Appendix J

History of Sanitation Facilities
(Excerpts from 1993 Study)

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STATE OF ALASKA
VILLAGE SAFE WATER

TUNTUTULIAK, ALASKA
COMMUNITY WATER AND SEWER
FEASIBILITY STUDY
FINAL REPORT

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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.

Study Recommendation:

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