SANITATION FACILITIES ALTERNATIVES

ID: 0132k/184H
LR: 090987

FOR

SUNSHINE SUBDIVISION

TANANA, ALASKA

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Department of Health and Human Services

October 1987

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I. REPORT SUMMARY

Twenty-four (24) single family homes were constructed in Tanana, Alaska by the Interior Regional Housing Authority (IRHA) in 1982. Fourteen (14) of the homes were sited in the Sunshine Subdivision. The remainder were sited in scattered locations in and around the city.

In the Sunshine Subdivision, individual privies were provided for waste disposal and a community water haul system was established for water supply. After the homes were completed and occupied, many of the residents became dissatisfied with the sanitation facilities - specifically with the individual privies. The present concern is the perception that contaminated water is percolating from the privy mounds and contaminating the small pond (Frog Lake) located within the subdivision.

This review indicated that the environmental health conditions found in the Sunshine Subdivision are typical of more urban areas lacking effective public health controls. There is no indication of contaminated water percolating from privy mounds. However, run-off from dog yards and surface dumping of honeybuckets and grey water do create the potential health hazards about which many residents are concerned. The poor site drainage characteristics increase this potential, as wastes are concentrated within the subdivision tract rather than being drained away.

The U.S. Department of Housing and Urban Development (HUD) has reserved $500,000 with which to improve environmental health conditions in the Sunshine Subdivision. To be effective, any solution selected must eliminate potential environmental hazards using a system that residents can afford to operate.

The same conditions which precluded the installation of piped utilities in 1980 exist today. The homeowners of the Sunshine Subdivision cannot afford to pay the operating costs for a piped water and sewer system.

Two (2) major options for corrective action are available. They are: (1) to improve existing conditions in the Sunshine Subdivision, or (2) to relocate the homes to a new site. If the homes are not moved, piped water and sewer facilities are not recommended. Rather, a comprehensive drainage plan should be implemented to help mitigate the potential environmental health hazards created by surface pollution. The level of sanitation facilities should remain the same, with individual privies and a water haul system. However, the existing raised mound privies should be replaced with conventional pit privies to improve accessibility and to allow homeowners to relocate privies when they become full. Pit elevation requirements should be incorporated into the grading plan of the site drainage scheme to allow the installation of conventional privy pits. The estimated total cost of the recommended facilities is $566,000. A more detailed preliminary cost estimate is presented in Table X.

The solution having the best long-term benefit for subdivision residents and the community as a whole includes relocating the homes closer to existing sanitation facilities. Piped water and sewer service then becomes an achievable goal. By relocating the homes next to existing city systems, anticipated user fees are less than half of those estimated for piped facilities in the Sunshine Subdivision. However, even at this reduced rate, most HUD homeowners could not afford piped services at this time. An interim level of service would be required using privies and the existing Village Safe Water (VSW) water haul system. Possible relocation sites include the Eller Subdivision and the Old Hospital tract, with the latter being more favorable. These sites were identified by the IHS based on reviews of townsite maps and field trips. No site location preferences or recommendations were made by residents or local agencies.

Less than 5 percent of existing city homes have piped water and sewer services. If economic conditions improve, piped water and sewer facilities could be readily extended to either of the new housing sites in conjuncton with a city-wide project. The initial costs for developing a new housing site are estimated at $1,045,000 for the Old Hospital site and $1,151,000 for the Eller Subdivision. Estimated costs to extend piped water and sewer are $887,000 for the Old Hospital site and $1,109,000 for the Eller Subdivision. A more detailed preliminary cost estimate is presented in Table XI. A proposed facilities layout is shown in Figure #8.

II. INTRODUCTION

A. Background

Tanana is located on the north bank of the Yukon River near the confluence of the Yukon and Tanana Rivers which is approximately 125 miles west-northwest of Fairbanks. Location and vicinity maps of Tanana are provided as Figures #1 & #2. The 1980 Census shows Tanana with a population of 388 of whom 70 percent are Native. The community was incorporated as a First Class City in 1982. Current 1986 state revenue sharing population figures list Tanana's population at 444.

The Sunshine Subdivision consists of fourteen single family houses which were constructed by the Interior Regional Housing Authority (IRHA) as part of Department of Housing and Urban Development (HUD) Project AK007007. Ten additional houses were also constructed on scattered sites around the city as part of this project. Home construction was completed in October 1982.

The subdivision tract is comprised of Lots 10 and 11 of U.S. Survey 4104, with a total area of 10.97 acres. The major physical feature of the tract is the two acre lake/marsh around which the houses are situated. The subdivision is located adjacent to the Yukon River, approximately one mile upstream from the center of town.

Several sanitation facilities alternatives were considered during the planning phase for this project. Soils conditions and area geology made individual wells and septic tank drainfields unfeasible. Project funding was not available to extend the existing piped water and sewer system. While the city agreed to operate a community trucked water system, the City Council elected not to operate a sewage haul program due to the anticipated operation and maintenance (O&M) burden. Therefore, the facilities selected to serve the HUD homes were predominately community or individual water haul and on-site privies. The proposed off-site sanitation facilities were substantially completed in November 1982 as part of the Indian Health Service (IHS) Project AN-81-231.

After the HUD construction contract was awarded and construction commenced, the project site was changed from Eller Subdivision to Sunshine Subdivison. Design recommendations and conclusions developed for the original site were followed by the IRHA for the new location. Shallow permafrost precluded the complete installation of conventional privies required by contract documents. Following congressional inquiries, funding was allocated by HUD to install privies on gravel fill pads so that privy pits would be above permafrost layers. These modified privies were completed in November 1983.

In August 1985, the Tanana Indian Reorganization Act (IRA) Council wrote a letter to the IRHA expressing concerns regarding contamination of Frog Lake by the elevated privies. The City wrote a similar letter and copied HUD, IHS, and Congressional Representatives. HUD responded by reserving $500,000 to resolve the problem and by requesting IHS to find a solution.

B. Participating Agencies

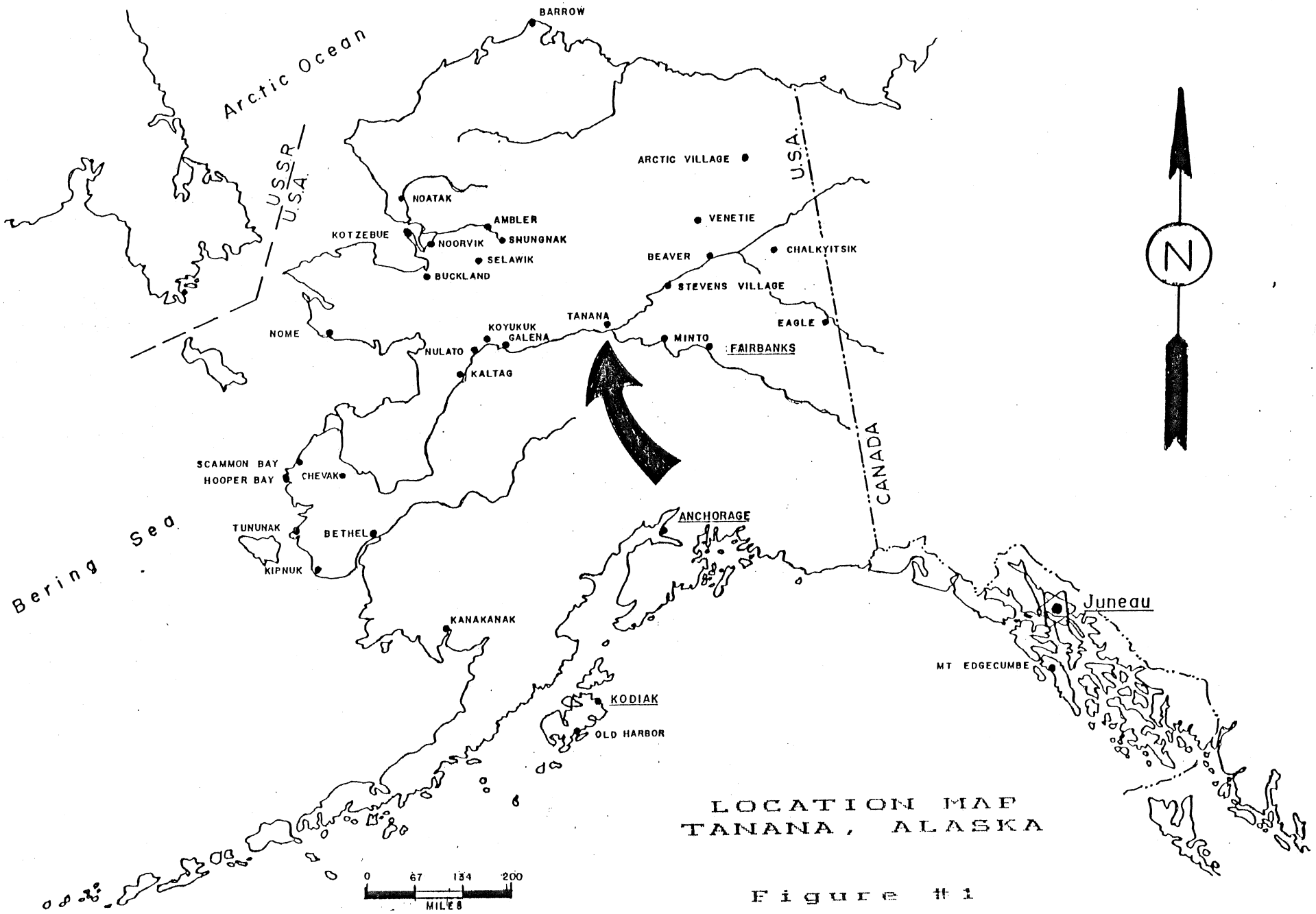
Under Public Law 86-121 the IHS, Environmental Health and Engineering Branch (EH&EB), plans and constructs sanitation facilities for Alaska Native communities. As part of that commitment, the IHS commonly works in conjunction with HUD to design sanitation facilities for HUD housing projects which provide new homes for Alaska Natives.

HUD requested EH&EB assistance in identifying the sanitation problems of the Sunshine Subdivision and outlining possible solutions in October 1985. This request was supplemented by an additional request for assistance from the City of Tanana in a letter from the Mayor dated December 30, 1985.

Other agencies and organizations involved with the sanitation problems at the Sunshine Subdivision are as follows:

1. Interior Regional Housing Authority (IRHA): Administrator of Sunshine Subdivision Housing Project
2. Department of Housing and Urban Development (HUD): Funding Source for Housing Project

3. Indian Reorganization Act Council of Tanana (IRA Council): Native Government
4. City of Tanana (City): Operations and Maintenance Organization for Existing Water and Sewer Systems
5. Tanana Chiefs Conference, Inc. (TCC): Technical Advisor on Environmental Health to Tanana. In addition, assisted EH&EB with field inspections, data collection and operation of Shasta unit pilot study.



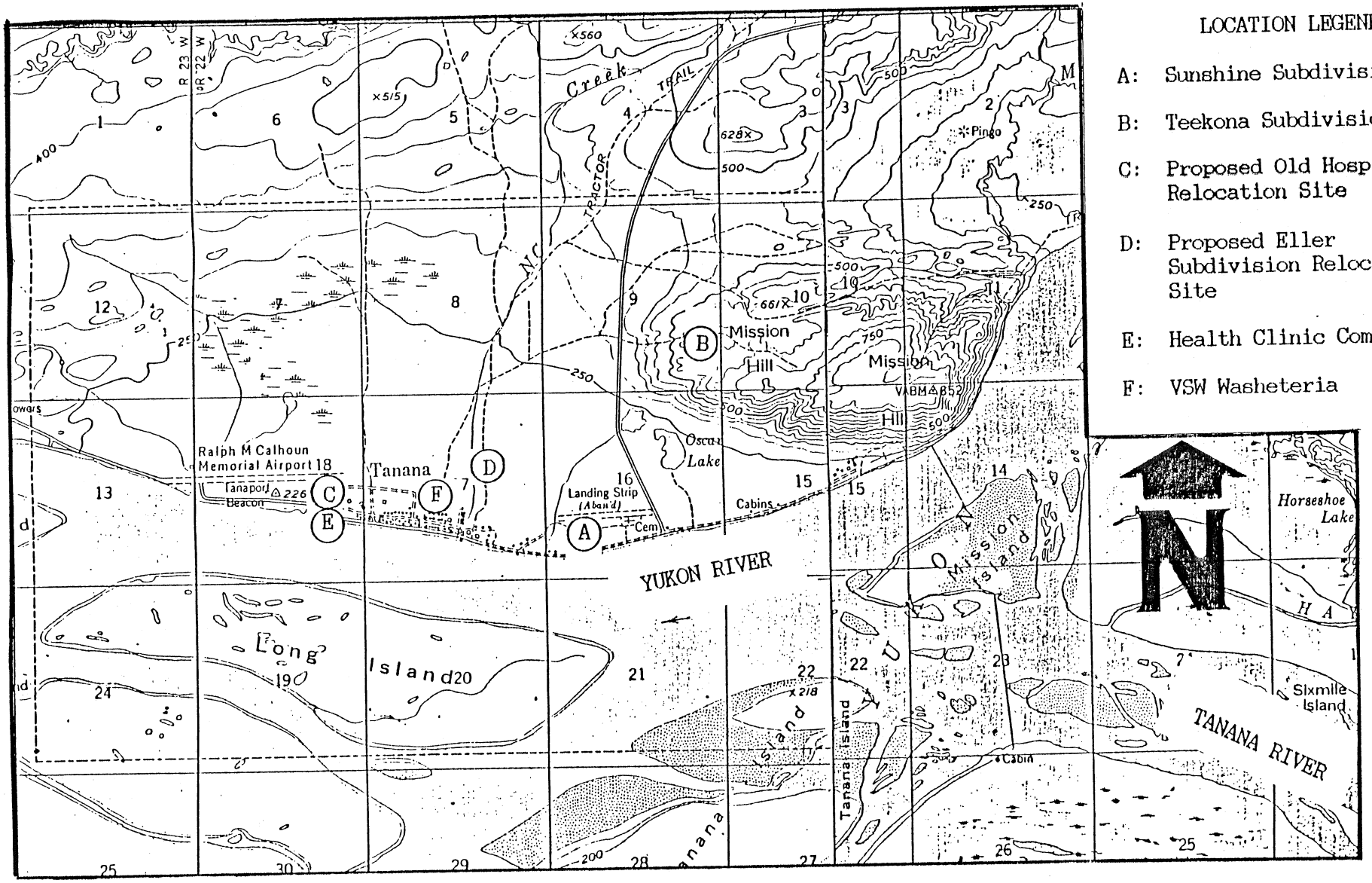
LOCATION MAP
TANANA, ALASKA

Figure #1

VICINITY MAP, TANANA, ALASKA

Figure #2

SCALE: 1.25 inches = 1 mile



III. SCOPE OF THE STUDY

Sunshine Subdivision residents have expressed concern regarding environmental health problems in the Subdivision related to the waste disposal practices on several occasions. Current concerns center on the possible contamination of Frog Lake by water percolating out of the raised privy mounds.

During the planning and implementation stages of this housing project, several alternatives for waste disposal were evaluated. The final selection was based on the following considerations:

1. That individual wells and septic tank drainfields were not technically feasible for most sites.

2. That the City was not prepared to participate in a joint venture to provide piped water and sewer facilities for the City of Tanana in conjunction with the proposed HUD Housing Project.

3. That the City was prepared to assume the O&M responsibility for a community water haul program, but not for a community sewage haul program.

4. That with the closing of the PHS Hospital the cash economy of Tanana was severely impacted, limiting the economic means of project participants to pay user fees.

5. That there was limited availibility of project funding.

This study evaluated existing information and indentified alternatives which may be used to improve the environmental health conditions of Sunshine Subdivision residents. A technical feasibility analysis and construction cost estimate for sanitation facilities is provided for each alternative. The comments and preferences of subdivision residents, local government, and other relevant agencies are also presented where available.

In conjunction with the study, an experimental modified privy was installed and is being tested for performance characteristics in an arctic

environment. The unit is a self-contained privy which uses evaporation and aerobic decomposition to reduce pumping requirements. This unit may provide one alternative for consideration in the Sunshine Subdivision.

IV. COMMUNITY PROFILE

A. Origin

The junction of the Yukon and Tanana Rivers had long been a well established Indian trading locality before Europeans came. Except for the Indian name, the first mention of a settlement in this area was made in 1869 by Capt. C. W. Raymond, U.S. Engineers, who on his map, applied the name "Fort Adams (American Station)," near the mouth of the Tozitna River. In 1891, a mission was founded west of Mission Hill. In 1897, one mile downstream from the mission, the trading post of the Northern Commercial Company, "Tanana Station," was established and the Tanana post office was located here in 1898. Tanana (Tananah) is an Indian word meaning "mountain river".

B. Location Description

Tanana is actually located approximately two miles west of the confluence of the Yukon and Tanana Rivers on the north bank of the Yukon River at latitude 65°10'N., longitude 152°04'W. The community is situated in the Kokrines-Hodzana Highlands which lie north of the Upper Yukon and are bounded on the north by the Porcupine Plateau and the Brooks Range.

C. Geology and Topography

The area surrounding the city is comprised of gently rolling terrain characteristic of the Yukon River Valley. Peaks of the Kokrines-Hodzana Highland to the north of Tanana rise in even-topped ridges of two to four thousand feet.

Soils in the city vicinity consist of 5 to 15 feet of silt, sandy silt and silty sand overlying gravelly sediments present to depths of 35 to 70 feet. The gravelly unit is comprised of lenses, beds and channel deposits varying in composition from fine sands to bouldery gravels. These deposits change abruptly in gradation and uniformity horizontally,

but have more gradational contacts vertically. The gravelly deposits likely represent sediments transported by braided glacial outwash streams at one time draining the Ray Mountains.

Thick silt and clay deposits underlie the gravelly soils except locally where the buried bedrock surface approaches nearer the ground surface. The deep silt unit is of alluvial/aeolian/lacustrine origin and likely becomes thinner to the north. Schist, sandstone, siltstone, claystone and shale underlie the village area at depths of 35 to 140 feet but most regularly at depths of 50 to 60 feet.

Tanana lies at the northern most extent of the discontinuous permafrost zone. The town is underlain by generally continuous permafrost 35 to 65 feet thick. Values of the depth to permafrost taken from well logs within the townsite vary from 1 to 48 feet, with average values being from 5 to 8 feet. Within the Eller Subdivision, IHS test well logs reflected permafrost at a depth of 4 to 5 feet. The depth to permafrost within the Sunshine Subdivision was found to be 1-1/2 to 2 feet. However, as the thaw bulb of the Yukon River is approached, permafrost is likely to thin or be entirely absent.

D. Flood and Seismic Hazard Evaluation: The U.S. Army Corps of Engineers Flood Plain Management Service Branch rates the flood hazard potential at Tanana as low. Flooding from ice jamming the river, causing stream overflow, and inundating 10 percent of the community would occur less than once in 100 years. The Corps also notes that there is a "slight" riverine erosion problem in Tanana.

Tanana is in seismic hazard zone 2 where moderate structural damage can be expected from earthquakes measuring 4.5 to 6.0 on the Richter scale.

E. Climate

Tanana is located in the central part of Alaska's vast interior and completely within the continental climatic zone. Winters are long and extremely cold, while summers are short and hot. Winds are relatively mild and precipitation is low. Diurnal temperature variations are not

as severe as would be expected in a continental climate because the sun does not rise significantly in winter and does not set completely in summer.

The temperature and precipitation data presented in Table I are from the Tanana FAA recording site as made available from the Arctic Environmental Information and Data Center. Other climatic data have been extrapolated from data collected at regional, generally low-lying sites. The data, while approximate, are generally applicable.

Table I
Climatological Data, Tanana, Alaska

Mean annual precipitation, inches	13
Mean annual temperature, °F	24
Mean annual snowfall, inches	50
Maximum temperature recorded, °F	94
Minimum temperature recorded, °F	-71
Mean January minimum temperature, °F	-18
Mean July maximum temperature, °F	70
Thawing index, degree days	2,500
Freezing index, degree days	5,500
Design freezing index, 1 yr. in 10, degree days	6,500

F. Population, Housing & Public Facilities

Over the past 25 years, the population of Tanana has grown steadily. The 1970 census was 120 residents and the 1980 census was 388. The 1986 State Revenue Sharing figures show Tanana's population to be 444 of which approximately 80 percent are Native.

There are approximately 124 occupied houses in the city. The majority of the housing was constructed on an individual basis. Several of the houses were constructed under the Bureau of Indian Affairs Housing Improvement Program and 24 were built in 1982 by the IRHA through HUD. The houses are of either log or wood frame construction. All of the IRHA houses are of log construction.

Public and private structures in the city include the Federal Aviation Agency (FAA) complex, the Bureau of Land Management (BLM) fire station, the Public Health Service (PHS) Hospital (now closed), a clinic, a post office, two general stores, and the elementary/high school operated by the Yukon-Koyukuk School District. The city maintains an office building, fire station, and Village Safe Water (VSW) watering point/washeteria.

The cash economy in Tanana is poor. Like most remote Alaskan communities, the mainstay of the residents is based on subsistence harvests of fish and game. With the closing of the PHS hospital, full-time employment in the city is limited. Seasonal employment in commercial fishing, construction, and fire fighting contributes to the cash economy.

The city is governed by a City Council headed by the Mayor. It was incorporated as a first class city in 1982. A Native Council also takes an active role in community affairs. Under the Alaska Native Claims Settlement Act, the Native community formed the Village Corporation of Tozitna, Ltd. and is a member of the Doyon Regional Native Corporation.

Transportation to Tanana is available by air and water routes. Several flights to Tanana from Fairbanks are made daily. Barge service from Nenana is frequent throughout the summer. There is no highway or road connection to Tanana, though the city has gravel roads interconnecting various areas of the community.

Electricity is produced by a private company using diesel generators and is distributed throughout the community. The mainline voltage is 2,400 volts and both single and three phase power are available.

Gasoline and fuel oil are available at a local store.

Primary community contacts include the Mayor, the Executive Director of the IRA Council, City Council members, Office Manager of Tozitna, Inc., and the clinic director.

V. EXISTING SANITATION FACILITIES

Existing water and wastewater facilities are shown in Figures 3A and 3B (see map pocket) and are described below:

A. Water

The VSW constructed watering point/washeteria was opened in June 1979. It provides residents with a source of treated water for home use at no charge (individually transported) and with complete laundry and wash house facilities. Untreated water is also available at watering points adjacent to the wells. The original well, used as a water source for the VSW facility, was constructed by the IHS in 1967 and rehabilitated during the VSW project. The last IHS project in Tanana provided an additional well and wellhouse 900 feet west of the VSW facility which was connected to the facility by a circulating water transmission line.

Recurring problems with low well water production have occurred during the last couple of months of winter each year. In an effort to improve water source reliability, the city recently installed two additional wells within the thaw bulb of the Yukon River to supplement existing city wells #1 and #2. Funding was provided through a state grant. Well #3 was completed in the Fall of 1986. It was located adjacent to Well #2 and the existing Well #2 pumphouse was utilized to house its controls. Though labeled as shallow wells, Wells #3 and #4 are essentially infiltration galleries installed in Yukon River gravels. Water intake screens for these wells are located within 20 feet of the surface and should, therefore, be identified as surface water sources. For the past two winter seasons, the city has relied almost exclusively on Well #3 to meet water source requirements during the last two months of winter.

City Well #4 is located within the thaw bulb of the Yukon River in the southeast corner of the Sunshine Subdivision tract. Construction was started during the winter of 1986 and completed the following spring. A 6-inch steel casing was set to a depth of 20 feet at the edge of the Yukon River during seasonal low flows. The sanitary well seal is flush

with the ground surface and located under the Yukon River for most of the year. Some 220 feet of 3-inch insulated HDPE pipe with a 3/4-inch PE carrier pipe connects the well with the top of the riverbank. A proposed submersible pump to be installed in the well on a 1 1/4-inch diameter pipe would only be accessible during periods of low flow. The well was test pumped at 50 gpm and samples were taken in April 1986. As the capital project funds originally allocated for the well were frozen by the state it was never completed. At this time no pump is installed in the well, no power is available at the site nor has a well house been constructed. However, the project funding has recently been affirmed by the State and it is anticipated that the well will be completed within the next year.

A water quality analysis based on water samples taken during test pumping indicated Alaska Department of Environmental Conservation maximum contaminant levels (MCL) are exceeded in Well #4. The water quality characteristics of Well #4 are presented in Table II as a comparison to existing city wells and state criteria. A review of water quality parameters shown in Table II indicate no significant change in water quality between the deep and the shallow city wells. The PHS Hospital well is currently owned and operated by the health clinic. This well has the best quality water in town.

Table II

Water Quality Characteristics, Tanana City Wells

	PHS Hospital Well	Well #1	Well #2	Well #3	Well #4	MCL
Color	-	-	-	-	100 CU	15 CU
Alkalinity	240	240	170	410	320	None
Hardness	56	290	-	550	342	None
Iron	0.1	.52	.14	0.85	2.19	.30
Manganese	-	.67	.38	0.54	.30	.05
Turbidity	-	-	-	-	34 NTU	1 NTU

units = mg/l unless otherwise noted
- = no test data available
MCL = maximum contaminant level

Well water pumped to the VSW facility receives treatment for hardness and iron removal, and chlorine and fluoride. Approximately ten public buildings, businesses, and private residences are connected to the VSW facility by a circulating water main and a combination gravity and force main sewer line.

Other sources of water in the community include a watering point at the old PHS hospital and several private wells. The well for the old PHS hospital is now operated by the Health Clinic, has a yield rate of 20 gpm, and provides water for the health clinic compound and the public school. An emergency water transfer connection to the VSW system is also available.

A city operated truck hauled water system initiated under PHS Project AN-81-231 in 1982 has been discontinued due to lack of consumer demand. The majority of residents individually haul water from the various VSW water points. During interviews with representatives of eleven Sunshine subdivision households, only one indicated that the truck hauled water system was used as a water source. All other households stated that the truck haul was too expensive and they hauled their own water. It is likely that any haul program which charges for water delivered will be unsuccessful so long as free water is available at the water plant.

Homes in the Sunshine Subdivision were provided with individual pressure systems and 200 gallon aluminum water tanks. These tanks were later modified to include an exterior fill port and PE tank liner. These individual systems were to be served by a community truck hauled water system established under IHS Project AN-81-231. The original scope of work for that project called for the city to install 75 individual storage tanks provided by the IHS in existing homes. The intent was to establish a user pool of approximately 100 homes to establish an economic base on which to feasibly operate a water haul system with low user fees. The water truck was provided to the City by the IHS. However, City funding to install the 75 storage tanks was never identified. The resulting low usage rates of the truck haul system required that the City set a delivery rate of 15¢/gallon to meet the cost of operations.

B. Wastewater Disposal

Over 90 percent of the households in Tanana dispose of wastewater in pit privies or honeybuckets. Honeybuckets may be emptied into the pit privies or at the VSW facility's honeybucket dumping station.

A combination gravity sewer/force main extending from the PHS hospital (clinic compound) to the VSW facility and an aerated lagoon was built as part of the VSW facility construction. Wastewater from the VSW facility, the clinic compound, school, FAA complex, approximately ten public buildings, businesses, and private residences flows to the lagoon via the wastewater collection system. Effluent from the lagoon flows by gravity through a heat-traced outfall line to a drainfield located within the thaw bulb of the river.

Designed with a detention time of 60 days, this lagoon was operating near its maximum capacity until the PHS hospital was closed. It is now operating at about 1/2 to 2/3 capacity.

Current waste disposal within the Sunshine Subdivision is via individual pit privy. Due to the shallow permafrost in the area, the original conventional privies were modified and placed on raised gravel mounds. Many of the privies are at or approaching capacity. Due to the nature of their construction there are no replacement sites unless additional gravel mounds are installed.

C. Solid Waste Disposal: The City operates a modified sanitary landfill about three miles west of town. Refuse is transported to the landfill on an individual basis, and city employees regularly burn combustibles and compress and cover all remaining debris.

D. Sunshine Subdivision Environmental Health Inspection: The environmental health deficiencies at Sunshine Subdivision were evaluated by representatives of TCC and EH&EB during several field trips to Tanana. These visits were conducted in April, May, October, and November of 1986 and June of 1987.

During the April trip, a public meeting of subdivision residents was held along with an inspection of the subdivision. As put forward by the residents, the basic cause of all problems at the subdivision was high water. Concerns ranged from the inability to get to privies and lack of a replacement area for privies to the health problems of children who played in and around Frog Lake. The primary cause of all these concerns was the standing water typically found throughout the subdivision during warmer months. During the inspection, it was noted that all homes were equipped with greywater drains that discharged directly onto the ground surface beneath the homes. Honeybucket wastes were being dumped on the ground at one residence. Two homeowners had large numbers of dogs chained up on their respective lots.

A visual inspection of the existing subdivision drainage system was done in May 1986 during break-up. It was obvious that there was no drainage network within the subdivision. All culverts were 12-inch diameter CMP, crushed or blocked with soil, and sloped to drain into Frog Lake. No overflow culvert existed between Frog Lake and the Yukon River. The subdivision access road surrounds the lake and prohibits water drainage from the subdivision. The White Alice Road runs between the subdivision and the Yukon River and run-off from the subdivision was also prevented by this road. Natural drainage was repeatedly blocked by driveways, house foundation pads, privy mounds, and roadways. Numerous pools of standing water were located throughout the site. The Mayor said that residents had borrowed city sump pumps and pumped standing water from their lots into Frog Lake for several days prior to our visit. An inspection of the raised mound privies found one overflowing, all the structures were in fair to poor condition and mound subsidence of as much as two feet existed at some privies.

Mosquito larvae darkened the water throughout the subdivision with one notable exception. One large standing pool adjacent to a dog yard showed no evidence of the larvae. It was thought that the acidity of the water resulting from the melting and run-off of dog wastes prevented mosquito growth. This pool was one of many pumped into Frog Lake.

During the May inspection, it was requested that the Health Clinic review medical records to see if there was a difference in visit frequency between residents of the Sunshine Circle and other residents, particularly regarding gastrointestinal complaints. During later telephone conversations, the clinic director said no differences in illness levels were readily apparent from the chart review.

Survey and soils information was obtained in October. Ground reference points were established for an aerial topographic survey, water samples were taken, and a soils test pit dug. Water samples were taken at Frog Lake, Oscar Lake, a small pool of water adjacent to a raised privy mound, and the old quarry pit. The lab indicated that a successful test procedure could only be run on the Oscar Lake sample, which showed a coliform colony count of 6/100 ml. Surface waters are considered safe for contact recreation where fecal coliform counts are less than 20/100ml.

One soils test pit was dug on the north side of Frog Lake across the road from Lot 8 utilizing a city backhoe. It took most of one day to reach a depth of 17-feet using a frost bucket and no further pits were attempted. Permafrost was first encountered at approximately two feet. This value was consistent with the figure given by the backhoe operator who dug the conventional privy pits in 1982. Soils consisted of alternating frozen organics and silts with ice lenses to a depth of 9 feet (for more detail see soils log in Appendix B). The remainder of the hole was frozen silts. The test pit was located some 450 feet from the river bank and excavated to a depth 6 feet lower than the sand and gravel layer visible on the river bank. While the test pit did not indicate the presence of a gravel layer connected with the river, the large fluctuations in the water levels of Frog Lake tend to indicate some type of connection. Utilizing Fairbanks relative humidity data, an annual lake evaporation rate of 18-inches was calculated for Tanana. With average summer rainfalls of 5-inches a net evaporation of about one foot would be expected, yet water levels in the pond fell more than 3 feet during the summer of 1986.

The November trip was made by representatives of TCC. Water samples were taken at Oscar Lake and Frog Lake. The depth of ice precluded taking samples at the other locations. The test results were 0 and 7 coliform colonies/100 ml, respectively, for Oscar and Frog Lakes.

The June 1987 trip was made by a representative of TCC. Water samples were taken at five locations. The results are as follows:

	Total Coliform Count*	Fecal Coliform Count*
Oscar Lake	4	4
Frog Lake	present	0
BLM gravel pit	>80	>64
Pool of water opposite Julie Roberts' home (dog yard)	present	0
Pool of water opposite Mike Andon's home (no dog yard)	0	0

* Units = no colonies per 100 ml

Testing was conducted following break-up and pumping of excess surface water into Frog Lake. Conditions within the subdivision tract were noted to be much dryer than normal.

VI. SANITATION FACILITIES ALTERNATIVES

A. Introduction

A public meeting held in Tanana in April 1986 established surface water pollution as the primary environmental health concern in the Sunshine Subdivision. This perception was based on water samples taken by the IRA Council in July 1985. Samples were taken at Frog Lake and the old BLM gravel pit and sent to Northern Testing Lab in Fairbanks. No copies of test results were available. Mr. Arley Charlie, then Executive Director IRA Council, stated that a swimming quality water test was conducted with a fecal coliform count of "too numerous to count" resulting. With that concern in mind, five alternatives were developed to correct the potential environmental health problem. They were as follows:

1. Relocate homes to a new, more centrally located site with better soil conditions.
2. Install individual sewage holding tanks and low flow toilets in each home; institute a sewage haul program.
3. Provide piped water and sewer systems.
4. Establish area-wide drainage and surface water diversion network.
5. Upgrade existing privies to self-contained units.

A questionnaire completed by eleven of the then thirteen households in April 1986 indicated a homeowner preference for solutions in the order presented above, with the most desired alternative being listed first. When the questionnaires were filled out, one home was vacant and representatives of two households were not available.

A workable solution for the Sunshine Subdivison will require the selection of more than one alternative. If a decision to relocate the subdivision is made, an additional concurrent selection will be required to identify the necessary sanitation facilities. Proposed sanitation facilities should be chosen based on site specific criteria to

minimize or eliminate environmental health hazards. If the subdivision is not moved, a drainage plan must be incorporated into any development plan for sanitation facilities to eliminate potential environmental health hazards.

B. Upgrade Existing Privies to Self-Contained Units

1. EXISTING FACILITIES

The privies currently used at the Sunshine Subdivision are conventional pit privies installed in gravel mounds. The subdivision has a high water table in summer and shallow permafrost. Individual wells were not installed because of the low yields and poor water quality; permafrost precluded the use of individual subsurface wastewater disposal systems. Community facilities such as a truck haul or piped system were not feasible as the City did not wish to assume the operation and maintenance responsibility, and residents could not afford to pay monthly fees. It is important to understand that pit privies were selected not because they were the method of choice, but rather because they were the only method left.

The circumstances that led to the original selection of pit privies remain unchanged. Interviews with subdivision residents have reconfirmed that most could not pay the user fees typically charged for piped or haul utility systems. Nor has the City changed its position on not operating a sewage haul system.

Existing mound privies are nearly full; at least one is overflowing. Residents stated that there were no replacement areas where they could install new pits. Health concerns regarding possible contamination of Frog Lake by water percolating from the privy mounds represent a major reason for the start of the latest round of community action. Residents are also concerned about all-weather access. Complaints of units surrounded by water or mound side slopes so slick as to require crawling rather than walking to get to the privies were given as examples.

2. SELF-CONTAINED PRIVIES

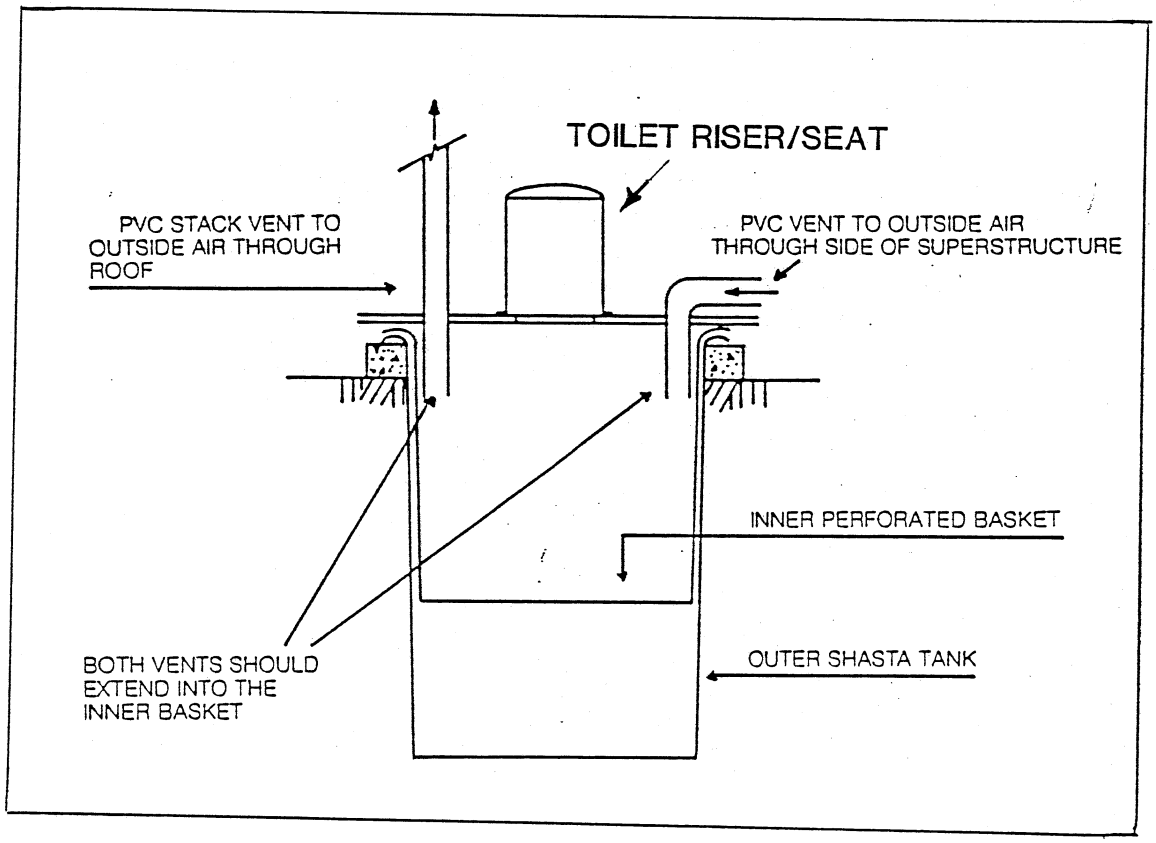
Given existing conditions, and the inability of residents to afford a higher level of service, self-contained privies may be a logical alternative. This option is now viable with the establishment of a private sewage pumper business in Tanana. A self-contained privy is a conventional privy where the usual log crib pit is replaced with a watertight storage tank. When full, sewage is pumped out and hauled to the sewage lagoon. The pumping cycle depends upon the use rate, but storage tanks are typically sized to last six months to one year.

Because permafrost conditions exist at the Sunshine Subdivision, a typical self-contained privy installation would be a concrete vault buried in a gravel pad. The existing wood outhouse would be set on top of the vault. When approaching capacity, the homeowner would contact a pumper service and pay to have the vault pumped out. In instances where the vault had also been used as a garbage pit, pumping would not be possible. In such a case the only remaining option would be for the homeowner to shovel the unit out by hand. Clearly a very unpleasant task. Garbage, particularly non-degradable items such as bottles and cans, should never be disposed of in a privy.

The major advantages of a self-contained privy are that possible ground water contamination and the need for replacement pits are eliminated. However, while conventional pit privies have virtually no operating requirements, self-contained units need pumping. Such a task is a homeowner responsibility. The currrent rate for pumping in Tanana is $50.00 per 300 gallon load.

3. SHASTA WATERLESS SANITATION SYSTEMS

Shasta waterless sanitation systems are essentially modified self-contained privies. The Shasta unit design utilizes a proprietary system which consists of a basket in the waste storage compartment to separate solids from liquids. By ventilating the



SHASTA Self-Contained Privy Schematic

Figure #4

storage compartment, waste volume is reduced and storage capacity extended. The venting of the waste storage compartment evaporates liquids and aerobically reduces solids. A schematic of the Shasta unit is shown in Figure #4.

Based on the manufacturer's literature, pumping requirements for the unit are less than for a conventional self-contained privy. With the goal of reducing homeowner operating costs, a Shasta unit is currently being tested. Should the tests be successful and self-contained privies be selected for the Sunshine Subdivision, Shasta units may represent a possible solution for the subdivision.

While the Shasta unit is being used successfully in many regions of the United States, a sub-arctic environment imposes some severe operational limitations to which the unit has not been previously subjected. The major benefit of the system is the reduction or elimination of pumping requirements. The primary method by which this is achieved is evaporation of liquids. Reduction of waste volume by evaporation is not possible in the Tanana Valley for approximately eight months of the year. As a result, the basic Shasta unit design requires modification to better suit the Alaskan climate.

As an operational concept it was decided to design a Shasta unit to act as a waste storage unit through the winter and allow for waste "treatment" only during summer months. A literature review indicated that typical human waste generation rates were 0.4 gallons per person per day. The design value for the annual number of days with below freezing temperatures (design freezing days) selected was 240. Therefore, an average storage volume of 480 gallons was required to get a five member household through the winter (0.4 gal/day x 5 people x 240 days = 480 gal.).

Little climatological data is available for Tanana. However, a review of historical temperature data indicates that weather in Tanana and Fairbanks is very similar. Therefore, the historical

humidity, temperature, and wind data for Fairbanks was utilized as the basis for design of the Shasta unit. Theoretical calculations indicate that it is possible to evaporate up to 600 gallons of liquid from a Shasta unit in the June through September time frame. However, how well the model equations correlate to real conditions is unknown. Therefore, it was resolved to conduct a pilot test in Alaska to test the effectiveness of the unit.

Based on discussions with the manufacturer, a design was developed. The 500 gallon model was selected as it had the best storage volume to surface area ratio. A configuration of one 500 gallon unit as an actual privy and one as a honey bucket dump station was developed to provide a maximum possible storage volume of 1,000 gallons. This provides a storage capacity safety factor of two for the unit.

To take advantage of the long summer days, passive solar characteristics are incorporated in the design. It is anticipated that this will greatly enhance evaporation rates. The holding tanks are black in color, and designed for installation above grade in the direct sunlight. Four inches of board stock insulation is provided under each tank to prevent the ground from becoming a heat sink. Wind directional vent caps are specified to improve natural ventilation. Supplemental forced air ventilation is provided with a solar powered stack fan. This ensures that proper ventilation occurs even on calm days during the summer.

A test site location in Fairbanks was selected as weather there closely approximates Tanana. The test site was also readily accessable by road to representatives of TCC who would monitor the system operation. An Alaska Native with a home having no existing sanitation facilities was selected for the test. As the unit was not installed until January 1986, a test period of 18 months was developed. Photos of the installation are provided in the Appendix of this report.

Design, purchase and installation of the prototype unit cost $15,000. Based on knowledge already acquired by installing the prototype, it is estimated that the units could be installed for approximately $10,000 each. It is important to note that this model is being developed for unusual circumstances where high ground water or permafrost prevent the installation of conventional pit privies. The self-contained privy is not an economical alternative to the conventional pit privy and should be considered only in applications which preclude the use of a conventional design.

4. CONVENTIONAL PIT PRIVIES

Conventional pit privies would require an area-wide drainage and surface water diversion network within the subdivision. Significant fill work would be needed to raise the surface elevations adjacent to the house pads and provide sufficient separation between groundwater and permafrost for pit privy installations.

A complete conventional pit privy and outhouse can be installed at a cost of $5,000 per unit. This type of privy requires little maintenance, and does not require operating instructions. As the pits are filled, the homeowner excavates a new pit. The outhouse structure is then moved and the old pit is abandoned and marked.

C. Establish Area-Wide Drainage and Surface Water Diversion Network

1. INTRODUCTION

An aerial topographic survey was conducted to identify drainage requirements at the three possible housing sites. This survey was completed in January 1987. Copies of the map were provided to study participants at that time. The reproducible topo map is on file in the Anchorage office of EH&EB. The topo survey shows that drainage is adequate at the proposed "Old Hospital" and "Eller Subdivision" sites. The Sunshine Subdivision site drainage problems were

confirmed by the survey. The accuracy of the survey is ± 2 feet and as such, should not be utilized for purposes other than preliminary planning.

Ground inspections by EH&EB and TCC personnel confirmed that there is no functional drainage network in the Sunshine Subdivision. The only drainage facilities provided were several 12-inch diameter culverts installed during access road construction. The culverts have done little to improve drainage within the subdivision. Most, if not all, of these culverts are now clogged with soil and/or crushed. The City maintains the access road but does not appear to have the resources to adequately maintain the culverts.

During initial visits, the option of diverting surface water run-off coming from above the subdivision to alternate drainage patterns was explored. The idea was to reduce the amount of water draining into and ponding within the subdivision. The possibility of channeling uphill run-off along the existing agricultural project access road and draining it into N.C. Creek was discussed. This option was disapproved by city officials because flows into the creek were already too high during break-up and diverting additional water would cause flooding of adjacent lands. Therefore, off-site drainage diversion was not considered.

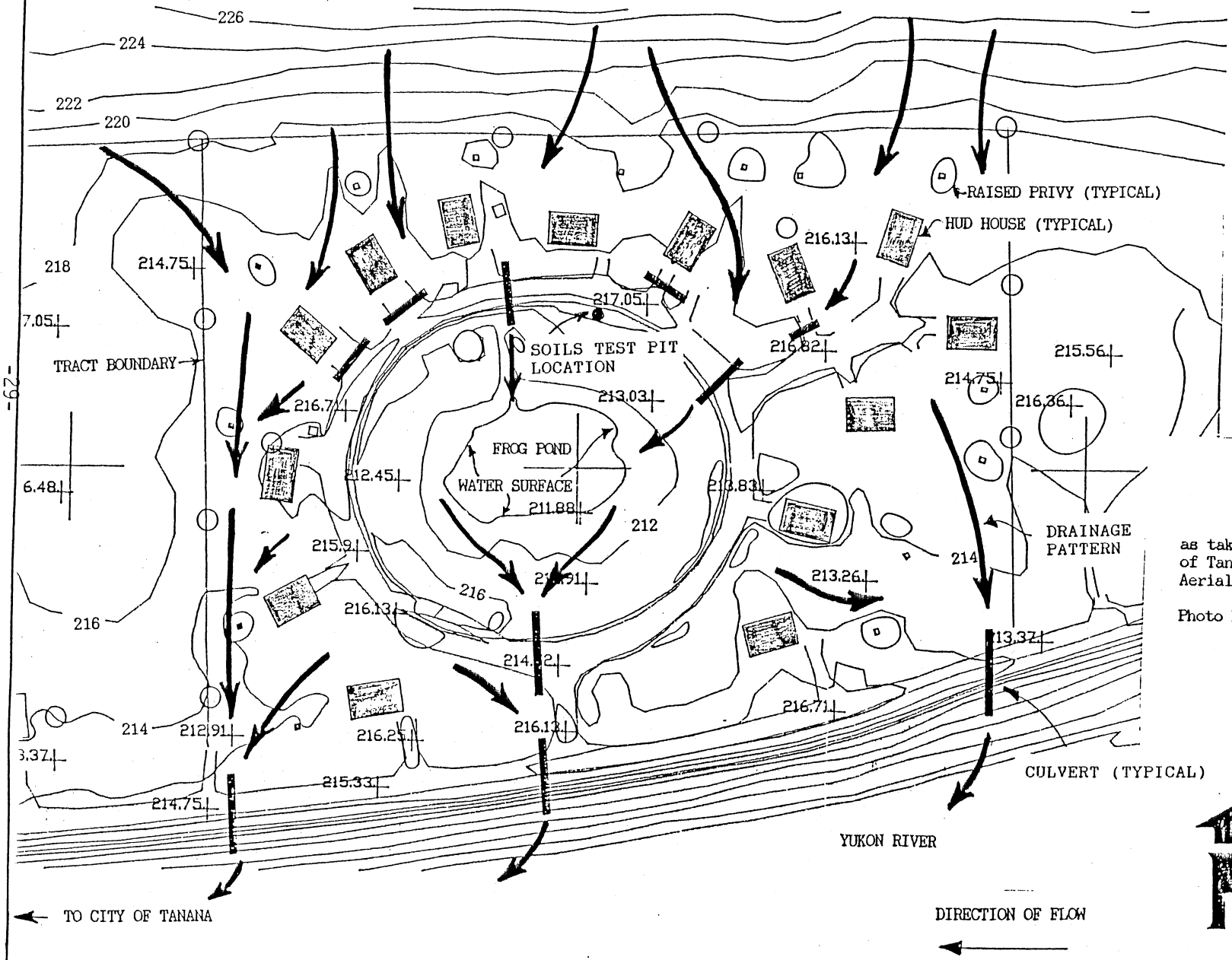
Low areas in the subdivision should be contoured with fill material to drain toward the Yukon River. Minimum 24-inch diameter culverts should be installed as necessary to drain water under access roads and to the river.

An option to consider in the drainage plan would be to eliminate Frog Lake. The lake could be filled and utilized by the community as a play lot or other public use facility. Based on the aerial topo map, an estimated 12,000 cubic yards of material is necessary to fill the lake to the level of the surrounding access road.

PRELIMINARY DRAINAGE PLAN

SUNSHINE SUBDIVISION
TANANA, ALASKA

Figure #5



AERIAL TOPOGRAPHIC MAP
SUNSHINE SUBDIVISION
TANANA, ALASKA

as taken from an aerial topographic map of Tanana prepared by North Pacific Aerial Surveys, Inc. of Anchorage, AK

Photo Date:9/11/84 Job #: 86094

NOT TO SCALE

CONTOUR INTERVAL = 2 feet

HOR./VERT. DATUM: assumed

A preliminary drainage plan is presented in Figure #5. Final plans would require detailed analysis based on a ground topographic survey. The use of culverts should be minimized to reduce city O&M requirements. Typically, culverts are needed most during break-up when they are still blocked by ice and snow. Thawing culverts prior to spring run-off would be an annual maintenance task. In addition, drainage ditches and resultant damage to surface organics should be minimized. The Sunshine Subdivision is sited on permafrost which begins less than two feet below existing grade. The soils under the Sunshine Subdivision are predominately frozen silts with ice lenses. A balanced cut and fill drainage plan is not appropriate under these conditions. Cut sections into ice rich permafrost could destabilize the soils which, in turn, could cause ground surfaces to settle. New low spots would result, with larger drainage problems being created rather than existing problems being solved.

Therefore, fill material will be required to establish the appropriate contours. Assuming an average increase in elevation of 2 feet over 50 percent of the site (10.97 acres), approximately 18,000 cubic yards of material would be necessary. In addition, extensive clearing of existing brush and small trees would be required.

2. PRELIMINARY COST ESTIMATE

The FAA upgraded and resurfaced the Tanana Airport runway during 1986 and 1987. As part of the project, a river dredging and gravel crushing operation was established just north of the Old Hospital. In conversations with the FAA project engineer, Mr. Ethan Birkholz, prices paid for river gravels were $6.10 per yard delivered. The cost of delivered crushed 1-inch minus gravel was $17.50 per yard. Volumes required for the runway were 55,000 yards of river gravels and 14,000 yards of crushed gravel. A preliminary cost estimate has been prepared based on these material costs and is presented in Table III.

Table III

Preliminary Cost Estimate for Sunshine Subdivision Site Drainage

	Item	Quanitity	Unit Cost	Total Cost
1.	Fill material for Frog Lake (delivered)	12,000 cu yds	$8.00	$ 96,000
2.	Fill operation at Frog Lake	L.S.		50,000
3.	Fill material for Subdivision (delivered)	18,000 cu yds	8.00	144,000
4.	Land clearing and contouring Subdivision	L.S.		250,000
5.	Culvert installation	L.S.		25,000
	Total Construction			$565,000
	Plus 10 Percent Surveying & Engineering			57,000
	Plus 15 Percent Contingencies			93,000
	TOTAL			$715,000

NOTE: Cost estimate does not include installation of replacement privies.

D. INSTITUTE A WATER AND SEWAGE HAUL PROGRAM

1. INTRODUCTION

A community water and sewage haul system typically uses a low flow toilet and sink that drain to a heated and/or insulated wastewater holding tank. Water is supplied to the fixtures from a storage tank located inside the home. This tank is filled by a community water truck on a regular schedule. The sewage holding tank is emptied on a similar schedule by a community operated pumper truck. Wastes are then hauled away and discharged into the community sewage lagoon. Service levels provided by a haul system can vary from the minimum of honey bucket collection to a conventional fully plumbed home similar to those served in a piped utility system. Due to hauling expenses, the level of service normally provided by a trucked system is less than that of a piped water and sewer system. Trucked systems are considered an intermediate level of service with the ultimate goal being a piped system.

2. DESCRIPTION

A 200 gallon aluminum potable water storage tank with PE liner and exterior fill port is located in each of the 14 homes in the Sunshine Subdivision. In a typical sewage haul program, the sewage holding tank is sized 50 to 100 percent larger than the water storage tank. Therefore, the holding tanks should have a minimum 300 gallon capacity. Truck hauled utility systems of this type can be provided at a full level of service. A hydropneumatic pressure system can be installed, the house fully plumbed, and water and sewer facilities typical of those found in any larger city provided.

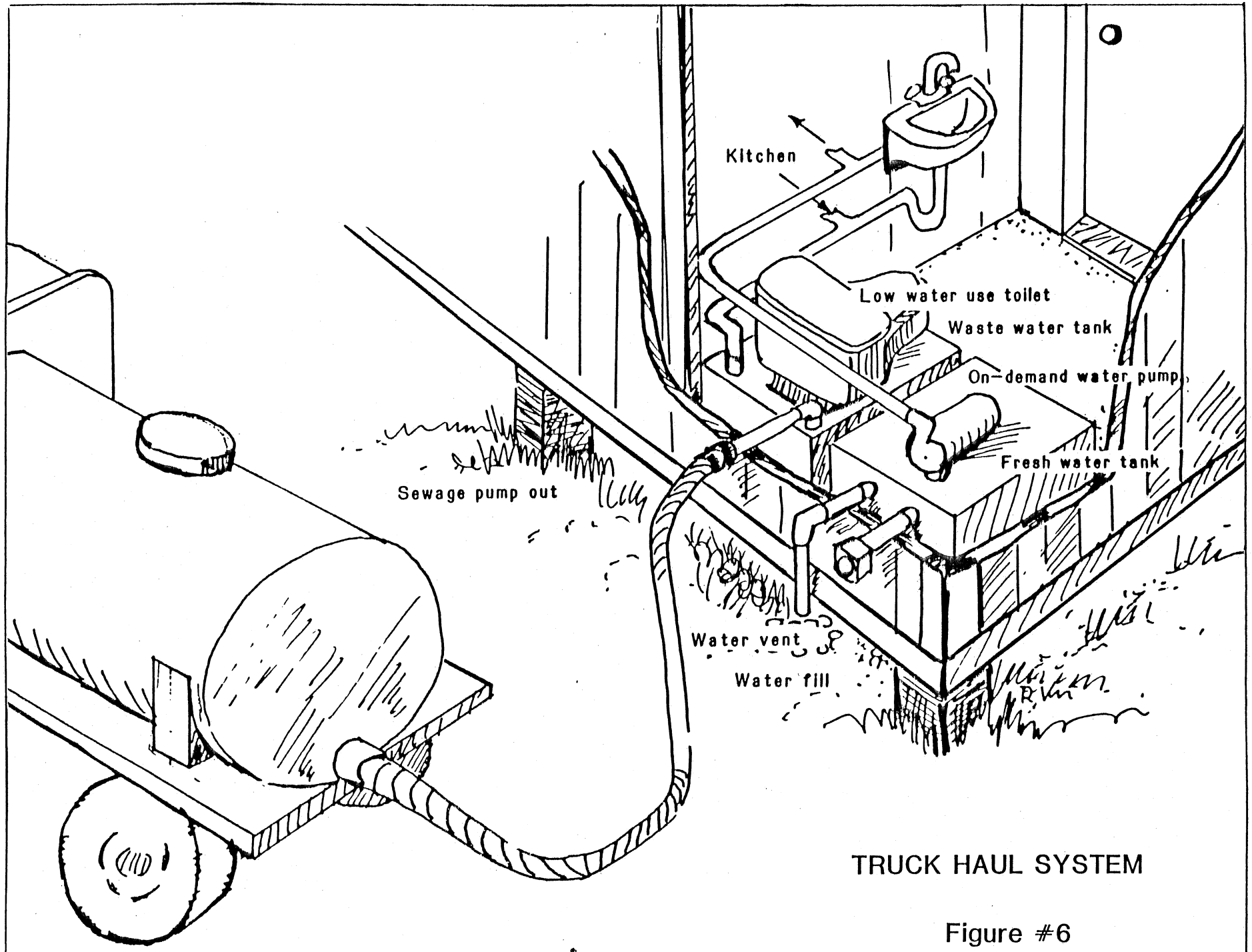
A national average for per capita water use in fully plumbed homes is 150 gallons per day. This average is normally reduced to 100 gallons per day when outside water usage is eliminated. A recent review of water haul system characteristics in Bethel, Alaska, which has an extensive haul program, indicates an average water consumption of 40 gallons per day per person for vehicle haul water and sewage systems. If low flow toilets

are installed, average values drop to 25 gallons per person per day. Households in the subdivision typically consist of five members. It is the writer's opinion that water usage rates can be further reduced to some 300 gallons per week per connection, if the limited plumbing configuration shown in the truck haul system Figure #6 is installed. Given these guidelines, operations and maintenance costs are presented with water use ranging from 300 to 900 gallons per week per household. The preliminary cost estimate for a truck haul system is presented in Table IV.

A lower cost alternative to the full scale sewage haul system would be a honeybucket haul system. With this option, no house plumbing is necessary and water use and wastewater generation is greatly reduced. Frequency of service would be based mainly on individual economic factors. A minimum pick-up schedule of twice weekly is recommended. Buckets would need to be stored in a heated area to facilitate scheduled dumping. Storage time should be reduced as much as possible.

These options have been presented to the City several times since planning for the original project started in 1979. The City is the only local entity with an existing capacity for operating a water, sewage, and/or honeybucket haul program. The City has consistently indicated that they will not assume responsiblity for the operation and maintenance of sewage or honeybucket haul systems. The water haul program initiated in 1982 under IHS Project AN-81-231 has been discontinued by the City due to lack of consumer demand. The delivered price for water was 15¢ per gallon delivered. The Mayor has recently stated that the City is currently assessing public interest to see if there is sufficient support to start the haul system again.

Since the waste haul proposal was last presented to the City, it appears that a private sewage pumping business has been established in town. Ms. Eileen Kozevnikoff, the Executive Director of the Tanana IRA Council, indicated that the business, K Enterprises, is owned by Mr. Wilfred Kozevnikoff. His equipment consists of a 300 gallon capacity trailer mounted septic tank pumper; the charge is $50.00 per load.



TRUCK HAUL SYSTEM

Figure #6

3. ADVANTAGES

a. Low capital costs, when compared to piped systems.
b. Services can be readily discontinued to specific subscribers for non-payment.
c. Level of service provided can be adjusted to individual subscriber's ability to pay based on frequency of delivery/removal.

4. DISADVANTAGES

a. Operation costs are high. When subdivision residents were questioned at a public meeting, only one individual stated that she had water delivered by the City. The others indicated that they could not afford the service.
b. Requires a maintenance program to ensure road network is reliable.
c. Necessitates regular snow removal in the winter to maintain service.
d. The system is labor and equipment intensive. O&M costs are higher than a piped system.
e. Requires large subscriber base before it can be considered as an option. It is not feasible to establish a haul system for the Sunshine Subdivision only.
f. If one or two households do not subscribe to the service, potential environmental hazards will not be eliminated.

Table IV

Preliminary Equipment and Maintenance Garage Capital Costs for Typical Trucked Haul System in Tanana, Alaska

	Item	Quantity	Unit Cost	Total
1.	Water haul vehicle (2 ton truck with 500 gallon water tank)	1 ea.	L.S.	$ 60,000[1,4]
2.	Sewage haul vehicle (2 ton truck with 500 gallon sludge pumper)	1 ea.	L.S.	50,000[1]
3.	Plumbing modifications to existing homes	14 ea.	$8,000	112,000
4.	Garage, insulated and heated for year-round maintenance	980 ft.[2]	150	147,000[3]
5.	Miscellaneous tools and shop maintenance equipment		L.S.	5,000
		TOTAL		$369,000

Note:

1. The cost difference between the water and sewage haul vehicles includes pumping equipment and stainless steel tank constructon for the water haul vehicle.

2. Costs are not included for a sewage lagoon, access road, or increased water production, treatment, and storage facilities. These existing facilities are considered adequate in Tanana.

3. The existing city garage facility may be an adequate base from which to operate a haul system. The cost of the garage may be eliminated from the estimate if this is the case.

4. The City was provided with a water haul vehicle by the PHS in 1982. The cost of this vehicle may be eliminated from the estimate if it is still in good condition.

5. OPERATIONS AND MAINTENANCE COST ESTIMATE

a. Water and Sewage Haul

Because water and sewage haul systems are labor and equipment intensive, operating costs are much higher than that of a comparable piped system. Economy of scale is another important factor. A cost effective haul program can not be operated for the Sunshine Subdivision alone, as there are too few subscribers available to realistically be able to support the system. For instance, the Bethel haul system services some 468 sewage evacuation accounts and 753 water fill accounts, Galena serves approximately 125 water fill and sewage evacuation accounts. During its operation, Tanana served between 3 and 5 water fill accounts per week.

Assuming weekly water use and sewage generation ranging from 300 gallons to 900 gallons, costs for hauled utility services were developed for homes located in Bethel, Galena, and Tanana. Unit prices were taken from the published utility rates of each community. The results were tabulated and presented in Table V. The community water haul and private sewage pumper services offered in Tanana cost some 500-600 percent more than comparable services offered in Bethel. This clearly illustrates the need for and benefit of an adequate subscriber base on which to provide a truck haul system.

If a comprehensive community-wide truck haul system were implemented in Tanana, user costs could be reduced from 50 to 75 percent. However, if a haul system comparable to the City of Galena is implemented, the minimum user level of 300 gallons of water per week would still be beyond the economic reach of almost all Sunshine Subdivision residents.

Table V

Current User Fees for Water & Sewage Haul Systems

Location	Monthly Cost with 300 gallon weekly usage		Monthly Cost with 900 gallon weekly usage	
	Water	Sewer	Water	Sewer
Tanana	$180.00	$200.00*	$540.00	$600.00*
Galena	66.00	54.00	198.00	162.00
Bethel	46.52	49.05	101.59	98.10

NOTE: See Appendix for utility rates and fee calculations.

* Cost shown is by utlilizing K Enterprises, as no city service is available. Please note that, if a regular service contract was developed, it may be possible to negotiate a reduced per trip rate.

b. Honeybucket Haul

The Bethel Public Works Department currently has 316 honeybucket accounts. With this subscriber base monthly service fees range from $1.67 for one service call per month to $13.08 for twice weekly service. There is a maximum limit of 5 honeybuckets dumped per call.

Labor projections for a honeybucket haul operator would be 3 hours per service loop assuming 14 subscriptions in Sunshine Subdivision. This provides for 1/2 hour start-up time, 1-1/2 hours collection time and 1 hour dumping and truck tank wash time. Current labor rates are $15.00 per hour. Assuming 6 hours per week for twice weekly service, monthly labor costs would be $360.00

The skid mounted 250 gallon honey holding tank unit is a basic unit with few moving parts. It is assumed that the unit has an unlimited potential useful life. Therefore, no allowance for annual replacement cost is necessary. The tank unit is mounted on a one ton 4 X 4 pick-up truck. Estimated purchase and delivery price is $25,000. With a useful life of five years, annual replacement cost would be $5,000 with a monthly cost of $420.00.

The total monthly operating cost is estimated at $780.00. Based on 14 subscribers, a monthly charge of $56.00 would be required for the system to be self-supporting.

Note that truck replacement and daily start-up and clean-up costs are fixed regardless of the number of subscribers. Increasing the number of subscribers to 28 would probably only result in an increase of two hours of operator time per cycle. The resultant per subscriber rate would then become $37.00 per month. By doubling the number of subscribers the fee rate costs can be reduced 34 percent. Providing a large subscriber base is the key to a more cost effective haul system.

These estimates assume that the truck is dumped in the VSW lagoon and that the number of honeybuckets picked up per call is limited to three. In addition, it assumes that subscribers are located in close vicinity to each other to keep travel time to a minimum.

This estimate does not account for the increased costs of road maintenance necessary to maintain year-round access, or for heated truck storage space.

E. Provide Piped Water and Sewer Services

1. INTRODUCTION

A piped water and sewer system was considered as an option during the original HUD housing project planning in 1980. Because off-site sanitation facilities funding for the project was limited, a proposal was developed whereby the City, IHS, and HUD would participate in a joint project to construct a city-wide piped system that would incorporate the proposed HUD homes. This proposal was presented to the City Council in July 1980, but was not approved because they felt that Tanana could not finance its operation.

The cost analysis on which the piped utilities proposal was based assumed the HUD homes would be located in the Eller Subdivision, some 1,200 feet from the existing city piped system. This was before the housing site was moved to the Sunshine Subdivision which is located approximately 5,000 feet from the existing city piped system.

2. DESCRIPTION

The methods considered to provide piped services to the Sunshine Subdivision include:

a. Provide individual wells and septic systems.
b. Provide a circulating loop water system independent of the existing city piped system.

c. Provide an extension of the existing city circulating water system.
d. Provide a community sewage lagoon.
e. Install a mechanical waste treatment plant providing effluent meeting secondary standards.
f. Provide a sewage collection system with lift station and force main connection to the existing city sewage lagoon.
g. Provide a community septic tank drainfield system.

The shallow groundwater resources study completed by the EH&EB in October 1980 indicated that individual wells were not feasible in Tanana. Well water found in the area was characterized by low production rates and poor water quality. Likewise, the location of the subdivision over shallow permafrost makes septic tank drainfield systems unfeasible. For these reasons, individual facilities were not further considered.

The City installed a shallow well/infiltration gallery within the Sunshine Subdivision tract after the housing project was completed. While not operational, water quality and quantity testing indicates this water source could be developed and that treatment would be necessary. The capital costs would be much less than extending the existing city piped water system to the subdivision. Therefore, for the subdivision water supply, only the installation of a circulating water system independent of the existing city system is presented. A community water system at the subdivision would require a combination treatment plant, pumphouse, and water point building to be located at the intersection of the subdivision access road and White Alice Road. A schematic layout of the proposed water system is presented in Figure #7A. A preliminary cost estimate is presented as part of Table VI.

Wastewater disposal using an independent lagoon was not considered. The Sunshine Subdivision tract is bordered to the south by the Yukon River. Private property surrounds the subdivision on all other

sides. Property to the east and west is developed, while property to the north is uphill. There is no convenient nearby location to site a sewage lagoon to serve the subdivision, and the subdivision tract is not large enough to accommodate a lagoon on the IRHA/Tozitna property and still provide appropriate set-back distances from the houses.

The option of installing a mechanical secondary treatment plant was not considered feasible. The operation and maintenance burden which would be placed on the City's resources was considered to be in excess of their current capabilities.

Extending the City sewer system to serve Sunshine Subdivision would require gravity sewage collection, primary settling in community septic tanks, two lift stations, and a combination 2-inch force main and 8-inch gravity sewer main. A schematic layout of the proposed system is provided in Figures #7A and 7B. A preliminary cost estimate is provided in Table VI.

The only other possible water disposal alternative is installing a community septic tank drainfield system within the Sunshine Subdivision. Frog Lake is the only area available within the subdivision for a community drainfield and would have to be filled with a permeable material. Drainfield installation would occur after the reclaiming of this land. It would take several years until the fill material consolidated and the underlying permafrost layer restablized. Very little soils testing has been conducted within the Sunshine Subdivision. As there is no clear identification of gravel layers located under Frog Lake, a buried intermittent sand filter which directly discharges into the Yukon River may be a requirement for the drainfield. Community septic tank drainfield systems require a carefully executed O&M program. Without such a program to provide regular sludge pumping, a drainfield can be permanently clogged by solids carry-over into the field. Once a drainfield has been plugged, the only available remedy is replacement. No other treatment method reviewed has this liability. The lack of regular

O&M in rural Alaska has resulted in a high failure rate for community septic tank drainfield systems. For this reason, a community septic system is not recommended for the subdivision.

3. ADVANTAGES

a. Typically has lower operating costs than a haul system.
b. Lowers possibility of drinking water contamination during delivery.
c. Less equipment intensive than a haul system and typically more reliable.
d. Eliminates the potential environmental health hazards of surface dumping of greywater and/or honeybuckets within the subdivision.

4. DISADVANTAGES

a. High capital costs.
b. Subdivision residents cannot afford to pay the monthly costs to operate a piped water and sewage system. Conversations with the Mayor indicated that monthly water and sewer connection fees are presently $80.00 for private residences and that city subsidies are still required to operate the system. When polled during a public meeting, only one of the eleven subdivision residents present indicated they could afford a $100.00 per month water and sewer bill.

5. OPERATION AND MAINTENANCE COST ESTIMATE

A detailed operation and maintenance analysis for the existing city water and sewer system was conducted and published by the Planning & Training (P&T) Unit, EH&EB, in 1982. At the time of the analysis, overall system income was listed as $123,560 while system O&M expenses were $131,317. A city subsidy of $7,757 was required to keep the system in operation. The user fee rate structure was last increased by the city in 1982, yet the operational costs of the utility system continues to increase annually. A conversation with the Mayor confirmed that the City continues to subsidize the operation of the water and sewer system.

The independent piped water system proposed for the Sunshine Subdivision is similar to the existing city piped water system. The 1982 report estimated the annual cost of operating the water system and VSW washeteria at $110,227. Assuming the cost of operating the piped water system was 25 percent of the water budget, an annual O&M cost of $27,557 is generated. Adjusting this figure to a 1987 value assuming an annual inflation rate of 5 percent results in a current annual O&M cost of $35,170. Because the Sunshine Subdivison water system would benefit from economy of scale, the annual O&M cost of that system was estimated to be 75 percent of the existing city system, or approximately $26,400.

The piped sewer extension proposed for the Sunshine Subdivision is similar to the existing city system in that it consists of two lift stations, force mains, and gravity mains. However, existing city force mains are not heated for freeze protection as they rely on the high water usage rates of the public school to keep heat in the system. The proposed subdivision layout would require 3,800 feet of force main. This distance and anticipated low usage rates would require heat addition during cold weather. Therefore, a force main with a circulating heat-add line is required. It is envisioned that a buried 8-inch arctic utilidor, carrying a 2-inch PE sewer pressure line, a heat-add loop, and a back-up thaw wire would be required for the force main extension.

At $2.00 per gallon for fuel oil, the average annual cost to heat the force main is approximately $2,700.

The 1982 O&M report estimated the annual cost of operating the sewage collection system at $21,090. Adjusting this figure to a 1987 value, assuming an annual inflation rate of five percent, results in an annual O&M cost of $26,917. Given that the Sunshine Subdivision sewer extension would be an addition to the City system and some overhead costs would remain fixed, the annual O&M cost of that system was estimated to be 75 percent of the existing city system, or

approximately $20,200. Added to this figure is the additional cost of heating the force main. The total annual O&M cost for the sewer system would then be $22,900.

6. USER FEES

In April 1982, the Tanana City Council established user fees for the water and sewer system. This fee structure is still in effect. Monthly domestic service rates are $35.00 for water and $45.00 for sewer. The December 1982 EH&EB O&M analysis recommended a monthly fee structure of $45.00 for water and $60.00 for sewer. Assuming an annual inflation rate of 5 percent over the past five years, the $105.00 total fee recommended in 1982 would be $134.00 in 1987.

However, due to the high operating costs of arctic utility delivery systems and the small consumer base for which to provide services, this fee structure would not cover anticipated O&M costs. If subdivision O&M costs were totally supported by subdivision residents, the monthly fee for piped water and sewer would be $294.00.

Table VI

Preliminary Cost Estimate for Piped On-Site Water and City Sewer Extension for Sunshine Subdivision

Item	Quantity	Unit Cost	Total Cost
Sewer			
1. Gravity Sewer Main (8-inch)	2,000 ft.	$85/ft.	$170,000
2. Manholes	8 each	5,000/ea.	40,000
3. Lift Stations	2 each	30,000/ea.	60,000
4. Service Lines (80 ft.)	14 each	6,000/ea.	84,000
5. Force Main (2-inch/8-inch arctic)	3,800 ft.	100/ft.	380,000
6. Gravity Main (6-inch)	1,200 ft.	75/ft.	90,000
7. Clean-Outs	6 each	3,000 ea.	18,000
Subtotal			$842,000
Water			
1. Circulating 4-inch PE	2,700 ft.	60/ft.	$162,000
2. Treatment Plant/Pumphouse (20' X 24')	L.S.		200,000
3. Service Lines (80 ft.)	14 each	8,000/ea.	112,000
Subtotal			$474,000
Drainage			
Site Drainage without filling Frog Lake			$ 419,000
Total Construction			1,735,000
Plus 10 Percent Engineering			174,000
Plus 15 Percent Contingencies			286,000
	TOTAL		$2,195,000

ASSUMPTIONS:

Gravity flow possible. This assumption is based on an aerial topo survey with an accuracy of ± two feet.

Required treatment scheme: softening for hardness, iron, manganese removal, polyelectrolyte injection, and filtration for color and turbidity removal, then chlorination and fluoridation.

Treatment plant/pumphouse to include treatment equipment, heating and circulation equipment, 10,000 gallon water storage, and public water point.

F. Relocate Homes to a New, More Centrally Located Site

1. DESCRIPTION

Sunshine Subdivision is presently located approximately 5,400 feet east of the VSW washeteria. It is not economically feasible to extend existing piped utilities to this location. High capital and operating costs also limit the probable development of an independent water and sewer system for the 14 subdivision homes. The present location is the low spot for a regional watershed. Because drainage requirements were not addressed in the original site development, standing pools of water are typically found throughout the subdivision during warmer months. Due to these problems, it was proposed that the Sunshine Subdivision homes be relocated to one of two alternate properties located on higher ground and adjacent to the existing VSW piped water and sewer systems. These locations were developed by the IHS based on reviews of townsite maps and field trips. No site location preferences or recommendations were made by residents or local agencies.

The proposed locations are the old PHS Hospital Tract and the Eller Subdivision Tract (see Figure #8). Both properties appear to be owned by Tozitna Limited, the local Native Corporation. As indicated in the Chronology of Events, the IRHA housing project was originally scheduled to be built in the Eller Subdivision. However, as a result of intervention by Tanana project participants, the location was changed to the Sunshine Subdivision. The Sunshine Subdivision Tract was obtained from Tozitna Limited by the IRHA in a land swap for the Eller Subdivision. Tozitna Limited maintains that the swap was never finalized and that technically the Sunshine Subdivision land is still owned by Tozitna. A review of property ownership at the State Recorder's Office confirmed Tozitna's statement. This matter was referred to the IRHA for resolution.

A review of HUD files indicated that the Eller Subdivision contained 15 lots and was originally purchased from Mr. Cliff Eller for $22,500. Conversations with the Tozitna Office Manager indicated that Tozitna was not very interested in swapping another tract for the Sunshine Subdivision Tract. When it was pointed out that the numerous improvements to the tract had raised its value since the land was last traded, the response was that the house pads, road, privy mounds, and electrical extensions would more likely be viewed as damages rather than improvements. Extensive negotiations with Tozitna will be required if a change in location for the subdivision is to be realized.

The Home relocation was the most popular with subdivision residents. However, this support was based on the stipulation that the homes be moved closer to town rather than farther away. When the decision was made by Tanana project participants to move the housing location from Eller Subdivision in 1981, Teekona Subdivision was considered prior to the selection of Sunshine Subdivision. The Teekona Subdivision is situated on higher ground and has much better soils conditions. Three individuals did elect to site their homes there. However, the majority decided that the Teekona site location on Mission Hill some three miles from town was much too far away. As a result, the Sunshine Subdivision was selected. It is interesting to note that most residents also consider Sunshine Subdivision as being too far from town. Only the two residents who own automobiles did not select moving the subdivision as their first choice. The Teekona Subdivision is no longer available as an option for relocation as all of its lots are now occupied.

2. ADVANTAGES

a. Relocation of the subdivision to the Eller or Hospital sites eliminates the need for larger capital expenditures for water source and wastewater disposal site development.

b. At both proposed locations (Eller Subdivision and old Hospital Tract), the existing community water wells and the sewage lagoon can be utilized.

c. The Hospital location has the added advantage of being able to use the existing sewage collection system as well as the circulating water loop.

d. The extensive site drainage requirements of the Sunshine Subdivision do not exist at either of the proposed sites.

e. By combining the proposed systems with the existing city VSW system, O&M requirements of the City will not significantly increase. Lower user fees can be established as additional users will be available to share operating costs.

f. Implementing a master plan with centralized higher density growth within the Tanana townsite should reduce capital and operating costs for future utility expansions. This may enable Tanana residents to receive services which would otherwise be economically unfeasible.

3. DISADVANTAGES

a. Tozitna Limited may be reluctant to provide the land necessary for an alternate site.

b. The removal, transport, and reestablishment of the homes on new foundations would be required.

c. Additional site development costs such as power extension, house pads, and access road construction will be required.

d. Subdivision residents currently cannot afford to pay anticipated monthly fees required to operate a piped water and sewerage system. Conversations with the Mayor indicated that monthly water and sewer service fees are presently $80.00 for private residences and that this rate still required city subsidies to operate the system. When polled during a public meeting, ony one of the eleven residents present indicated they could afford a $100.00 per month water and sewer bill.

e. The relocation of homes originally placed in the Sunshine Subdivision may generate public interest in the relocation of other IRHA housing projects located at questionable sites in other communities.

4. SITE DEVELOPMENT

The site development costs for the Sunshine Subdivision in excess of those incorporated in the original bid for the Eller Subdivision were as follows:

a. House site development (electric extend house pads etc)	$168,000
b. Access road construction/water tank modifications	133,600
c. Raised mound privies	134,500
TOTAL	$436,100

Site development costs for the Eller Subdivision were not available from HUD. Current estimated development costs for the Eller Subdivision and the old Hospital tract are presented in Table VII. Estimates for sanitation facilities are presented in Tables VIII and IX; the proposed facilities layout is shown in Figure #8.

5. OPERATION AND MAINTENANCE COST ESTIMATE

A detailed O&M analysis was conducted by the Planning and Training Unit of EH&EB, in 1982 and published in December of that year. At that time, the annual O&M cost of the VSW facility was approximately $131,000. It is anticipated that the facilities proposed will not appreciably increase O&M costs over the current level. By assuming an annual inflation rate of five percent, the 1982 cost figure can be adjusted to a 1987 value of approximately $167,200.

6. USER FEES

In April 1982 the Tanana City Council established user fees for the water and sewer system. This fee structure is still in effect. Monthly domestic service rates are $35.00 for water and $45.00 for sewer. In 1982, the O&M analysis recommended a monthly fee structure of $45.00 for water and $60.00 for sewer. Assuming an annual inflation rate of 5 percent over the past 5 years, the $105.00 total fee recommended in 1982 would be $134.00 in 1987.

It is assumed that any proposed community facilities operated by the city would be charged out at a common rate. This would be advantageous to the city as an increase in revenue without an increase in O&M costs will allow the city to reduce subsidy levels.

Table VII

Preliminary Eller Subdivision and Old Hospital Tract Development Costs[3]

	Item	Eller	Old Hospital
1.	Relocate 14 homes	$ 250,000	$ 250,000
2.	Abandon Sunshine Subdivision @ $3,000 ea. homesite	42,000	42,000
3.	Electric power extension	40,000	30,000
	Access roads/site preparation	160,000	90,000
4.	14 house pads/driveways @ $15,000 ea.	200,000	200,000
5.	14 house foundations @ $7,000 ea.	98,000	98,000
Total Construction		790,000	710,000
Plus 10 Percent Engineering		119,000	107,000
Plus 15 Percent Contingencies		136,000	123,000
	Total	$1,045,000	$ 940,000

Note:
1. Values rounded to nearest thousand.
2. Assumes no land acquisition costs.
3. This table does not include water and sewer costs. See Tables VIII and IX for water and sewer installation costs.

Table VIII

Preliminary Cost Estimates for Piped Utilities to Proposed HUD Home Relocation Site at Eller Subdivision Tract

Item	Quanitity	Unit Cost	Total Cost
Sewer			
1. Gravity Main	2,600 ft	$80/ft	$208,000
2. Manholes	10 ea	$5,000/ea	50,000
3. Sewer Service Lines (100 ft.)	14 ea	$60/ft	84,000
Subtotal			$342,000
Water			
1. Circulating 4-inch PE	5,000 ft	$50/ft	$250,000
2. Service lines (100 ft. each)	14 ea	$75/ft	105,000
3. VSW Water Plant & Source Upgrade	L.S.		100,000
Subtotal			$455,000
Total Construction			$797,000
Plus 10 Percent Engineering			80,000
Plus 15 Percent Contingencies			132,000
TOTAL			$1,109,000

Note: Gravity sewer connection to existing VSW sewage lagoon assumed feasible based on aerial topo review.

Table IX

Preliminary Cost Estimates for Piped Utilities to Proposed HUD Home Relocation Site at Old Hospital Tract

Item	Quanitity	Unit Cost	Total Cost
Sewer			
1. Gravity Main	1,400 feet	$80/ft	$112,000
2. Manholes	5 ea	5,000/ea	25,000
3. Sewer Service Lines (100 ft. each)	14 ea	60/ft	84,000
Subtotal			$221,000
Water			
1. Circulating 4-inch PE	5,500 ft	50/ft	$275,000
2. Service Lines (100 ft. each)	14 ea	75/ft	105,000
3. VSW Water Plant & Source Upgrade	L.S.		100,000
Subtotal			$480,000
Total Construction			$701,000
Plus 10 Percent Engineering			70,000
Plus 15 Percent Contingencies			116,000
TOTAL			$887,000

Note: Gravity sewer connection to existing sewer system opposite school assumed feasible based on aerial topo review.

VII. CONCLUSIONS AND RECOMMENDATIONS

A. Environmental Health Data

Original concerns regarding polluted water in the Sunshine Subdivision were based on 1985 IRA Council water quality testing. Copies of these tests were requested from the Council and then from Northern Testing Lab in Fairbanks. No records were located at either source. Coliform testing conducted by the PHS and TCC during the fall and winter of 1986 and summer of 1987 reflected no signs of unusually polluted water within the subdivision tract.

No records remain of the Council water quality tests. Assuming the Council tests were valid samples, one possible reason for the discrepency is variations in rainfall. The average amount of winter precipitation in the Tanana Valley (October - May) is 5-inches. During the winter of 1984, 6.8-inches of precipitation was recorded, while the winter of 1986 recorded only 3.7-inches. It is possible that the environmental hazards created in unusually wet years would not exist in unusually dry ones, particularly if these hazards are created by surface run-off.

If the primary source of contamination of Frog Lake was from the raised privy mounds and not surface run-off, contamination would be at uniform levels throughout the summer and fall. Once the ground thawed and allowed the percolation of water from the privy mounds, this water would tend to perc into Frog Lake at a relatively constant rate. This type of contamination should produce relatively constant levels of coliform bacteria when tested. However, this is not the case for Frog Lake. Coliform testing done by the IRA Council indicated a coliform level "too numerous to count" while samples collected by the PHS and TCC in the fall and winter reflected minimal coliform counts.

Based on this limited data, it appears that there may be seasonal contamination of Frog Lake which takes place during break-up in wet

years. Through a process of biological stablization, the lake gradually treats itself and returns to normal levels of coliform bacteria by fall. Field observations and soils testing support this idea. The soils test confirms that permafrost is less than two feet below grade. Frog Lake is totally surrounded by a road constructed of compacted gravel. It is unlikely that any significant amount of water percolates into Frog Lake as a road built on permafrost acts similar to a dam. However, it is a standard practice of residents to clear their lots of as much water as possible by pumping it into Frog Lake during break-up. There are numerous sources of possible contamination on the lots themselves. Graywater drained on the ground surface, honeybucket wastes tossed in a snow bank rather than the privy during the winter, and waste products of the numerous dogs chained within the subdivision are primary examples. During break-up, all these contaminates thaw and collect in the low spots. Contaminants from areas uphill from the subdivision also collect around the homes. This water is then typically pumped or drained into Frog Lake by the various homeowners as there is little or no natural run-off from the lots. As Frog Lake has no outlet, contaminated water pumped into the lake remains there through most of the summer.

It is highly unlikely that effluent from the raised privy mounds is contributing to pollution in the subdivision. The raised privy mounds will contribute little or no pollution during break-up as the sewage would be sealed within the frozen mounds. Following break-up, contaminated water may percolate slowly from the mounds throughout the summer, but the presence of blackwater seepage was not confirmed by visual observation or water quality testing.

B. Sunshine Subdivision Sanitation Facilities

1. INTRODUCTION:

One long range goal for Tanana should be the establishment of a community piped water and sewer system. With this goal in mind, the

moving of the subdivison closer to the center of town and existing utilities would be desireable. The relocation would cut water and sewer extension costs and potential monthly user fees for the HUD homeowners in half. The city would also benefit from this solution. Increased housing density will result in reduced unit costs for future city utility projects. This makes future projects more feasible and, therefore, more likely to be funded and implemented.

Existing economic conditions preclude the further development of piped water and sewer systems at this time. The same conditions which were identified in 1980 exist today. The homeowners of the Sunshine Subdivision cannot afford to pay monthly water and sewer user fees. Were the subdivision to be relocated and piped utilities developed and offered at the current city subsidized rate, most if not all of the homeowners would still be unable to pay user fees. Likewise, the city cannot afford to subsidize additional system operating costs.

The IHS has narrowed the number of available options to two recommended alternatives. These two alternatives are presented for decision making study participants to consider. Approximately $500,000 in HUD funds are available to finance sanitation facilities improvements for the Sunshine Subdivision. Because both alternatives exceed $500,000, the City and local organizations will need to seek additional funding sources before meaningful improvements can occur. In addition, prior to selecting the alternative requiring the relocation of the subdivision homes, land negotiations and site control will be necessary.

2. RECOMMENDATIONS FOR THE EXISTING SUNSHINE SUBDIVISION:

Capital improvement costs to provide piped water and sewer facilties to the Sunshine Subdivision are estimated at $2.2 million with anticipated monthly user fees of $294. As such, piped water and

sewer facilities are not feasible. It is unlikely that the economic conditions in Tanana will change to where homeowners could afford such service at this location. Therefore, the provision of piped water and sewer services to the Sunshine Subdivision is not recommended. It is recommended that a comprehensive drainage plan be implemented in conjunction with replacing raised mound privies with conventional pit privies. As drainage needs will require large amounts of fill, it is anticipated that the surface elevation around the homes will be raised to the level of the existing house pads. An increase of some 3 to 4 feet above existing grade is expected. This should allow sufficient separation from the permafrost to accommodate conventional privy pits. These modifications should be coordinated with city plans to complete the well house and public watering point for the city well (#4) located on the Sunshine Subdivision tract. These improvements will mitigate most of the current environmental health problems in the subdivision.

Table X provides a detailed cost for drainage and privy pit replacement. The estimated cost of a subdivision drainage plan for Sunshine Subdivision is $530,000. Replacement pits for the privies are estimated at a cost of $36,000.

Table X

Preliminary Cost Estimate for Recommended Site Improvements for Existing Sunshine Subdivision

Item	Total Cost
Drainage	
1. 18,000 yds.^{3} fill material (excluding Frog Lake)	$144,000
2. Land clearing and contouring/subdivision	250,000
3. Culvert installation	25,000
Subtotal	$419,000
Sewer	
14 ea. pit privy replacement pits	28,000
Total Construction	447,000
Plus 10 Percent Engineering	45,000
Plus 15 Percent Contingencies	74,000
Total	$566,000

Note: 1. Assumes completion of city well #4 with water point using existing State grant funds
2. See Table III for additional information on drainage expenses.

3. RECOMMENDATIONS FOR ALTERNATE LOCATIONS OF THE HUD HOMES:

If the subdivision is relocated, piped water and sewer facilities become an achievable long-term goal. While current economic conditions preclude piped water and sewer, the relocation of the homes sets the stage for such future service. An interim level of sanitation service could be established using pit privies and the existing city/individual water haul system. If economic conditions improve, piped services could be extended. Therefore, if a decision is made to relocate the homes, it is recommended that subdivision planning be done to allow for future piped water and sewer services. Of the two sites identified in this study, the Old Hospital tract would have the lowest sanitation facilities development costs. The project should be developed using a two-phased approach.

Phase I would include site development and the installation of conventional pit privies. Phase II would provide for the extension of water and sewer services. The estimated cost of Phase I is $1,045,000 to $1,151,000. Phase II is projected to be $887,000 to $1,109,000 for a total cost of $1,932,000 to $2,260,000. A more detailed estimate is presented in Table XI.

Table XI

Preliminary Cost Estimate for
Recommended Site Improvements for Relocated HUD Homes

Item	Eller	Old Hospital
Phase I		
1. Relocate 14 homes	$ 250,000	$ 250,000
2. Abandon Sunshine Subdivision @ $3,000 ea. homesite	42,000	42,000
3. Electric power extension	40,000	30,000
4. Access roads/site prep.	160,000	90,000
5. 14 house pads/driveways @ $15,000 ea.	210,000	210,000
6. 14 house foundations @ $7,000 ea.	98,000	98,000
7. 14 ea, pit privies @ $5,000 ea.	70,000	70,000
Total Construction	$ 870,000	$ 790,000
Plus 15 Percent Engineering	131,000	119,000
Plus 15 Percent Contingencies	150,000	136,000
Subtotal, Phase I	$1,151,000	$1,045,000
Phase II		
Sewer		
1. Gravity Main @ $80/ft.	$ 208,000	$ 112,000
2. Manholes @ $5,000 ea.	50,000	25,000
3. Sewer Service Lines @ $60/ft.	84,000	84,000
Subtotal	$ 342,000	$ 221,000
Water		
1. Circulating 4-inch PE @ $50/ft.	$ 250,000	$ 275,000
2. Service Lines @ $75/ft.	105,000	105,000
3. VSW Water Plant & Source Upgrade	100,000	100,000
Subtotal	$ 455,000	$ 480,000
Total Construction	$ 797,000	$ 701,000
Plus 10 Percent Engineering	80,000	70,000
Plus 15 Percent Contingencies	132,000	116,000
Subtotal, Phase II	$1,109,000	$ 887,000
TOTAL	$2,260,000	$1,932,000

Note: For additional information on sanitation facilities See Tables VIII and IX.

C. Shasta Waterless Sanitation Systems

1. OPERATIONAL REVIEW

A prototype individual self-contained outhouse and honeybucket dump station was installed in the Fairbanks area in January 1987. The experimental system has been used by a family of four for the past nine months. Final results and recommendations will not be available until the completion of the 18-month test period; interim results are presented here.

Use patterns were normal. During the winter, the honeybucket dump station was used almost exclusively. Following break-up, the outhouse was predominantly used. The 500 gallon storage volume of each unit easily held the blackwater wastes generated. The Shasta design of separating solids and liquids using a fiberglass basket in the holding tank worked effectively. As only the honeybucket dump station was used in freezing conditions, sufficient heat was available with each "dose" of the station to allow liquid/solid separation and prevent coning within the basket. A side benefit of reduced odor was also confirmed by TCC inspection and homeowner comment.

Starting in the spring, the honeybucket dump station was used by the family for graywater disposal. The holding tank was filled halfway in one month. Following a reminder that the system was for blackwater only and that using it for graywater would require frequent pumping, this activity stopped.

The solar fan, panel and battery assembly required several adjustments and modifications during the summer. The fiberglass outhouse building was damaged during shipment and required some repair and structural reinforcement during setup. In August, the wood lattice originally installed around the tank was replaced on the south side with plexiglass to improve solar heating.

Actual evaporation was significantly less than the theoretical evaporation rates. At the beginning of summer, the outhouse had approximately 5-inches of liquid in the storage tank. This level remained constant for the entire summer. Evaporation was able to keep up with summer additions, but was unable to evaporate any of the winter storage. This suggests that liquid volumes can be reduced with evaporation by about 30 percent as the Fairbanks area has an average of 4-months of non-freezing temperatures each year. The remaining volume would require pumping.

2. CONCLUSIONS

The Shasta unit is a viable concept for use in a sub-arctic environment where permafrost or high groundwater precludes using a conventional pit privy. The reduced odors and above ground holding tank make its location on a gravel pad adjacent to a home an acceptable location. Foundations for homes built on shallow permafrost often raise floor elevations to four feet above grade. For such a home, a Shasta unit could be located on a common gravel pad and attached directly to the home with a porch or veranda for ease of access. However, as with any self-contained privy, pumping stored sewage would be required once or twice each year, depending upon household use.

Based on experience gained from the prototype the following are recommendations for construction of future units:

a. Given the level of service provided and the maintenance capabilities typical of bush Alaska, the use of solar powered fans is not recommended. Repair or replacement of this assembly is difficult, and whether it enhances evaporation significantly remains unclear. Only passive solar and ventilation techniques should be used.

b. The holding tanks should be installed above grade and totally enclosed. The enclosure's southern sides should be made of Lexan (plexiglass) to improve solar heating.

c. The manufacturer has indicated the holding tanks are now available in a square shape. This increases the surface area to storage ratio which will improve evaporation rates.

d. The outhouse building should be constructed of wood for ease of homeowner maintenance.

e. The outhouse and honeybucket dump station should be configured under a double outhouse floor with one toilet riser used for a dump station and the other riser utilized in the outhouse. This will eliminate custom manufacturing requirements and reduce the space needed for the unit to 5 feet by 10 feet.

3. RECOMMENDATIONS

If additional funding for sanitation facilities improvement is not available for the Sunshine Subdivision and the proposed scope of the drainage plan is reduced to where conventional pit privies cannot be used, a self-contained privy should be considered as a possible replacement for the raised mound privies. While an annual operating cost of $50 to $100 is anticipated, privy access would be greatly improved and no replacement mounds would be necessary.

APPENDIX A

CHRONOLOGY OF EVENTS

SUNSHINE SUBDIVISION
TANANA, ALASKA
IHS PROJECT AN-81-231 - HUD PROJECT AK007007

Activity	Date
IRHA Contract for Architect for Tanana Housing Project to GDM & Associates	June 1979
IHS initial project planning started for off-site sanitation facilities	July 1979
Preliminary site report submitted by IRHA	November 1979
Conditional approval of amended PSR by IHS for Eller Subdivision	July 1980
City Council decides piped water and sewer not feasible for city-wide service	July 1980
Test well agreement between IHS and IRHA	July 1980
Proposed water and sewer facilities reviewed with each prospective homeowner by IRHA	August 1980
Bid opening for IRHA housing project	August 1980
IRHA transferred $32,500 to IHS for well drilling	September 1980
Test well drilling commences at Eller Subdivision /start of IHS project construction	September 1980
IRHA awards Tanana HUD housing construction contract to McKinney-Alaska, Inc.	October 1980
Two unsuccessful test wells in Eller Subdivision completed by IHS	October 1980
IHS Report on shallow groundwater resources completed	October 1980
Development of a water haul system recommended by IHS	November 1980
Tanana City Council Resolution 80-22 requests IHS assistance with water and sewer for HUD project	November 1980
IHS Project Summary approved	January 1981
IHS MOA approved	January 1981

IHS informed housing project site moved from Eller Subdivision to Sunshine Subdivision	August 1981
Sunshine Subdivision site inspection by IRHA, HUD, and Architect	August 1981
Sunshine Subdivision site inspection by IHS	September 1981
New PSR approved by IHS based on understanding that on-site sanitation facilities were an IRHA responsibility	September 1981
Pre-final inspection of IHS off-site water facilities/ IHS project construction substantially complete	November 1981
IRHA bid opening for additional site work required at Sunshine Subdivision	April 1982
Construction on subdivision starts by IRHA contractors	May 1982
Supplemental HUD funds awarded for site development costs at Sunshine Subdivision	September 1982
Final inspection of IHS off-site water facilities	September 1982
Project proposal for piped water and sewer for Sunshine Subdivision submitted to IHS by Tanana IRA Council	October 1982
Final inspection for HUD housing project - pit for privies not completed as permafrost is within 2 feet of surface on subdivision tract	October 1982
First Congressional request for information on waste disposal at Sunshine Subdivision	October 1982
Final inspection of HUD housing project by IRHA	October 1982
Transfer of community off-site water facilities By IRHA to City of Tanana	November 1982
Part I Certificate of Completion for Tanana homes by IRHA	November 1982
IHS response/explanation to IRA Council on sanitation facilities for Sunshine Subdivision	December 1982
IHS operations and maintenance analysis of VSW water and sewer system completed	December 1982
Second Congressional request for information on waste disposal at Sunshine Subdivision	January 1983

IRHA Request for technical assistance with on-site disposal at Sunshine Subdivision to IHS	January 1983
Final inspection punch list for off-site water facilities completed by IHS	January 1983
IHS on-site sewerage disposal recommendations forwarded to IRHA to place outhouses on raised mounds	February 1983
Coordination meeting with IHS, IRHA, HUD, and the City	June 1983
Bid opening for on-site water and sewer sewerage disposal modifications	September 1983
Contract completion date for IRHA on-site water and sewerage disposal modifications	November 1983
Letter from Tanana IRA Council to IRHA requesting information on possible contamination of Frog Lake by modified privies	August 1985
City request to start planning for sanitation improvements to Sunshine Subdivision. Addressed to Tanana IRA Council; copies to Senators, Congressman, IRHA, HUD, & IHS	August 1985
Third Congressional request for information on waste disposal at Sunshine Subdivision	September 1985
HUD letter responding to Congressional inquiry, reserving $500,000 to correct problem and requesting IHS assistance in resolving the problem.	October 1985
City request for IHS assistance with solving sanitation problems, to include Sunshine Subdivision	December 1985
Notice of $500,000 funding reservation from HUD to IRHA	January 1986
Public meeting in Tanana cancelled due to weather representatives of IRHA, TTC, & IHS met in Fairbanks to discuss possible options.	March 1986
Public meeting in Tanana	April 1986
Draft Planning Agreement circulated for comment	May 1986
Planning Agreement approved by all parties	September 1986
Collection of field data for feasbility study starts	October 1986
$20,000 in planning funds transferred from IRHA to IHS with which to prepare a feasibility study	November 1986

Design and purchase of modified self-contained privy and honeybucket dump station (Shasta Unit)	December 1986
Installation of Shasta Unit in Fairbanks home and start of 18-month trial operation	January 1987
Completion of data collection for feasibility study	February 1987
Distribution of feasibility study	October 1987

APPENDIX B

WELL LOG

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

LOCATION PHS Hospital-Tanana, Alaska DATE STARTED August 18, 1976

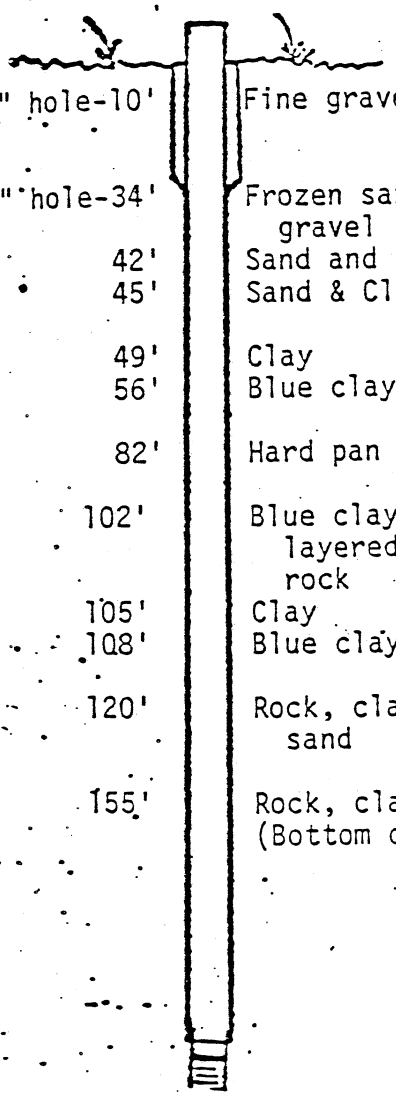
DATE COMPLETED August 28, 1976 CREW Bordner & Horner

TOTAL DEPTH OF WELL 155 FT. CASING INSTALLED 97' DIAMETER 8" & 6"

GROUT Bentonite SCREEN SIZE #40 MFG. Johnson LENGTH 10'

STATIC WATER LEVEL 25'-6" HRS. PUMPED 20 @ 50 GPM DRAWDOWN _____ FT.

DEVELOPMENT PROCEDURES Run surge blocks 8 h



DATE	DEPTH FROM - TO	FORMATION
	0-10'	Fine gravel
	10-34'	Frozen sand & gravel
	34-42'	Sand & gravel
	42-45'	Sand & gray clay
	45-49'	Gray clay
	49-56'	Blue clay silt
	56-82'	Hard pan gravel
	82-102'	Blue clay, layered rotten rock
	102-105'	Clay (purplish color)
	105-108'	Blue clay
	108-120'	Rock, clay (gray) & sand
	120-155'	Rock, clay (bottom of hole)

WATER DATA FIELD TEST

TASTE Good APPEARANCE FRESH Good

AFTER 24 HOURS _____ IRON _____ CHLORIDES _____

TDS _____ ALKALINITY _____ pH _____

SPECIAL NOTES:

See attached drawing.

ANCHORAGE, ALASKA 99509

PHS Hospital
Water

ANALYTICAL REPORT

Water Analysis(Facility) Alaska Area Native Health Service

Date Collected: 8-30-76 Time Collected: ---- By: ---

Source of Sample: Tanana (4-621R)

Physical Observations, Remarks:

[ ]		mg/l	Aluminum	[X]	410	mmhos	Conductivity
[ ]		mg/l	Arsenic	[X]	7.3	units	pH
[ ]		mg/l	Barium	[ ]		mg/l	Ammonia Nitrogen-N
[ ]		mg/l	Boron	[ ]		mg/l	Kjedahl Nitrogen-N
[ ]		mg/l	Cadmium	[ ]		mg/l	Organic Nitrogen-N
[X]	6	mg/l	Calcium	[ ]		mg/l	Nitrate(N)
[ ]		mg/l	Copper	[ ]		mg/l	Nitrite(N)
[ ]		mg/l	Chromium-Total	[ ]		mg/l	Phosphorus (Ortho)-P
[ ]		mg/l	Chromium-Tri	[ ]		mg/l	Phosphorus (Total)-P
[ ]		mg/l	Chromium-Hex	[X]	4	mg/l	Chloride
[X]	<0.1	mg/l	Iron-Total	[ ]		mg/l	Fluoride
[ ]		mg/l	Iron-Dissolved	[ ]		mg/l	Cyanide
[ ]		mg/l	Lead	[X]	Trace	mg/l	Sulfate
[X]	10	mg/l	Magnesium	[ ]		mg/l	Phenol
[ ]		mg/l	Manganese	[ ]		mg/l	MBSA
[ ]		mg/l	Mercury	[ ]		mg/l	BOD
[ ]		mg/l	Nickel	[ ]		mg/l	COD
[X]	2	mg/l	Potassium	[X]	149	mg/l	TD Solids
[ ]		mg/l	Selenium	[ ]		mg/l	TV Solids
[X]	3	mg/l	Sodium	[ ]		mg/l	Suspended Solids
[ ]		mg/l	Silver	[ ]		mg/l	SV Solids
[ ]		mg/l	Zinc	[ ]		JTU	Turbidity

[X]	56	mg/l	Hardness as $CaCO_3$
[X]	240	mg/l	Alkalinity $CaCO_3$
[ ]		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
[X]	<0.1	mg/l	Oil and Gr
[ ]			

Transported by:
Received by:

Transported by:
Received by:

FOR LAB USE ONLY

Lab# 4704 Rec'd by: Se

Date sample rec'd: 8-30-76

Date analysis completed: 8-30-

Date results reported: 8-31-

Signed: Cynthia R. Brumfield

Date: September 3, 1976

WELL LOG

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

TION Tanana, City Well #2 DATE STARTED March 17, 1981

COMPLETED March 20, 1981 DRILLER Archibald

L DEPTH OF WELL 48 FT. CASING INSTALLED 44 DIAMETER 6"

r Bentowite SCREEN SIZE 40 MFG. Johnson LENGTH 5 feet

IC WATER LEVEL 32 feet HRS. PUMPED _____ @ 10 GPM DRAWDOWN 43-1/2" FT.

HOLE DIAMETER
CASING DIAMETER

DEPTH	FORMATION
rch 20, 1981	
	0 frozen
	6 silt
	10 silt
	20 sand
	30 gravel
feet top -- screen	40 gravel
	45 gravel

SOIL DATA TO 15 FT.
FEET THAWED _____
BOTTOM OF FROST & MATERIAL 6 feet
SEASONAL OR PERMA FROST _____

WATER DATA FIELD TEST
TASTE Iron
APPEARANCE FRESH yes
AFTER 24 HOURS yes
IRON 3 ppm
CHLORIDES _____
TDS _____

PUMP TEST 32 feet - STATIC LEVEL
PUMPING LEVEL 42 feet @ 10 GPM
AFTER 12 HRS.

HIGHEST RECOMMENDED PUMP RATE

WILL STATIC LEVEL CHANGE WITH
TIDES _____ OR FROST _____

FLOP PROCEDURE _____

MATED MAN HOURS FOR DRILLING _____ HOURS FOR TOTAL JOB _____

EW Archibald

CHEMICAL & GEOLOGICAL LABORATORIES OF ALASKA, INC.

TELEPHONE (907)-279-4014
274-3364

ANCHORAGE INDUSTRIAL CENTER
5633 B Street

ANALYTICAL REPORT

Alaska Area Native Health Service SAMPLE LOCATION: Tanana, Alaska

LECTED 3-23-81 TIME COLLECTED: ---

BY P.Archibald SOURCE City Well No. 2

Well Located on River Bank in Front of Store

FOR LAB USE ONLY
RECVD.BY GY LAB # 7126
DATE RECEIVED 4-3-81
DATE COMPLETED 4-10-81
DATE REPORTED 4-10-81
SIGNED Archie L Green

	mg/l		mg/l		mg/l
lver	<0.05	[]P,Phosphorous	<0.05	[]Cyanide	
minum	<0.05	[]Pb,Lead	<0.05	[]Sulfate	14
enic	<0.10	[]Pt,Platinum	<0.05	[]Phenol	
id	<0.05	[]Sb,Antimony	<0.10	[]Total Dissolved Solids	185
n	<0.05	[]Se,Selenium	<0.10	[]Total Volatile Solids	
rium	0.29	[]Si,Silicon	5.0	[]Suspended Solids	
muth	<0.05	[]Sn,Tin	<0.10	[]Volatile Suspended Solids	
lcium	56	[]Sr,Strontium	0.19	[]Hardness as $CaCO_3$	
dmium	<0.01	[]Ti,Titanium	<0.05	[]Alkalinity as $CaCO_3$	170
alt	<0.05	[]W,Tungsten	<1	[]	
romium	<0.05	[]V,Vanadium	<0.05	[]	
per	<0.05	[]Zn,Zinc	<0.05	[]	
on	0.14	[]Zr,Zirconium	<0.05	[]	
				* * * * * *	
cury	<0.10	[]Ammonia Nitrogen-N		[]mmhos Conductivity	300
ssium	<1	[]Kjedahl Nitrogen-N		[]pH Units	7.3
gnesium	14	[]Nitrate-N		[]Turbidity NTU	
ganese	0.38	[]Nitrite-N		[]Color Units	
ybdenum	<0.05	[]Phosphorus (Ortho)-P		[]T.Coliform/100ml	
ium	3.0	[]Chloride	8	[]	
ckel	<0.05	[]Fluoride		[]	

NORTHERN TESTING LABORATORIES, INC.

600 UNIVERSITY PLAZA WEST, SUITE A
6957 OLD SEWARD HWY., SUITE 101
FAIRBANKS, ALASKA 99701
ANCHORAGE, ALASKA 99518
907-479-3115
907-349-8623

ent: City of Tanana
ress: Box 181
Tanana, Alaska 99777

n: Harold Gillam

rce: Old and New Wells

Date Arrived : 12-10-85
Time Arrived : 1530
Date Sampled : 12-09-85
Time Sampled : --
Date Completed: 12-13-85

Sample ID #: 121085-7&8

mple Identification and Parameter	Unit	Result	Standard Deviation	ADEC MCC*
1085-7 Old Well well # 1				
Alkalinity	mg/l as CaCO3	240	--	--
Hardness	mg/l as CaCO3	290	--	--
Iron	mg/l	0.52	0.03	0.3
Manganese	mg/l	0.67	0.00	0.05
1085-8 New Well well #3				
Alkalinity	mg/l as CaCO3	410	--	--
Hardness	mg/l as CaCO3	550	--	--
Iron	mg/l	0.85	0.03	0.3
Manganese	mg/l	0.54	0.00	0.05

* MCC = Maximum Contaminant Concentration

Quality Control Report

ed below are quality control assurance reference samples with a known entration prior to analysis. The acceptable limits represent 5% confidence interval established by the Environmental Protection ncy or by our laboratory through repetitive analyses of the rence sample. The reference samples indicated below were analyzed the same time as your sample, ensuring the accuracy of your results.

le #	Parameter	Unit	Result	Acceptable Limit
4-2	Alkalinity	mg/l as CaCO3	17	14 - 20
-2	Hardness	mg/l as CaCO3	24	16 - 24
-6	Iron	mg/l	0.90	0.82 - 0.97
5-6	Manganese	mg/l	0.44	0.42 - 0.56

rted By: Thomas Benjamin
Thomas Benjamin, Chemistry Supervisor

Date: Dec 17, 1985

COPY

NORTHERN TESTING LABORATORIES, INC.

600 UNIVERSITY PLAZA WEST, SUITE A
6957 OLD SEWARD HWY., SUITE 101
FAIRBANKS, ALASKA 99709
ANCHORAGE, ALASKA 99518
907-479-3115
907-349-8623

Client: Tanana Chiefs
Address: Public Health Service
201 1st Ave.
Fairbanks, Alaska 99701
Attn: Mike Gillenwater

Date Arrived : 04-24-86
Time Arrived : 1145
Date Sampled : 04-24-86
Time Sampled : 0930
Date Completed: 05-13-86

Source: New Well (Well #4 - Sunshine SubDiv.) Sample ID #: 042486-3

Parameter	Unit	Result	Standard Deviation	ADEC MCC*
INORGANIC CHEMICAL CONTAMINANTS:				
Arsenic	mg/l	0.002	0.001	0.05
Barium	mg/l	0.18	0.05	1
Cadmium	mg/l	<0.005	-	0.010
Chromium	mg/l	<0.05	-	0.05
Fluoride	mg/l	0.14	-	2.4
Lead	mg/l	<0.001	-	0.05
Mercury	mg/l	<0.0002	-	0.002
Nitrate-N	mg/l	<0.10	-	10
Selenium	mg/l	<0.002	-	0.01
Silver	mg/l	<0.01	-	0.05
SECONDARY CONTAMINANTS:				
Chloride	mg/l	1.4	-	250
Color	C.U. @ pH	100 @ 7.2 @ 22 deg. C		15
Copper	mg/l	<0.02	-	1
Corrosivity				
Langelier Index		0.2 (Scaling)		Noncorrosive
Alkalinity	mg/l as CaCO3	320	-	
Calcium	mg/l	91	3	
pH	pH Units	7.2 @ 22 deg. C		6.5-8.5
Hardness	mg/l as CaCO3	342	-	
Foaming Agents	mg/l	<0.025	-	0.5
Iron	mg/l	2.19	0.02	0.3
Manganese	mg/l	0.30	0.00	0.05
Odor	T.O.N.	<1	-	3
Sodium	mg/l	4.1	0.1	250
Sulfate	mg/l	20	-	250
Total Dissolved Solids	mg/l	316	-	500
Zinc	mg/l	0.005	0.001	5
MISCELLANEOUS:				
Turbidity	NTU	34	-	1

REPORTED BY: Kathleen Siftar DATE: 5-16-86
Kathleen Siftar, Asst. Chemistry Supervisor

* MCC = Maximum Contaminant Concentration

SUNSHINE SUBDIVISION SOIL PIT

TANANA, ALASKA

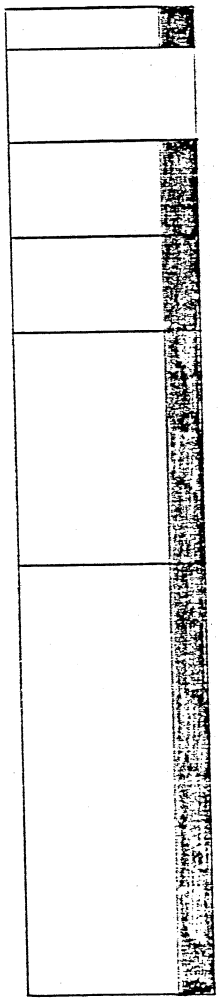
Excavated by: Tanana City Case 680 Backhoe

Date: October 9-10, 1986

Hole logged by: Kevin Chadwick

Location: North Shore of Frog Pond at edge of subdivision road, across road from Lot #B

Depth in Feet:



Depth in Feet	
0	Surface - 2 inch 3 inch diameter spruce stumps, snow covered
2	Organic soil, frozen to 2 inch
3	Brown organic soil, frozen
4.5	Silt, frozen
9	Brown organic soil, frozen with clear ice lenses and wood fragments
17	Silt, frozen Bottom of Hole

APPENDIX C

WATER

Inside Fills

167
42 On Call Service
209

Outside Fills

521
21 On Call Service
544

Piped (Asha)

188 Set Rate

188

Piped (Other)

9 Metered
5 Set Rate (non-asha)
14

SEWER

Hauled (Honey Bucket)

299
17
316

Evacuation

426
42
468

Piped (Asha)

188 Set Rate

188

Piped (Other)

21 Metered
3 Set Rate including ACCO
24

Metered water is 1¼ cents per gallon or 12.50 per thousand.
Metered sewer is 1 cent per gallon or 10.00 per thousand.

Set rate for piped water (asha) 31.25
Set rate for piped sewer (asha) 25.00

"Deep Sea Port and Transportation Center of the Kuskokwim"

BETHEL WATER & SEWER RATES IN EFFECT MAY 1986

PER MONTH
WATER FILL RATES

GAL. CAP.	FREQUENCY	OUTSIDE FILL RATE	INSIDE FILL RATE
0-100 01	1/month	3.32	13.32
	2/ "	6.69	16.69
	1/week	13.83	23.83
	2/ "	28.58	38.58
101-150 02	1/month	4.70	14.70
	2/ "	9.73	19.73
	1/week	20.13	30.13
	2/ "	41.58	51.58
151-200 03	1/month	6.07	16.07
	2/ "	12.57	22.57
	1/week	26.00	36.00
	2/ "	53.72	63.72
201-250 04	1/month	7.35	17.35
	2/ "	15.22	25.22
	1/week	31.47	41.47
	2/ "	65.01	75.01
251-300 05	1/month	8.53	18.53
	2/ "	17.66	27.66
	1/week	36.52	46.52
	2/ "	75.44	85.44
301-350 06	1/month	9.61	
	2/ "	19.90	
	1/week	41.15	
	2/ "	85.01	
351-400 16	1/month	10.60	
	2/ "	21.94	
	1/week	45.37	
	2/ "	93.73	
401-450 07	1/month	11.48	
	2/ "	23.78	
	1/week	49.17	
	2/ "	101.59	
451-500 17	1/month	12.27	
	2/ "	25.41	
	1/week	52.56	
	2/ "	108.59	
501-600 08	1/month	14.15	
	2/ "	29.29	
	1/week	60.58	
	2/ "	135.16	
601-750 09	1/month	17.20	
	2/ "	35.61	
	1/week	73.66	
	2/ "	152.17	
751-1000 10	1/month	21.96	
	2/ "	45.48	
	1/week	94.06	
	2/ "	194.32	
1001-1500 11	1/month	31.49	
	2/ "	65.20	
	1/week	134.86	
	2/ "	278.62	
1501-2000 12	1/month	40.05	
	2/ "	82.93	
	1/week	171.52	
	2/ "	354.34	

HONEY BUCKET SERVICE

1/month	1.67
2/ "	3.27
1/week	6.54
2/ "	13.08

5 buckets max.

SEPTIC EVACUATION

1/month	12.25
2/ "	24.50
1/week	49.05
2/ "	98.10
3/ "	147.15
4/ "	196.20
5/ "	245.25

ASHA METERED

water	31.25
sewer	25.00
trash	7.25

FLAT DELIVERY RATES
*PRE-PAID SERVICE & EXTRA CALLS

gal.0-100	9.00	601-750	67.50
101-150	13.50	751-1000	90.00
151-200	18.00	1001-1500	135.00
201-250	22.50	1501-2000	180.00
251-300	27.00	2001-2500	225.00
301-350	31.50	2501-3000	270.00
351-400	36.00	3001-3500	315.00
401-450	40.50	3501-4000	360.00
451-500	45.00	4001-4500	405.00
501-600	54.00	4501-5000	450.00

* Add 5% sales tax.

ON CALL SERVICES

Honey Bucket.....	10.90
Septic Evacuation.....	49.05
Containers (dumpster)....	35.00
(bags)....	15.00

PIPED WATER RATE

1.25 cents/gallon $12.50/1000 gallons

PIPED SEWAGE RATE

1 cent/gallon $10.00/1000 gallons

DEPOSITS

	$100.00 Min.
gal. 100-300	100.00
300-500	120.00
500-750	140.00
751-1000	160.00
1001-1500	200.00
1501-2000	240.00
ASHA	100.00

City of Galena

Antoski Hall • P.O. Box 149 • Galena, Alaska 99741 • Telephone (907) 656-1301

ORDINANCE 85-6

AUTHORIZING RATE INCREASES FOR THE CITY OF GALENA WATER AND SEWER SERVICES AND SHOWER/LAUNDROMAT FACILITY.

BE IT ENACTED BY THE CITY COUNCIL OF THE CITY OF GALENA, ALASKA:

Section 1.

This is a non-code ordinance.

Section 2.

Rate increases for Water and Sewer Distribution are as follows:

Water Haul and Piped Water	Rate
0 - 150 gallons	$8.25 minimum, increase from $7.50
Over 150 gallons	.055 per gallon, increase from .05

There is no rate increase for the watering point.

Sewer Haul Systems

Container Size (gallons)	From	To Per Pick-up
0 - 200	$8.00 min.	$8.80
201 - 300	11.25	12.10
301 - 400	14.00	15.40
401 - 500	16.25	18.70
501 - 600	18.00	21.45
601 - 700	20.30	24.20
701 - 800	22.40	27.50
801 - 900	24.30	30.25
901 - 1000	32.30	33.00
1001 - 1100	32.30	35.75
1101 - 1200	35.35	38.50
1201 - 1300	38.30	41.25
1301 - 1400	40.55	44.00
1401 - 1500	42.30	46.75
1501 - 1600	44.60	49.50
1601 - 1700	46.70	52.25
1701 - 1800	48.60	55.00
1801 - 1900	56.60	[illegible]
1901 - 2000	59.85	[illegible]

Rate increases for the laundromat/shower facility are as follows:

Showers:	From 75 cents to $1.00 (one dollar)
Dryers:	From 50 cents to 75 cents
Jr. Washers:	From $3.25 to $3.50
Sr. Washers:	From $4.25 to $4.50
Regular Washers:	No rate increase
Extractor:	From 25 cents to 50 cents

Trash pick-up rates are as follows:

Residents	From $10.00 to $20.00 per month.
Business and Multi-dwelling units	From $10.00 to $35.00 per month.

Section 3.

This ordinance takes effect August 1, 1985.

INTRODUCTION: June 11, 1985

FIRST READING: June 11, 1985

PUBLIC HEARING: June 25, 1985

ADOPTED AND APPROVED by the City Council of Galena, Alaska, this 25th day of June, 1985.

Vernon White
Mayor

ATTEST:

Pat Myers
City Manager

MAY 1985

Sewer:

(1) Container Size (gallons)	(2) Current Rate	(3) 10% rate increase	(4) Proposed rate .045	(5) Rec. rate .0425 per gallon	(6) Increase based on .0425	(7) %	(8) Revised rates	(9) X10%
		per container, gal.						
0 - 200	8.00 min.	8.80	9.00	8.50	.50	.06	8.00	8.80
201 - 300	11.25	12.38	13.50	12.75	1.50	.13	11.00	12.10
301 - 400	14.00	15.40	18.00	17.00	3.00	.21	14.00	15.40
401 - 500	16.25	17.88	22.50	21.25	5.00	.30	17.00	18.70
501 - 600	18.00	19.80	27.00	25.50	7.50	.41	19.50	21.45
601 - 700	20.30	22.33	31.50	29.75	9.45	.46	22.00	24.20
701 - 800	22.40	24.64	36.00	34.00	11.60	.51	25.00	27.50
801 - 900	24.30	26.73	40.50	38.25	13.95	.57	27.50	30.25
901 - 1000	32.30	35.53	45.00	42.50	10.20	.31	30.00	33.00
1001 - 1100	32.30	35.53	49.50	46.75	14.45	.44	32.50	35.75
1101 - 1200	35.35	38.89	54.00	51.00	15.65	.44	35.00	38.50
1201 - 1300	38.30	42.13	58.50	55.25	16.95	.44	37.50	41.25
1301 - 1400	40.55	44.61	63.00	59.50	18.95	.46	40.00	44.00
1401 - 1500	42.30	46.53	67.50	63.75	21.45	.50	42.50	46.75
1501 - 1600	44.60	49.06	72.00	68.00	23.40	.52	45.00	49.50
1601 - 1700	46.70	51.37	76.50	72.75	26.05	.55	47.50	52.25
1701 - 1800	48.60	53.46	81.00	76.50	27.90	.57	50.00	55.00
1801 - 1900	56.60	62.26	85.50	80.75	24.15	.42	52.50	57.75
1901 - 2000	59.85	65.84	90.00	85.00	25.15	.42	55.00	60.50

CITY OF TANANA
P.O. Box 181
Tanana, Alaska 99777
(907) 366-7159

"CHALAWOYYA" - Where the two rivers meet.

RESOLUTION NO. 82-06

A RESOLUTION ESTABLISHING RATES FOR WATER AND SEWAGE FOR THE COMMUNITY OF TANANA FROM VSW

WHEREAS, the City of Tanana has received a safe water facility a state grant process, and

WHEREAS, the VSW facility has the capability of treating sewage in excess of that generated by the facility, and

WHEREAS, it is beneficial for the health of the citizens of Tanana to obtain sewage treatment to the greatest extent possible, and

WHEREAS, it is in the best interests of both the City and the customers to have a definite reate established for sewer services;

NOW THEREFORE BE IT RESOLVED, that the following monthly charges be adopted:

1. Private Homes

   Water Service - $ 35.00 per month
   Sewer Service - $ 45.00 per month

15¢ gallons delivered

2. Commercial

   Water SErvice - $ 70.00 per month
   Sewer Service - $ 90.00 per month

3. Other

   FAA Sewer - $29.00 per day or $870.00 per month
   School Sewer - $93.00 per day or $2790.00 per month
   Hospital - $160.00 per day or $4800.00 per month

RESOLUTION NO 82-06 APPROVED AND ADOPTED by a constituted quorum of the City Council of Tanana, Alaska this 22nd day of April, 1982.

Allen D. Walker
Mayor

Patti L. Hyslop
Attest - City Clerk

Calculations for Estimated Costs of Monthly User Fees
Water and Sewerage Haul System

Assumptions:

@ 300 gallons water per week use rate:

Water storage tank capacity = 200 gallons
Sewerage holding tank capacity = 300 gallons

@ 900 gallons water per week use rate:

Water storage tank capacity = 500 gallons
Sewerage holding tank capacity = 750 gallons

Tanana

Water @ 300/week = 1,200/month x $ .15/gallon = $180.00
@ 900/week = 3,600/month x $ .15/gallon = $540.00

Sewer (Utilizing K Enterprises)

@ 300/week ÷ 300 gallons/load = 1 load/week = 4 loads /month x $50/load = $200/month

@ 900/week ÷ 300 gallons/load = 3 loads/week = 12 loads/month x $50/load = $600/month

Galena

Water @ 300 gallons/week - assume 1 delivery/week, 4 deliveries/month @ $16.50 each = $66.00/month

Water @ 900 gallons/week - assume 2 deliveries/week @ 400 - 500 gallons
8 deliveries/month @ $24.75 each = $198.00/month

Sewer @ 300 gallons/week X 4 weeks/month X $0.45/gallon = $54.00
Sewer @ 900 gallons/week X 4 weeks/month X $0.45/gallon = $162.00

Bethel

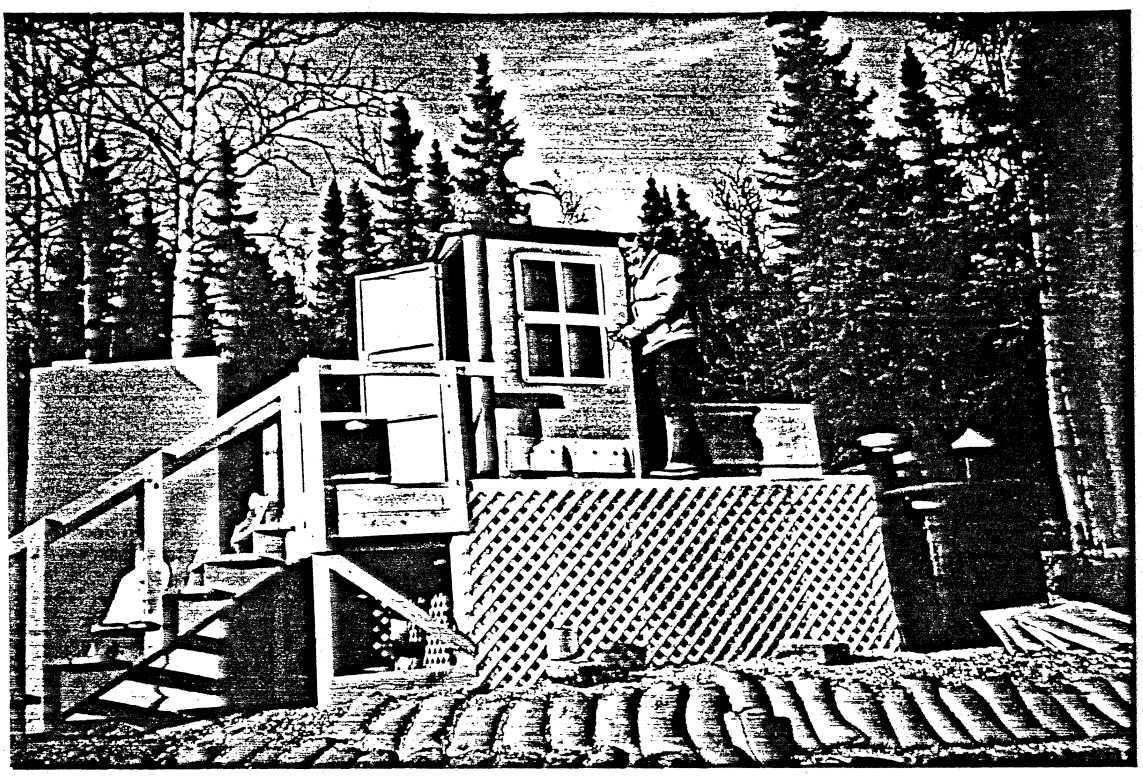
Water @ 300 gallons/week - assume 1 delivery/week = $46.52/month (outside fill)

Water @ 900 gallons/week - assume 2 deliveries/week = $101.59/month (outside fill)

Sewer @ 300 gallons/week - no load max. @ 1 call/week = $49.05

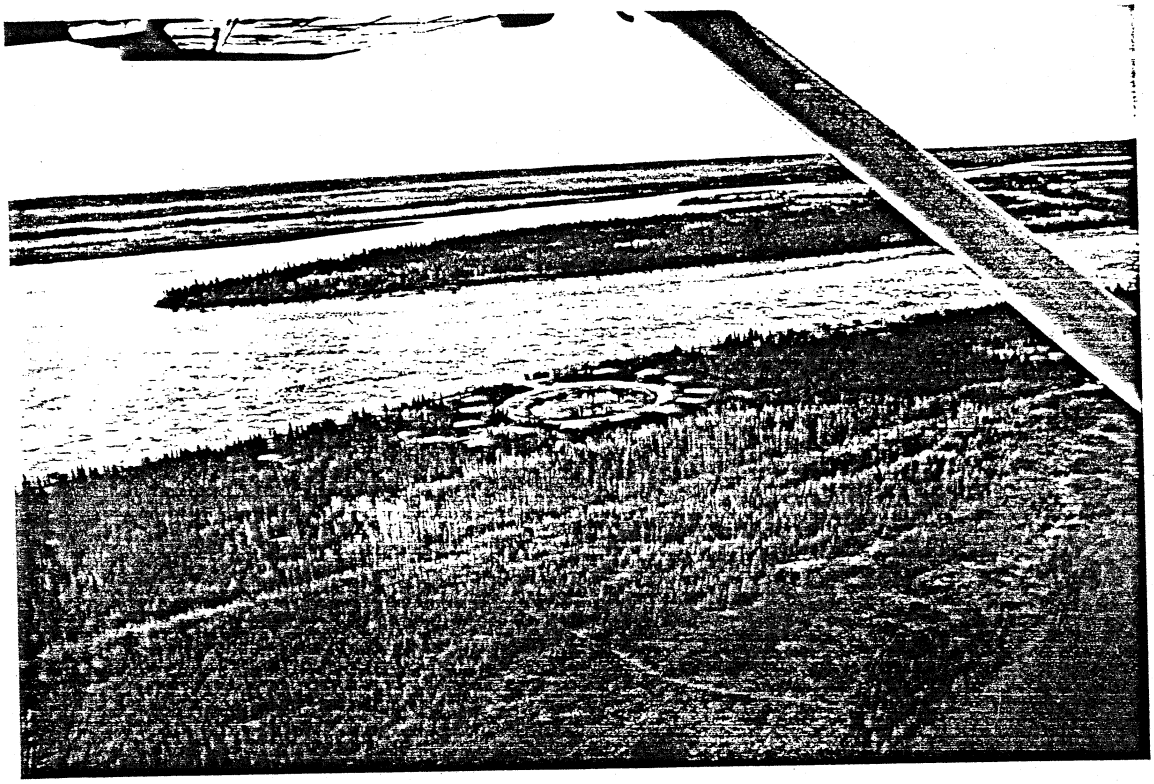
Sewer @ 900 gallons/week = 2 calls/week = $98.10

APPENDIX D

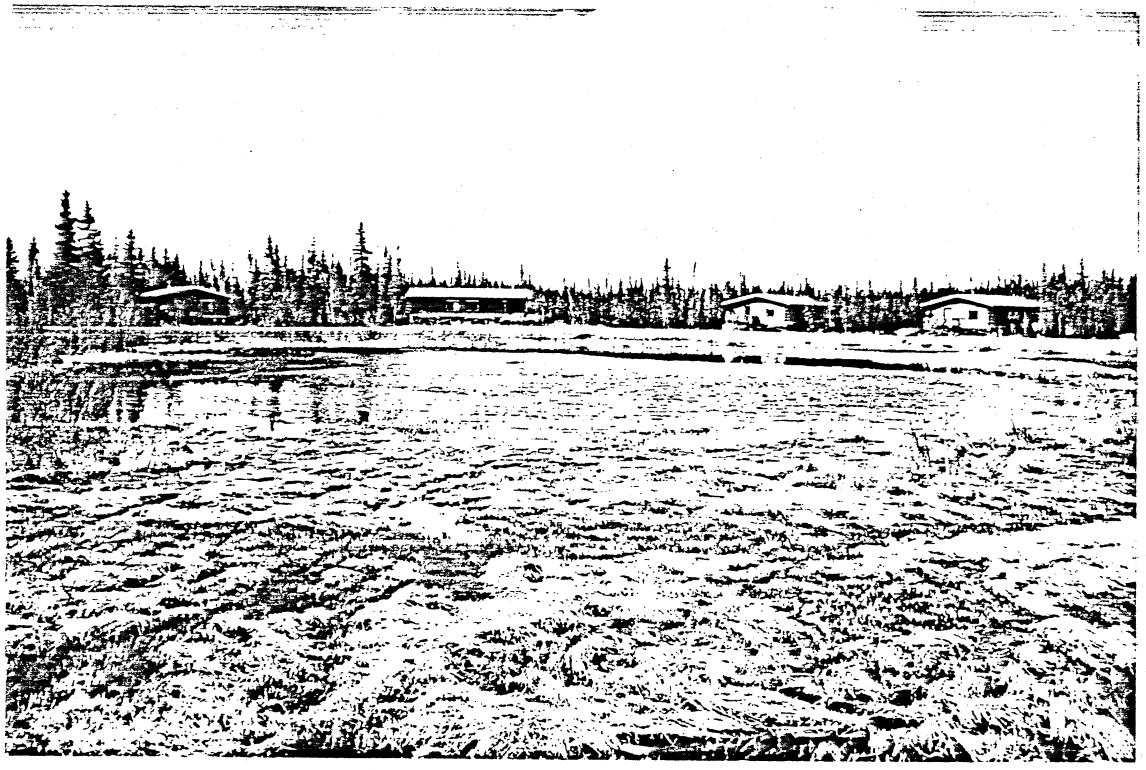


Shasta Waterless Toilet Test Configuration consists of an individual privy and individual honeybucket dump station (black tank). Raised platform and surface installation is for permafrost applications

Solar panels power a vent fan in the exhaust stack to improve evaporation rates

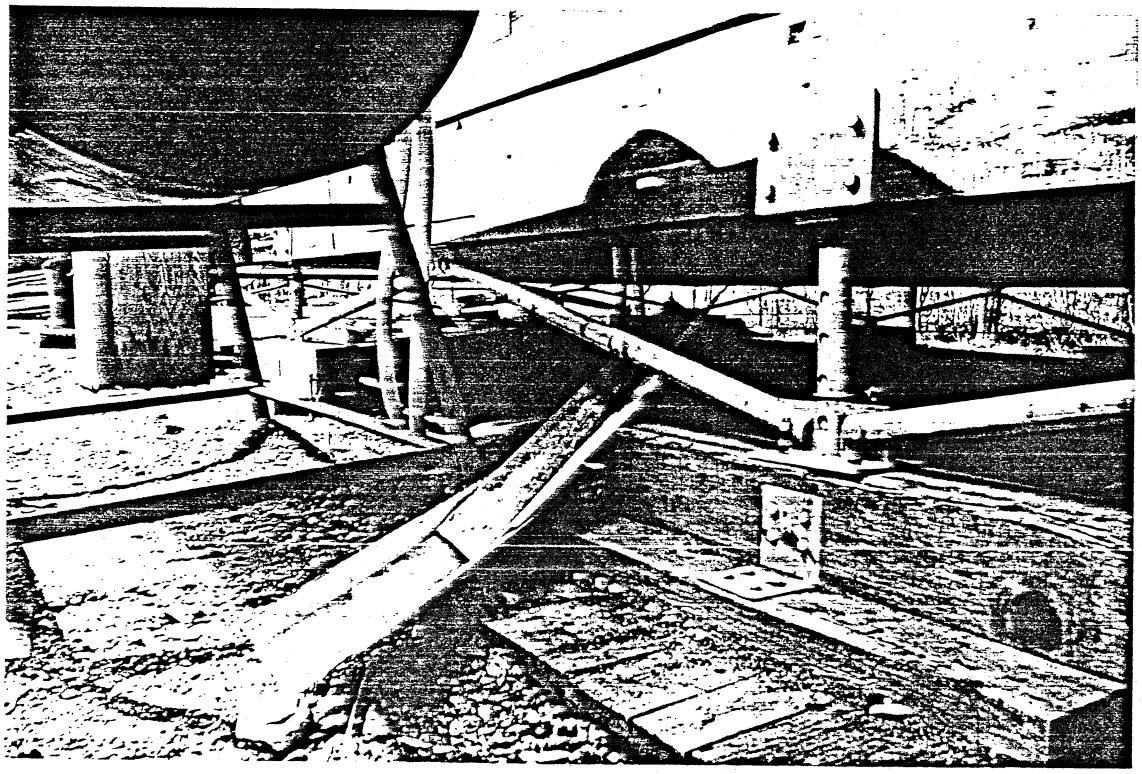


Sunshine Subdivision - Tanana, Alaska
Aerial View
Break-up 1986

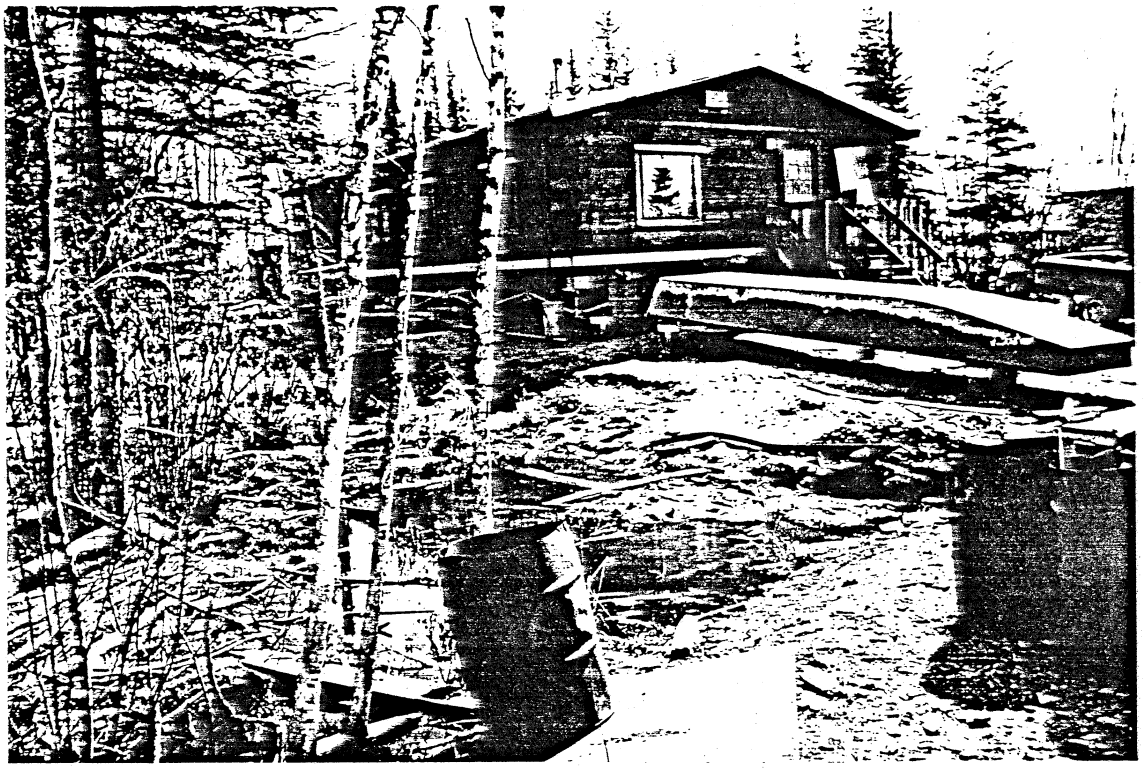


Frog Lake
Break-up 1986
Ringed in by subdivision access road with
no allowance for outlet

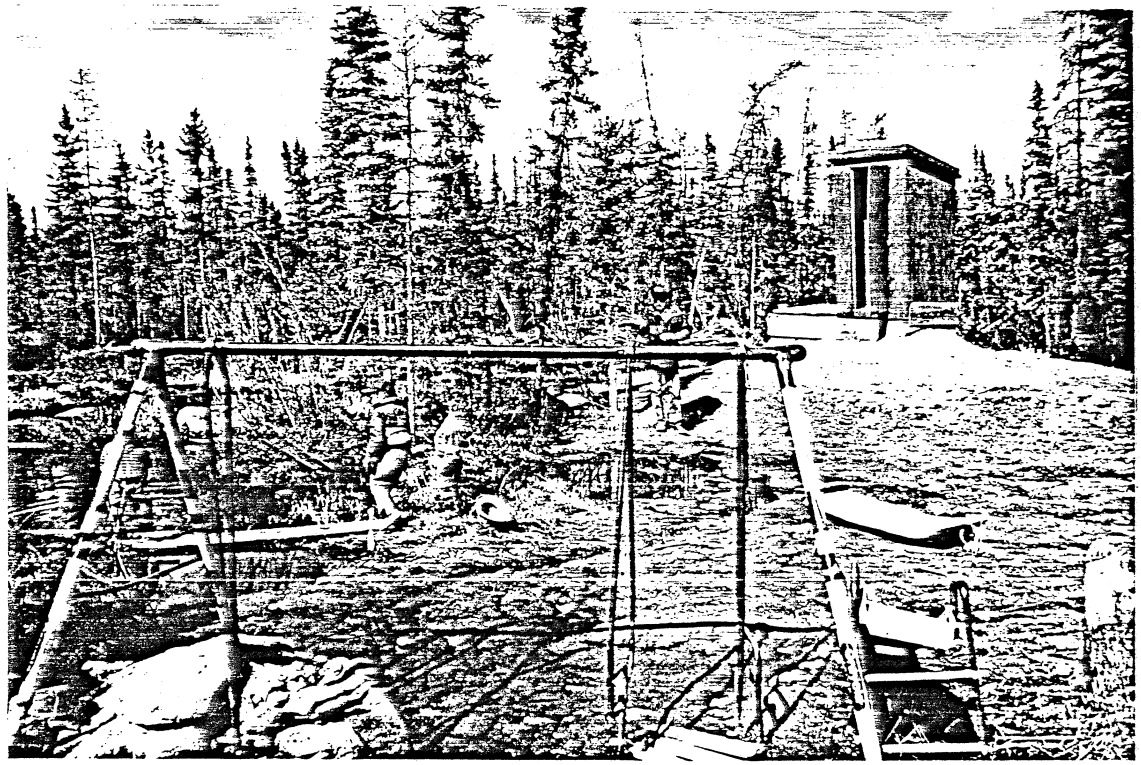
Ditch cut through road to drain water into Frog Lake - 1986



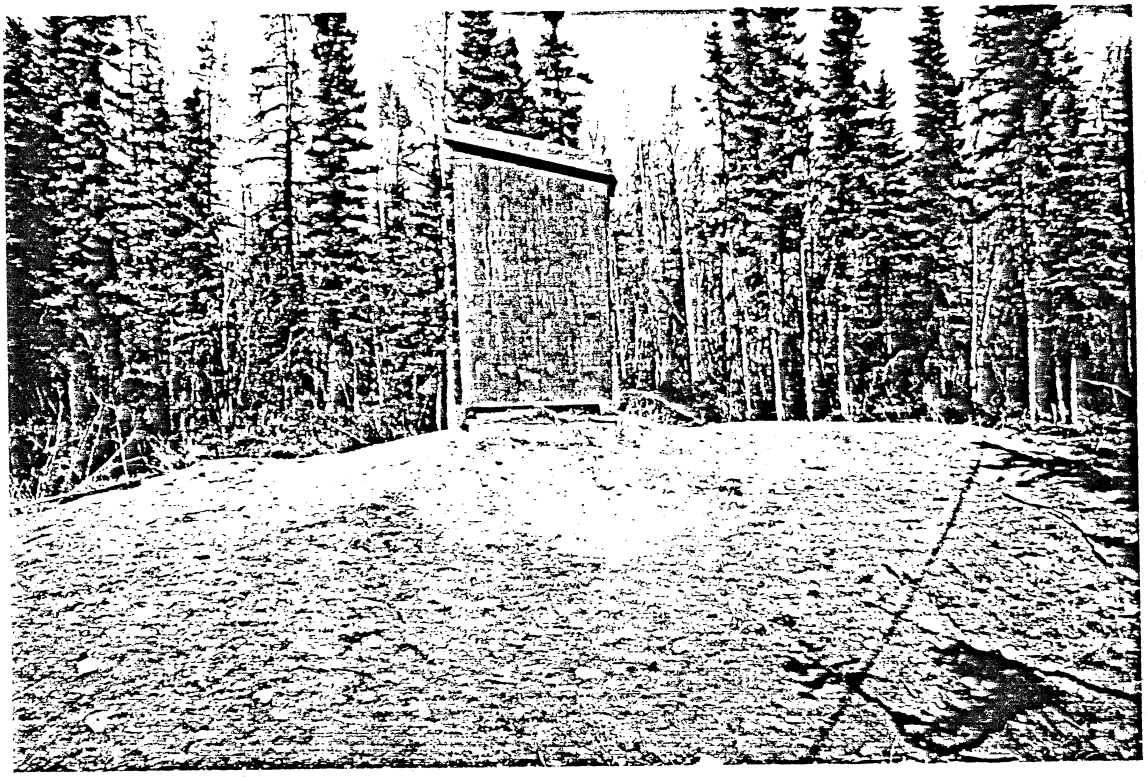
Typical Sunshine Subdivision gray water drain - such drains contribute contaminated water to standing pools of water throughout the subdivision and eventually to Frog Lake - May 1986



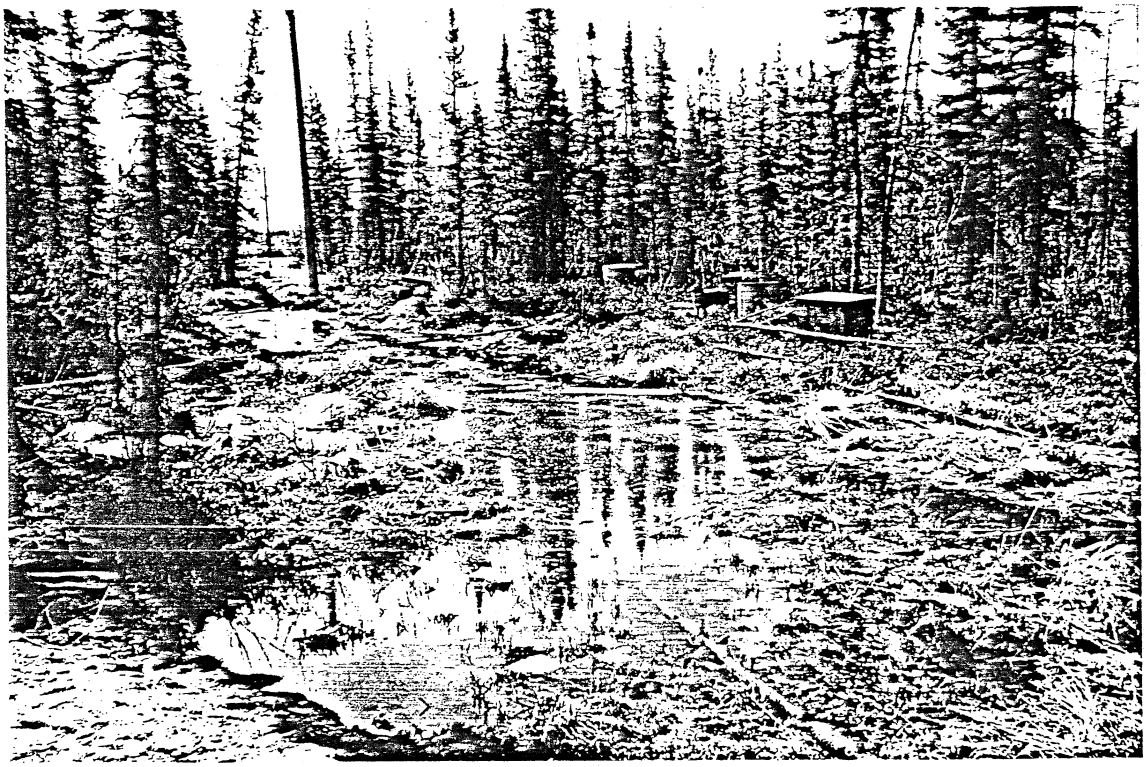
Pools of standing water are typical throughout the subdivision, in spite of efforts with city sump pump



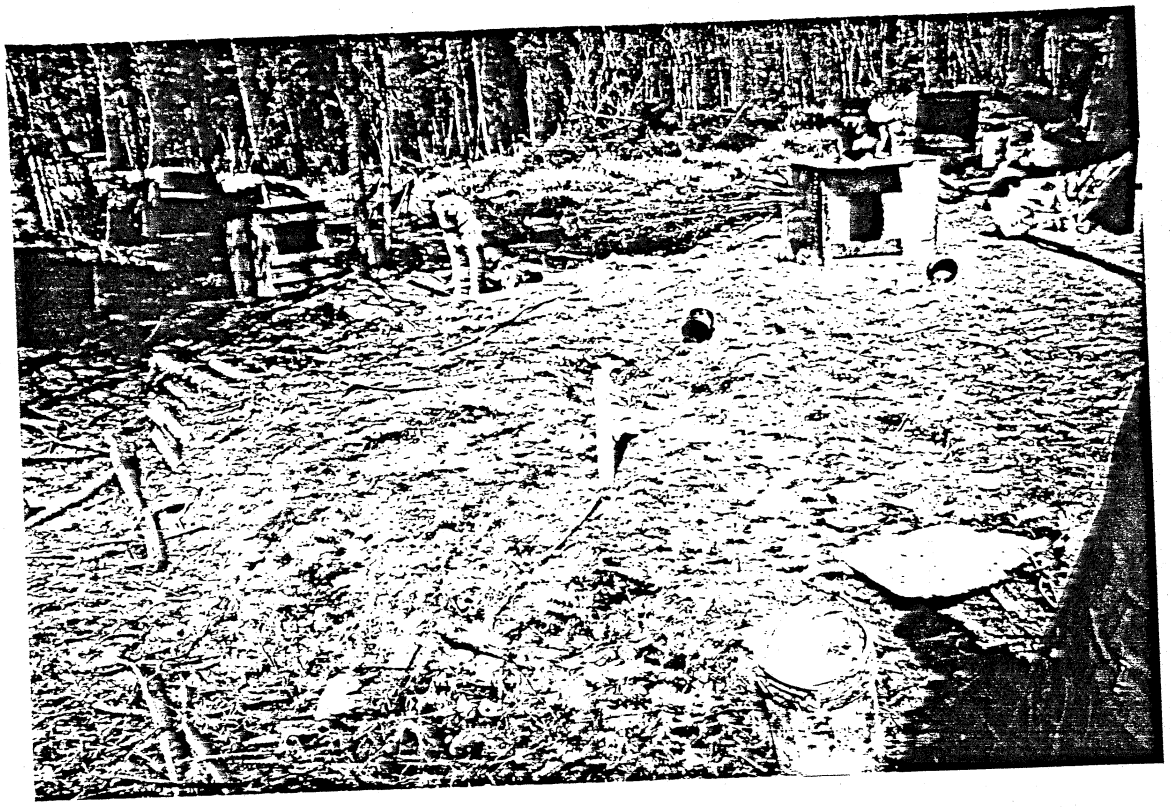
Children playing adjacent to contaminated standing pool of water during site inspection by TCC sanitarian. Pool contaminated by dog wastes and possible percolating effluent from raised privy mound May 1986

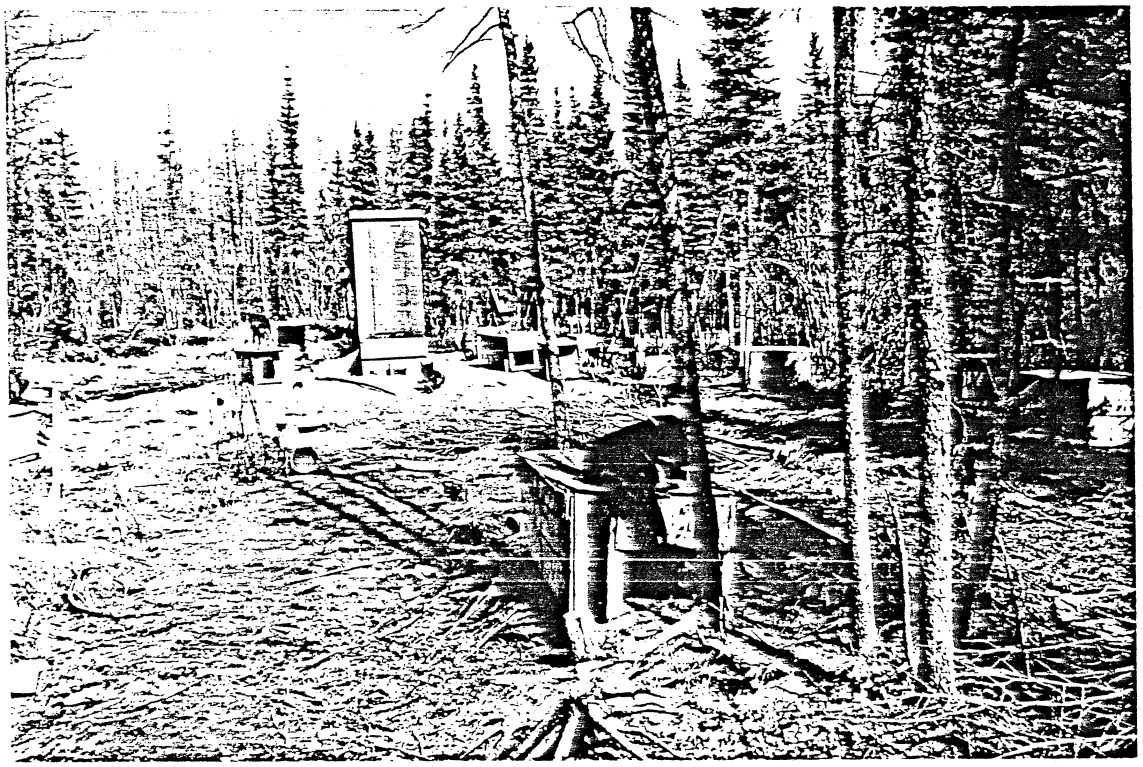


Overflowing raised mound privy at
Sunshine Subdivision
Break-up 1986



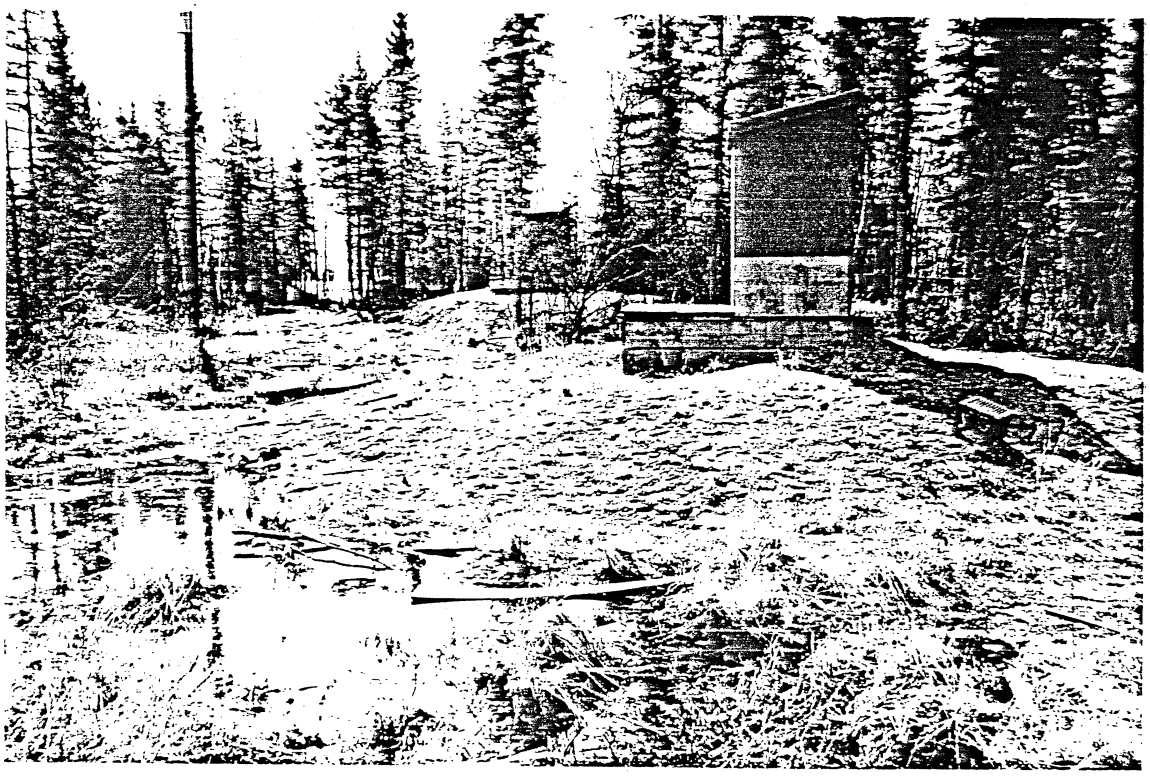
Standing pool of water within Sunshine
Subdivision contaminated with dog
wastes



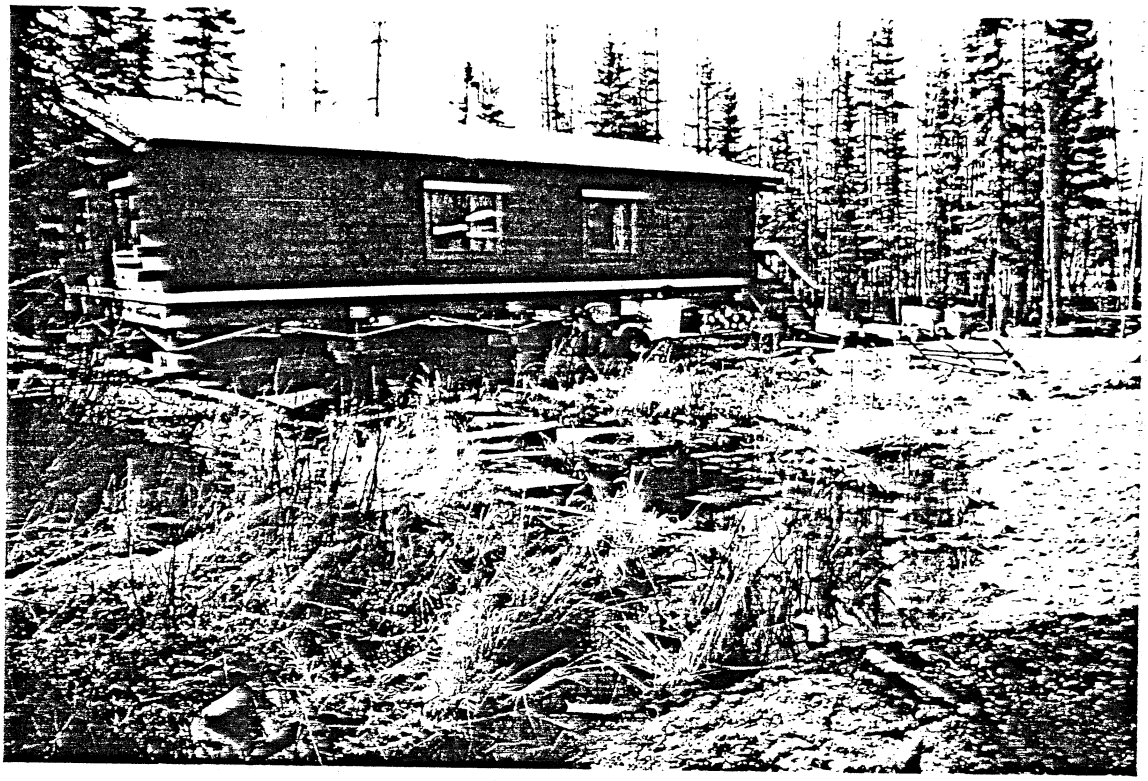


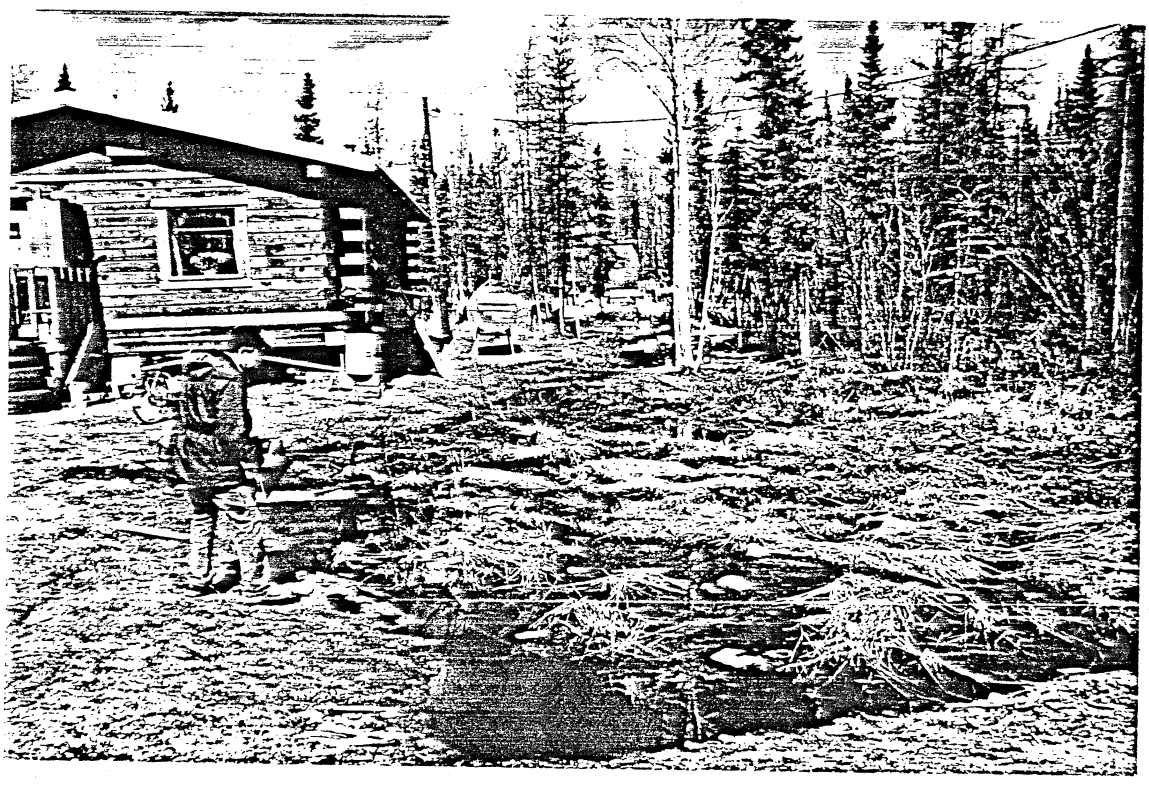
During break-up an eight month build-up of
dog wastes is flushed into Frog Lake.

May 1986

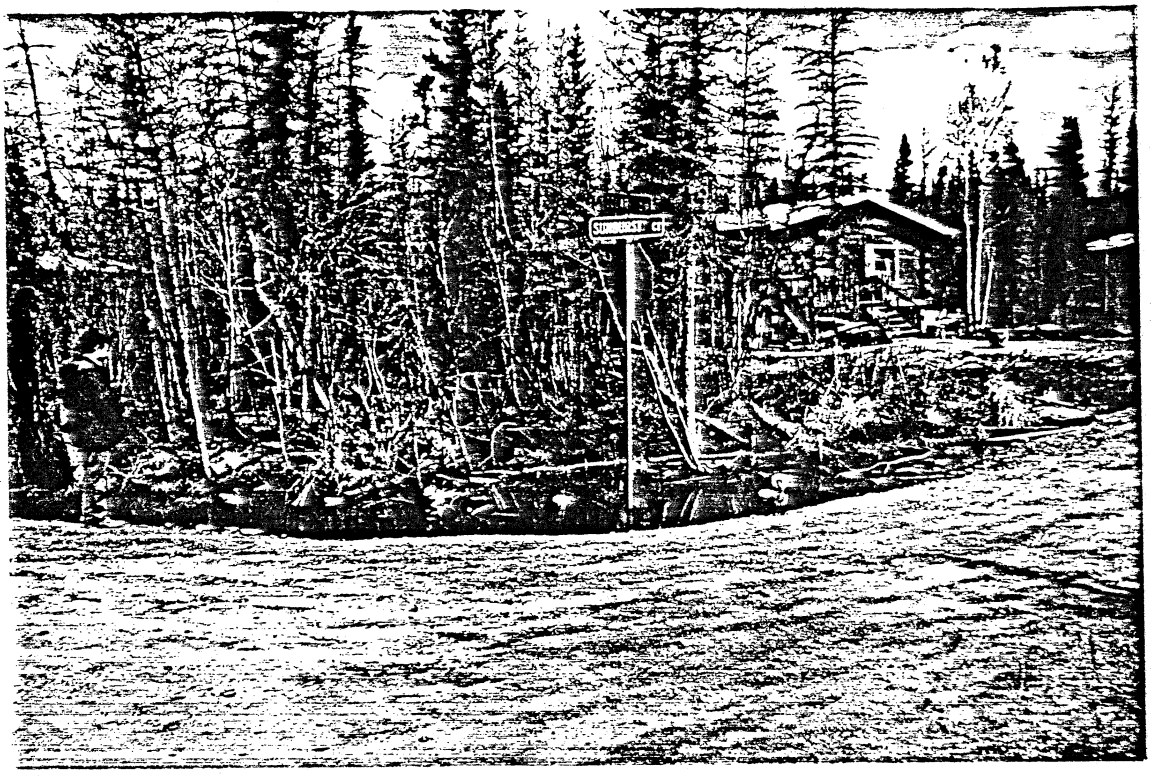


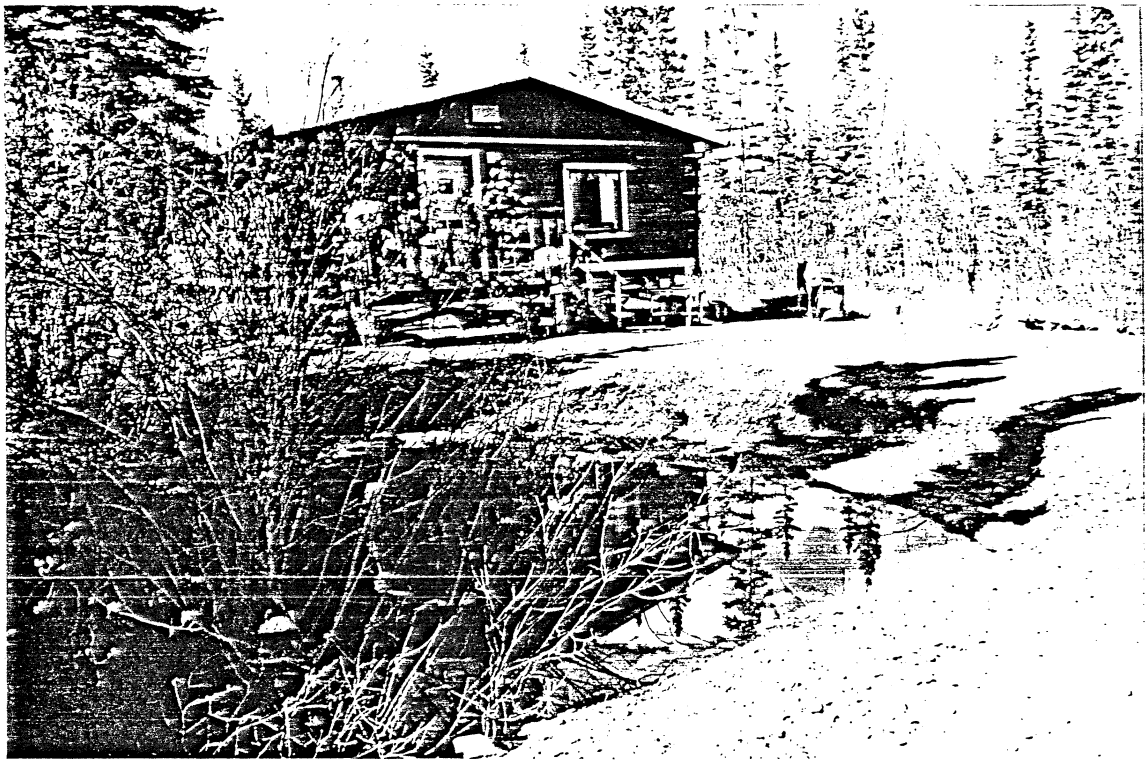
Typical raised mound privy installation in Sunshine Subdivision. NOTE: Subsidence of mound around privy - original mound elevation at level of wood privy floor. NOTE: Standing water adjacent to privy mounds





Standing water in Sunshine Subdivision
following two days of pumping with
city sump pumps





Natural drainage blocked by streets
at Sunshine Subdivision