6	Equipment	Hr	$50.00	65	$3,250
	Sub Total				$55,396
	Contingency	%	0.25		$13,849
	Local administration	%	0.08		$4,432
	TOTAL				$73,677

Assumptions:
Use of tundra pond lagoon without earthwork modifications for haul type systems only.

Pressurized Water Distribution System
Capital Cost

Item No.	Item	Unit	Unit Cost	No. Units	Sub Total
1	4" arctic pipe main w/ht trace &1" return	LF	$45.00	12,000	$540,000
2	Boiler units - main and back-up	Ea	$9,000.00	2	$18,000
3	Pumps & pump controls	Ea	$4,500.00	2	$9,000
4	Pipe supports & hangers	Ea	$214.00	800	$171,200
5	Electrical services	LF	$2.00	12,000	$24,000
6	Water service connections	Ea	$3,450.00	76	$262,200
7	Valves, shut off	Ea	$250.00	19	$4,750
8	Valves, check	Ea	$250.00	3	$750
9	Arctic manholes	Ea	$5,000.00	27	$135,000
10	Labor	Hr	$12.00	4,224	$50,688
11	Superintendent	Hr	$35.00	1,056	$36,960
12	Freight	LF	$10.00	12,000	$120,000
13	Misc. freight	LS	$5,000.00	1	$5,000
14	Additional water storage tank	LS	$175,000.00	1	$175,000
15	Washeteria modifications	LS	$25,000.00	1	$25,000
	Sub Total				$1,577,548
	Design engineering	%	0.10		$157,755
	Contingency	%	0.25		$394,387
	Local administration	%	0.08		$126,204
	TOTAL				$2,255,894

Assumptions:
54 gpd/capita water consumption
Water and wastewater piping use same support, installed at same time
Utilidor is placed on piling support
Water main is dual pipe recirculating
Interior house plumbing is not modified

Pressurized Water Distribution System
O&M Cost Estimate
Annual

Item No.	Item	Unit	Unit Cost	No. Units	Sub Total
1	Full time operator	Hr	$15.00	2,080	$31,200
2	Treatment chemicals	LS	$12,000.00	1	$12,000
3	Electric power	Kw	$0.38	19,000	$7,220
4	Boiler Fuel	Gal	$1.75	6,050	$10,588
5	Insurance	LS	$6,000.00	1	$6,000
6	Equipment replacement	LS	$16,000.00	1	$16,000
7	Water sampling	LS	$2,500.00	1	$2,500
	Sub Total				$85,508
	Contingency	%	0.25		$21,377
	Local administration	%	0.08		$6,841
	TOTAL				$113,725
	Cost per user per month =				$125

Assumptions:
54 gpd/capita water use
155 gpm peak flow rate
Recirculating water line
Utility self-power electricity rate

Pressurized Sewer System
Capital Cost

Item No.	Item	Unit	Unit Cost	No. Units	Sub Total
1	3" Arctic pipe main w/ht trace	LF	$41.50	12,000	$498,000
2	Pipe supports & hangers	Ea	$214.00	800	$171,200
3	Service pipe, grinder pump, control,tank	Ea	$4,100.00	70	$287,000
4	3" check valve	Ea	$200.00	19	$3,800
5	Shut off valves	Ea	$200.00	5	$1,000
6	Arctic manholes	Ea	$5,000.00	30	$150,000
7	Sewage lagoon improvements	LS	$175,000.00	1	$175,000
8	Collection stations	Ea	$30,500.00	2	$61,000
9	Labor	Hr	$12.00	4,224	$50,688
10	Superintendent	Hr	$35.00	1,056	$36,960
11	Freight	LF	$10.00	12,000	$120,000
	Sub Total				$1,554,648
	Design engineering	%	0.10		$155,465
	Contigency	%	0.25		$388,662
	Local administration	%	0.08		$124,372
	TOTAL				$2,223,147

Assumptions:
54 gpd/capita waste generation
Water and wastewater piping on same support, installed at same time
Force main from school to lagoon is installed @ $772,482

Pressurized Sewer System
O&M Cost
Annual

Item No.	Item	Unit	Unit Cost	No.	Sub Total
1	Full time operator	Hr	$15.00	2,080	$31,200
2	Equipment replacement	LS	$16,000.00	1	$16,000
3	Collection pump power	Kw	$0.38	3,200	$1,216
4	Heat trace power	Kw	$0.38	10,500	$3,990
	Sub Total				$52,406
	Contingency	%	0.25		$13,102
	Local administration	%	0.08		$4,192
	TOTAL				$69,700
	Cost per user per month =				$76

Assumptions:
Each user provides electricty for individual grinder pump
Utility self-power electricity rate

Vacuum Sewer System
Capital Cost

Item No.	Item	Unit	Unit Cost	No. Units	Sub Total
1	4" main arctic pipe w/ heat tract	LF	$41.50	11,500	$477,250
2	Pipe supports & hangers	Ea	$214.00	800	$171,200
3	1.25" service connect line	Ea	$1,700.00	70	$119,000
4	Unit plumbing fixtures	Ea	$1,800.00	70	$126,000
5	Interface valve, controls, elec	Ea	$1,500.00	70	$105,000
6	Shut off valves	Ea	$200.00	14	$2,800
7	Arctic manholes	Ea	$3,200.00	30	$96,000
8	Vacuum pump station	Ea	$200,000.00	1	$200,000
9	Sewage lagoon improvements	LS	$175,000.00	1	$175,000
10	Labor	Hr	$12.00	4,224	$50,688
11	Superintendent	Hr	$35.00	1,056	$36,960
12	Freight	LF	$10.00	11,500	$115,000
	Sub Total				$1,674,898
	Design engineering	%	0.10		$167,490
	Contigency	%	0.25		$418,725
	Local administration	%	0.08		$133,992
	TOTAL				$2,395,104

Assumptions:
54 gpd/capita waste generation
Water and sewer lines on shared support, installed at same time
Force main from school to lagoon is installed at $772,482

Vacuum Sewer System
O&M Cost
Annual

Item No.	Item	Unit	Unit Cost	No.	Sub Total
1	Line repair & parts	LS	$5,000	1	$5,000
2	Replace pump unit core (5 year life)	Ea	$15,000	1	$15,000
3	Vacuum pump power	Kw	$0.38	9,800	$3,724
4	Maintenance labor	Hr	$15.00	2,080	$31,200
5	Heating fuel	Gal	$1.75	2,000	$3,500
	Sub Total				$58,424
	Contingency	%	0.25		$14,606
	Local administration	%	0.08		$4,674
	TOTAL				$77,704
	Cost per user per month =				$91

Assumption:
Utility self-power electricity rate

Sewage Force Main
Scool Location to Lagoon
Capital Cost

Item No.	Item	Unit	Unit Cost	No. Units	Sub Total
1	3" Arctic pipe force main	LF	$30.00	4,080	$122,400
2	Joint kits	Ea	$25.00	204	$5,100
3	Pile supports	Ea	$368.00	272	$100,096
4	Hangers	Ea	$60.00	265	$15,900
5	Electrical services	LF	$10.00	4,080	$40,800
6	Heat traces	LF	$5.00	4,080	$20,400
7	Bends & fittings	LS	$8,000.00	1	$8,000
8	Lift station	Ea	$50,000.00	1	$50,000
9	Equipment	Hr	$150.00	620	$93,000
10	Superintendent	Hr	$40.00	360	$14,400
11	Specialty labor	Hr	$50.00	80	$4,000
12	Labor	Hr	$12.00	1,604	$19,248
13	Freight	LS	$41,000.00	1	$41,000
	Sub Total				$534,344
	Design engineering	%	0.15		$80,152
	Contingency	%	0.25		$133,586
	Local administration	%	0.08		$42,748
	TOTAL				$790,829

Sewage Force Main - School Location to Lagoon
Village and School Use
O&M Costs
Annual

Item No.	Item	Unit	Unit Cost	No. Units	Sub Total
1	Line repair & parts	LS	$4,000.00	1	$4,000
2	Replace pump (5 year life)	Ea	$1,000.00	1	$1,000
3	Pump power	Kw	$0.38	6,250	$2,375
4	Maintenance Labor	Hr	$12.00	520	$6,240
5	Heat trace operation	Kw	$0.38	13,219	$5,023
5	Heating fuel	Gal	$1.75	1,200	$2,100
	Sub Total				$20,738
	Contingency	%	0.25		$5,185
	Local administration	%	0.08		$1,659
	TOTAL				$27,582
	School monthly rate based on 55% of use				$1,263
	Per family monthly rate=				$15

NOTE:
Above figures represent flow rate associated with COWATER(FTH) system for home use.
Per month family rate would apply if haul truck utilized force main as dump station reducing haul travel time.
School figure may require adjustment based on actual metered water usage.

Honey Bucket Haul (HBH) System
Capital Cost

Item No.	Item	Unit	Unit Cost	No. Units	Sub Total
1	Collection stations	Ea	$2,800.00	8	$22,400
2	Winter haul vehicles	Ea	$9,000.00	2	$18,000
3	Summer haul vehicles	Ea	$5,000.00	2	$10,000
4	Collection trailer	Ea	$4,000.00	2	$8,000
5	Vehicle storage facility	LS	$20,000.00	1	$20,000
6	Wash equipment	LS	$4,000.00	1	$4,000
7	Operator training (O&M)	LS	$5,000.00	1	$5,000
8	Freight	LS	$11,000.00	1	$11,000
	Sub Total				$98,400
	Design engineering	%	0.15		$14,760
	Contingency	%	0.25		$24,600
	Local administration	%	0.08		$7,872
	TOTAL				**$145,632**

Assumes tundra pond lagoon and complete boardwalk system is in place.

Honey Bucket Haul (HBH) System
O&M Cost
Annual

Item No.	Item	Unit	Unit Cost	No.	Sub Total
1	Haul operator	Hr	$12	2,920	$35,040
2	Vehicle fuel	Gal	$3	3,855	$9,638
3	Equipment repair	LS	$800	1	$800
4	Equipment replacement	LS	$7,280	1	$7,280
5	Heating fuel (vehicle storage facility)	Gal	$2	300	$525
	Sub Total				$53,283
	Contingency	%	0.25		$13,321
	Local administration	%	0.08		$4,263
	TOTAL				$70,866
	cost per trip=				$18
	est. cost per avg. residence per mo. =				$88

Analysis assumptions:
Waste rate = 2.6 gpd/capita
Haul container = 80 gallons
Haul time = 45 minutes
Vehicle life = 5 years

COWATER (FTH) System Capital Costs All Buildings In Village					
Item No.	**Item**	**Unit**	**Unit Cost**	**No. Units**	**Sub Total**
1	External tank system	Ea	$6,800.00	29	$197,200
2	External tank with second pump	Ea	$7,400.00	47	$347,800
3	Modification to old buildings	Ea	$1,800.00	47	$84,600
4	Modification to new buildings	Ea	$800.00	29	$23,200
5	Summer haul vehicles	Ea	$5,000.00	2	$10,000
6	Winter haul vehicles	Ea	$9,000.00	2	$18,000
7	Sewage tanks and blowers	Ea	$5,200.00	2	$10,400
8	Water tanks and blowers	Ea	$5,300.00	2	$10,600
9	Vehicle storage facility	Ea	$20,000.00	1	$20,000
11	Freight	LS	$22,000.00	1	$22,000
12	Operator and administrative training	LS	$17,000.00	1	$17,000
13	Wash equipment	LS	$4,000.00	1	$4,000
	Sub Total				**$764,800**
	Engineering design	%	0.10		$76,480
	Contingency	%	0.15		$114,720
	Local administration	%	0.08		$61,184
	TOTAL				**$1,017,184**

NOTE:
Above estimate assumes complete boardwalk and lagoon improvements are in place as a condition of implementing a haul system

COWATER (FTH) System Water and Sewage O&M Cost Annual					
Item No.	**Item**	**Unit**	**Unit Cost**	**No. Units**	**Sub Total**
1	Haul operator	Hr	$12.00	2,375	$28,500
2	Maintenance	Hr	$12.00	90	$1,080
3	Repairs	LS	$500.00	1	$500
4	Vehicle fuel	Gal	$2.50	1,500	$3,750
5	Heating fuel (vehicle storage facility)	Gal	$1.75	300	$525
6	Vehicle & equipment replacement	LS	$5,600.00	1	$5,600
	Sub Total				**$39,955**
	Contingency	%	0.15		$5,993
	Local administration	%	0.08		$3,196
	***TOTAL**				**$49,145**
	**Cost per trip (water haul) =				$26
	Cost per trip (sewage haul) =				$18
	Estimated monthly cost per home =				$174

Assumptions:
3 gpd per capita water use.
Average household size = 4.5 people with 4 haul trips per month.
40 minute round trip haul time assumed, cost will reduce if less haul time is realized.
Small electrical amounts are required to operate pump and heat trace in a storage unit estimtated at $3.00 per month.
* Total applies separately to water and sewage hauls
** Water haul includes water charge at $.12 per gallon.

Gravity Collection System 12 Homes, Community Hall, Clinic & Store Capital Cost					
Item No.	**Item**	**Unit**	**Unit Cost**	**No. Units**	**Sub Total**
1	6"/14" Arctic pipe	LF	$65.00	1,885	$122,525
2	4 "/12" Arctic pipe	LF	$41.50	800	$33,200
3	Joint kits	Ea	$70.00	95	$6,650
4	Pipe supports	Ea	$386.00	179	$69,094
5	Hangers	Ea	$60.00	179	$10,740
6	Electric service	LF	$10.00	2,685	$26,850
7	Equipment	Hr	$150.00	430	$64,500
8	Labor	Hr	$12.00	1,120	$13,440
9	Superintendent	Hr	$40.00	250	$10,000
10	Freight	LS	$20,000.00	1	$20,000
	Sub Total				$376,999
	Design engineering	%	0.15		$56,550
	Contingency	%	0.25		$94,250
	Local administration	%	0.08		$30,160
	TOTAL				$557,959

Gravity Main O&M Costs Annual					
Item No.	**Item**	**Unit**	**Unit Cost**	**No. Units**	**Sub Total**
1	Line repair and parts	LS	$2,600.00	1	$2,600
2	Maintainance Labor	Hr	$12.00	160	$1,920
3	Heat trace Power	Kw	$0.38	8,699	$3,306
	Sub Total				$7,826
	Contingency	%	0.25		$1,956
	Local administration	%	0.08		$626
	TOTAL				$10,408
	*Est. monthly rate per unit connected=				$74

*Includes force main delivery charge to lagoon.

Solid Waste Site Capital Costs					
Item No.	Item	Unit	Unit Cost	No. Units	Sub Total
1	Movable fencing*	LF	$12.00	480	$5,760
2	Burn box	Ea	$7,500.00	1	$7,500
3	Dozer JD-350	Ea	$50,000.00	1	$50,000
4	Storage trailer	Ea	$3,500.00	1	$3,500
5	Freight, LS,	Ea	$7,500.00	1	$7,500
6	Labor	Hr	$12.00	120	$1,440
7	Superintendent	Hr	$35.00	40	$1,400
	SubTotal				$77,100
	Design engineering & permitting	%	0.15		$11,565
	Contingency	%	0.25		$19,275
	Local administration	%	0.08		$6,168
	TOTAL				$114,108

Solid Waste Site O&M Costs Annual					
Item No.	Item	Unit	Unit Cost	No.	Sub Total
1	Burning	Hrs	$12.00	8	$4,992
2	Police site	Hrs	$12.00	2	$1,248
3	Dozer	Hrs	$50.00	2	$5,200
	SubTotal				$11,440
	Contingency	%	$0.20		$2,288
	Local administration	%	$0.08		$915
	TOTAL				$14,643
	Cost per residence mo.				$13
	Cost without dozer option				$5

Assumptions:
6 commercial users are charged $50 per mo. flat rate.

Abandon Honey Bucket Bunkers (20) Capital Cost					
Item No.	**Item**	**Unit**	**Unit Cost**	**No. Units**	**Sub Total**
1	Lime	Lbs	$0.30	5,000	$1,500
2	Filter fabric	SYd	$4.00	540	$2,160
3	Sand	CYd	$120.00	190	$22,800
4	Labor	Hr	$12.00	190	$2,280
5	Superintendent	Hr	$35.00	320	$11,200
6	Training	Hr	$12.00	12	$144
7	Equipment	Hr	$50.00	200	$10,000
	Sub Total				$50,084
	Contingency	%	0.20		$10,017
	Local administration	%	0.08		$4,007
	TOTAL				$64,108

APPENDIX B
SCHOOL WATER USAGE CALCULATIONS

School Water Usage Calculations (1993)

Item No.	Fixture Item	Unit	Fixture Value	No. Units	Fixture Units
1	Water closet	Ea	5	7	35
2	Lavatories	Ea	2	6	12
3	Urinal	Ea	5	1	5
4	Showers	Ea	4	13	52
5	Washer	Ea	5	1	5
6	Laundry tub	Ea	4	1	4
	Total				113

94 students x 21.1 gpd (EPA) = 1,983 gpd
8 resident teachers x 75 gpd (EPA) = 600 gpd
TOTAL = 2,583 gpd

Peak water demand estimates:
at 35 psi = 53 gpm
at 20 psi = 40 gpm
Design assumption of 40 + 10 gpm
Design flow rate for water point = 50 gpm

APPENDIX C
WASHETERIA EXPENSE RECORDS

From Interview with Lucy Enoch, Bookkeeper
Fiscal Year 1992, January-December

Electrical consumption = 13,810 kwh @ $0.38/kwh	$ 5,247.80
Heating fuel = 4,000 gallons @ $1.219/gallon	4,876.00
Employee wages, gross	26,662.71
Telephone bills	248.47
Insurance	6,000.00
Equipment*	4,140.00
Treatment chemicals	1,379.00
Water samples	262.00
Cleaning chemicals	80.28
TOTAL COST TO OPERATE	$48,896.26
Income	$27,435.00

Total gallons water treated = 358,439
Cost per gallon water = $0.14

* Does not include expenses in 1992 for initial start-up of washing machine and initial phone installation.

APPENDIX D
WATER QUALITY DATA

NORTHERN TESTING LABORATORIES, INC.

3330 INDUSTRIAL AVENUE FAIRBANKS, ALASKA 99701 (907) 456-3116 • FAX 456-3125
2505 FAIRBANKS STREET ANCHORAGE, ALASKA 99503 (907) 277-8378 • FAX 274-9645

Eagle River Engineering
P.O. Box 773294
Eagle River AK 99577

Attn: Louis Butera

Report Date: 07/08/93

Date Arrived: 06/17/93
Date Sampled: 06/16/93
Time Sampled: 1254
Collected By: LB

* Definitions *
B = Below Regulatory Min.
H = Above Regulatory Max.
E = Estimated Value
M = Matrix Interference
D = Lost to Dilution
MDL = Method Detection Limit

Our Lab #: A124182
Location/Project: Tuntutatuliak
Your Sample ID: Washeteria
Sample Matrix: Water
Comments: SAMPLED AFTER WELL FLOW TESTING

Lab Number	Method	Parameter	Units	Result	*	MDL	Date Prepared	Date Analyzed
A124182	EPA 110.2	Color, Apparent	Unit	110	H	5		06/18/93
A124182	EPA 150.1	pH	Unit	7.8				06/17/93
A124182	EPA 160.1	Total Dissolved Solids	mg/l	290		1		06/18/93
A124182	EPA 170.1	Temperature	Deg F	20.0				06/24/93
A124182	EPA 215.2	Calcium as CaCO3	mg/l	150		0.5		06/24/93
A124182	EPA 310.1	Alkalinity as CaCO3	mg/l	240		1		06/24/93
A124182	EPA 340.2	Fluoride	mg/l	<MDL		0.4		06/28/93
A124182	EPA 353.3	Nitrate-N	mg/L	<MDL		0.1		06/22/93
A124182	EPA 354.1	Nitrite	mg/l	<MDL		0.1		06/18/93
A124182	SM203	Corrosivity		0.9				06/28/93

Susan C. Tifental

Reported By: Susan C. Tifental
Microbiology Supervisor

NORTHERN TESTING LABORATORIES, INC.
3330 INDUSTRIAL AVENUE FAIRBANKS, ALASKA 99701 907-456-3116
2505 FAIRBANKS ST. ANCHORAGE, ALASKA 99503 907-277-8378

Eagle River Engineering Service
PO Box 773294
Eagle River AK 99577

Attn: Louis Butera

Report Date: 07/06/93

Date Arrived: 06/21/93
Date Sampled: 06/16/93
Time Sampled: 1254
Collected By: LB

MDL = Method Detection Limit

* Flag Definitions
B = Below Regulatory Min.
H = Above Regulatory Max.

Our Lab #: F125328
Location/Project: A123182
Your Sample ID: Washeteria Tuntutatuliak
Sample Matrix: Water
Comments:

Method	Parameter	Units	Results	*	MDL	Date Prepared	Date Analyzed
EPA 200.7	Aluminum	mg/l	<MDL		0.003		06/24/93
	Barium	mg/l	0.461		0.001		06/22/93
	Copper	mg/l	0.007		0.006		06/25/93
	Iron	mg/l	5.18	H	0.003		06/25/93
	Manganese	mg/l	0.070	H	0.001		06/28/93
	Sodium	mg/l	10.7		0.070		06/24/93
	Zinc	mg/l	<MDL		0.009		06/24/93
EPA 206.2	Arsenic	mg/l	0.040		0.005		06/25/93
EPA 213.2	Cadmium	mg/l	<MDL		0.0001		06/28/93
EPA 218.2	Chromium	mg/l	<MDL		0.001		06/26/93
EPA 245.1	Mercury	mg/l	<MDL		0.0002		06/22/93
EPA 270.2	Selenium	mg/l	<MDL		0.002		07/02/93
EPA 272.2	Silver	mg/l	<MDL		0.0001		06/23/93
EPA 300.0	Chloride	mg/l	6.44		1.20		06/28/93
	Sulfate	mg/l	<MDL		0.13		06/30/93

Patricia A. Woody
Reported By: Patricia A. Woody
Senior Chemist

CHEMICAL & GEOLOGICAL LABORATORY

A DIVISION OF COMMERCIAL TESTING & ENGINEERING CO.

5633 B STREET ANCHORAGE, ALASKA 99518 TELEPHONE (907) 562-2343 FAX: (907) 561-5301

REPORT of ANALYSIS

Chemlab Ref.# :93.1369-1
Client Sample ID :TUNTULIAK WASHETERIA
Matrix : WATER

Client Name	:EAGLE RIVER ENGINEERING	Collected	:04/01/93 @ 11:49 hrs.
Ordered By	:LOU BUTERA	Received	:04/02/93 @ 12:15 hrs.
Project Name	:	WORK Order	:64518
Project#	:	Report Completed	:
PWSID	:UA	Technical Director	:STEPHEN C. EDE
		Released By :	Stephen C. Ede

Sample Remarks: ROUTINE SAMPLE COLLECTED BY: L. BUTERA. SPECIAL SAMPLE

Parameter	Results	QC Qual.	Units	Method	Allowable Limits	Extract Date	Analysis Date	Init
INORGANIC CHEMICALS/TITLE 18	n/a		n/a	ASTM/EPA	n/a			
ARSENIC	0.005	U	mg/l	ASTM D2972/EPA 206.2	0.05 maximum	04/07/93	04/07/93	BMW
BARIUM	0.32		mg/l	EPA 200.7	1.0 maximum	04/06/93	04/07/93	DFL
CADMIUM	0.0050	U	mg/l	EPA 213.2	0.010 maximum	04/06/93	04/08/93	KAW
CHROMIUM	0.0050	U	mg/l	EPA 218.2	0.05 maximum	04/06/93	04/06/93	KAW
FLUORIDE	0.069		mg/l	SM16 413E	4.0 maximum	04/06/93	04/06/93	CMR
LEAD	0.0050	U	mg/l	EPA 239.2	0.05 maximum	04/06/93	04/06/93	KAW
MERCURY	0.0002	U	mg/l	SM14 301AVI	0.002 maximum	04/06/93	04/06/93	KAW
NITRATE-N	0.10		mg/l	EPA 353.2/300.0	10 maximum		04/07/93	LIH
SELENIUM	0.005	U	mg/l	ASTM D3859/EPA 270.2	0.01 maximum	04/07/93	04/08/93	BMW
SILVER	0.0010	U	mg/l	EPA 272.2	0.05 maximum	04/06/93	04/07/93	KAW
TURBIDITY	0.40		NTU	EPA 180.1	1.0 maximum		04/02/93	MCE

* See Special Instructions Above
** See Sample Remarks Above
U - Undetected, Reported value is the practical quantification limit.
D - Secondary dilution.

UA - Unavailable
NA - Not Analyzed
LT - Less Than
GT - Greater Than

NORTHERN TESTING LABORATORIES, INC.

3330 INDUSTRIAL AVENUE
2505 FAIRBANKS STREET

FAIRBANKS, ALASKA 99701
ANCHORAGE, ALASKA 99503

907-456-3116
907-277-8378

Drinking Water Analysis Report for Total Coliform Bacteria

TO BE COMPLETED BY CLIENT

☒ PUBLIC WATER SYSTEM I.D. #

☐ PRIVATE WATER SYSTEM

Eagle River Engineering
NAME

POB 773294
Mailing Address

Eagle River
City, State, Zip Code

SAMPLE DATE: 4 - 1 - 93 (Mo. Day Year) Phone 694-5795

Purchase Order No.

SAMPLE TYPE:

☒ Routine
☐ Special Purpose
☐ Check Sample (for original contaminated sample with lab reference no. ________)

☒ Treated Water
☐ Untreated Water

METHOD OF ANALYSIS:

☒ MF Membrane Filter
☐ MPN — Most Probable Number

TO BE COMPLETED BY LABORATORY

Received at: ☒ Anch. ☐ Fbks.

Date Received 04.02.93

Time Received 08:12

Date Analyzed 4.2.93

Time Analyzed 1600

Next Sample Due 5/93

COMMENTS:

SATISFACTORY	S
UNSATISFACTORY	U
RESAMPLE	R
OTHER BACTERIA	OB
TOO NUMEROUS TO COUNT	TNTC

Sample No.	Location	Time Collected	Collected by	Laboratory Ref. No.	Direct Count	Verification LSB	Verification BGB	Final Result*	Comments
1	fountain sink Washateria	11:50am	L Butera	AA11820	0	—		0	S
2									
3									
4									
5									
6									
7									
8									

Signature of Representative [signature]

*No. of Total Coliform Colonies per 100 mls.

Reported by [signature]

Date 4.3.93 1600

D-5

FOR LABORATORY USE ONLY					
CASH	CHARGE	PREPAID	TRANSMITTAL	SPECIAL INSTRUCTIONS	MAIL / HOLD FOR PICKUP

ADEC PUBLIC WATER SUPPLY PROGRAM
PWS FACILITY MASTER LIST

FACILITY INVENTORY

PWSID: **271211** status: A class: A district: 7 fileno:
ystem name: **TUNTUTULIAK WASHETERIA** system phone: 907-256-2529
AKA names: FAX:
addressee: TUNTUTULIAK COMMUNITY SERVICE
address: GENERAL DELIVERY
TUNTUTULIAK AK 99680

region: 2 certified op:
wner type: 6
svc connections: 1 vulnerable: N
residents: 300 regulator: S
non-resident pop: 0 system startup:
service cat: MU YK deactivate date:
strategy: Y survey date: 10/08/92
target: Y surveyor: TATE HAYMAN, PH
lab access: Y rmt vil id:
location: TUNTUTULIAK
comments: WATERING POINT/SAN SURVEY UPDATE 10-16-89.
SPOKE W/CASWELL PHS 2/13/91 AND HE SAID THAT THE SYSTEM WAS SHUTDOWN 2YRS AGO, BUT RESIDENTS MIGHT BE USING THE WELL, HE DID NOT KNOW. 03-11-92..Wally, RMW from YKHC informed us that the washeteria is now open to the public. I will write a letter to the comm assoc and inform them of their monitoring requirements.

associate names

OPER	MR JACOB DANIEL	PHONE: 907-256-2326
OWNER	TUNTUTULIAK COMMUNITY SERVICE GENERAL DELIVERY TUNTUTULIA AK 99680	PHONE:
OPER	MR. ROBERT ENAK	PHONE: 907-256-2529
COPY	OEH BETHEL	PHONE:

changedate: 04/05/93

PWS SOURCE LISTING
PWSID: **271211 TUNTUTULIAK WASHETERIA**
source.id: **001 PRIMARY SYSTEM SOURCE RECORD**

PWSID: 271211
source id: 001 source name: PRIMARY SYSTEM SOURCE RECORD
record type: S SOURCE
ource type: G Groundwater, Non-purchased

location:

status: A
fill & draw:
availability: P

seasonal start:
seasonal end:
purchased:

urbidity meter:

contam group	/ freq	contaminant name	/ freq
BACTIS*001	*	**NO CONTAM NAMES**	
INORGA*036	*		
RADIOA*048	*		
VOCTBG*003			
VOCTBG*003			
TABLEG*060			
NITRAT*012			
NITRIT*036			

treatment objectives		treatments	
F	IRON REMOVAL	560	PERMANGNATE
F	IRON REMOVAL	343	FILTRATION, GREENSAND
M	MANGANESE REMOVAL	343	FILTRATION, GREENSAND

storage: 20000
avgprod:
maxprod:
date drilled:
casing size:
case depth:

well depth:
grout depth:
pump cap:
intake type:
well yield:
change date: 04/19/93

BACTI SAMPLE HISTORY
PWSID: **271211** **TUNTUTULIAK WASHETERIA**
source.id: **001** **PRIMARY SYSTEM SOURCE RECORD**

SAMPLE DATE	TYPE	MTHD	RESULTS COLI	OB	HPC	LABNUM	ENTRY DATE	LOCATION
01/12/88	R	MF	OLD				01/29/88	
01/25/88	R	FT	0				02/09/88	
02/11/88	R	FT	0				03/07/88	
03/17/88	R	FT	0				04/07/88	
04/12/88	R	FT	0				05/11/88	
06/17/88	R	FT	0				07/11/88	
07/20/88	R	FT	0				08/05/88	
08/09/88	R	FT	0				09/01/88	
09/12/88	R	FT	0				10/11/88	
10/13/88	R	FT	0				10/28/88	
02/25/92	R	PA	0	0	NT		03/04/92	TREATMENT AREA SINK
05/07/92	R	PA	0	0	NT		05/26/92	TREATMENT AREA SINK
06/02/92	R	PA	0	0	NT		06/17/92	TREATMENT AREA - SIN
07/02/92	R	PA	0	0	NT		07/21/92	TREATMENT AREA SINK
08/04/92	R	PA	0	0	NT		08/14/92	TREATMENT AREA SINK
09/02/92	R	PA	0	0	NT		09/17/92	TREATMENT AREA SINK
10/02/92	R	PA	0	0	NT		10/13/92	TREATMENT AREA-SINK
10/09/92	R	PA	0	0	NT		10/23/92	WASHETERIA SINK
	R	PA	0	0	NT			CLINIC
11/04/92	R	PA	0	0	NT		11/16/92	TREATMENT AREA - SIN
12/02/92	R	PA	0	0	NT		12/15/92	TREATMENT AREA SINK
01/06/93	R	PA	0	0	NT		01/20/93	TREATMENT AREA SINK
02/02/93	R	PA	0	0	NT		02/08/93	TREATMENT AREA SINK
03/09/93	R	PA	0	0	NT		03/16/93	
04/05/93	R	PA	0	0	NT		04/19/93	TUNTUTULIAK AREA SIN

INORGANIC SAMPLE HISTORY
PWSID: **271211** **TUNTUTULIAK WASHETERIA**
source.id: **001** **PRIMARY SYSTEM SOURCE RECORD**

sample date : 11/12/91 sample type : S lab number : A115285
sample location : WELL SAMPLE

arsenic :	5	lead :	ND
barium :	319	mercury :	ND
cadmium :	ND	nitrate-n :	ND
chromium :	ND	selenium :	ND
fluoride :	ND	silver :	.7

--- others ---
comments :

sample date : 04/01/93 sample type : R lab number : 931369-1
sample location :

arsenic :	ND	lead :	ND
barium :	320	mercury :	ND
cadmium :	ND	nitrate-n :	100
chromium :	ND	selenium :	ND
fluoride :	69	silver :	

--- others ---
SILVER : ND TURBIDITY : .40 NTU
comments :

OPERATOR SAMPLE HISTORY
PWSID: **271211** **TUNTUTULIAK WASHETERIA**
source.id: **001** **PRIMARY SYSTEM SOURCE RECORD**

SAMPLE MONTH	TYPE	ENTRY DATE	TMCL VIOL	TMON DAYS	CMCL VIOL	CMON DAYS	FMCL VIOL	FMCL DAYS	CDAYS UNDER	2.OVER 5	AVG TRB	FDAYS NOT	AVG NTU
10		11/09/92			N	11	Y	2	11			2	
		COMMENTS : FMON DAYS <1.0											
01		02/12/93			N	13			13				
02		03/12/93			N	12			12				
03		04/19/93			N	15			15				

ORGANIC SAMPLE HISTORY

PWSID: **271211** **TUNTUTULIAK WASHETERIA**

source.id: **001** **PRIMARY SYSTEM SOURCE RECORD**

sample date : 11-12-91 labnum : A115285

TTHM : ND
1,2,dichloroethane : ND
1.4.dichlorobenzene : ND
trichloroethane : ND
1,1,1-trichloroethane : ND
1,1,dichloroethylene : ND
vinyl chloride : ND

comments :

sample date : 11-30-92 labnum : 926579-1

TTHM : ND
1,2,dichloroethane : ND
1.4.dichlorobenzene : ND
trichloroethane : ND
1,1,1-trichloroethane : ND
1,1,dichloroethylene : ND
vinyl chloride : ND

comments :

NORTHERN TESTING LABORATORIES, INC.
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Yukon Kuskokwim Health Corporation
P.O. Box 528
Bethel AK 99559

Report Date: 11/25/91

Date Arrived: 11/14/91
Date Sampled: 11/12/91
Time Sampled: 1510
Collected By: WW

Attn: Wally Wallace

Definitions
MDL = Method Detection Limit
B = Below Regulatory Min.
H = Above Regulatory Max.
E = Below Detection Limit Estimated Value

Our Lab #: A115285
Location/Project: Tuntutuliak
Your Sample ID: Well Sample
Sample Matrix: Water
Comments: WASHETERIA

Lab Number	Method	Parameter	Units	Result	Flag	MDL	Date Analyzed
A115285	EPA 200.7	Barium	mg/l	0.319		0.002	11/18/91
A115285	EPA 206.2	Arsenic	mg/l	0.005		0.001	11/18/91
A115285	EPA 213.2	Cadmium	mg/l	<MDL		0.0001	11/15/91
A115285	EPA 218.2	Chromium	mg/l	<MDL		0.001	11/19/91
A115285	EPA 239.2	Lead	mg/l	<MDL		0.001	11/20/91
A115285	EPA 245.1	Mercury	mg/l	<MDL		0.0002	11/20/91
A115285	EPA 270.2	Selenium	mg/l	<MDL		0.002	11/21/91
A115285	EPA 272.2	Silver	mg/l	0.0007		0.0002	11/18/91
A115285	EPA 340.2	Fluoride	mg/l	<MDL		0.5	11/19/91
A115285	EPA 353.3	Nitrate-N	mg/l	<MDL		0.1	11/16/91
A115285	EPA 502.2	Benzene	ug/l	<MDL		0.2	11/18/91
		Bromobenzene	ug/l	<MDL		0.3	
		Bromochloromethane	ug/l	<MDL		0.3	
		Bromodichloromethane	ug/l	<MDL		0.2	
		Bromoform	ug/l	<MDL		1.0	
		Bromomethane	ug/l	<MDL		2.0	
		n-Butylbenzene	ug/l	<MDL		0.3	
		sec-Butylbenzene	ug/l	<MDL		0.3	
		tert-Butylbenzene	ug/l	<MDL		0.5	
		Carbon Tetrachloride	ug/l	<MDL		0.2	
		Chlorobenzene	ug/l	<MDL		0.2	

William E. Buchan
Reported By: William E. Buchan
Anchorage Operations Manager

NORTHERN TESTING LABORATORIES, INC.

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Lab Number	Method	Parameter	Units	Result	Flag	MDL	Date Analyzed
A115285	EPA 502.2	Dibromochloromethane	ug/l	<MDL		0.4	11/18/91
		Chloroethane	ug/l	<MDL		2.0	
		Chloroform	ug/l	<MDL		0.2	
		Chloromethane	ug/l	<MDL		2.0	
		o-Chlorotoluene	ug/l	<MDL		0.3	
		p-Chlorotoluene	ug/l	<MDL		0.2	
		1,2-Dibromo-3-Chloropropane	ug/l	<MDL		2.0	
		Dibromomethane	ug/l	<MDL		0.4	
		1,4-Dichlorobenzene	ug/l	<MDL		0.2	
		m-Dichlorobenzene	ug/l	<MDL		0.2	
		o-Dichlorobenzene	ug/l	<MDL		0.2	
		Dichlorodifluoromethane	ug/l	<MDL		2.0	
		1,1-Dichloroethane	ug/l	<MDL		0.2	
		1,2-Dichloroethane	ug/l	<MDL		0.2	
		1,1-Dichloroethylene	ug/l	<MDL		1.0	
		cis-1,2-Dichloroethylene	ug/l	<MDL		0.2	
		trans-1,2-Dichloroethylene	ug/l	<MDL		0.2	
		Methylene Chloride	ug/l	<MDL		1.0	
		1,2-Dichloropropane	ug/l	<MDL		0.2	
		1,3-Dichloropropane	ug/l	<MDL		0.2	
		2,2-Dichloropropane	ug/l	<MDL		1.0	
		1,1-Dichloropropene	ug/l	<MDL		0.5	
		1,3-Dichloropropene	ug/l	<MDL		0.2	
		Ethylbenzene	ug/l	<MDL		0.2	
		1,2-Dibromoethane	ug/l	<MDL		1.0	
		Trichlorofluoromethane	ug/l	<MDL		0.5	
		Hexachlorobutadiene	ug/l	<MDL		0.3	
		Isopropylbenzene	ug/l	<MDL		0.3	
		p-Isopropyltoluene	ug/l	<MDL		0.3	
		Naphthalene	ug/l	<MDL		0.3	
		n-Propylbenzene	ug/l	<MDL		0.3	

William E. Buchan

Reported By: William E. Buchan
Anchorage Operations Manager

NORTHERN TESTING LABORATORIES, INC.
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Lab Number	Method	Parameter	Units	Result	Flag	MDL	Date Analyzed
A115285	EPA 502.2	Styrene	ug/l	<MDL		0.2	11/18/91
		1,1,1,2-Tetrachloroethane	ug/l	<MDL		0.2	
		1,1,2,2-Tetrachloroethane	ug/l	<MDL		0.2	
		Tetrachloroethylene	ug/l	<MDL		0.3	
		Total Trihalomethane	ug/l	<MDL		0.2	
		Toluene	ug/l	<MDL		2	
		1,2,3-Trichlorobenzene	ug/l	<MDL		0.3	
		1,2,4-Trichlorobenzene	ug/l	<MDL		0.3	
		1,1,1-Trichloroethane	ug/l	<MDL		0.3	
		1,1,2-Trichloroethane	ug/l	<MDL		0.2	
		Trichloroethylene	ug/l	<MDL		0.4	
		1,2,3-Trichloropropane	ug/l	<MDL		0.2	
		1,2,4-Trimethylbenzene	ug/l	<MDL		0.3	
		1,3,5-Trimethylbenzene	ug/l	<MDL		0.2	
		Vinyl Chloride	ug/l	<MDL		0.2	
		m,p-Xylenes	ug/l	<MDL		2.0	
		o-Xylene	ug/l	<MDL		0.4	
		Surrogate Spike (Recovery)	%	115.0		0.2	

William E. Buchan

Reported By: William E. Buchan
Anchorage Operations Manager

CHEMICAL & GEOLOGICAL LABORATORIES OF ALASKA, INC.
P.O. BOX 4-1276
ANCHORAGE, ALASKA 99509
5633 "B" STREET
TELEPHONE (907) 279-4014

ANALYTICAL REPORT

CUSTOMER Alaska Area Native Health Service SAMPLE LOCATION: Tuntuliak, Alaska

DATE COLLECTED 2-28-79 TIME COLLECTED: ----

SAMPLED BY ---- SOURCE Water Well

REMARKS

FOR LAB USE ONLY
RECVD.BY GY LAB # 9851-1
DATE RECEIVED 3-5-79
DATE COMPLETED 3-8-79
DATE REPORTED 3-8-79
SIGNED Archie L. Green

	mg/l		mg/l		mg/l
Ag, Silver	<0.05	[]P, Phosphorous	1.7	[]Cyanide	
Al, Aluminum	0.3	[]Pb, Lead	<0.05	[]Sulfate	<1
As, Arsenic	0.2	[]Pt, Platinum	<0.1	[]Phenol	
Au, Gold	<0.1	[]Sb, Antimony	<0.1	[]Total Dissolved Solids	250
B, Boron	<0.1	[]Se, Selenium	<0.1	[]Total Volatile Solids	
Ba, Barium	0.6	[]Si, Silicon	17	[]Suspended Solids	
Bi, Bismuth	<0.1	[]Sn, Tin	0.7	[]Volatile Suspended Solids	
Ca, Calcium	51	[]Sr, Strontium	0.3	[]Hardness as $CaCO_3$	270
Cd, Cadmium	<0.01	[]Ti, Titanium	<0.1	[]Alkalinity as $CaCO_3$	240
Co, Cobalt	<0.05	[]W, Tungsten	<0.1	[]	
Cr, Chromium	<0.05	[]V, Vanadium	<0.1	[]	
Cu, Copper	<0.1	[]Zn, Zinc	0.1	[]	
Fe, Iron	50	[]Zr, Zirconium	<0.1	[]	
Hg, Mercury	<0.1	[]Ammonia Nitrogen-N		* * * * * *	
K, Potassium	1	[]Kjedahl Nitrogen-N		[]mmhos Conductivity	390
Mg, Magnesium	9.9	[]Nitrate-N		[]pH Units	6.7
Mn, Manganese	0.53	[]Nitrite-N		[]Turbidity NTU	
Mo, Molybdenum	<0.05	[]Phosphorus (Ortho)-P		[]T.Coliform/100ml	
Na, Sodium	7	[]Chloride	12	[]	
Ni, Nickel	<0.1	[]Fluoride		[]	

CHEMICAL & GEOLOGICAL LABORATORIES OF ALASKA, INC.

TELEPHONE (907) 279-4014

P.O. BOX 4-1276 ANCHORAGE, ALASKA 99509

5633 "B" STREET

ANALYTICAL REPORT

R Alaska Area Native Health Service SAMPLE LOCATION: Tuntutuliak, Alaska

COLLECTED ---- TIME COLLECTED: ----

ED BY S. St.Anthony SOURCE Well #7-23-79

rS ---

FOR LAB USE ONLY	
RECVD.BY	SE
LAB #	1170
DATE RECEIVED	8-2-79
DATE COMPLETED	8-3-79
DATE REPORTED	8-6-79
SIGNED	Archie L. Green

	mg/l		mg/l		mg/l
,Silver	<0.05	[]P,Phosphorous	0.6	[]Cyanide	
,Aluminum	<0.05	[]Pb,Lead	<0.05	[]Sulfate	<3
,Arsenic	<0.1	[]Pt,Platinum	<0.1	[]Phenol	
,Gold	<0.01	[]Sb,Antimony	<0.01	[]Total Dissolved Solids	205
,Boron	0.02	[]Se,Selenium	<0.1	[]Total Volatile Solids	
,Barium	0.3	[]Si,Silicon	14	[]Suspended Solids	
,Bismuth	<0.05	[]Sn,Tin	<0.1	[]Volatile Suspended Solids	
Ca,Calcium	41	[]Sr,Strontium	0.2	[]Hardness as $CaCO_3$	168
Cd,Cadmium	<0.01	[]Ti,Titanium	<0.05	[]Alkalinity as $CaCO_3$	188
,Cobalt	<0.05	[]W,Tungsten	<0.05	[]	
Cr,Chromium	<0.05	[]V,Vanadium	<0.05	[]	
,Copper	<0.05	[]Zn,Zinc	0.11	[]	
,Iron	2.4	[]Zr,Zirconium	<0.05	[]	
,Mercury	<0.1	[]Ammonia Nitrogen-N		[]mmhos Conductivity	360
,Potassium	1.1	[]Kjedahl Nitrogen-N		[]pH Units	6.7
,gnesium	15	[]Nitrate-N		[]Turbidity NTU	
,nganese	0.05	[]Nitrite-N		[]Color Units	
lybdenum	<0.05	[]Phosphorus (Ortho)-P		[]T.Coliform/100ml	
lium	7.5	[]Chloride	10	[]	
el	<0.05	[]Fluoride		[]	

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CHEMICAL & GEOLOGICAL LABORATORIES OF ALASKA, INC.
TELEPHONE (907) 279-4014
P.O. BOX 4 1276 ANCHORAGE, ALASKA 99509 4640 BUSINESS PARK BLVD.

ANALYTICAL REPORT

Water Analysis(Facility) B.I.A. Water Well at Tuntatuliak

Date Collected: 4-21-72 Time Collected: — By: August Alexie

Source of Sample: Well drilled 12/64 by B.I.A.

Physical Observations, Remarks: clear when collected

[]		mg/l	Aluminum
[]		mg/l	Arsenic
[]		mg/l	Barium
[]		mg/l	Boron
[]		mg/l	Cadmium
[]	46.	mg/l	Calcium
[]		mg/l	Copper
[]		mg/l	Chromium-Total
[]		mg/l	Chromium-Tri
[]		mg/l	Chromium-Hex
[]	17.	mg/l	Iron-Total
[]		mg/l	Iron-Dissolved
[]		mg/l	Lead
[]	18.	mg/l	Magnesium
[]	.46	mg/l	Manganese
[]		mg/l	Mercury
[]		mg/l	Nickel
[]	2.4	mg/l	Potassium
[]	13	mg/l	Selenium
[]		mg/l	Sodium
[]		mg/l	Silver
[]		mg/l	Zinc

[]	452	mmhos	Conductivity
[]	7.2	units	pH
[]		mg/l	Ammonia Nitrogen-N
[]		mg/l	Kjedahl Nitrogen-N
[]		mg/l	Organic Nitrogen-N
[]	.4	mg/l	Nitrate(N)
[]		mg/l	Nitrite(N)
[]		mg/l	Phosphorus (Ortho)-P
[]		mg/l	Phosphorus (Total)-P
[]	7.0	mg/l	Chloride
[]	.2	mg/l	Fluoride
[]		mg/l	Cyanide
[]	.8	mg/l	Sulfate
[]		mg/l	Phenol
[]		mg/l	MBSA
[]		mg/l	BOD
[]		mg/l	COD
[]	247	mg/l	TD Solids
[]		mg/l	TV Solids
[]		mg/l	Suspended Solids
[]		mg/l	SV Solids
[]		JTU	Turbidity

[]	189	mg/l	Hardness as $CaCO_3$
[]	212	mg/l	Alkalinity as $CaCO_3$
[]		mg/l	Acidity-T as $CaCO_3$
[]		mg/l	Acidity Free as $CaCO_3$
[]		/100ml	Coliform-T
[]		/100ml	Coliform-F
[]		/100ml	Strep-F
[]		units	Color
[]			
[]			

Transported by:
Received by:

Transported by:
Received by:

FOR LAB USE ONLY

Lab# Rec'd by:

Date sample rec'd:

Date analysis completed:

Date results reported:

Signed:

Date:

D-17

NORTHERN TESTING LABORATORIES, INC.

3330 INDUSTRIAL AVENUE · FAIRBANKS, ALASKA 99701 · 907-456-3116
2505 FAIRBANKS STREET · ANCHORAGE, ALASKA 99503 · 907-277-8378

Drinking Water Analysis Report for Total Coliform Bacteria

TO BE COMPLETED BY CLIENT

☒ PUBLIC WATER SYSTEM I.D. # [ ]
☐ PRIVATE WATER SYSTEM

NAME: Eagle River Engineering Srv
Mailing Address: PO B 773254 Eagle River
City, State, Zip Code: AK 99577

SAMPLE DATE: 4 - 1 - 93 (Mo. Day Year) Phone 694-5195

Purchase Order No. ______

SAMPLE TYPE:

☐ Routine
☐ Special Purpose
☐ Check Sample (for original contaminated sample with lab reference no. ______)

☒ Treated Water
☐ Untreated Water

METHOD OF ANALYSIS:

☐ MF Membrane Filter
☐ MPN — Most Probable Number

TO BE COMPLETED BY LABORATORY

Received at: ☒ Anch. ☐ Fbks.

Date Received: 04'02'93
Time Received: 0812
Date Analyzed: 4.2.93
Time Analyzed: 1600
Next Sample Due: 5/93

COMMENTS:

SATISFACTORY	S
UNSATISFACTORY	U
RESAMPLE	R
OTHER BACTERIA	OB
TOO NUMEROUS TO COUNT	TNTC

Sample No.	Location	Time Collected	Collected by	Laboratory Ref. No.	Direct Count	Verification LSB	Verification BGB	Final Result*	Comments
1	Tuntutuliak School	11:00 Am	L Badera	AA11818	0		—	0	S
2									
3									
4									
5									
6									
7									
8									

Signature of Representative ______

*No. of Total Coliform Colonies per 100 mls.

Reported by: SDL
Date: 4.3.93
Time: 1600

D-18

FOR LABORATORY USE ONLY					
CASH	CHARGE	PREPAID	TRANSMITTAL	SPECIAL INSTRUCTIONS	MAIL / HOLD FOR PICKUP

[redacted] [redacted]

CHEMICAL & GEOLOGICAL LABORATORY

A DIVISION OF COMMERCIAL TESTING & ENGINEERING CO.

5633 B STREET ANCHORAGE, ALASKA 99518 TELEPHONE (907) 562-2343 FAX: (907) 561-5301

ANALYSIS RESULTS for INVOICE # 59369
Chemlab Ref.# 92.5568 Sample # 1 Matrix: WATER

Client Sample ID : L ANGAPAK TUNTUTULIAK JANITOR'S CLOSET SCHOOL
PWSID : 271017
Collected : OCT 7 92 @ 10:30 hrs.
Received : OCT 8 92 @ 11:00 hrs.
Preserved with : AS REQUIRED

Analysis Completed : OCT 19 92
Laboratory Supervisor : STEPHEN C. EDE
Released By :

Client Name :L K S D
Client Acct :LKSDAPP
BPO# :
Req# :
Ordered By :J. STEWART

PO# :NONE RECEIVED

Send Reports to:
1)L K S D
2)

Parameter	Results	Units	Method	Allowable Limits
INORGANIC CHEMICALS/TITLE 18	n/a	n/a		n/a
ARSENIC	0.018	mg/l	ASTM D2972/EPA 206.2	0.05 maximu
BARIUM	0.27	mg/l	EPA 200.7	1.0 maximum
CADMIUM	ND(0.0005)	mg/l	EPA 213.2	0.010 maxim
CHROMIUM	ND(0.005)	mg/l	EPA 218.2	0.05 maximu
FLUORIDE	0.051	mg/l	SM16 413E	4.0 maximum
LEAD	ND(0.0050)	mg/l	EPA 239.2	0.05 maximu
MERCURY	ND(0.0002)	mg/l	SM14 301AVI	0.002 maxim
NITRATE-N	ND(0.10)	mg/l	EPA 353.2/300.0	10 maximum
SELENIUM	ND(0.005)	mg/l	ASTM D3859/EPA 270.2	0.01 maximu
SILVER	ND(0.001)	mg/l	EPA 272.2	0.05 maximu
TURBIDITY	4.7	NTU	EPA 180.1	1.0 maximum

INORGANIC

Sample ROUTINE SAMPLE COLLECTED BY: J. STEWART.
Remarks: TURBIDITY EXCEEDS 1 NTU.

12 Tests Performed
ND- None Detected
NA- Not Analyzed

* See Special Instructions Above
** See Sample Remarks Above
LT-Less Than, GT-Greater Than

UA-Unavailable

NORTHERN TESTING LABORATORIES, INC.
600 UNIVERSITY PLAZA WEST, SUITE A FAIRBANKS, ALASKA 99709 907-479-3115
2505 FAIRBANKS ST. ANCHORAGE, ALASKA 99503 907-277-8378

LANGELIER INDEX CALCULATION

CLIENT,#: RoEn Design
PROJECT: Tuntutuliak School
SAMPLE: Untreated #A032889-7

Langelier Index = pH - pHs
pH = pH of sample
pHs = pH of saturation of CaCO3 = A + B - log[Ca+2] - log[Alk]
Where: A = Water Temperature Constant (* P.65 Standard Methods 16th Edition)
B = Total Dissolved Solids Constant (* P.65 Standard Methods 16th Edition)
log[Ca+2] = log of the Calcium ion concentration (mg/l CaCO3)
log[Alk] = log of the Alkalinity concentration (mg/l CaCO3)

SAMPLE DATA:

Alkalinity (mg/l CaCO3):	286	Log:	2.45636603
Calcium (mg/l CaCO3):	62.4	Log:	1.79518459
Temperature (°C):	20	Constant A:	2
TDS (mg/l):	376	Constant B:	9.859

pHs =	7.60744938	
pH =	2.90	† <0 = Corrosive
pH - pHs =	-4.7074494	0 = Neutral
Langelier Index =	-4.71 †	> 0 = Scaling
	==========	

Analyst: [signature] Date: April 30, 1989

M.J. Freeman-Wittig, PhD.,Laboratory Director

NORTHERN TESTING LABORATORIES, INC.

600 UNIVERSITY PLAZA WEST, SUITE A — FAIRBANKS, ALASKA 99709 — 907-479-3115
2505 FAIRBANKS ST. — ANCHORAGE, ALASKA 99503 — 907-277-8378

RoEn Design Associates, Inc.
1028 Aurora Drive
Fairbanks, AK 99701

Date Received:	3/24/89
Time Received:	16:15
Date Sampled:	3/24/89
Time Sampled:	8:00
Date Completed:	4/29/89

TUNTUTULIAK/TREATED WATER

ANALYSIS RESULTS

Parameter	Units	Results NTL I.D. # A032889-11	ADEC Maximum Contaminant Concentration	QUALITY CONTROL INFORMATION * Reference Sample I.D. #	Result	Acceptable Range
INORGANIC CHEMICAL CONTAMINANTS:						
Arsenic	mg/L	0.091±0.005	0.05	378-14	0.043	0.035 - 0.055
Barium	mg/L	0.8±0.1	1	1183-2	10.3	9.4-11.4
Cadmium	mg/L	<0.005	0.010	386-1	0.025	0.020 - 0.028
Chromium	mg/L	<0.005	0.05	386-1	0.093	0.086 - 0.119
Fluoride	mg/L	0.21	2.4	WP987	1.03	0.89-1.09
Lead	mg/L	0.002±0	0.05	378-14	0.051	0.044 - 0.062
Mercury	mg/L	0.0003±0.0003	0.002	378-10	0.0049	0.0027 - 0.0053
Nitrate-N	mg/L	<0.1	10	WP284-3	0.138	0.10-0.18
Selenium	mg/L	0.006±0.001	0.01	378-12	0.0109	0.0058 - 0.0116
Silver	mg/L	<0.01	0.05	378-14	0.025	0.021 - 0.031
ORGANIC CHEMICAL CONTAMINANTS:						
Endrin	µg/L	<DL	0.2			
Lindane	µg/L	<DL	4			
Methoxychlor	µg/L	<DL	100			
Toxaphene	µg/L	<DL	5			
2,4-D	µg/L	<DL	100			
2,4,5-TP Silvex	µg/L	<DL	10			
RADIOACTIVE CONTAMINANTS:						
Gross Alpha***	pCi/L	2.8±2.5	15			
TOTAL COLIFORM BACTERIA:						
	Colonies/100 ml	Satisfactory	1			
TOTAL TRIHALOMETHANES:			0.10			
Chloroform	µg/L	<DL		NTL CCC5	7.7	6.2-9.4
Bromodichloromethane	µg/L	<DL		NTL CCC5	8.9	7.1-10.7
Dibromochloromethane	µg/L	<DL		NTL CCC5	8.9	7.5-11.3
Bromoform	µg/L	<DL		NTL CCC5	10.2	9.2-14.0

REPORTED BY: [signature] DATE: April 30, 1989

M.J. Freeman-Willig, PhD., Laboratory Director

* The reference samples listed are quality control assurance samples with a known concentration prior to analysis. The acceptable limits represent a 95% confidence interval established by the Environmental Protection Agency or Northern Testing Laboratories, Inc. through repetitive analyses of the reference sample. These reference samples were analyzed simultaneously with the samples reported above to ensure the accuracy of the results.

***Analysis performed by an ADEC certified subcontract laboratory.

REVISION

NORTHERN TESTING LABORATORIES, INC.

600 UNIVERSITY PLAZA WEST, SUITE A — FAIRBANKS, ALASKA 99709 — 907-479-3115
2505 FAIRBANKS ST. — ANCHORAGE, ALASKA 99503 — 907-277-8378

RoEn Design Associates, Inc.
1028 Aurora Drive
Fairbanks, AK 99701

Date Received:	3/28/89
Time Received:	15:00
Date Sampled:	3/27/89
Time Sampled:	10:30
Date Completed:	4/29/89

TUNTUTULIAK/UNTREATED

ANALYSIS RESULTS Parameter	Units	Results NTL I.D. # A032889-7	ADEC Maximum Contaminant Concentration	QUALITY CONTROL INFORMATION * Reference Sample I.D. #	Result	Acceptable Range
INORGANIC CHEMICAL CONTAMINANTS:						
Arsenic	mg/L	0.144±0.008	0.05	378-14	0.043	0.035 - 0.055
Barium	mg/L	0.8±0	1	1183-2	10.3	9.4 - 11.4
Cadmium	mg/L	<0.005	0.010	386-1	0.025	0.020 - 0.032
Chromium	mg/L	0.10±0.006	0.05	386-1	0.093	0.086 - 0.119
Fluoride	mg/L	0.07	2.4	378-2	0.41	0.36-0.49
Lead	mg/L	0.022±0.004	0.05	378-14	0.051	0.044 - 0.062
Mercury	mg/L	0.0003±0	0.002	378-10	0.0049	0.0027 - 0.0053
Nitrate-N	mg/L	<0.1	10	WP284-3	0.127	0.10-0.18
Selenium	mg/L	0.004±0	0.01	386-1	0.0109	0.0058-0.0116
Silver	mg/L	<0.01	0.05	378-14	0.025	0.021 - 0.031
SECONDARY CONTAMINANTS:						
Chloride	mg/L	12	250	987	54.2	48.2-55.4
Color	units	400	15			
Copper	mg/L	0.05±0	1	386-1	0.104	0.088-0.113
Corrosivity (Langelier Index)		-4.71	Noncorrosive			
Alkalinity	mg/L as CaCO3	286				
Calcium	mg/L as CaCO3	62.4±2.9		1183-1	0.45	0.42-0.58
pH	units	2.9@20°C	6.5-8.5			
T. Diss. Solids	mg/L	376	500	1185-2	380	342-456
MBAS	mg/L	<0.1	0.5			
Iron	mg/L	11.08±0.08	0.3	386-1	0.094	0.083-0.119
Manganese	mg/L	0.62±0	0.05	386-1	0.090	0.088 - 0.109
Odor	TON	<1	3			
Sodium	mg/L	12.0±0.1	250	1183-2	1.62	1.30-1.78
Sulfate	mg/L	<0.1	250	987	19.5	16.3-23.1
Zinc	mg/L	0.413±0.013	5	386-1	0.102	0.086-0.115

* The reference samples listed are quality control assurance samples with a known concentration prior to analysis. The acceptable limits represent a 95% confidence interval established by the Environmental Protection Agency or Northern Testing Laboratories, Inc. through repetitive analyses of the reference sample. These reference samples were analyzed simultaneously with the samples reported above to ensure the accuracy of the results.

REVISION

Parameter	Units	A032889-7 Sample	A032889-8 Travel Blank	Detection Limits	ADEC MCC****
TURBIDITY:	NTU	1.02			
RADIOACTIVE CONTAMINANTS:					
Gross Alpha***	pCi/L	0±1.3			15
VOLATILE ORGANIC COMPOUNDS					
EPA Method 502.2					
Benzene	ug/L	<DL	<DL	0.2	
Bromobenzene	ug/L	<DL	<DL	0.2	
Bromochloromethane	ug/L	<DL	<DL	0.2	
Bromodichloromethane	ug/L	<DL	<DL	0.3	
Bromoform	ug/L	<DL	<DL	1	
Bromomethane	ug/L	<DL	<DL	2	
n-Butylbenzene	ug/L	<DL	<DL	0.2	
sec-Butylbenzene	ug/L	<DL	<DL	0.2	
tert-Butylbenzene	ug/L	<DL	<DL	0.2	
Carbon tetrachloride	ug/L	<DL	<DL	0.2	
Chlorobenzene	ug/L	<DL	<DL	0.2	
Chloroethane	ug/L	<DL	<DL	1	
Chloroform	ug/L	<DL	<DL	0.2	
Chloromethane	ug/L	<DL	<DL	1	
2-Chlorotoluene	ug/L	<DL	<DL	0.2	
4-Chlorotoluene	ug/L	<DL	<DL	0.2	
Dibromochloromethane	ug/L	<DL	<DL	0.5	
1,2-Dibromo-3-chloropropane	ug/L	<DL	<DL	0.2	
1,2-Dibromoethane	ug/L	<DL	<DL	0.2	
Dibromomethane	ug/L	<DL	<DL	0.4	
1,2 - Dichlorobenzene	ug/L	<DL	<DL	0.2	
1,3 - Dichlorobenzene	ug/L	<DL	<DL	0.2	
1,4 - Dichlorobenzene	ug/L	<DL	<DL	0.2	
Dichlorodifluoromethane	ug/L	<DL	<DL	2	
1,1 - Dichloroethane	ug/L	<DL	<DL	0.2	
1,2 - Dichloroethane	ug/L	<DL	<DL	0.2	
1,1 - Dichloroethene	ug/L	<DL	<DL	1	
cis - 1,2 - Dichloroethene	ug/L	<DL	<DL	0.2	
trans - 1,2 - Dichloroethene	ug/L	<DL	<DL	1	
1,2-Dichloropropane	ug/L	<DL	<DL	0.5	
1,3-Dichloropropane	ug/L	<DL	<DL	0.5	
2,2-Dichloropropane	ug/L	<DL	<DL	0.5	
1,1-Dichloropropane	ug/L	<DL	<DL	0.5	
Ethylbenzene	ug/L	<DL	<DL	0.2	
Hexachlorobutadiene	ug/L	<DL	<DL	0.3	
Isopropylbenzene	ug/L	<DL	<DL	0.2	
p-Isopropyltoluene	ug/L	<DL	<DL	0.2	
Methylene chloride	ug/L	<DL	<DL	2	
Naphthalene	ug/L	<DL	<DL	0.4	
n-Propylbenzene	ug/L	<DL	<DL	0.2	
Styrene	ug/L	<DL	<DL	0.2	
1,1,1,2-Tetrachloroethane	ug/L	<DL	<DL	0.4	
1,1,2,2-Tetrachloroethane	ug/L	<DL	<DL	0.4	
Tetrachloroethane	ug/L	<DL	<DL	0.2	

***Analysis performed by an ADEC certified subcontract laboratory.
****Maximum Contamination Concentration

REVISION

VOLATILE ORGANIC COMPOUNDS-Continued
EPA Method 502.2

Parameter	Units	A041289-85 Sample	A041289-86 Travel Blank	Detection Limits
Toluene	ug/L	<DL	<DL	0.2
1,2,3-Trichlorobenzene	ug/L	<DL	<DL	0.4
1,2,4-Trichlorobenzene	ug/L	<DL	<DL	0.3
1,1,1-Trichloroethane	ug/L	<DL	<DL	0.4
1,1,2-Trichloroethane	ug/L	<DL	<DL	0.4
Trichloroethene	ug/L	<DL	<DL	0.2
Trichlorofluoromethane	ug/L	<DL	<DL	2
1,2,3-Trichloropropane	ug/L	<DL	<DL	0.4
1,2,4-Trimethylbenzene	ug/L	<DL	<DL	0.2
1,3,5-Trimethylbenzene	ug/L	<DL	<DL	0.2
Vinyl chloride	ug/L	<DL	<DL	2
o-Xylene	ug/L	<DL	<DL	0.2
m,p-Xylene	ug/L	<DL	<DL	0.4
ORGANIC CHEMICAL CONTAMINANTS:				
Endrin	µg/L	<DL		0.2
Lindane	µg/L	<DL		4
Methoxychlor	µg/L	<DL		100
Toxaphene	µg/L	<DL		5
2,4-D	µg/L	<DL		100
2,4,5-TP Silvex	µg/L	<DL		10

Parameter	Unit	QC Result	Acceptable Range
*NTL CCC5:			
Chloroform	µg/L	7.2	6.2-9.4
Bromodichloromethane	µg/L	7.6	7.1-10.7
Dibromochloromethane	µg/L	9.3	7.5-11.3
Benzene	µg/L	8.5	6.5-9.8
Toluene	µg/L	12.3	6.2-9.3
Ethylbenzene	µg/L	8.2	6.3-9.5
Chlorobenzene	µg/L	9.6	7.2-10.9
m,p-Xylene	µg/L	12.2	8.9-13.8
o-Xylene	µg/L	6.8	5.4-8.1
1,4-Dichlorobenzene	µg/L	10.4	7.7-11.7
1,3-Dichlorobenzene	µg/L	10.7	8.4-12.6
1,2-Dichlorobenzene	µg/L	10.4	8.5-12.9
*AEPA 1 NTU:			
Turbidity	NTU	1.02	0.9-1.1

REPORTED BY: MJFreeman Wittig DATE: April 30, 1989

M.J. Freeman-Wittig, PhD., Laboratory Director

* The reference samples listed are quality control assurance samples with a known concentration prior to analysis. The acceptable limits represent a 95% confidence interval established by the Environmental Protection Agency or Northern Testing Laboratories, Inc. through repetitive analysis of the reference samples. These reference smaples were analyzed simultaneously with the samples reported above to ensure the accuracy of the results.

APPENDIX E
WELL LOGS, FLOW TEST DATA

U.S. PUBLIC HEALTH SERVICE, DIVISION OF INDIAN HEALTH

LOCATION TUNTATULIAK DATE STARTED 7/8/79

DATE COMPLETED 7/[illegible]/79 DRILLER ST ANTHONY

TOTAL DEPTH OF WELL 201' FT. CASING INSTALLED 197 DIAMETER 6"

GROUT 12' SCREEN SIZE 6" .010 MFG. JOHNSO LENGTH 5'9"

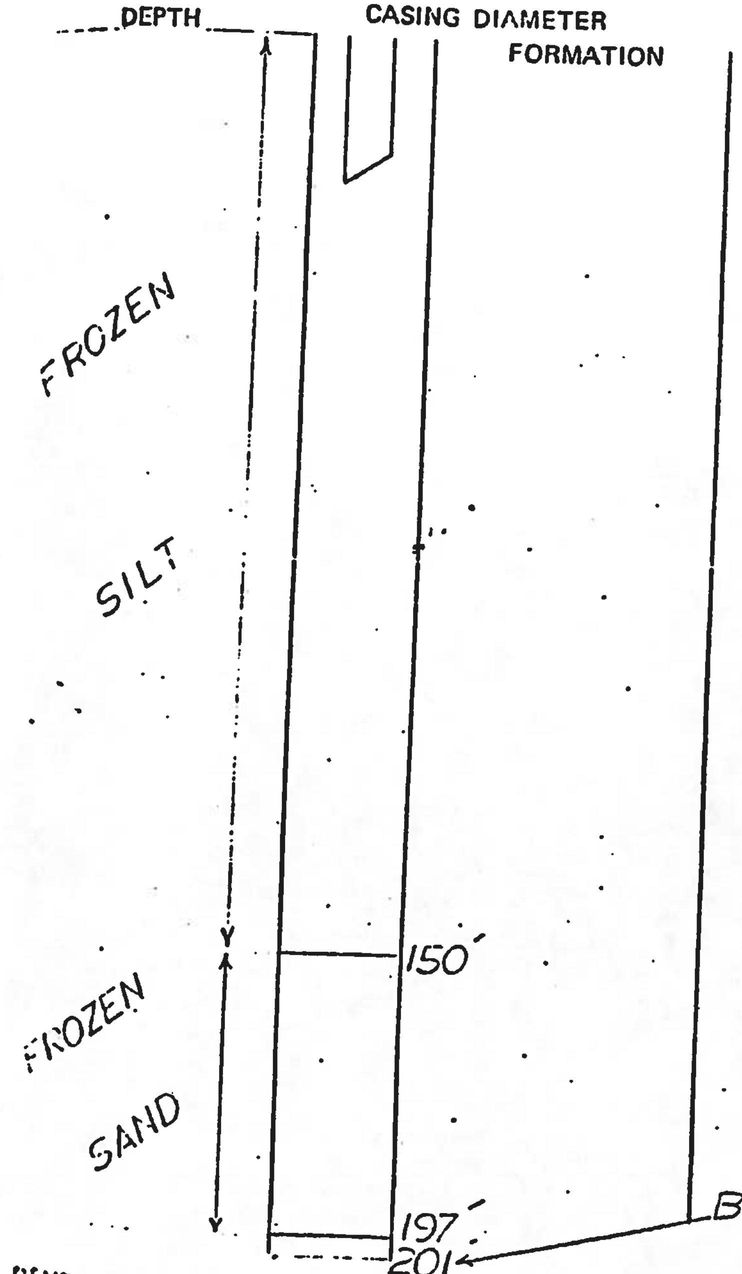
STATIC WATER LEVEL 8' HRS. PUMPED 24 @ 10 GPM DRAWDOWN 62' F

HOLE DIAMETER

DEPTH

CASING DIAMETER

FORMATION



SOIL DATA TO 15 FT.

FEET THAWED 2'

BOTTOM OF FROST & MATERIAL

SEASONAL OR PERMA FROST

WATER DATA FIELD TEST

TASTE GOOD

APPEARANCE FRESH

AFTER 24 HOURS

IRON

CHLORIDES

TDS

PUMP TEST 8' STATIC LEVEL

PUMPING LEVEL 62' @ 10 GPM

AFTER 24 HRS.

HIGHEST RECOMMENDED PUMP RATE

WILL STATIC LEVEL CHANGE WITH

TIDES NO OR FROST NO

DEVELOP PROCEDURE SURGE BLOCK

ESTIMATED MAN HOURS FOR DRILLING HOURS FOR TOTAL JOB

CREW ST. ANTHONY / FOWLER

U.S. PUBLIC HEALTH SERVICE, DIVISION OF INDIAN HEALTH

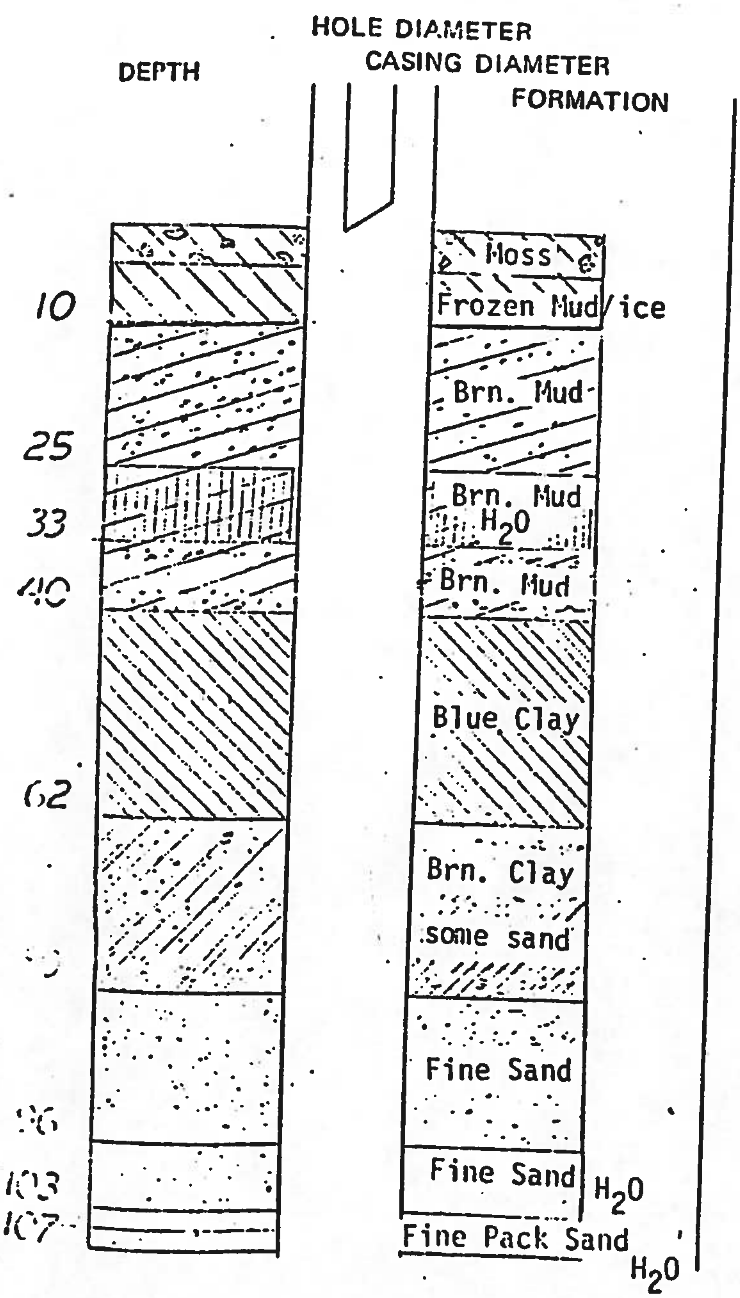
LOCATION TUNTATULIAK DATE STARTED 1/11/79

DATE COMPLETED 2/27/79 DRILLER HOHNER/APPLETON

TOTAL DEPTH OF WELL 107 FT. CASING INSTALLED 103 DIAMETER 6"

GROUT 10' 8" dia. SCREEN SIZE 6 in 110 slot MFG. johnson LENGTH 10'

STATIC WATER LEVEL 14' 7" TOC HRS. PUMPED 25 @ 15 GPM DRAWDOWN 74 FT



SOIL DATA TO 15 FT.

FEET THAWED ____

BOTTOM OF FROST & MATERIAL ____

SEASONAL OR PERMA FROST ____

WATER DATA FIELD TEST

TASTE IRON

APPEARANCE FRESH ____

AFTER 24 HOURS ____

IRON 50 PPM

CHLORIDES ____

TDS ____

PUMP TEST 15' 6" STATIC LEVEL

PUMPING LEVEL 81' 4" @ 25 GPM

AFTER 24 HRS.

HIGHEST RECOMMENDED PUMP RATE

WILL STATIC LEVEL CHANGE WITH TIDES N OR FROST ____

DEVELOP PROCEDURE SURGE BLOCK

ESTIMATED MAN HOURS FOR DRILLING ____ HOURS FOR TOTAL JOB ____

CREW [illegible] / HENRY HOFNER

U.S. PUBLIC HEALTH SERVICE, DIVISION OF INDIAN HEALTH

LOCATION TUNTATULIAK DATE STARTED 2/1/65

DATE COMPLETED 2/8/65 DRILLER LONGBOTHAM

TOTAL DEPTH OF WELL 90 FT. CASING INSTALLED 90 4" DIAMETER 4"

GROUT NONE SCREEN SIZE 4" / .010 MFG. EVSED. LENGTH 5' 8

STATIC WATER LEVEL 3' 8" HRS. PUMPED 56 @ 35 GPM DRAWDOWN 81' 3" FT.

HOLE DIAMETER

CASING DIAMETER

DEPTH	FORMATION
FRZ. MUCK	0 3'
BLACK MUCK	3' 35'
GR MUCK	35'-40'
FINE SILT	40'-55'
GR SAND	55'-61'
FINE PACK SAND	61'-71'
FINE SAND	71'-76'
FINE AND MED SAND	76' 84'
GRAVEL	84' 87
[illegible]	87-90'

WATER

SOIL DATA TO 15 FT.

FEET THAWED 0

BOTTOM OF FROST & MATERIAL

SEASONAL OR PERMA FROST

WATER DATA FIELD TEST

TASTE IRON

APPEARANCE FRESH

AFTER 24 HOURS

IRON

CHLORIDES

TDS

PUMP TEST 3' 8" STATIC LEVEL

PUMPING LEVEL 15' 7" @ 35 GPM

AFTER 56 HRS.

HIGHEST RECOMMENDED PUMP RATE

WILL STATIC LEVEL CHANGE WITH

TIDES OR FROST

[illegible] PROCEDURE

[illegible] MAN HOURS FOR DRILLING HOURS FOR TOTAL JOB

SCREEN AT 90 [illegible] EXPOSED

... TUNTATULIAK ... DATE STARTED 12/64
COMPLETED 12/64 DRILLER LONGBOTHAM / HALE
... DEPTH OF WELL 97 FT. CASING INSTALLED 88' DIAMETER 4"
... N/A SCREEN SIZE 4" .006 MFG. COOK LENGTH 10'
... WATER LEVEL 5' HRS. PUMPED ____ @ 35 GPM DRAWDOWN 18

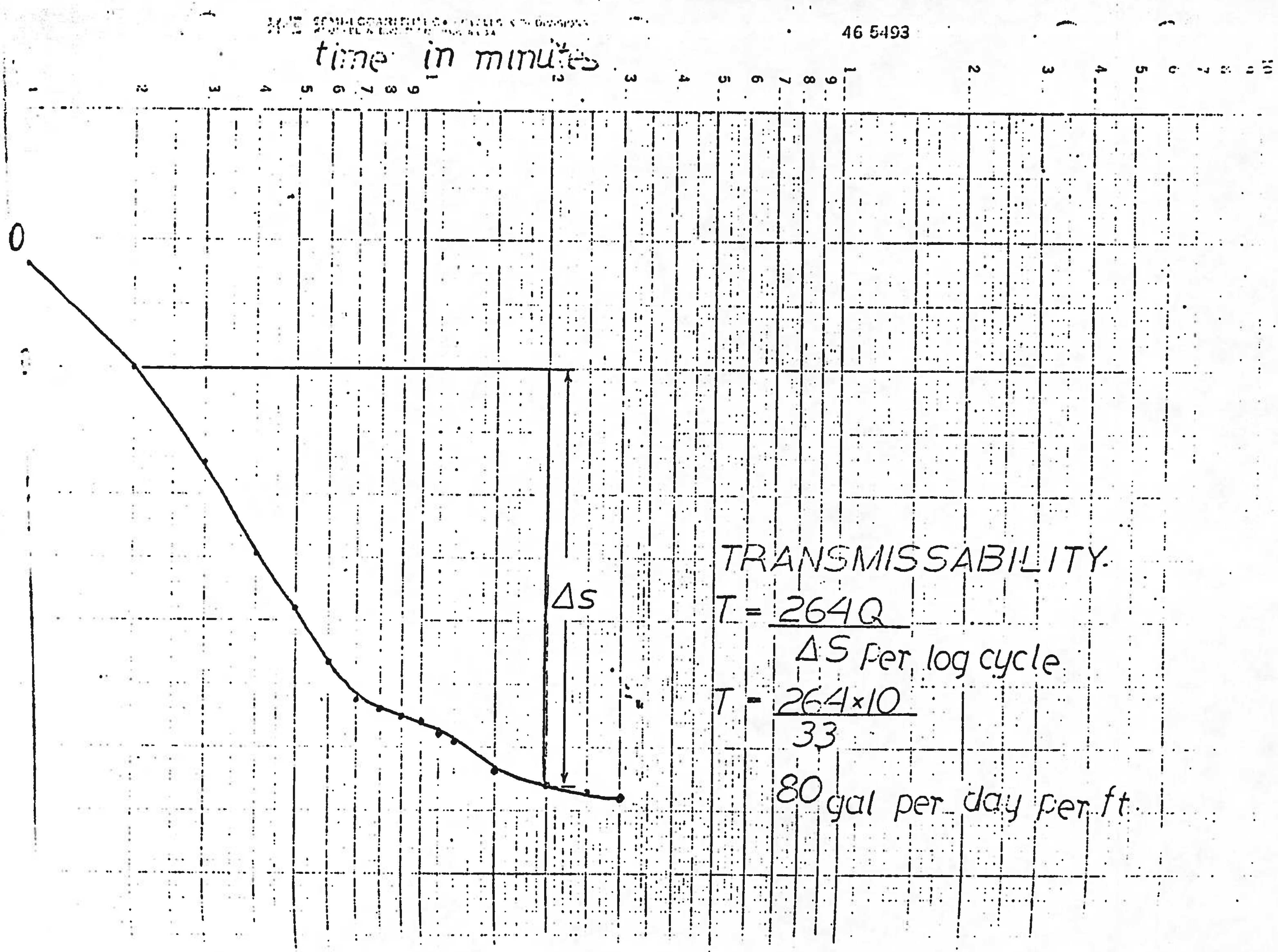
DEPTH	HOLE DIAMETER / CASING DIAMETER
Permafrost (Frozen Muck)	1, 2, 3
Unfrozen Muck.	48, 49, 50, 51, 52
Fine Sand & Water	53, 54, 55
Fine, tightly Packed Sand.	71, 72
Packed Sand w/ Some Water.	73, 74, 75, 76, 77, 78
Fine, Tightly Packed Sand.	79, 80, 81, 82, 83
F... Sand & some W...	84, 85, 86
F..., tight Sand	87, 88
... Medium ... Sand, ...	89, 90, 91, 92

SOIL DATA TO 15 FT.
FEET THAWED 3'-97'
BOTTOM OF FROST & MATERIAL ____
SEASONAL OR PERMA FROST ____

WATER DATA FIELD TEST
TASTE ____
APPEARANCE FRESH ____
AFTER 24 HOURS ____
IRON ____
CHLORIDES ____
TDS ____

PUMP TEST 5' STATIC LEVEL
PUMPING LEVEL 23' @ 35 GPM
AFTER 36 HRS.

HIGHEST RECOMMENDED PUMP RATE
WILL STATIC LEVEL CHANGE WITH
TIDES NO OR FROST NO


46 5493
time in minutes
0
Δs
TRANSMISSABILITY
T = 264Q / ΔS per log cycle
T = 264×10 / 33
80 gal per day per ft

AQUIFER TEST FIELD DATA SHEET

Project No. 6251 Project Name Tuntatuliak Well # PHS #1

Location of Well Hill behind church Date Tested 2/27/79

Depth of Well 107 ft Length of Casing 103 ft Pumped Well/Observation Well

If Observation Well, Dist. to Pump Well N/A ft Top of Casing to Static Level 14'7"ft

Date Drilling Completed 2/27/79 Driller Horner/Appleton Pumping at 25 gpm

Clock Time	*E. T. Started/ Stopped	Depth to Water From TOC	Drawdown/ Recovery	Clock Time	*E. T. Started/ Stopped	Depth to Water From TOC	Drawdown/ Recovery
	1	15' 6"			660	54' 5"	
	2	15' 9"			720	56' 3"	
	3	16'			780	58' 1"	
	4	16' 2"			840	60' 3"	
	5	16' 4"			900	62' 8"	
	6	16' 7"			960	64' 3"	
	7	16' 11"			1020	66' 4"	
	8	17' 2"			1080	69' 10"	
	9	17' 4"			1140	71' 5"	
	10	17' 7"			1200	73' 6"	
	11	18'			1260	75' 3"	
	12	18' 4"			1320	77' 4"	
	15	18' 9"			1380	79' 7"	
	20	19' 6"			1440	81' 4"	
	25	20' 4"			1500	83' 1"	
	30	22' 1"			1560	85' 5"	
	40	23' 2"			1620	87' 6"	
	50	24'			1680	89'	
	60	25' 7"					
	80	26' 8"					
	100	28'					
	140	32'					
	180	34' 6"					
	240	36' 10"					
	300	40'					
	360	42' 6"					
	420	44' 3"					
	480	46' 2"					
	540	48' 2"					
	600	51' 1"					

*Time Since Pumping Started/Stopped in Minutes

Page 1 of 1

Project No 6251 Project Name Tuntutuliak Well # PHS #2

Location of Well 300' from river next to city hall Date Tested 7/23/79

Depth of Well 201 ft Length of Casing 197 ft Pumped Well/Observation Well

If Observation Well, Dist. to Pump Well N/A ft Top of Casing to Static Level 8 ft

Date Drilling Completed 7/23/79 Driller St. Anthony Pumping at 10 gpm

Clock Time	*E. T. Started/ Stopped	Depth to Water From TOC	Drawdown/ Recovery	Clock Time	*E. T. Started/ Stopped	Depth to Water From TOC	Drawdown/ Recovery
9:01	1	20'			1	60'	
	2	28'			2	50'	
	3	35' 5"			3	38' 2"	
	4	42' 9"			4	33' 3"	
	5	47'			5	29'	
	6	51' 2"			6	25'	
	7	54' 1"			7	23' 1"	
	8	55'			8	21' 2"	
	9	55' 5"			9	18' 6"	
	10	56'			10	16' 2"	
	11	57'			11	15'	
	12	57' 6"			12	14' 1"	
	15	60'			15	12'	
	20	61'			20	10'	
	25	61' 6"			25	8' 11"	
	30	62'			30	8'	
	40	62'					
	50	62'					
	60	62'					
	80	62'					
	100	62'					
	140	62'					
	180	62'					
	240	62'					
	300	62'					
	360	62'					
	420	62'					
	480	62'					
	540	62'					
	600	62'					

*Elapsed Time Since Pumping Started/Stopped in Minutes

STATE OF ALASKA

DEPARTMENT OF NATURAL RESOURCES

DIVISION OF WATER

WALTER J. HICKEL, GOVERNOR

P.O. Box 772116
Eagle River, Alaska 99577-2116
Phone: (907) 696-0070
Fax: (907) 696-0078

ALASKA HYDROLOGIC SURVEY

September 29, 1993

Mr. Louis Butera, P.E.
Eagle River Engineering
PO Box 773294
Eagle River AK 99577

Dear Mr. Butera:

I am providing you with a summary of the Tuntutuliak well flow test data as you requested. You are in possession of the original field data and all relevant plots and calulations that we prepared, so I will not include them herein.

The Cooper-Jacob method was used to calculate transmissivity from the drawdown data collected during the constant rate test. This method yields a calculated aquifer transmissivity of 24 ft^2/day, with rapid stabilization of the drawdown cone. This rapid stabilization indicates that some source of water was available to the aquifer outside of the assumptions of the Cooper-Jacob method. This method assumes impermeable boundaries above and below the aquifer and an infinite horizontal extent of the aquifer. The geology of the site suggests that the aquifer receives water through upper or lower leaky confining beds, or both.

Water-level recovery data collected after cessation of constant-rate pumping yielded a calculated transmissivity value of 35 ft^2/day. This value is generally consistent with the value obtained from the drawdown data.

Calculations based on the step drawdown data yielded well efficiency values ranging from 104% to 114%. It is unusual for well efficiencies to exceed 100%. These numbers could be an artifact of the few minutes of pumping at the maximum pump flow rate early in the test. The later data confirm, however, that the well is highly efficient at the rates pumped. Well efficiency could decrease at higher rates.

Considering the available drawdown in the well and the results of the yield test, it appears likely that the well could sustain a flow rate of 20 gpm indefinitely. Periodic monitoring of water levels is advisable to confirm this interpretation of the data.

Rough field estimates indicate that the elevation of the pumping water level in the well is about 18 ft below sea level at a pumping rate of 20 gallons per minute. Additionally, considering the proximity of Tuntutuliak to the coast and the history of brackish ground water at other communities in the region, the possibility of future salt-water intrusion or upconing into the production aquifer cannot be discounted. Although the results of water-quality monitoring during the test showing no evidence of intrusion are encouraging, future scenarios both with and without significant intrusion or upconing are plausible. Without further testing using additional monitoring wells, the long-term response of the aquifer to increased pumping is difficult to predict. Please contact me if you would like additional information.

Sincerely,

James A. Munter

James A. Munter
Hydrogeologist, CGWP

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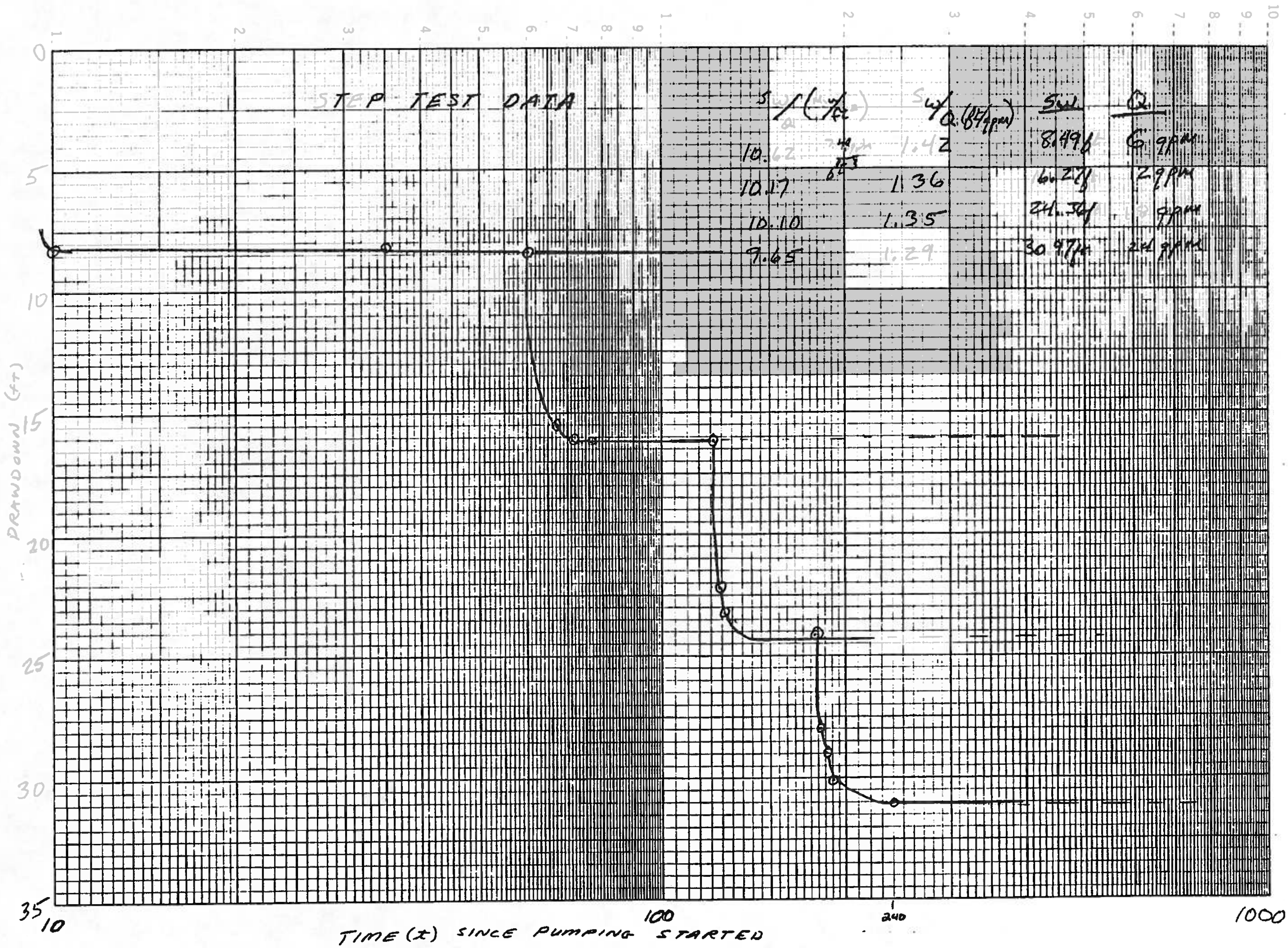
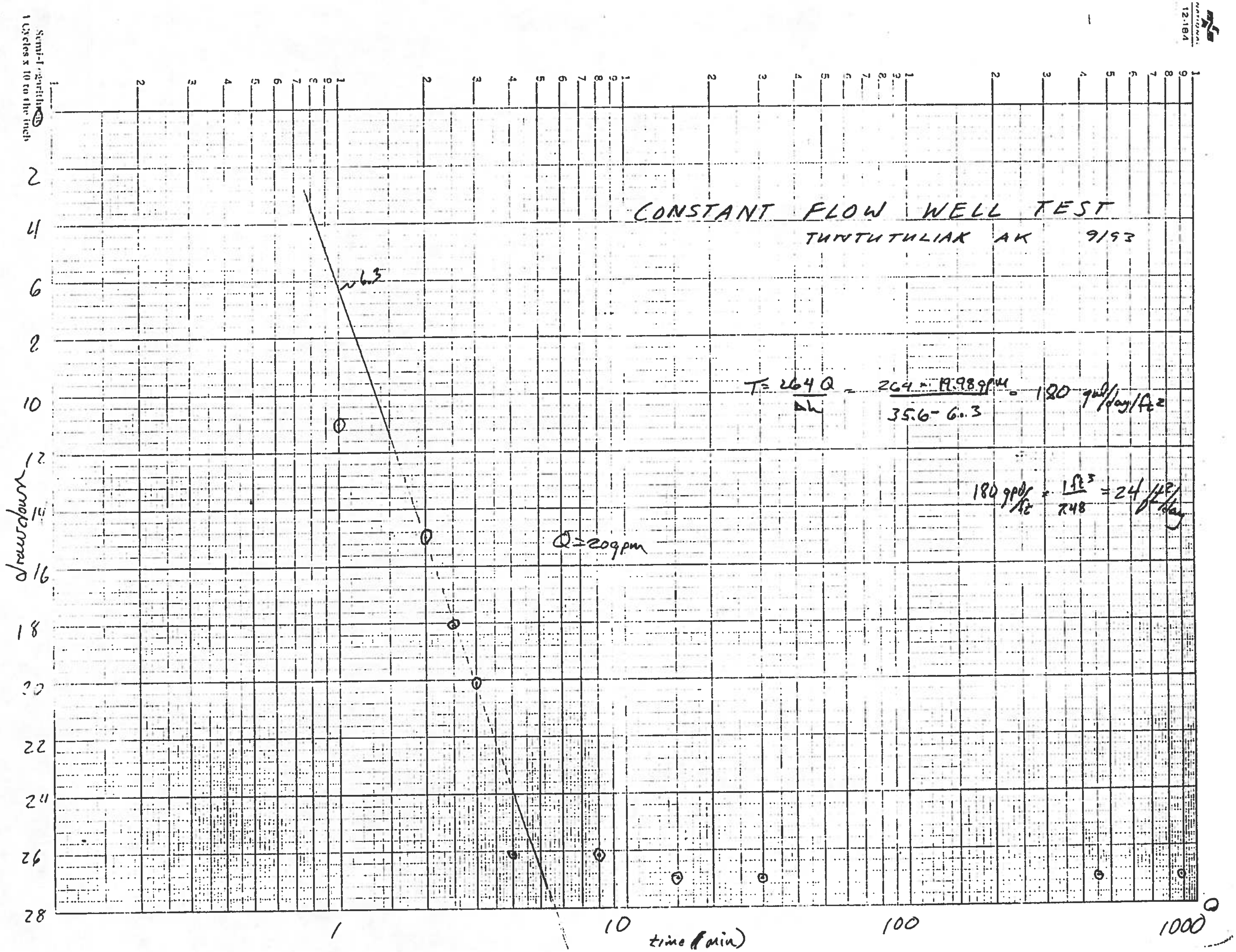
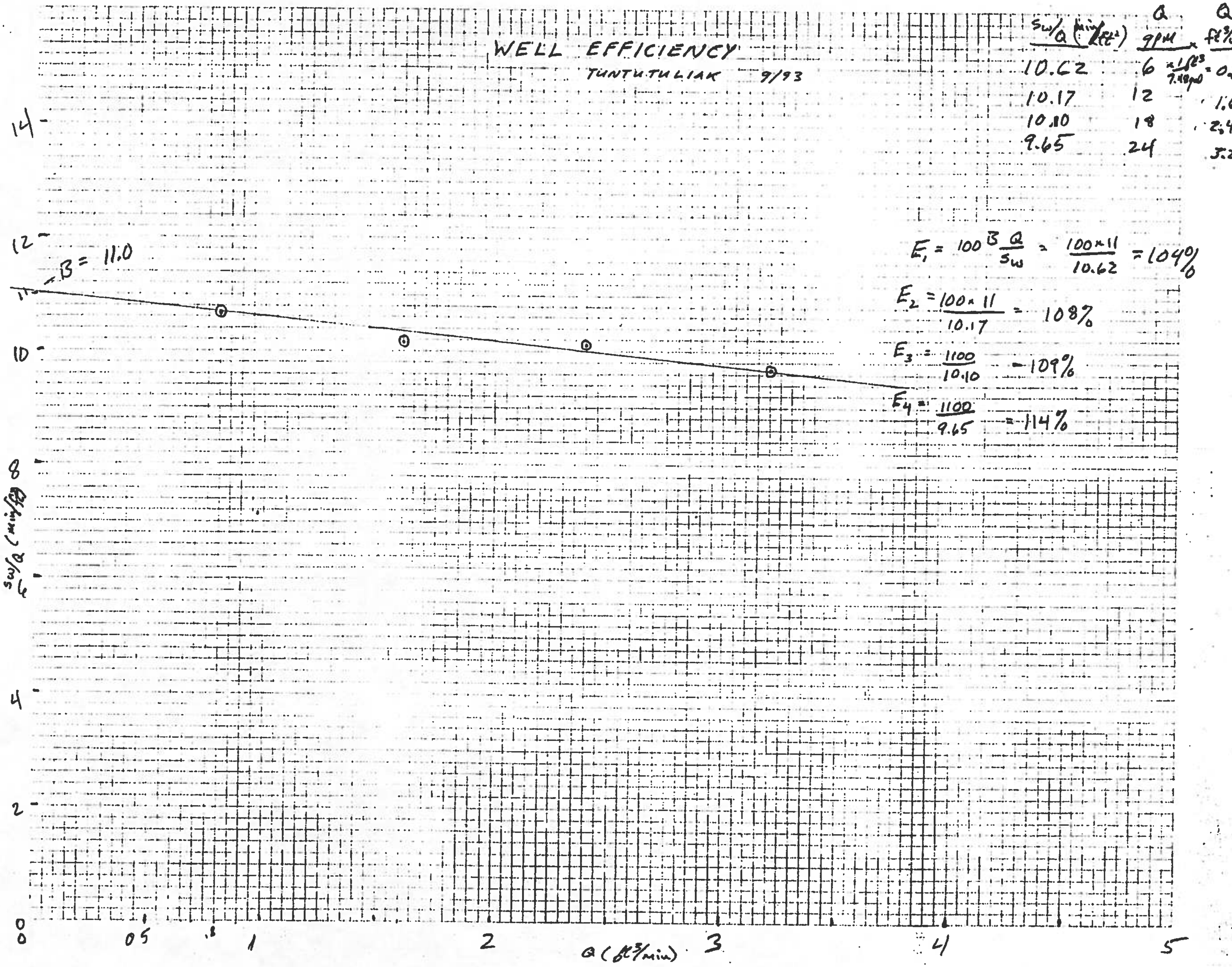



CONSTANT FLOW WELL TEST
TUNTUTULIAK AK 9/93
$T = \frac{264\,Q}{\Delta h} = \frac{264 \times 19.98\,gpm}{35.6 - 6.3} = 180\ gpd/ft^2$
$180\ gpd/ft \times \frac{1\,ft^3}{7.48} = 24\ ft^2/day$
Q=20gpm
~6.3
drawdown
time (min)
Semi-Logarithmic
1 Cycles x 10 to the inch
12-184
NATIONAL



sw/Q (min/ft²)	Q gpm	Q ft³/min
10.62	6 $\times \frac{1 ft^3}{7.48 gal}$	= 0.80
10.17	12	1.60
10.10	18	2.40
9.65	24	3.21

$E_1 = 100 \frac{B\,Q}{s_w} = \frac{100 \times 11}{10.62} = 104\%$

$E_2 = \frac{100 \times 11}{10.17} = 108\%$

$E_3 = \frac{1100}{10.10} = 109\%$

$E_4 = \frac{1100}{9.65} = 114\%$

TUNTUTULIAK WELL FLOW TEST

Time	AM/PM	Flow Meter	Depth to Water, Feet Below Top of Casing	INCR. CHANGE IN WELL LEVEL (FT.)	CUM. CHANGE IN WELL LEVEL (FT.)	Pumping Rate, GPM	Remarks
6/15/93							
3:09:50	PM	142,512	9.67			23+-	Start test 06/15/93, pump at full flow rate
3:10:30	PM					23.10	
3:12:30	PM					6.00	Flow rate adjusted to 6 GPM
3:14:00	PM		19.24		9.57	6.00	
3:15:00	PM		18.48	0.76	8.81	6.00	
3:16:00	PM		18.20	0.28	8.53	6.00	
3:17:00	PM		18.09	0.11	8.42	6.00	
3:18:00	PM		18.00	0.09	8.33		
3:19:00	PM		17.92	0.08	8.25		
3:20:30	PM		17.90	0.02	8.23		
3:22:33	PM	142,620					
3:25:30	PM		17.89				
3:30:30	PM		17.98	-0.09	8.31		
3:35:30	PM	142,701	18.00	-0.02	8.33		
3:40:30	PM		18.07	-0.07	8.40		
3:45:30	PM	147,761	18.03	0.04	8.36	6.00	
3:50:30	PM		18.11	-0.08	8.44		
3:55:30	PM	142,820	18.13	-0.02	8.46		
4:00:30	PM		18.16	-0.03	8.49		
4:05:30	PM	142,889	18.14	0.02	8.47		
4:10:30	PM		18.16	-0.02	8.49		
4:12:30	PM					12.00	Flow increase 1 step to 12 GPM
4:16:30	PM					12.00	
4:17:30	PM		25.18		15.51		
4:18:30	PM		25.50	-0.32	15.83		
4:19:30	PM		25.59	-0.09	15.92		
4:20:30	PM		25.71	-0.12	16.04		
4:21:30	PM	143,031	25.79	-0.08	16.12	12.00	
4:26:30	PM	143,099	25.82	-0.03	16.15		
4:31:30	PM		25.80	0.02	16.13		
4:36:30	PM	143,216	25.83	-0.03	16.16	12.00	
4:41:30	PM		25.83	0.00	16.16		
4:46:30	PM	143,336	25.88	-0.05	16.21		
4:51:30	PM		25.89	-0.01	16.22		
4:56:30	PM	143,448	25.89	0.00	16.22		
5:01:30	PM		25.90	-0.01	16.23		
5:06:30	PM	143,557	25.92	-0.02	16.25	11.80	
5:11:30	PM		25.94	-0.02	16.27		
5:12:30	PM		25.94	0.00	16.27	17.50	Increase flow rate to 18 GPM
5:13:30	PM					17.50	
5:14:30	PM		31.85		22.18	18.00	
5:15:30	PM		32.62	-0.77	22.95		
5:16:30	PM		33.21	-0.59	23.54		

TUNTUTULIAK WELL FLOW TEST

5:17:30	PM		33.53	-0.32	23.86		
5:18:30	PM	143,740	33.79	-0.26	24.12	18.00	
5:23:30	PM		34.07	-0.28	24.40		
5:28:30	PM	143,911	34.03	0.04	24.36		
5:33:30	PM		34.01	0.02	24.34		
5:38:30	PM	144,096	34.02	-0.01	24.35		
5:48:30	PM	144,262	34.00	0.02	24.33		
5:58:30	PM		34.00	0.00	24.33		
6:03:30	PM		34.00	0.00	24.33		
6:08:30	PM	144,626	34.03	-0.03	24.36	18.00	
6:12:30	PM		35.80				Increase step to 23-24 GPM
6:13:30	PM		37.66	-1.86	27.99	22.50	
6:14:30	PM		38.72	-1.06	29.05		
6:15:30	PM		39.24	-0.52	29.57		measure
6:16:30	PM		38.63	0.61	28.96	25+-	flow by timed bucket
6:17:30	PM		39.54	-0.91	29.87		
6:18:30	PM		39.97	-0.43	30.30		
6:19:30	PM		40.30	-0.33	30.63		
6:20:30	PM		40.50	-0.20	30.83		
6:21:30	PM		40.63	-0.13	30.96	24.80	
6:26:30	PM		40.62	0.01	30.95	24.70	
6:31:30	PM		40.60	0.02	30.93		
6:36:30	PM		40.58	0.02	30.91		
6:41:30	PM		40.58	0.00	30.91		
6:46:30	PM		40.62	-0.04	30.95		
6:51:30	PM		40.63	-0.01	30.96	24.80	
6:56:30	PM		40.64	-0.01	30.97		
7:01:30	PM		40.64	0.00	30.97		
7:06:30	PM		40.65	-0.01	30.98		
7:11:30	PM		40.64	0.01	30.97		
7:12:30	PM		38.20	2.44	2.45		Stopped step test
7:13:00	PM		30.70	7.50	9.95		Recovery
7:13:30	PM		26.00	4.70	14.65		
7:14:00	PM		22.30	3.70	18.35		
7:14:30	PM		19.20	3.10	21.45		
7:15:00	PM		17.10	2.10	23.55		
7:15:30	PM		15.50	1.60	25.15		
7:16:00	PM		14.30	1.20	26.35		
7:16:30	PM		13.50	0.80	27.15		
7:17:00	PM		12.85	0.65	27.80		
7:17:30	PM		12.30	0.55	28.35		
7:18:00	PM		11.85	0.45	28.80		
7:18:30	PM		11.50	0.35	29.15		
7:19:00	PM		11.30	0.20	29.35		
7:20:00	PM		10.91	0.39	29.74		
7:21:00	PM		10.71	0.20	29.94		
7:22:00	PM		10.57	0.14	30.08		
7:23:00	PM		10.47	0.10	30.18		
7:24:00	PM		10.41	0.06	30.24		
10:28:17	PM		9.97	0.44	30.68		
7:13:03	PM		30.00		10.65		Supplemental recovery numbers. Whole number recoveries using sonar.

TUNTUTULIAK WELL FLOW TEST

7:13:16	PM		28.00		12.65		
7:13:20	PM		27.00		13.65		
7:13:29	PM		26.00		14.65		
7:13:43	PM		24.00		16.65		
7:13:57	PM		23.00		17.65		
10:40:00	PM	144,770	9.87				Start constant flow test
10:41:00	PM		21.00	-11.13	11.13		
10:42:00	PM		25.00	-4.00	15.13	18.00	
10:42:30	PM		28.20	-3.20	18.33		
10:43:00	PM		30.19	-1.99	20.32		
10:43:30	PM		32.00	-1.81	22.13		
10:44:00	PM		33.10	-1.10	23.23		
10:44:30	PM		N/A				
10:45:00	PM		36.00	-2.90	26.13		
10:45:30	PM		35.31	0.69	25.44		
10:46:00	PM		35.76	-0.45	25.89		
10:46:30	PM	144,890	36.10	-0.34	26.23	20.00	
10:47:00	PM		36.37	-0.27	26.50		
10:47:30	PM		36.55	-0.18	26.68		
10:48:00	PM		36.68	-0.13	26.81		
10:48:30	PM		36.79	-0.11	26.92		
10:49:00	PM		36.91	-0.12	27.04		
10:50:00	PM	144,960	37.00	-0.09	27.13		
10:55:00	PM	145,072	37.17	-0.17	27.30	20.30	
11:00:00	PM		37.17	0.00	27.30	20.30	
11:05:00	PM		37.23	-0.06	27.36		
11:10:00	PM	145,380	37.23	0.00	27.36	20.10	
11:15:00	PM	145,491	37.24	-0.01	27.37	20.00	
6/16/93							
12:15:00	AM	146,695	37.47	-0.23	27.60	20.50	
6:15:00	AM	153,741	37.23	0.24	27.36	19.70	
9:15:00	AM		38.97	-1.74	29.10	20.10	
10:03:00	AM	158,465	37.78	1.19	27.91	19.70	
12:50:00	PM	161,731	37.39	0.39	27.52	19.60	
1:15:00	PM	162,225	37.42	-0.03	27.55	19.30	GPM
1:19:05	PM	162,280				0.00	Start well recovery
1:19:20	PM		33.00		5.97		Whole foot sonar readings
1:19:26	PM		32.00		6.97		
1:19:30	PM		31.00		7.97		
1:19:45	PM		28.00		10.97		
1:19:58	PM		26.00		12.97		
1:20:12	PM		24.00		14.97		
1:20:25	PM		23.00		15.97		
1:23:00	PM		13.10				
1:23:30	PM		12.30	0.80	26.67		
1:24:00	PM		11.80	0.50	27.17		
1:24:30	PM		11.36	0.44	27.61		
1:25:00	PM		11.00	0.36	27.97		
1:26:00	PM		10.48	0.52	28.49		
1:27:00	PM		10.29	0.19	28.68		
1:28:00	PM		10.00	0.29	28.97		
1:29:00	PM		9.90	0.10	29.07		
1:30:00	PM		9.82	0.08	29.15		
1:31:00	PM		9.77	0.05	29.20		
1:32:00	PM		9.73	0.04	29.24		
1:33:00	PM		9.71	0.02	29.26		

TUNTUTULIAK WELL FLOW TEST

1:34:00	PM		9.70	0.01	29.27		
1:35:00	PM		9.69	0.01	29.28		
1:40:00	PM		9.70	-0.01	29.27		
1:50:00	PM		9.70	0.00	29.27		End test recovery period

APPENDIX F
COMMUNITY SURVEY RESULTS

GENERAL

This appendix is a summary of the Tuntutuliak community survey. It is written in narrative form to convey the community comments as received directly from residents during interviews. An example of the survey form and a summary of results is included in this appendix.

COMMENTS

Community house to house surveys were conducted at 47 out of approximately 70 homes from March 29 through April 1, 1993. Homes that were not included were those of people who were either not at home or out of town. All homes spoke Yu'pik as the primary language and several homes of elderly people required tedious translation.

In summary, Tuntutuliak residents were overwhelmingly receptive to improvements in their water, wastewater and solid waste disposal system. Evidently, it was the consensus among the majority of people that experienced the past history of failure of the school sewage system, the problems associated with the honey bucket self haul system, the labor intensive method of obtaining water for drinking and washing, and the unsanitary condition of the dumpsite that improvement is needed on all levels. One individual said this action is overdue. All homes but three desired piped water. Of these three, one home had a holding tank with pressurized water supply and a flush toilet, and the other two homes were those of bachelor men who were happy to remain without conveniences.

Nearly all residents favored a piped sewer system, but expressed concern for the monthly cost for the service. Some people said they would pay whatever the cost because they are so concerned with the health of their families. Individuals who do not have a steady income were generally resigned to make do with a honey bucket haul system. If piped sewer and water were unattainable due to cost, most people expressed high interest in the COWATER type system. The honey bucket haul system was considered more favorable than self-haul because of the inadequacy of the present self haul bunker system. Some areas of town experienced more problems than others, in terms of access convenience and bunker failures. The downside of the traditional honey bucket haul system, as expressed by some people, was their knowledge that waste does spill from the container as it is hauled to the dumping site.

The community experienced an unfortunate incident several years ago when two school age children who resided in new housing in close proximity near the school died of hepatitis. People blame the contamination caused by the school sewage lagoon failure or leakage. The community youth population is growing steadily and residents repeatedly expressed concern for the health of their families.

WATER SYSTEM

Summer

Without exception, all homes relied on rain barrels for their summer water supply. The water storage quantity ranged from 55 to over 400 gallons, contained in household water barrels. If summer rains are infrequent, people use water from the Kinak River or obtain it from the washeteria. Many people who would otherwise use washeteria water do not because it is too far away in the summer. Depending on the location of homes or reluctance or inability of people to pay for washeteria water, some individuals obtain water for washing by walking to the river with six gallon buckets. One individual whose family recently moved back to the village after living in Bethel for years described getting water from the river with buckets as "backbreaking." It was mentioned that hauling water is harder for single parent families or families who depend on others to haul water for them. According to one gentleman, the present system of getting your own water was "not that bad," and those that complained were either lazy or sick. Women are generally responsible for washing and some hauling, and those with newborn babies or large families were more outspoken about obtaining piped or running water. Many older people who were used to depending on themselves for hauling their own water and dumping their own honey buckets were more accepting of getting by like they always have than younger people who are more familiar with modern conveniences.

Everyone interviewed favored the taste of rain water, especially for drinking tea and coffee. The majority of people said the quality of the rain water was good. However, several did express concern for rain water collected from roofs in the older part of town, because soot particles from the chimneys and burn barrels are sometimes found floating in the rain barrels and the water is dark looking.

Washeteria water is available for $0.15 per gallon. Residents favor drinking rain and ice water to washeteria water because it "tastes better." Several individuals described how the washeteria water makes blacker coffee and darker, less palatable tea. One individual commented that when coffee is made from this water, something floats in it. Another will not drink it because it has, "too many chemicals in it." The water also yellows clothes. (Wally Wallace in charge of maintenance at the PHS explained that this condition is due to the manganese content in the water and he would call the washeteria operator to correct the situation.) Some people do not use washeteria water because it costs money, while others say the washeteria is located too far away from their homes. Winter use of an alternative water source is made easier by snowmachine transportation. Obtaining water from the washeteria in the summer requires people to either carry buckets or use wheelbarrows for a long distance. Tuntutuliak's boardwalks to the washeteria are narrow and during the flooding season, portions become submerged under water. These portions were identified on the basemap by land committee members of the Qinarmiut Corporation. The pathways located within the Federal Townsite are reserved as a right-of-way and are sufficient for accommodating larger boardwalks.

The water quality of the river water, as described by residents, varies with the season. With spring runoff and fall floods, the river gets "too brown," or turbid. In the summer, it is silty. People who use river water for steambaths in the summer wait for the water to settle before using it. When no other alternative exists, river water is used for drinking, but it is boiled by most people. (Families with newborn babies boil all water used by the baby.) River water is used mostly for washing.

Winter

Ice is obtained from ponds, lakes, and the Kinak River by all homes in Tuntutuliak during the winter. Individuals travel by snowmachines distances ranging from 1/2 to 20 miles to collect ice. One individual who traveled from 10 - 15 miles to get ice said he goes far because his, "wife wants good ice." People who do not have working snowmachines have to rely on other people to get their ice. Several people mentioned that long ago, people were able to get ice from the ponds now located in the heart of the village. Now, everyone considers these ponds contaminated and do not use them for any purposes. People who are most concerned about contamination go longer distances to obtain ice. When there is clear ice on the river, people will obtain it there. The best times to collect river ice is during the first part of winter and during breakup. River ice is not used in late winter because it becomes yellow and is not suitable for washing.

People expressed much concern about the permit the school has to pump lagoon effluent into the Kinak river because they depend on the river for winter ice gathering and fishing all year around.

One individual mentioned that watering points used several years ago by community residents did not function as designed. This system was not maintained and eventually was discarded.

WASTEWATER (GREY WATER) SYSTEM

The majority of homes who had sinks used buckets underneath to catch wastewater. Several homes installed drain pipes under their sinks to dispose of wastewater. The location of homes, bunkers, and availability of nearby ponds and sloughs influenced where residents dumped their wastewater. Residences located near ponds dispose of the wastewater in the ponds. People who lived in new housing near the school, dump their wastewater in the ponds because they are considered contaminated already. Other residents dispose of wastewater in the bunkers near their homes, if they are not overflowing. Some throw wash water out their door, or in the front or back of their homes. All residents consider this disposal method inadequate.

SOLID WASTE DISPOSAL

Honey Buckets

Almost all residents rely on bunkers for disposal of honey bucket waste. Some throw their wastes in ponds nearby. Everyone agreed that this method of disposal is absolutely not adequate for a number of reasons. Wastes thrown in bunkers located in the floodplain of the lower village rise with the water. Some bunkers overflow in the summer and freeze in the winter. It was noted that in summer the bunkers fill with water. When wastes are thrown in the bunkers in tied garbage bags, they freeze and fill up more quickly in the winter, and do not seep into the ground in the summer. Several older bunkers have failed and new bunkers constructed within the last few years appear to be holding their own. At least two individuals constructed their own bunkers because their old bunkers filled to capacity. If bunkers fill up, people move to the next closest one. Several commented that they are too far away. One individual commented that bunkers are beginning to leak noticeably into the lakes this year. Residents complained that some people throw trash into the bunkers and cause them to fill up faster. Many consider the self haul inconvenient and too much work.

Although everyone interviewed maintained that honey buckets are dumped into bunkers, several people mentioned that occasionally some people dumped their wastes into the little creek in the lower village. During the community meeting, one individual said new bunkers in the lower village were an immediate need because elderly people were dumping their honey buckets in the creek. Because children play nearby, parents are concerned about this practice.

One individual who helped another build a collection tank for his home mentioned that he would also like to build his own system but is afraid because the permafrost may melt.

When asked about possible sites for a new sewage lagoon, one individual mentioned that there the land around the village was no good for anything. Another said the village should relocate because it is in a flooding area. High winds from the south causes flooding, and water fills the village. If a new lagoon is constructed then it would have to be located away from the village on higher ground. Several people stated that if a new sewage lagoon is located a long distance away, someone would need to be hired to haul wastes away. One individual commented that probably the only system that will work is a manual haul system because of the availability of funds.

Everyone expressed the concern that the school sewage lagoon is a health risk. The lagoon is located in the middle of the village. In the summer the lagoon smell is offensive, and people who live in the new housing area are forced to walk past the school. The lagoon has leaked into the surrounding ponds and at one time was pumped into a lake on a Native Allotment.

One residence in the community had a flush toilet, running water, and a hot water tank. Wastewater disposal from this residence was to an unpermitted seepage pit.

Solid Waste

The amount of garbage generated by families ranged from one to 15 bags per week. The consensus of community residents on the adequacy of the dumpsite in terms of location, suitability, and cleanliness was unanimously negative. The comments most frequently repeated are as follows: "The dumpsite is located too close to the community. The dumpsite is not fenced. During windy days, trash is blown all over the place. High tides fill the slough near the dump and fall floods raise the water table at the dump causing garbage to float everywhere. High winds from the north blow trash into the village. The slough near the dump empties into the Kinak River and causes pollution of the river. The dumpsite is an eyesore. The trash is getting closer and close to the village. I don't like it when people throw their dead dogs out there. The garbage should be buried right away. The dump contaminates the whole area. People have to go farther to get ice. It is really bad when the snow thaws, it's a real concern. Foxes who come to the dump, go into the village. The dump is a health hazard. Some people dump anywhere they want, they don't know how to take care of the land. This area is worse than other surrounding villages. People should be more responsible."

Many people mentioned how the last 100-200 feet of the boardwalk to the dumping area is now covered with garbage, causing inconvenience for people who use it in the summer. Since wheelbarrows are used for dumping, people are reluctant to walk further and simply dump their garbage at the end of the uncluttered boardwalk causing the garbage to spread farther and farther from the designated dumping area. Depending on the volume of garbage generated every week and distance people have to travel to dump garbage with wheel-barrows, it is sometimes more convenient for residents to store garbage underneath their homes until winter when they could be easily hauled with snowmachines. One individual mentioned that he would like a central collection bin located nearby.

Several people expressed concern for the lack of supervision for what is thrown at the dump. For example, the dead dogs mentioned above are tossed out with other garbage and are not buried. On warm, sunny days in the summer, the smell from the dump makes people sick. Several people commented that some agency hired people to collect garbage years ago. Because two people were directly responsible for the dumping, they had control of where the garbage was dumped and took care to see that it was done properly.

Most residents sort burnable and non-burnable items. Several have 55 gallon burn barrels on their property for this purpose. Everyone approved of the idea of installing a burn box or incinerator at the dump. One individual mentioned that it would be more convenient for her family because she always had to check to see if her neighbor was burning garbage before she hung out her clothes to dry. Others say how much more convenient it would be for them to be able to burn their garbage at the dump instead of outside of their homes. Winds scatter the burning debris causing fire hazards in the summer.

Illegal dumping is occurring on the far end of town, on the other side of the new housing. One individual mentioned that dumping is also occurring near the river.

21 of out the 47 people interviewed stated that they would pay for garbage collection. 17 said that they haul their own garbage and do not want to pay someone to do it for them. A recycling program was mentioned as a program that would work. Cans were collected in some homes already. They would have to be shipped out on planes.

Tuntutuliak Community Survey Results

Name	Lot	Block	Number People in Home Winter	Number People Summer Only	Water Use (gpw) per house	Have Bath room	Water Source Winter	Water Source Summer	Water $/Month do you now pay?	Water $/Month would you pay?	Sewage $/Month would you pay?	Would you sort trash? (Burn / nonburn)	Trash No. Bags Per Week	Trash $/Month would you pay?
Lupie/Chase	7	3	5.00	5.00	20.00	Yes	LI	Rn, Rv	8.00	12.50	?	Yes	4.50	?
Stewart, J	11	3	3.00	3.00	10.00	Yes	I, W	Rn, W	0.00	12.50	?	Yes	2.50	?
Pavila, P	2	14	4.00	4.00	50.00	No	I	Rn,Rv,W	17.50	12.50	25.00	Yes	7.50	Yes
Thomas, E	6	1	7.00	7.00	150.00	Yes	I	Rn,Rv	20.00	40.00	35.00	Yes	5.50	No
Jimmie, D	4	1	7.00	7.00	60.00	Yes	I	Rn	10.00	35.00	?	Yes	2.00	?
Andrew, C	5	2	4.00	4.00	12.50	Yes	I	Rn	5.00	12.50	?	?	?	?
David, E	3	10	2.00	2.00	7.00	Yes	I	Rn,W	17.00	40.00	40.00	Yes	1.00	10.00
Evan, E	6	12	1.00	1.00	25.00	Yes	I	W,Rn	25.00	?	Yes	Yes	1.00	No
Enoch, J	8	4	4.00	7.50	90.00	Yes	LI	Rn,W	50.00	?	30.00	Yes	2.50	12.50
Enoch, L	6	4	7.00	0.00	70.00	Yes	LI	Rn,W	28.00	12.50	25.00	Yes	2.00	No
Andrew, P	2	4	5.00	5.00	65.00	Yes	I	Rv	20.00	35.00	25.00	Yes	2.50	?
White, E	6	3	3.00	?	50.00	Yes	I	Rn,Rv	12.50	25.00	20.00	Yes	3.50	12.50
Lewis, K	5	3	6.00	6.00	25.00	Yes	LI	Rn	27.50	25.00	25.00	Yes	4.50	20.00
Kernak, J	4	4	2.00	3.00	25.00	Yes	I	Rn	10.00	50.00	17.50	Yes	?	No
Enoch, D	4	2	5.00	5.00	55.00	Yes	I	Rn	20.00	15.00	20.00	Yes	2.50	15.00
Simon, R	1	4	5.50	5.50	30.00	Yes	I	W,Rn	40.00	30.00	50.00	Yes	2.00	?
McIntyre, N	3	2	7.00	7.00	30.00	Yes	I,W	Rn,W	40.00	40.00	12.50	Yes	?	No
Lupie, H	2	2	4.00	4.00	27.50	Yes	I	Rn	48.00	17.50	?	Yes	2.50	No
Wassilie, M	3	1	9.00	9.00	150.00	Yes	I	Rn	30.00	25.00	12.50	Yes	2.50	?
Andrew, W	10	1	2.00	?	50.00	Yes	LI	Rn,Rv	19.00	25.00	25.00	Yes	2.00	No
Andrew, J	9	1	5.00	2.00	30.00	Yes	LI,RI	Rn,Rv	30.00	25.00	25.00	Yes	?	No
Frank, N	2	3	9.00	9.00	400.00	Yes	RI	Rn,Lk	21.00	25.00	35.00	Yes	2.00	Yes
Pavila, J	12	1	3.00	3.00	120.00	Yes	I	Rn,Rv	18.00	12.50	12.50	Yes	3.50	No
Lupie, P	5	1	5.00	0.00	45.00	Yes	LI	Rn,Rv	?	12.50	12.50	Yes	2.50	12.50
Wassilie, F	3	3	4.00	4.00	125.00	Yes	LI	Rn,Rv	60.00	12.50	12.50	Yes	2.00	12.50
Albrite, E	2	1	8.00	8.00	60.00	Yes	I	Rn,W	?	25.00	25.00	Yes	2.00	No
Lupie/Evan	2	6	5.00	0.00	12.00	No	RI	Rn,Rv,W	?	12.50	12.50	Yes	2.00	12.50
Charlie, S	17	3	3.00	3.00	35.00	Yes	LI	Rn,Lk	?	12.50	12.50	Yes	5.50	12.50
Evan, J	4	12	8.00	8.00	110.00	Yes	RI	Rn,Rv	0.00	40.00	35.00	Yes	2.00	5
Andrew, E	3	3A	6.00	6.00	90.00	Yes	RI,LI	Rn,W	10.00	12.50	25.00	Yes	2.50	No
Daniel, E	19	3	2.00	2.00	20.00	Yes	LI	Rn,Lk	?	12.50	12.50	Yes	1.00	No
Manutoli, W	13	3	1.00	1.00	30.00	No	I	Rn,Rv	?	12.50	12.50	Yes	1.00	?
Frank, A	4	3	5.00	2.00	55.00	Yes	I	Rn,Rv	25.00	35.00	35.00	Yes	5.00	10.00
Miller, A	4	1	1.00	1.00	20.00	No	RI	Rn	0.00	12.50	25.00	Yes	2.00	No
McIntyre, C Jr	6	1	6.00	5.00	75.00	Yes	I	Rn,W,Lk	10.00	50.00	50.00	Yes	4.50	No
Charles, J	?	?	4.00	4.00	100.00	Yes	I	Rn	60.00	?	?	Yes	10.00	?
Daniels, I	?	3	6.00	6.00	120.00	Yes	I	Rn,W	?	25.00	25.00	Yes	?	Yes
Savok/Wassilie	3	1	8.00	8.00	100.00	Yes	I	Rn,Lk	?	100.00	50.00	Yes	14.00	No
Joseph, P Sr	2	1	7.00	7.00	110.00	Yes	I	Rn,Rv	15.00	17.50	25.00	Yes	1.00	5.00
David, H	7	5	4.00	4.00	50.00	No	I	Rn,W,Rv	19.00	25.00	100.00	Yes	3.00	10.00
Wassilie, E	8	1	9.00	9.00	220.00	Yes	I	Rn,Rv	?	40.00	12.50	Yes	3.00	10.00
Jimmie, P	12	1	4.00	4.00	40.00	Yes	I	Rn,Rv	40.00	50.00	?	Yes	4.00	No
Lupie, N	1	2	8.00	0.00	55.00	Yes	I	Rn,Rv	8.00	35.00	25.00	Yes	4.50	12.50
Jimmie, J	4	3	7.00	7.00	50.00	Yes	I	Rn,Rv	120.00	25.00	85.00	Yes	1.50	No
Fitka, J	6	3	6.00	6.00	58.00	No	I	Rn,Rv	24.00	25.00	100.00	Yes	4.00	Yes
Charlie, T	8	5	4.00	4.00	258.00	Yes	I	Rn,W	?	?	25.00	Yes	7.00	16.00
Andrews, E	3	3	3.00	3.00	60.00	Yes	I	Rn	?	Yes	25.00	Yes	?	10.00
AVERAGE			4.97	4.47	73.40				25.21	26.67	30.19		3.41	12.09*

LEGEND

? = "Don't know"

I = Ice

LI = Lake Ice

RI = River Ice

Rv = River

Lk = Lake

W = Washeteria

Rn = Rain

* Based on those wanting service

Tuntutuliak Community Survey Summary

Community Survey Summary
Number of homes surveyed = 47
Total Number of people in homes surveyed = 234

No. People Living in Home	**No. Homes**	**as % of Homes Surveyed**
1	3	6
2	4	9
3	5	11
4	9	19
5	7	15
6	6	13
7	6	13
8	4	9
9	3	6
		-
How much is spent for water utility each month?		
$/Month	**No. Homes**	**as % of Homes Surveyed**
0-19	17	36
20-39	11	23
40-59	5	11
60-79	2	4
Over 80	1	2
No response	11	23
How much are you willing to pay for water?		
$/Month	**No. Homes**	**as % of Homes Surveyed**
0-19	17	36
20-39	16	34
40-59	8	17
60-79	0	0
Over 80	1	2
No response	5	11
How much are you willing to pay for sewer?		
$/Month	**No. Homes**	**as % of Homes Surveyed**
0-19	11	23
20-39	20	43
40-59	5	11
60-79	0	0
Over 80	3	6
No response	8	17
Would you pay for trash collection?		
Response	**No. Homes**	**as % of Homes Surveyed**
Yes	21	45
No	17	36
No response	9	19
Do you have a bathroom?		
Response	**No. Homes**	**as % of Homes Surveyed**
Yes	41	87
No	6	13
Would you sort trash?		
Response	**No. Homes**	**as % of Homes Surveyed**
Yes	46	98.00
No	0	0.00
No response	1	2.00

APPENDIX G
SUMMARY OF ARCHAEOLOGICAL INVESTIGATIONS

The National Park Service, as well as the State Historic Preservation officer were contacted to determine whether Tuntutuliak had cultural resources of archaeological or historical significance.

There is no listing in the National Register of Historic Places that involve the Tuntutuliak area. There is however, one site determined to be of historical value and listed in the Alaska Heritage Resource Survey. It is the St. Agaphia Chapel, the Russian Orthodox Church located within the townsite which was built to replace an earlier structure. Also mentioned but not listed, was a prehistoric house pit site upriver from Tuntutuliak.

The work site for this sanitation facility will not be in conflict with the church site or the upriver house pit site.

Further research was accomplished through an interview conducted with a local elders at a Traditional Council Land Meeting. There was no local knowledge of any archaeological sites affecting any of the project area.

APPENDIX H
SITE CONTROL REQUIREMENTS

Qinarmiut Corporation owns the surface estate of the land considered for development of the sewage lagoon, dumpsite and access routes. On March 31, 1993 the Qinarmiut Corporation Land Committee determined that the dumpsite and sewage lagoon would be conveyed to the State Municipal Land Trustee under ANCSA 14(c)(3) to fulfill site control requirements for public projects. ANCSA Section 14(c)(3) states:

> The Village Corporation shall then convey to any Municipal Corporation in the Native village or to the State in trust for any Municipal Corporation established in the Native village in the future, title to the remaining surface estate of the improved land on which the Native village is located and as much additional land as is necessary for community expansion,and appropriate rights-of-way for public use, and other foreseeable community needs: Provided, That the amount of lands to be transferred to the Municipal Corporation or in trust shall be no less than 1,280 acres unless the Village Corporation and the Municipal Corporation or the State in trust can agree in writing on an amount which is less than one thousand two hundred and eighty acres; Provided Further, That any net revenues derived from the sale of surface resources harvested or extracted from lands reconveyed pursuant to this subsection shall be paid to the Village Corporation by the Municipal Corporation or the State in trust: Provided, however, That the word "sale", as used in the preceding sentence, shall not include the utilization of surface resources for governmental purposes by the Municipal Corporation or the State in trust, nor shall it include the issuance of free use permits or other authorization for such purposes; As provided in the law, ANCSA Section 14(c)(3) only refers to the conveyance of the surface estate. The subsurface owner, Calista Corporation requires that the subsurface estate of these sites be acquired from them before construction of the sewer and water project. Calista has established formal procedures with other agencies such as the U.S. Public Health Service and State Department of Transportation and Public Facilities for the acquisition of the subsurface estate of projects funded by their agencies. PHS has negotiated an agreement with Calista for subsurface acquisitions and amended their manuals and procedures accordingly. Calista states that they have not negotiated agreements with Village Safe Water in the past but will need to in order to address State projects under construction in their region. Similar agreements are to be worked out with Alaska Energy Authority for bulk fuel storage.

Calista Corporation policy for subsurface acquisition requires that they break the chain of title by selling the subsurface or exchanging it for another parcel elsewhere. Depending on the location of the land, Calista estimates that the value of the subsurface in Tuntutuliak at approximately $250 an acre. In villages like Goodnews Bay where there is gravel, the value of the subsurface runs higher. The sewage lagoon is approximately 2.2 acres and the dumpsite is approximately 1.9 acres for a total of 4.18 acres. At $250 an acre, the total cost for purchasing the subsurface estate would be approximately $1,045.

In incorporated communities, the City or Borough purchases the subsurface estate from the appropriate ANCSA Regional Corporation. Consequently, they end up owning both the surface and subsurface estates of 14(c)(3) dumpsites and sewer lagoons even though 14(c)(3) normally does not involve conveyance of the subsurface. In the Bristol Bay Region, which has a borough, municipalities purchase the subsurface estate of the dumpsites in incorporated cities. In Naknek, an unincorporated community, the Bristol Bay Borough purchased the subsurface estate from BBNC.

In the Calista Region, where there is no borough, traditional and IRA Councils are the recognized forms of Government in unincorporated communities. Many of these communities have strong inclinations to retain their traditional government structure. In Tuntutuliak, the Traditional Council (TTC) is formally recognized by the State of Alaska as the Appropriate Village Entity who is responsible for overseeing 14(c)(3) decisions. The TTC, however, can not own the land since the State of Alaska does not recognize them as instrumentalities of the State for the purposes of owning 14(c)(3) land. In Tuntutuliak, the surface estate of the dumpsite and sewer lagoon will be conveyed to the State-in-Trust by Qinarmiut Corporation. The State plans to lease the land to the Tuntutuliak Traditional Council who will maintain the facilities.

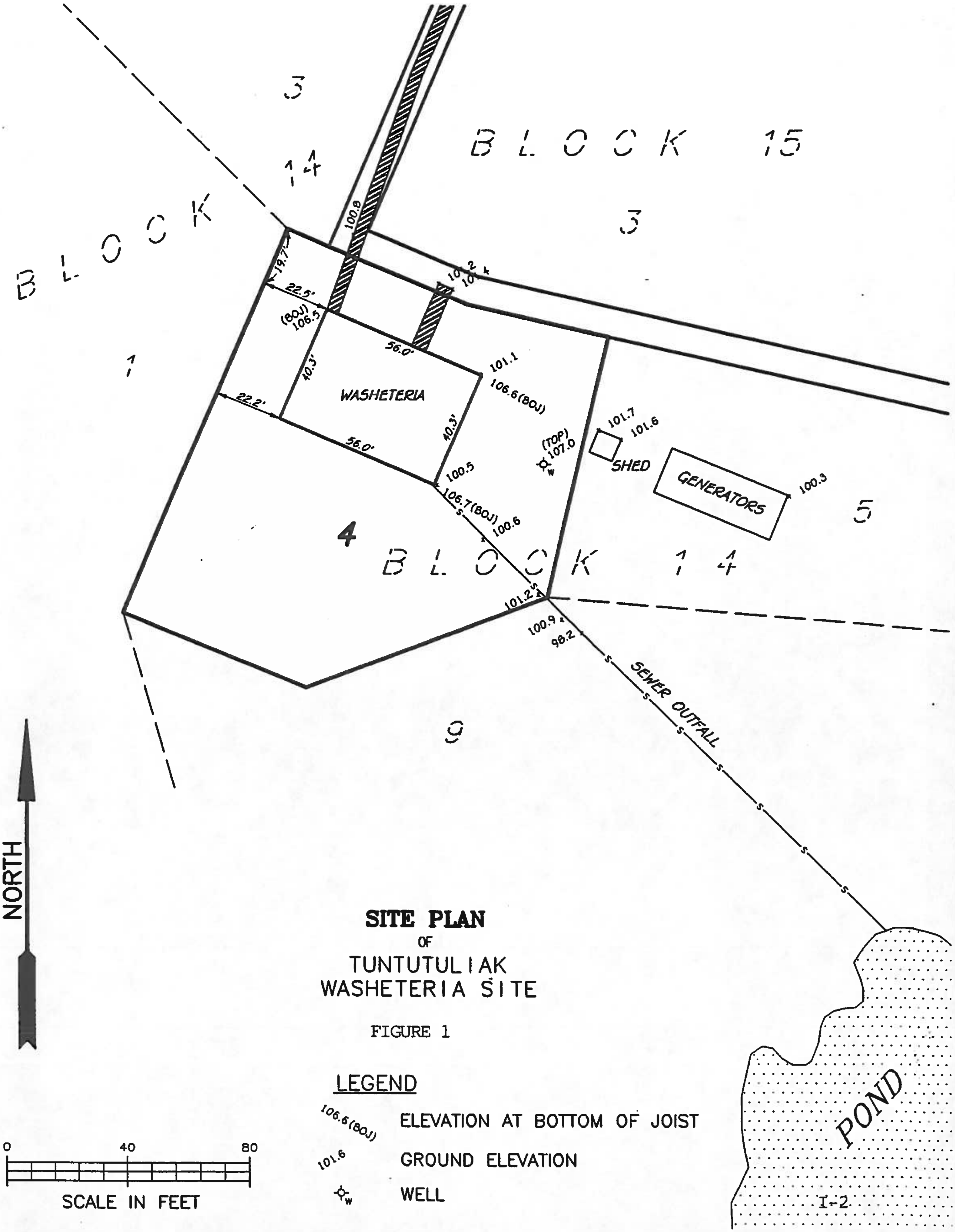
The funding for acquisition of the subsurface would be a part of the capital cost for the project. The acquisition procedures requires Tuntutuliak Traditional Council to write a letter to Calista informing them of their intention to purchase. They also require that TTC provide them with a legal description of the property. Once the parties agree on a price and it is paid, Calista will issue a Quit Claim Deed for the subsurface rights to the Traditional Council.

The Traditional Council will determine whether it is in their best interest to retain the subsurface or convey it to the State. The primary concern in ownership of the subsurface of the sites is liability. Because the MLT will own the surface it is reasoned that MLT should own both surface and subsurface rights.

At this point a technical problem exists because TTC cannot legally convey the subsurface of the sites to the State MLT. The State maintains that A.S. 44.47.151 ss 2 only refers to acquisition of land through 14(c)(3). Conveyance of the subsurface is made aside from 14(c)(3). Further, State law bars the MLT from acquiring land from entities other than a State or Federal agency like DOT or PHS. In a meeting held on April 26, 1993 between Calista and DCRA's Deputy Director and staff of the MLT Program, DCRA recognized that they would need to introduce legislation to allow the State MLT to own subsurface. Calista agreed that the State should address this issue. An Attorney General opinion has been formally requested, and the MLT Program is preparing the language which will be submitted to the Legislature in August for consideration for legislative action for the next session.

Site control for new roads or access ways to the sewage lagoon and dumpsite will also be conveyed under 14(c)(3). Established rights-of-way within the Federal Townsite are large enough to accommodate larger boardwalks and roads therefore site control for any boardwalk upgrade is not needed.

APPENDIX I
MAPS



SITE PLAN
OF
TUNTUTULIAK
WASHETERIA SITE

FIGURE 1

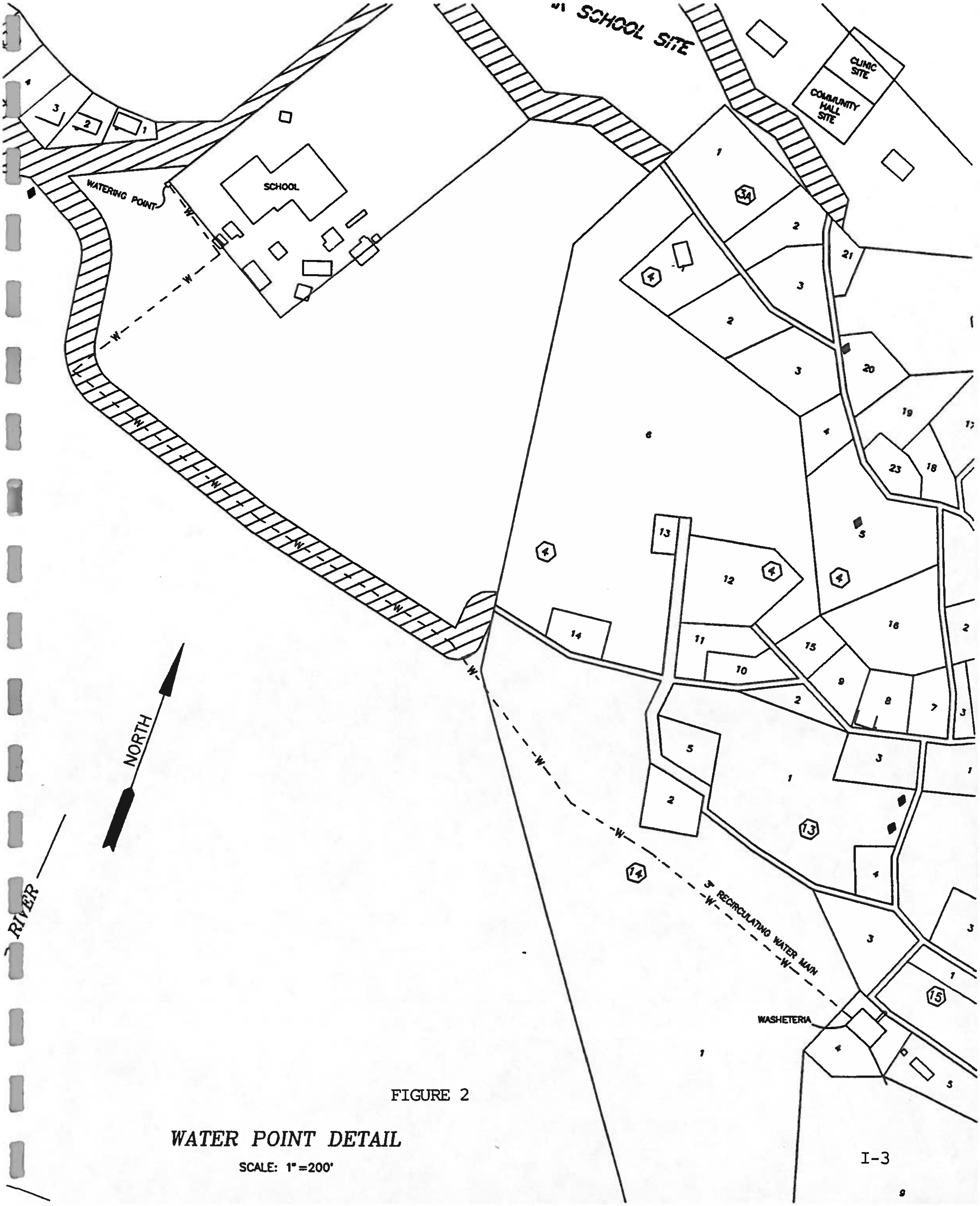
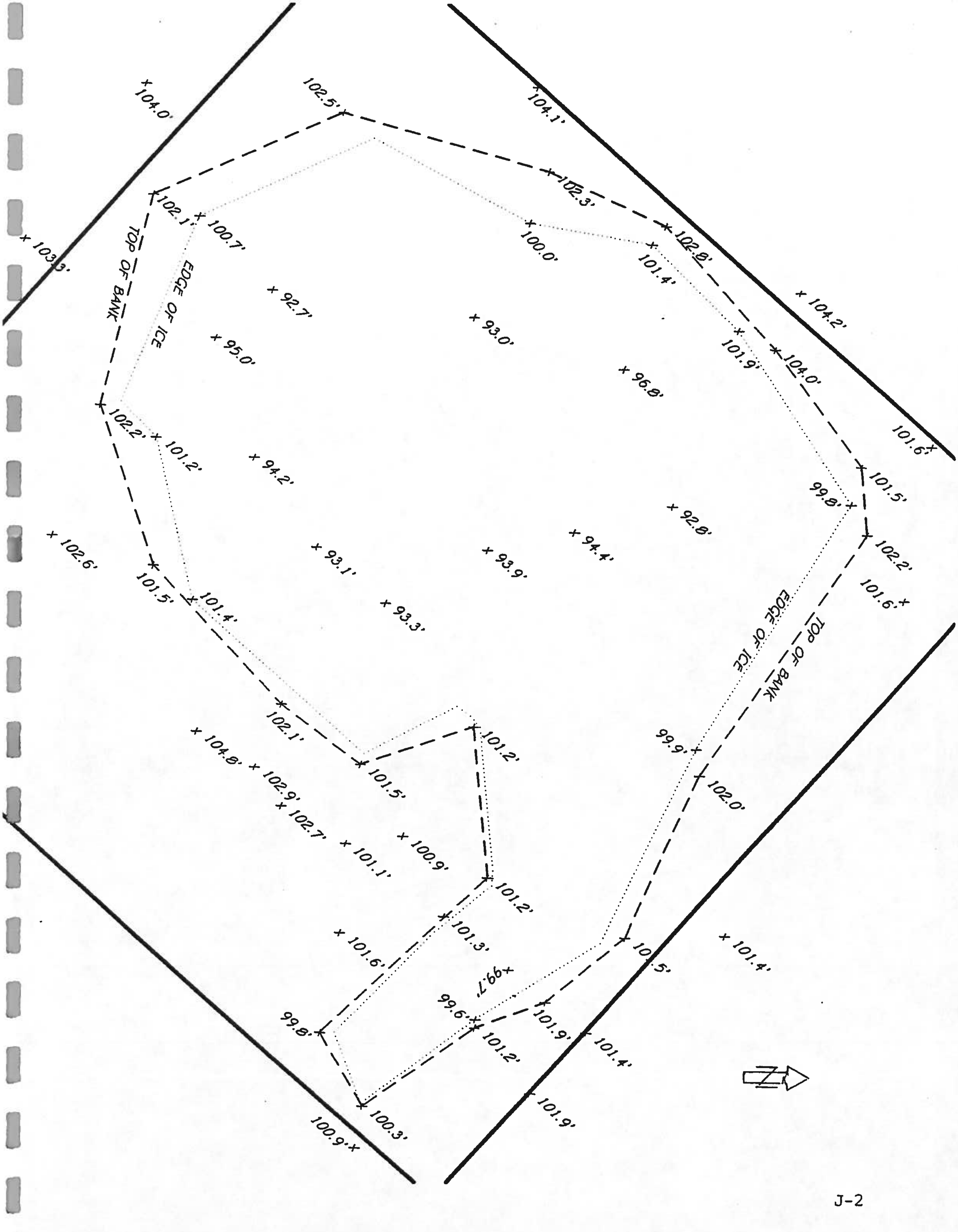


FIGURE 2

WATER POINT DETAIL

SCALE: 1"=200'

APPENDIX J
LAGOON CROSS SECTIONS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102.1'
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104.0'
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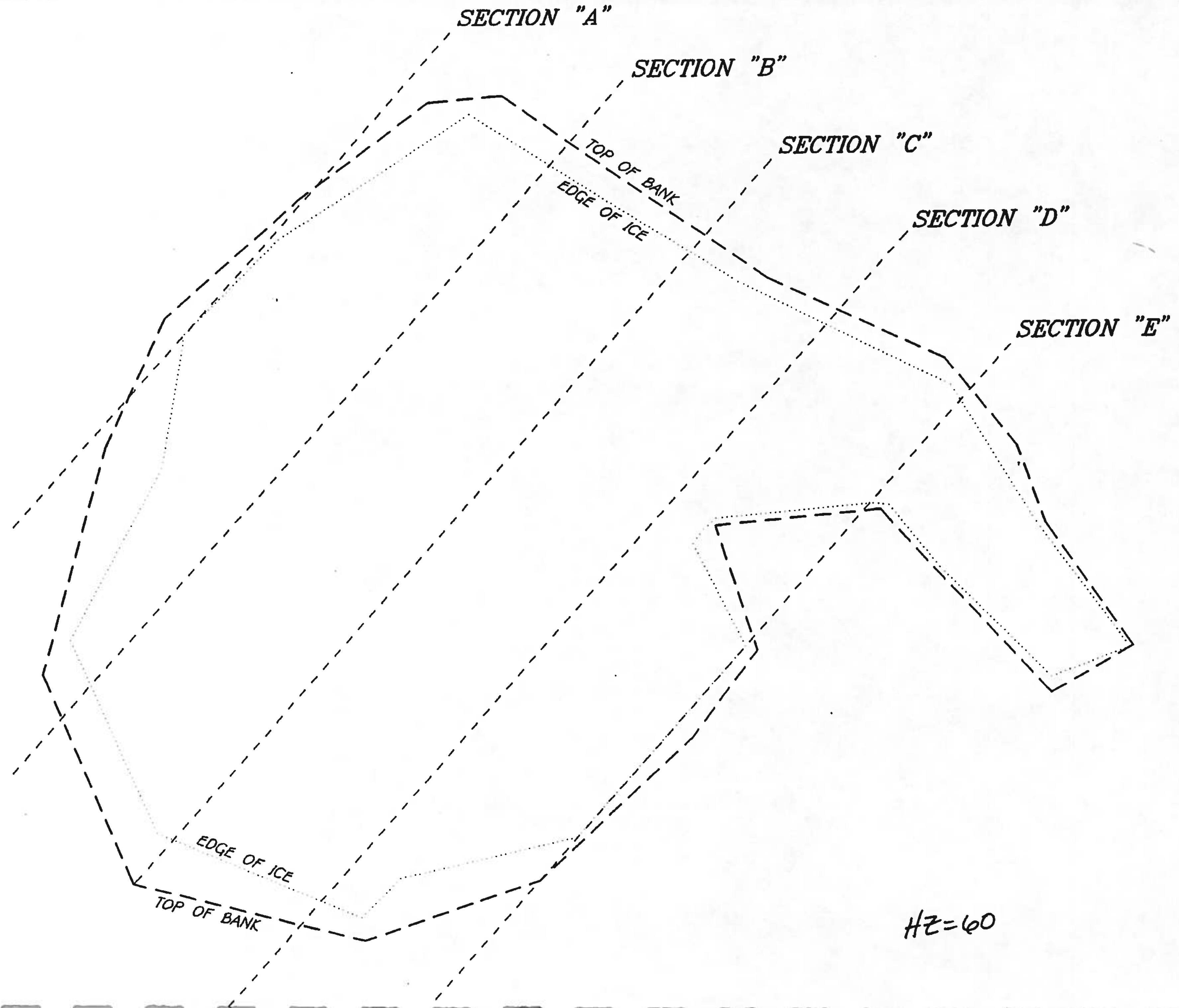
100.9'


SECTION "A"
SECTION "B"
SECTION "C"
SECTION "D"
SECTION "E"
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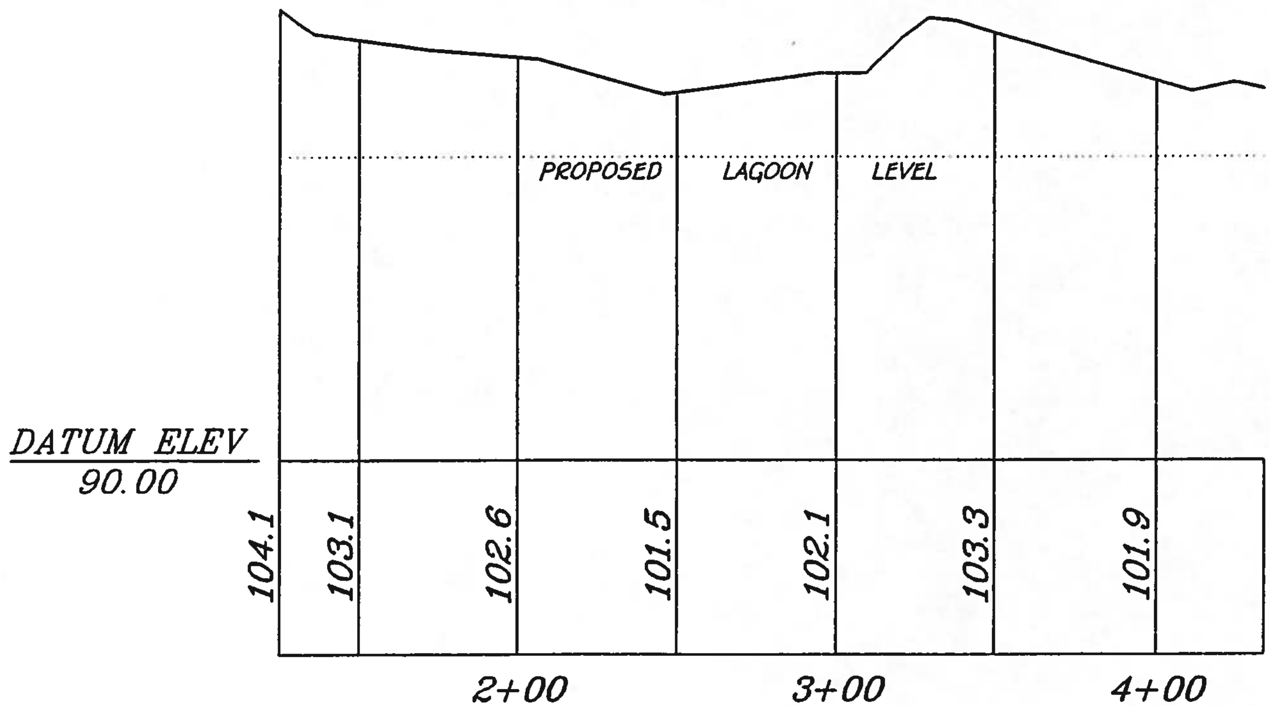
EDGE OF ICE
EDGE OF ICE
TOP OF BANK
HZ=60



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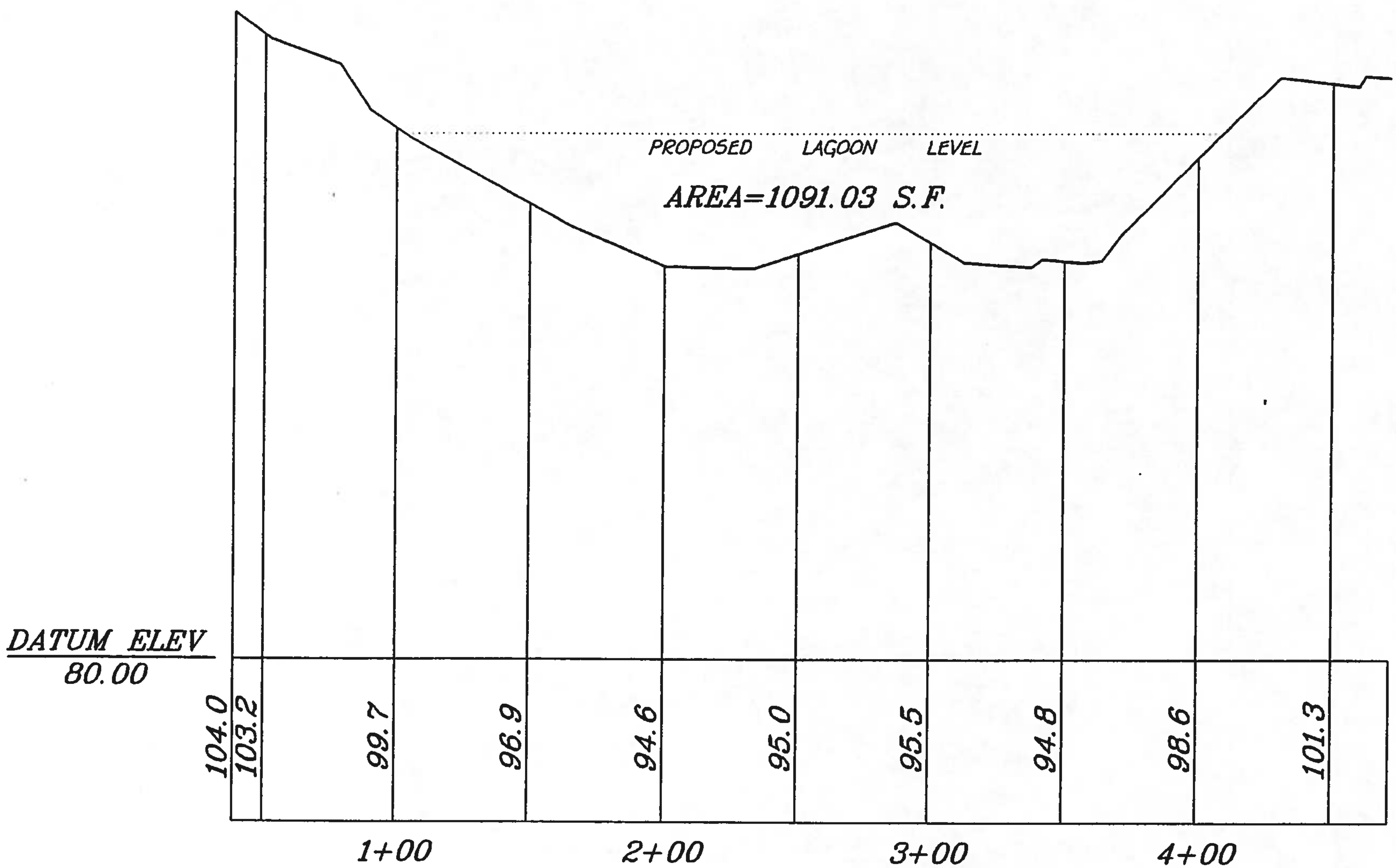

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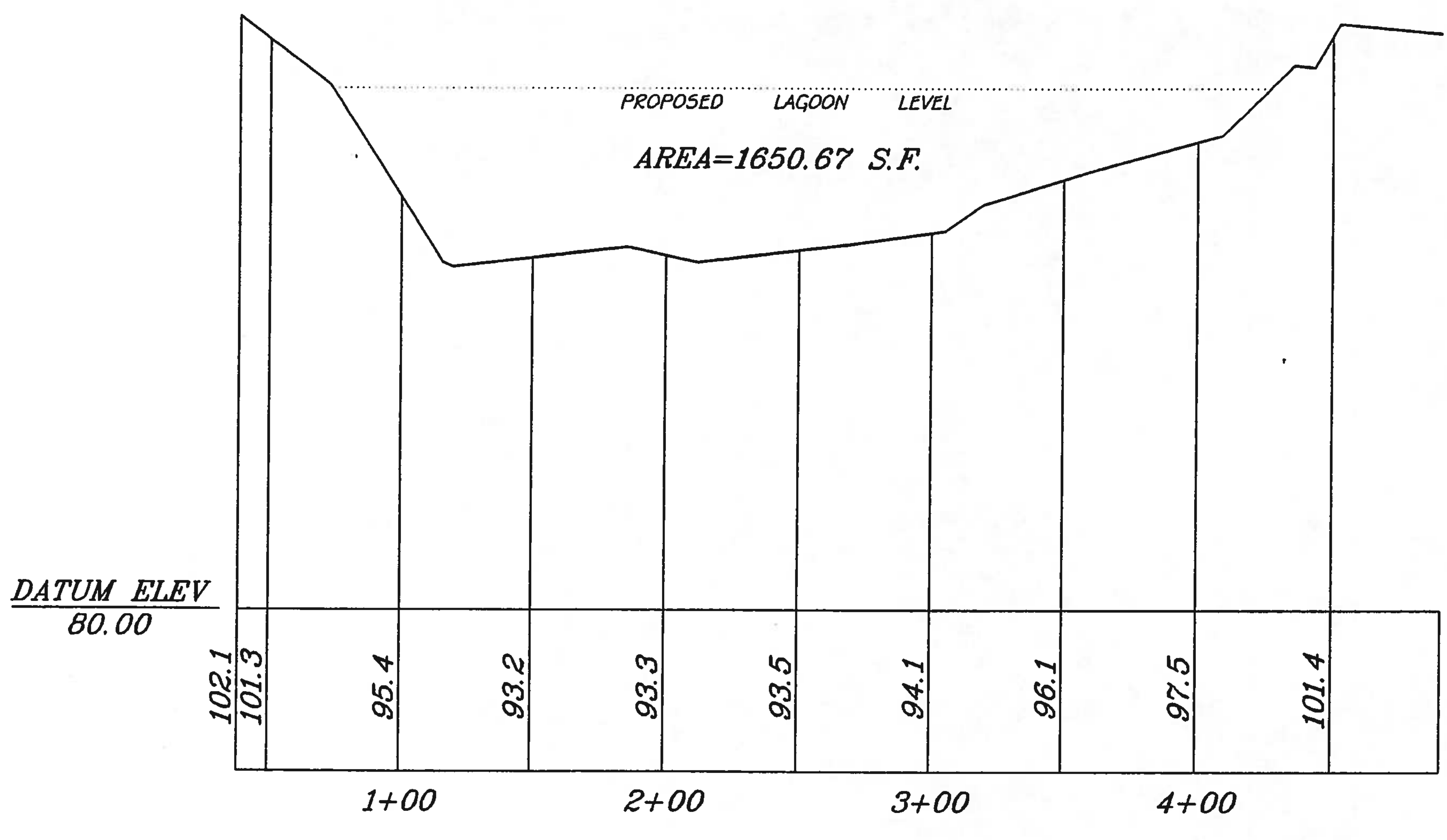
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101.3
95.4
93.2
93.3
93.5
94.1
96.1
97.5
101.4
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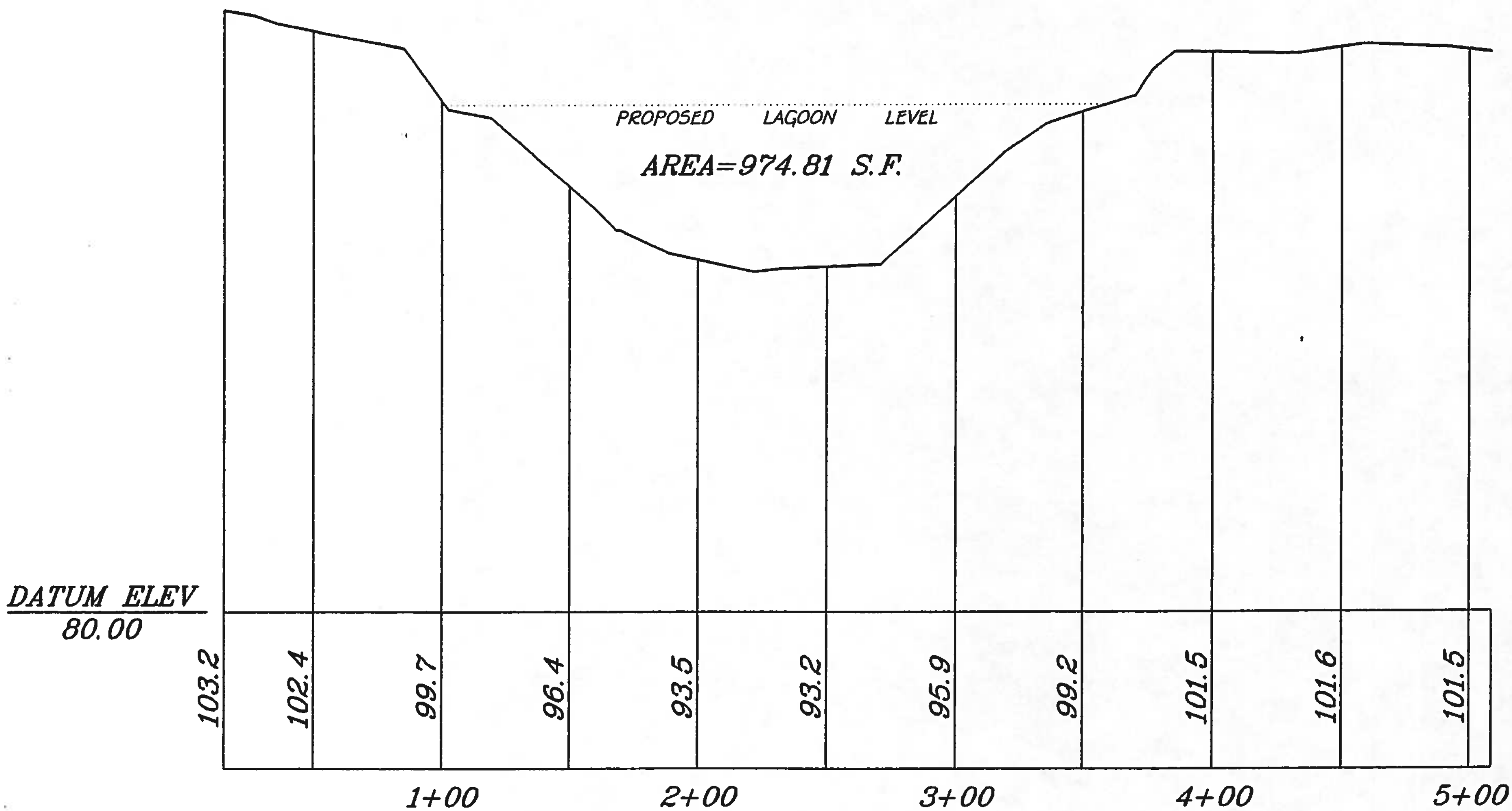
2+00
3+00
4+00
HZ =60
VT=6

SECTION "C"



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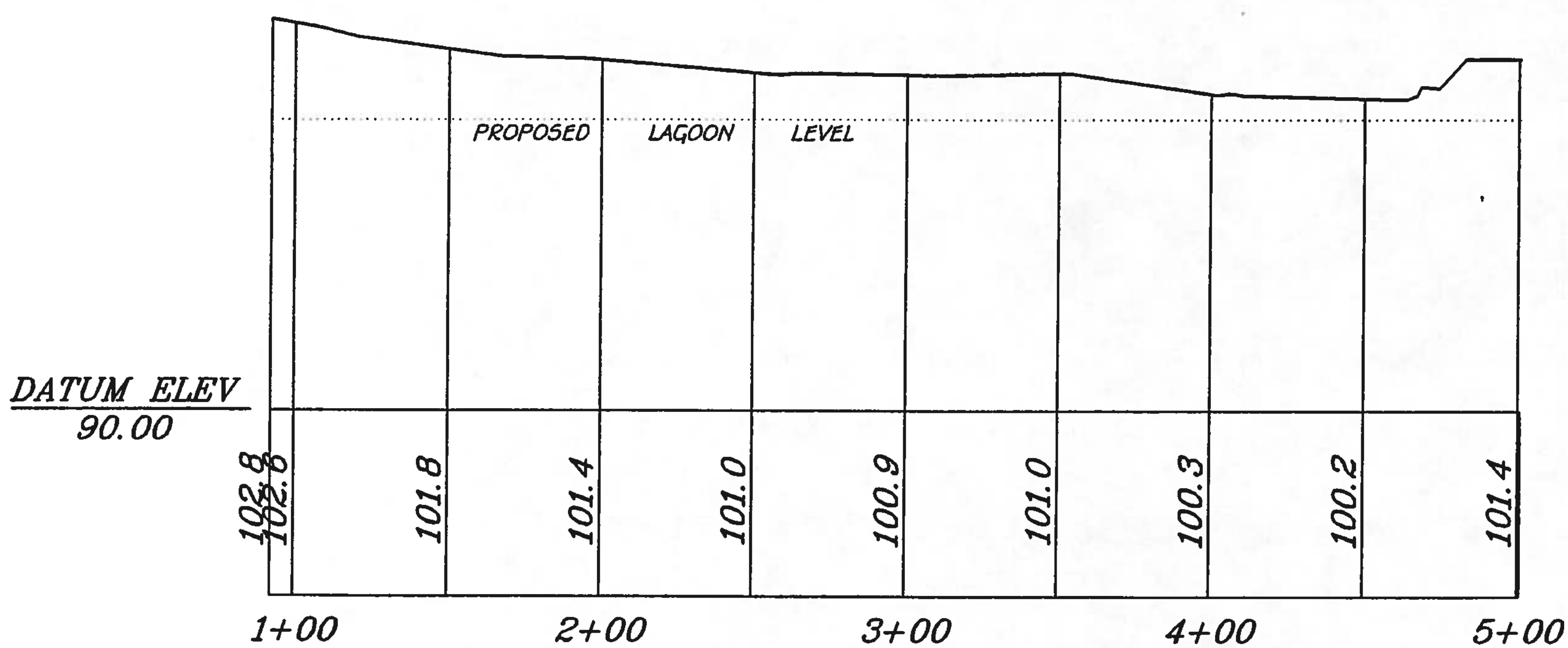

SECTION "E"

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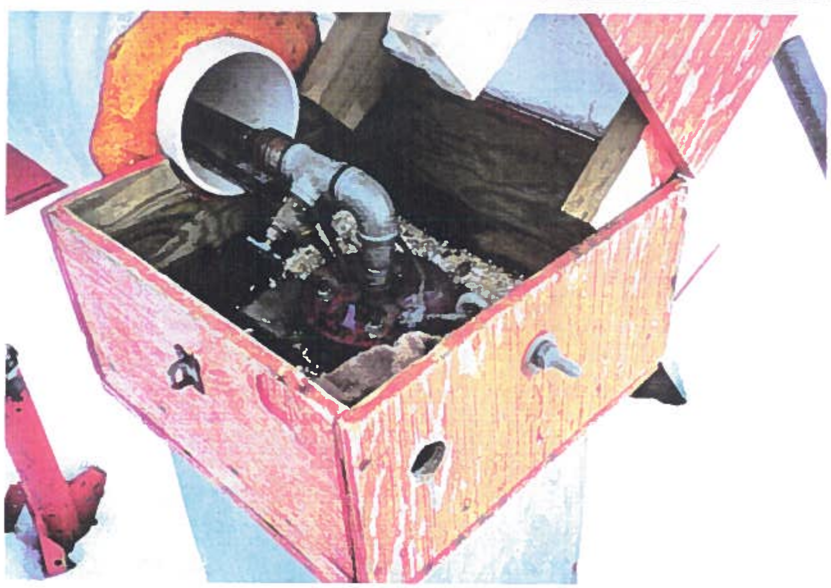
VT=6

APPENDIX K
PHOTOS

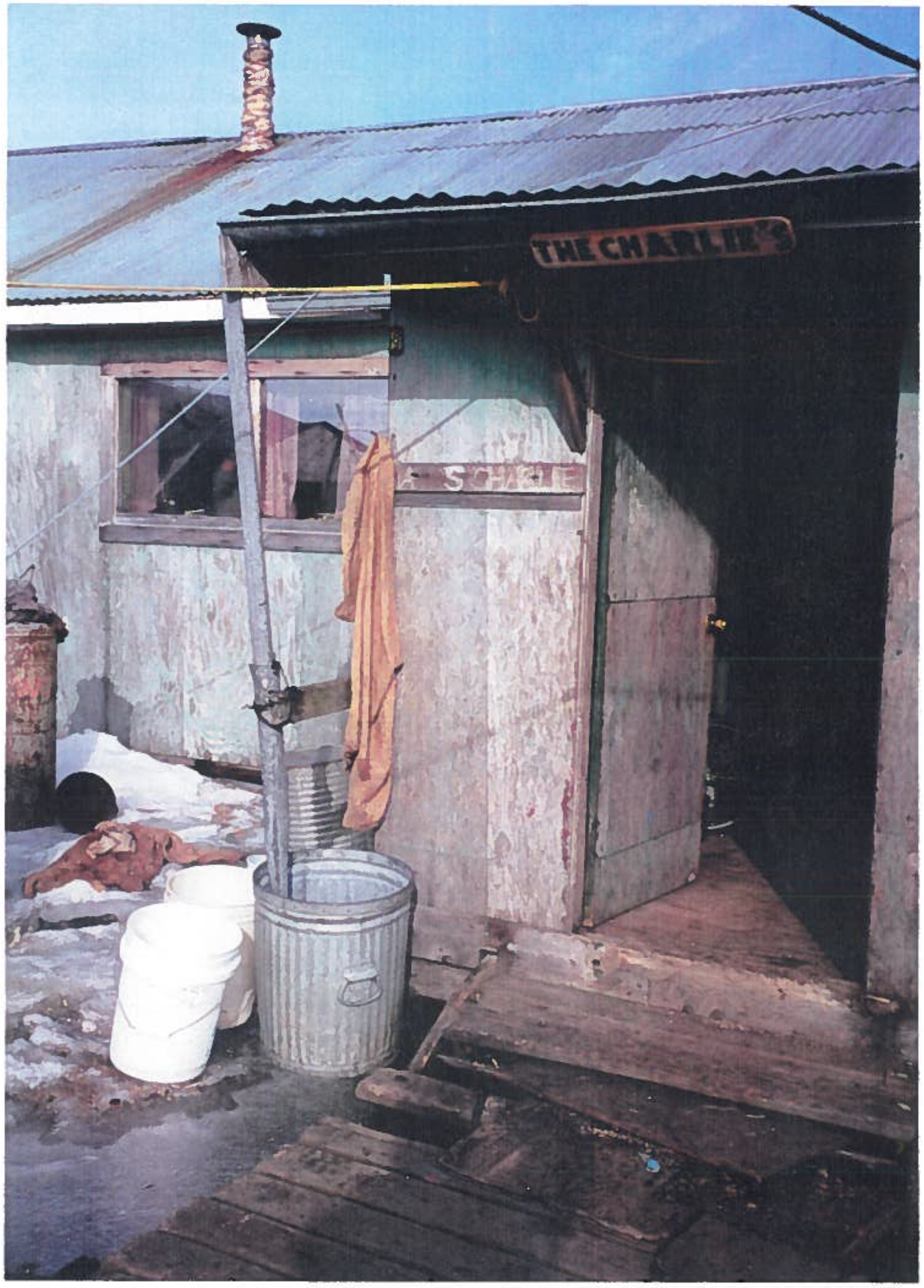
Existing Honey Bucket Bunkers

Present Solid Waste Dumpsite

Trash Bin and School Burn Barrel



Top: Water Collection Point, Middle: River Ice Collection, Bottom: Washeteria Well Head



Rain Water Collection System

Collapsing Honey Bucket Bunders

Proposed Lagoon Site

School Well House and Old BIA School Outfall

APPENDIX L
LOCAL SPARK PLUGS

The village of Tuntutuliak has two organizations involved with the water and sewer project. The lead organization is the Tuntutuliak Community Services Association (TCSA). Mr. Robert Enoch is the project contact and has provided the valuable service of coordinating visits to the village and providing washeteria data. Mr. Enoch's present position is head of the water and electric utility. In this capacity he is familiar with the operation of the water plant, its employees and acts as liaison with the Tuntutuliak Village Traditional Council.

The Tuntutuliak Village Traditional Council (TTC) is composed of five members and is the main governing body in Tuntutuliak. Mr. Adolph Lupie is the Co-Administrator and has acted as our contact with the Traditional Council.

Mr. Jacob Daniels is the water plant operator and is in charge of water treatment and daily maintenance operations at the washeteria.

Mr. David Enoch is the Chairman of TCSA, and the president of TTC.

Archie Andrews is the Vice-Chairman of TCSA.

Robert Enoch is President of Qinarmiut Corporation, the ANCSA village corporation which owns the land surrounding Tuntutuliak.

APPENDIX M
SUMMARY OF SECOND PUBLIC MEETING

On June 15, 1993, following an interview and meeting with Tuntutuliak Traditional Council Village Administrator, Robert Enoch, Sharon McClintock, Land Planner, part of an ERES Feasibility Study Team conducted door to door follow-up interviews with community residents. The purpose of these interviews was to obtain additional information from residents about their ability to pay monthly costs for various options considered in the VSW 65% Phase Feasibility Study. The initial house to house surveys conducted March 25-27, 1993 asked preliminary questions relating to general household consumption of water, water sources, waste disposal, adequacy of present water and disposal systems and ability of people to pay for services. At the time the initial surveys were conducted, tangible monthly costs for the various services had not yet been determined. The questionnaire presented sliding costs in $10 increments starting at zero. People selected average amount of $26 for water and $30 for sewage collection as a monthly maintenance fee.

The second interviews were conducted June 15 with the knowledge of estimated monthly household costs for the options of a pressurized sewer and water distribution system, pressurized water and vacuum sewer system, COWATER flush tank and haul system, honey bucket haul system, and costs to obtain water from central watering points. Residents were also briefed on the construction costs, time involved for installation of each system and asked to provide comments on the proposed location of the sewage lagoon, new dumpsite location, watering points, location of boardwalks, interim solutions and sales tax possibilities.

House to House Interviews

Interviews were initiated at the upper village section of town which contains newer ACVP housing. The next morning the middle and lower part of town were interviewed. The King Salmon were running and many people were at summer fish camps. Those remaining in town were busy cutting, drying and smoking fish. Most homes on the upper village and about a dozen homes in the lower village where visited. The people listed below were either interviewed or present at the community meeting held Tuesday evening on June 15, 1993. Approximately 12 residents were present at the public meeting. In discussions with several people following the community meeting, it was learned that public meetings are generally not well attended by local residents because it is the village traditional custom to elect officials to represent public interests. They are trusted to make decisions and speak on everyone's behalf at meetings.

<u>Residents Interviewed</u>
Robert Enoch *
Sophie Andrews
David Enoch
Nellie McIntyre
Peter Joseph Sr.*

Johnny Evon
Mike Wassille
Lena Chase
Joe Kernak/Edith Kernak
Wilson Manutoli
Martha Albright
Charles Andrew *
Ron Simon *
Willie Andrews *
Adolph Lupie *
Peter Miller *
Pansy Lupie *
Ivan Daniels *
Sophie Charlie
Andrew Frank
Joseph Lupie *

* Also attended public meeting.

Most individuals interviewed appeared initially stunned at the estimated cost of $167-175 they would be required to pay per month for piped sewer and water. One elderly man said "Ah-zee!" which means "It hurts!" When informed about the cost of the various options, all individuals opted for the pressured sewer and water system as a first choice. The COWATER system was a secondary choice. It was the interviewer's impression that when residents are presented with the realization that the cheapest system available did not solve the health problems associated with honey buckets, combined with the cost of .15 - .30 per gallon for water, the cost difference of approximately $40 - $50 per month for a phased system of piped sewer and water was not considered significant.

General comments indicated that residents were willing to hold off on the selection and construction of the project until the feasibility of obtaining BIA ISTEA funding of the boardwalks was known. Mr. Robert Enoch asked that during the interview the people should be informed that the project would be conducted in phases. Mr. Enoch felt that the piped sewer and water system should be an ultimate goal even it takes years to complete. The honey bucket haul system was viewed as starting all over again with a system that was totally inadequate. His and others' concern was that spillage during collection was an ever present possibility and would spread disease and continue the health hazards the community has tried to combat for years. He echoed the sentiment of many people that it was worth waiting for something that will last, and that people would find a way to pay $175-200 a month to improve their lives. He still expressed concern for people who lived on the economic border line and questioned their ability to pay.

General Interview Narrative

Sophie Andrews commented that a flat rate charged to everyone would be fair. When asked about the possibility of instituting a sales tax to help reduce monthly costs per household, she thought it would be okay at 2%. She said that she would be willing to pay from $50-200 per month for services. Her comments on interim solutions was that a honey bucket haul system would be alright for now. The dump is relocated in a better place and the burnbox will be helpful. When asked abut the location of the watering points, she said the watering points were more convenient than the washeteria, which was far away from her house. She said she would pay the amount of .15-.30 per gallon. She did express concern that the water and sewer pipes running above the ground might be broken by snowmachines and said that a main access area or corridor for snowmachines is needed.

David Enoch recommended that construction of any system should be held off until the Traditional Council hears from BIA on the boardwalk funding. He said that he preferred a pressured water and sewer system and can pay $175 per month for the service. He was concerned about the ability of people to pay and whether it was possible for people to hook up to the system later and be bypassed in the interim. When asked about the possibility of a sales tax, he said residents have never had a sales tax before and may consider a tax if it is the only choice left. In the interim until a system is built, he said a honey bucket haul system would work. He also said that a central pumping system for the school would be a start.

When asked about the cost to obtain water from watering points, he said that people who obtain water from the washeteria were already paying .15 per gallon for water, and .15-.25 per gallon would be a reasonable cost per gallon. He said that people had been talking about paying .75 for five gallons and they think that it is okay. He recommended that if a honey bucket haul system is instituted as an interim measure, the underground bunkers should be built close to old bunkers.

Nellie McIntyre said she would to pay $167-175 per month for a piped sewer and water system, as well as a sales tax. She preferred a pressurized system over a COWATER system. She commented that some people would not be able to afford the monthly cost for this system. As an interim measure, she would be willing to pay for a honey bucket haul system. The self haul of the honey buckets was especially inconvenient for her because she is hauling them herself and they were too heavy. She expressed concerned for the washeteria water because it had too many chemicals.

When surveys were conducted in April, elder Joseph Lupie required a translator and there was none available at the time. His son, Paul Lupie who interpreted for him and understood the cost for all the options, stated that a cost of $170 per month was affordable, and they will find some way to pay this cost. Joseph expressed concern for the monthly cost, and was concerned that the costs would go up in the future. The issue of paying a sales tax was discussed and Paul said that they would be able to pay it if it would help bring monthly costs down.

The Lupies' house was located at the far end of town and they said that the watering point location was fine for them. They would be willing to pay for water if this was the only option. In discussing the choice of the sewer and water alternative verses the COWATER system, they chose the sewer and water since it was more convenient. If they had to depend on a honey bucket haul, they would be able to pay the $92 a month. They asked if there was a pump station, whether they could haul their own honey buckets to the pump station. The boardwalk locations and the dumpsite location appeared to be acceptable.

Mike Wassille is a local store owner which provided an opportunity to obtain input on the sales tax issue. Robert Enoch has asked that we interview him about the convenience of a sales tax to a business owner. Mr. Wassille said a sales tax has never been used before, but with the help of his wife he would be able to accommodate a tax if the residents were in favor of one. He said that he would be able to pay $170 per month for sewer and water. The honey bucket hall system was good too, and he would pay the $92 a month if it were the only way to go. He expressed high interest in the COWATER system. He said the watering point by the school was good if it were established, and they would be about to pay .15-.25 per gallon for the water.

Andrew Frank said he would be able to afford to pay $150-175 per month for a pressurized sewer and water system. He works at the school and knows of the problems with the school sewage lagoon. He believed that establishing a new lagoon was good. He would pay a sales tax at whatever rate the people decide if one were instituted. If the honey bucket haul system was the only way, he would pay the $92 a month. He would also like to see the watering points established. His house is among the farthest away from the washeteria. He would be willing to pay .15-.25 per gallon for water. He said the COWATER system was a good consideration. Mr. Frank is the maintenance man at the high school and expressed concern for the current water well at the school because it was high in arsenic.

Lena Chase expressed concern for the cost of the monthly water and sewer charges, and asked if it was possible for them to hook up at a later time. She liked the idea of the watering points and said that she would be willing to pay .15-.30 per gallon for getting the water. She did not have an opinion about the sales tax. She said that she preferred the piped sewer and water option, however, it would appear that monthly charges may be cost prohibitive.

Edith Kernak/Joe Kernak preferred the piped sewer and water alternative and were willing to pay for the monthly cost. The COWATER system was also a possibility. Mrs. Kernak said that they could pay for the piped sewer and water system but the COWATER system might be cheaper for some people. She said that of all the options presented the piped sewer and water price was just a little more but more convenient. She was willing to pay a 2% sales tax if necessary. Mrs. Kernak was unhappy with the current bunker system by her house. It was filled to capacity, so her husband built a new bunker.

Martha Albrite was interviewed without the benefit of a translator. She did communicate that she wanted piped sewer and water and will find a way to get it.

Wilson Manutoli first expressed concern for the cost of the piped sewer and water system and said that it was expensive and he would rather have the honey bucket haul system. After discussing the cost for the haul system and efforts to obtain water, he changed his mind. He said that they have been trying to get away from honey buckets. He recognized the serious health problems associated with the present system and said that they have to try to improve their lives. Despite his economic concerns he said that there has to be change. "Even if the honey bucket haul is cheaper, it was no good." He said that a form of piped sewer and water service is the only alternative in the long run and they will have to find some way to pay, whatever it takes.

Johnny Evon also favored the piped sewer and water alternative and cost. He was interested in the COWATER system and was willing to pay for water at .15-.30 per gallon. His house is located in the lower village part of town. He said that he would pay a sales tax if it would help with costs. The boardwalks and dump location was "good."

Community Meeting

The public meeting was called to order at the Community Hall at 7:30 P.M. Lou Butera and Curt Holler of ERES, Steve Eng of VSW and Sharon McClintock of MLA, Inc. and approximately 10-12 people were in attendance. Robert Enoch, Village Administrator of the Tuntutuliak Traditional Council introduced those present and explained that this meeting was a follow-up to last spring's meeting. The purpose of this meeting was to present findings gathered in the feasibility study on the various options studied since that time.

Lou Butera stated that the study at this point arrived at several options available to Tuntutuliak residents:

1) Honey Bucket Haul system similar which is in place at Kongiganak, Napakiak.
2) COWATER system - A 100 gallon tank is pulled by a 4-wheeler or snowmachine. There is no spillage problem. Wastes go into tank and are hauled to the sewage lagoon.
3) Pressurized sewer and water system which is similar to the system in place in Bethel, and requires above ground piping system.
4) Vacuum sewer and water system. A similar system is in place in Emmonak.

A sewer lagoon will need to be constructed with any option. The proposed lagoon site may need to be diked to increase the capacity of the lagoon and will also require fencing. The new solid waste disposal site will be nearby. A dozer will need to be purchased to effectively operate the solid waste disposal site. An operator will be required a few hours a week to operate the dozer and maintain the burn box which will be installed at the dump. A council member asked whether a liner would have to be installed in the sewer lagoon. It is not anticipated that a liner will be installed. Another expressed concern for the school sewer lagoon and how it has contaminated nearby lakes. It was recommended by one resident, that sandbags be placed around the lagoon to reinforce the system. Lou Butera explained possible diking and outfall controls and obtained local information on the drainage of surface water around the lagoon and how the lakes are connected. There were differing opinions on the drainage path.

The pressurized sewer and water system will cost $5.5 million in capital costs to construct and approximately $177 per month operational cost for residents. The construction cost is expensive because existing houses are not arranged in a fashion which would accommodate orderly, effective development.

The COWATER system is expected to cost $2.2 in capital construction costs which includes boardwalks. Households would pay from $50-200 per month depending on usage patterns. The Honey Bucket haul system will cost $900,000 to construct with an estimated monthly cost of $92 per residence.

Residents had expressed prior concern for health because of spillage of honey bucket waste during hauling and contamination of surface water due to leakage. Lou explained that the responses coming from places such as Kipnuk and Kongiganak varied based on the success of their systems. The Honey Bucket haul system costs less to construct, monthly payments are estimated at $92 a month and an operator is hired.

It would cost $500,000 to construct an all weather watering point in town next to the school location. This option was included in the study because many people who lived in the upper part of the village complained that the washeteria was too far away for people to access. The watering points would be coin operated. In answer to concerns of the palatability of washeteria water, Lou explained that the washeteria water would be improved by the installation of an improved filtering system and water tempering system. These costs would run $31,000 + to include training of personnel. The school has expressed interest in purchasing improved water from the washeteria.

It is also possible to run a summer water line (uninsulated) which could be expanded at any time. It would cost $120,000 to install the summer lines. A council member expressed concern for the summer pipes in the winter because freight sleds might tear them up. It was explained that they would be drained before winter sets in and that designated trails and protection will have to be established in order to avoid damaging the water lines.

The monthly cost for the sewer and water system was discussed. Lou explained that if the school district could pay $380 per month for its services, the monthly rate for each family will be reduced. We had earlier estimated cost reduction measures. A sales tax on fuel heating oil for example could conceivably bring in $280 per month for a 2% tax, a 3% tax would bring in $420.00 per month while a 4% tax would provide revenue of $560 per month. If these revenues were divided among 70 households, the contributions would conceivably be $4-8 per month.

The existing wastewater system, it was explained, is not adequate. The existing dumpsite is not adequate. New boardwalks are needed for a haul system. There is not enough money in the present grant to establish a system with gravel roads.

A council member asked if the construction occurred in phases, would the community be able to get money from the State. Steve Eng responded by saying, "Yes, State projects are phased and there is more funding priority for construction projects in the works." He explained that there are more federal funds earmarked for the State Village Safe Water program. He further explained that the construction cost estimates are typically a little on the high side. In actual practice, the estimates tend to be more conservative and the actual constructions costs are usually more efficient.

Steve Eng explained that Alaska operates differently than a country like Canada who not only assists in the construction of large capital projects, but takes the fiscal responsibility for maintenance costs. In Alaska, the operation and maintenance costs of projects has to be borne by the community.

David Enoch stated that it is better to totally scratch the honey bucket system. People spoke up about this at the spring meeting and are again speaking up about doing away with it entirely. He recommended a phased pressurized sewer and water, including the COWATER system as the primary, in home system.

Ivan Daniels said that the construction of the new sewer lagoon and boardwalks will be the start of an economic base in Tuntutuliak. At this point, many attendees spoke in turn about their opinions in Yu'pik.

Peter Joseph Sr. said he initially favored the flush toilet COWATER system but since we are talking about phases, he wants to see whatever system constructed include the upgrade of the boardwalks and building of a new dumpsite as the first priorities. He said he wouldn't want to see a honey bucket haul system in place here.

Robert Enoch stated that he wants to see a system that does away with the present system because of health concerns. He preferred a system that would be used on a long term basis, one that is "actually useful." He stated that he was not concerned with the monthly bill people would be required to pay. Perhaps when it becomes an issue, "We will have a Legislature that will hear our concerns," he stated. Further, in the time it takes to construct the project, the state or federal governments may come up with a solution.

Mr. Enoch further expressed concern that the older portion of town is in dire need of boardwalks. With a fully piped sewer and water system, the community might not have the benefit of boardwalks. The COWATER system he pointed out, comes with new boardwalks. He did not see much difference between the costs between the systems after they are constructed. The long term benefits of the piped sewer and water are more advantageous. The cost difference of approximately $80 was not much.

The cost for the COWATER system, Lou Butera explained, could be greatly reduced if people hauled their own water verses having it delivered. He explained that in a phased system, the community will need to determine who will be among the first to get the systems. For example, during the first year of the COWATER installation, only 30 systems may be installed. In the interim, people will need to decide what should be done with those who must wait.

In response to questions about the COWATER efficiency, Lou explained that the people who manufacture the system are concerned that the system work properly. He said that homeowners may be expected to participate in the cost of installation by paying up front costs. In other village projects, participation in the projects promotes feelings of ownership.

Lou Butera further explained that the COWATER system may be phased into a piped delivery sewer system eventually, and therefore the community must look into this aspect more. A lift station and force main may be installed in the back of the school if the community is willing to allocate funds for this project. The community would benefit from this system as it may reduce haul distance to the lagoon, and the force main would be incorporated into any future piped system. Lou Butera said that the school would like to access the washeteria well and will pay for the water.

In discussing the boardwalk needs, a council member mentioned that the State Department of Community and Regional Affairs and possibly the State Department of Transportation and Public Facilities were willing to assist in the construction of the boardwalks and have an existing program to prioritize grants for roads. They suggested that DCRA be contacted for further information. The names of Mike McKinnon at DOT/PT and John Tolley at DCRA were given as contact people.

A council member asked whether the grant funds have to spent this year. Steve Eng said, they did not, but suggested that the dump be relocated and fenced as soon as possible. The failing bunkers can also be decommissioned by September.

The council members decided that they would like to wait for a couple of months until they hear from BIA about the ISTEA funds. They felt that these decisions are important and they must be considered carefully. They also agreed to send two council members to visit Emmonak and Mekoryuk to view their respective systems and report back to the council about their efficiency. Steve Eng said the VSW funds are available to pay the travel costs. The council members agreed to move forward with the dumpsite closure and fencing of the new dumpsite, and decommissioning of the old bunkers. The members thought it would be a good idea to write a letter to BIA informing them of their decision. Steve Eng agreed to write a letter from VSW also. The members agreed to meet again in September.

Questions which were brought to the meeting were asked and answered as follows. In response to people dumping their own honey buckets at the pump station, the answer was no, an operator has to do this. On whether people could hook up later, the answer was yes, but the cost of maintenance per month would be more expensive for those hooked up. Regarding the possibility that operational costs may rise in the future, Steve Eng said yes that is a possibility. Several people asked if the pipes will freeze in the winter, and yes that is a possibility if maintenance is not performed. The summer water pipes would not, because they would be drained. About the COWATER Tank freezing, Lou explained that the tank was superinsulated and contained a heat tape system. The possibility of the tank freezing was remote. It was also explained that the COWATER heat trace system operates at a very low wattage. In answering the question about what kinds of vehicles would be required for maintenance of a haul system for the COWATER system, the answer was Alpine showmachines and a Honda 4-wheeler.

The meeting adjourned at 10:30 P.M.