FINAL

Report on Site Conditions and Recommended Plan of Action For Sanitation Improvements in Tununak, Alaska

Prepared for the

TUNUNAK TRIBAL COUNCIL

and

VILLAGE SAFE WATER

Prepared by

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Acronyms and Abbreviations

%	percent
AAC	Alaska Administrative Code
ADCRA	Alaska Division of Community and Regional Affairs
ADEC	Alaska Department of Environmental Conservation
ADOT&PF	Alaska Department of Transportation and Public Facilities
AWWA	American Water Works Association
BIA	Bureau of Indian Affairs
Community	Tununak Tribal Council
DBP	disinfection byproduct
EPA	U.S. Environmental Protection Agency
FTH	Flush Tank and Haul
gpd	gallons per day
hp	horsepower
IBC	International Building Code
MCL	maximum contaminant level
MG	million gallons
MSL	mean sea level
MWH	MWH Americas, Inc.
PCA	Phukan Consulting Engineers & Associates, Inc.
SWTR	Surface Water Treatment Rule
VAC	volt alternating current
VSW	Village Safe Water
WST	water storage tank
WTP	water treatment plant

EXECUTIVE SUMMARY

The Tununak Tribal Council was awarded a grant in 2008 from the Alaska Department of Environmental Conservation Village Safe Water Program for the development of a sanitation facilities master plan to upgrade, replace, or abandon the existing washeteria and associated facilities (water treatment, water storage tank, and laundromat) and address problems associated with the all-season remote watering points. The community desired to make additional improvements to their community-wide water and wastewater facilities to improve the quality of life for Tununak residents. As a first step to identify needs and alternatives to meet these community goals, MWH Americas, Inc. (MWH) was requested in 2010 to prepare the *Report on Site Conditions and Recommended Plan of Action for Sanitation Improvements in Tununak, Alaska*. The report was prepared under the direction of the Tununak Tribal Council and the Village Safe Water Program.

During the spring of 2010, the MWH design team consisting of senior staff from MWH, EDC and GV Jones & Associates, Inc. completed a site visit with representatives from VSW to the village of Tununak. During the site visit, the MWH design team conducted an on-site assessment of the existing water and sewer systems serving Tununak and then met with the community residents at a project kick-off meeting. Several serious sanitary infrastructure deficiencies were identified. Resident dissatisfaction was consistent with our observations. Summarizing, persons neither trust nor drink Tununak water (they obtain water from the school), there is no community honey bucket haul system, even so, the honey bucket waste bunkers are full. And, as itemized herein, the washeteria, water treatment plant, water point distribution system, flush tank and haul system, and school and flush tank and haul wastewater disposal systems are antiquated, substandard, non-functional, and/or include significant health and safety code violations

Currently, the sanitation facilities operating in Tununak consist of a surface water source, washeteria, water treatment plant, water distribution system that delivers water to six community watering points used by residents to haul water to their homes, a small percentage of homes are served by a flush tank and haul system while most homes in the community use honey buckets that dispose waste in below grade sewage bunkers. The community's school has running water and flush toilets that are served by a shallow ground water well and on-site septic tank system. Nearly all the residents in Tununak haul their drinking water from a community watering point served by the school's well.

The site investigation completed by the MWH design team found the following serious and health threatening deficiencies in the existing sanitation facilities:

- <u>Water Source</u> (Un-named Creek) – The water source well house is in poor physical condition. It is located downgradient of nearby existing and potential future new residential structures and, therefore, subject to contamination from fuel and/or wastewater stored on those properties. Also, it is subject to seasonal burial from drifting snow and aufeis (ice overflows) formation in the creek immediately below the intake structure as well as flooding and immersion of the building structure components- the uncovered well casing was observed to be inundated by flood water during the site visit.

- Washeteria - The equipment within the building has deteriorated to a point that the facility can no longer serve its intended purpose with any reliability. Of the laundry equipment only one working washer remains and both dryers have been removed. The toilet/shower rooms have missing fixtures and are no longer usable. Control systems for the water storage tank and washeteria mechanical equipment appear to be non-functioning. Numerous building code violations exist. The heating boilers are deteriorated beyond economical repair.
- Water Treatment Plant - The treatment plant is in poor physical condition and disrepair. The treatment system does not meet current drinking water regulations for Cryptosporidium removal. The majority of electrical equipment within the building has deteriorated past its useful life. The power distribution and utilization equipment showed signs of significant deterioration due to corrosion. Numerous building code violations were found throughout the facility in the power distribution and lighting systems. These violations represent a significant hazard to maintenance personnel working in the facility.
- Water Storage Tank – It has been reported that the 50,000 gallon tank experiences leakage and its foundation is in very poor condition. The tank exterior has obvious signs of physical deterioration. The condition of the tank interior is unknown as it has not been inspected nor cleaned for many years. The water storage tank appears to be unsuitable for reconditioning or upgrade.
- Community Watering Points - Of the six watering points located in the village, only one was found to be usable. All of the watering points' enclosures were deteriorated, with damage to the access doors and floors. The water distribution lines serving the watering points appear to provide adequate flow to the watering points; however, the physical condition of the water lines is unknown and the water demand is very low due to the number of unusable watering points. Because of the non-operational circulation pumps and heat trace controls (both at the water treatment plant and watering points), the distribution piping has a high potential to freeze as winter weather progresses.
- Flush Tank and Haul System - The community currently has 18 homes that are served by the flush tank and haul system. The homeowners expressed their frustration and dissatisfaction with the current operation of the flush tank and haul system. They explained that many of the operational problems were primarily associated with the failure of valves and lack of adequate maintenance.
- Honey Bucket Usage - It is estimated 64 households currently rely on the use of honey buckets. Residents and businesses using honey buckets typically self-haul their water. The honey bucket waste is self-hauled and disposed of in several sewage bunkers that are located in near proximity to the homes throughout the community. Most of these bunkers appeared to be in a state of failure with overflow of raw sewage onto the surrounding ground surface which is accessible to contact by animals and humans.
- Septic Tank Systems – The septic tank system serving the school, teacher housing and washeteria was found to be in a state of failure. Based on discussions with the operators of the septic tank system, hydraulic failure occurs frequently and they temporarily relieve the hydraulic overload by pumping effluent from the drainfield observation pipes to the nearby failing septic tank system serving the flush tank and haul system. The septic tanks

serving the flush tank and haul system are currently in a state of failure. Consequently, the operators dump their haul contents of raw sewage in an open trench located next to the septic tanks. The trench is accessible to the public and animals (especially loose dogs).

The recommended plan of action for future sanitation improvements in Tununak are based on a comparison of technical, health and cost benefits with a consideration of ease of operation. The following provides a list of the recommended sanitation improvements that should be further evaluated for future development to meet the goals of Tununak:

- Replace the Unnamed Creek well house with an upgradient (hillside) water source.
- Replace the water treatment plant.
- Replace the Washeteria.
- Replace the existing 50,000 gallon water storage tank with a 100,000-gallon tank.
- Replace all of the community watering points.
- Expand the flush tank and haul system to serve all households in the community. This recommendation involves the installation of interior plumbing to connect to the flush tank in existing households that currently use honey buckets. Also, the flush tank and haul system will need additional upgrades to the water and sewage haul equipment and expansion of the on-site septic tank/drainfield system.
- As an interim corrective action measure, until such time as the flush tank and haul system can be implemented throughout the community, it is recommended honey bucket waste transfer system and a waste disposal facility be installed at a suitable location outside of the residential area.
- Upgrade the septic tank system for the flush tank and haul system, new water treatment plant, new washeteria, school, and school housing.

As a sanitation deficiency stop gap measure, a honey bucket collection and disposal system is immediately warranted. Furthermore, it is recommended that development of a new “safe” water source be a priority. A site investigation to evaluate a suitable water source should be completed as the first step in addressing sanitation needs of Tununak.

1.0 INTRODUCTION

A contract was awarded to MWH Americas, Inc. (MWH) by the Tununak Tribal Council (TTC) on March 31, 2010, to provide a Phase I Engineering Design Services for the Washeteria and Water Treatment Facility for Tununak, Alaska. The Alaska Department of Environmental Conservation (ADEC), Village Safe Water (VSW) was assigned to act as TTC's agent in all matters concerning the VSW project. The MWH design team for the Phase I engineering design services included the subconsultants firms of GV Jones & Associates, Inc. and EDC.

Tununak is located in western Alaska on the northwest coast of Nelson Island along the Bering Sea coast. The village is about 519 miles west of Anchorage and approximately 115 miles northwest of Bethel. The community of Tununak is comprised of two residential areas: the "main" part of the community lies on a narrow spit of land between the Tununak River and Tununak Bay, and the "new" area consists of 23 homes in AVCP Subdivision located on the North Fork of the Tununak River at the base of the foot slope to Ugchirnak Mountains. According to an uncertified population estimate completed in 2009 reported by the Alaska Division of Community and Regional Affairs (ADCRA), Tununak has a population of 330 who are primarily Yup'ik Eskimo. The 2000 U.S. Census reported 93 households in the community of which 11 were vacant.

The scope of work for the Phase I Engineering Design Services included the following tasks:

- Compile and review existing project data and background reports
- Conduct site assessment of existing sanitation facilities and project kick-off meeting
- Prepare site conditions report with a recommended plan of action for future sanitation improvements

During the spring of 2010, the MWH design team compiled and reviewed the background reports in preparation for a site visit to the community. The site visit was completed on May 18 and 19, 2010. During the site visit the design team meet with the residents at a Project Kick-off Meeting held in the Paul T. Albert Memorial School and conducted an assessment of the existing water and sewer systems serving Tununak. Photographs of the existing sanitation facilities taken during the May 2010 site visit are provided here in Appendix B. The photo captions describe the sanitary deficiencies that were observed by the design team.

The preliminary findings of the May 2010 site visit were described in two field trip reports prepared by MWH and EDC that were submitted to TTC and VSW. The following bulleted list summarizes the significant sanitary issues and concerns were identified during the site visit which included community input during the Project Kick-off Meeting:

- The community residents do not trust the existing drinking water system that supplies water to the community watering points.
- During the Project Kick-Off Meeting, the community residents delivered a very clear message to the MWH team that … "No one who is on a flush tank and haul system likes it."

- The community residents strongly desire to have a new Washeteria facility with a new safe water source and new water treatment plant (WTP).
- During the kick-off meeting, there was a consensus that a new sanitary facility questionnaire should be completed by the residents as soon as possible to determine what improvements were needed to address the critical deficiencies in the sanitary facilities serving Tununak. Following the meeting, the new questionnaire was prepared by MWH and approved by VSW for distribution in the community. TTC assisted in the solicitation of input from the residents for the completion of the questionnaire.
- The Washeteria, 50,000-gallon water storage tank (WST), and WTP were found to be in very poor operating condition and appeared to be marginally (barely) functional and deficient in reliability.
- The condition of the abandoned Musk-Ox Creek water well, pump house, and arctic pipe transmission line appeared to be not suitable for upgrade and/or replacement with another source on Musk-Ox Creek. However, the arctic pipe appears to be in good enough condition to be used elsewhere in the community.
- The Unnamed Creek well and pump house were found to be in a flooded condition that prevented reasonable entry to hook up the well pump. The creek was overflowing the entire structure, which resulted in an unsanitary condition for a community drinking water source.
- The community watering points were found to be in very poor condition and appeared to be unsuitable for upgrade and should be replaced.
- The Lower Kuskokwim School District operates the Paul T. Albert Memorial School which was a former Bureau of Indian Affairs (BIA) school. The School has its own water source well (referred to as the old BIA well) and water treatment system. It was learned that the majority of the residents haul their drinking water from the watering point at the old BIA well house. Drinking water for the flush tank and haul (FTH) system is also obtained from the same watering point.
- The two septic tank/drainfield systems serving the Paul T. Albert Memorial School, teacher housing and WTP/Washeteria and the FTH system were determined to be in a state of failure and need substantial upgrade and/or replacement.
- The existing sewage bunkers located throughout the community all appeared to be in a state of failure and a serious health concern due to overflow of raw sewage from the dumping of honey-buckets.
- The community needs a new pumper truck for pumping the septic tanks and a new backhoe or excavator for underground utility repair work.

The final task of the Phase I Engineering Design Services is the preparation of this report (*Report on Site Conditions and Recommended Plan of Action*). The purpose of this report is to provide an assessment of the condition of the existing sanitary facilities serving Tununak. This report includes a summary of the findings of the 2010 Sanitary Facility Questionnaire and provides a recommended plan of action for addressing the deficiencies noted in the existing sanitary facilities.

2.0 DESCRIPTION OF EXISTING SANITATION FACILITIES

Community profile maps prepared by ADCRA are provided in Appendix A (Figures A-1 and A-2). The ADCRA maps provide a general overview of the layout of the community and show the locations of the creeks used for water sources. These profile maps are also helpful to note the locations of the community developments with respect to the surrounding physical terrestrial features such as the river, sea, and mountains.

A comprehensive description of the existing sanitation facilities was provided in the report titled *Tununak Sanitation Feasibility Study and Environmental Review*, dated March 22, 1993, prepared by Phukan Consulting Engineers & Associates, Inc. [PCA]). Although the report was prepared by PCA over 17 years ago, it is still a good overall guide to understanding the conditions of the sanitation facilities, many of which are still in operation and have since further degraded. PCA recommended the construction of a FTH system and new water transmission line to a proposed water well source on Muskox Creek. These improvements were installed during the mid-1990s. A drawing from the 1993 PCA report showing the locations of the sanitation facilities that currently exist in the community is shown on Figure A-3 in Appendix A.

The following provides a description of the existing sanitation facilities in Tununak:

2.1 WATER FACILITIES

The community operates a public water system that includes:

- A pair of surface water intake structures and pumping stations located on:
  - Unnamed Creek
  - Muskox Creek
- Raw water transmission mains
- A WTP designed to treat surface water
- A washeteria
- Treated WST
- Potable water distribution system:
  - Pressure and Circulation Pumps
  - Water Distribution System
    - Six community watering points
    - Service connection to the Village Clinic

The existing water system and washeteria is aged and in need of upgrades and/or replacement to sustain service. A sanitary survey of the water system was recently completed in August 2010 on behalf of the ADEC Drinking Water Program. The sanitary survey identified several non-compliance items on the water system that are potential health risks and safety concerns. Many of these deficiencies were noted during the site assessment work completed during the May 2010 site visit completed by the MWH design team and were described in the field trip reports. These deficiencies are addressed in this report, as well as recommendations for corrective action.

2.2 SEWAGE FACILITIES

The majority of the households in Tununak lack complete plumbing facilities, consequently most of the residents use honey buckets for disposal of their wastewater. It is estimated that approximately 64 households rely on the use of the honey bucket. The honey bucket waste is disposed by the residents in sewage disposal bunkers located in close proximity to the homes. These bunkers consist of buried timber cesspools that are located along the north and west banks of the Tununak River. The remainder of the community consisting of 18 households has interior plumbing facilities that are serviced with the FTH system.

Two on-site community septic tank systems and drainfields currently exist in Tununak. The community septic systems are located on the sand spit north of the old "main" village and northwest of the school and WTP/washeteria facility. These septic systems include:

- One septic tank system serves the School, teacher housing, and the WTP/washeteria.
- The second septic tank system is used for the disposal of wastewater collected from the flush tank and haul system.

3.0 OPERATIONAL ASSESSMENT OF SANITATION FACILITIES

3.1 WATER TREATMENT PLANT AND WASHETERIA

3.1.1 Mechanical

The WTP and washeteria were constructed in the mid-1970s based on a similar style to others built in that timeframe. The building is configured as:

- A washeteria with four washers and two hydronic dryers.
- Two toilet/shower rooms, each with two showers, a toilet and a lavatory.
- A mechanical room with two oil-fired boilers, a hydronic heating system, domestic hot water generators, and standby power generator.
- A water treatment room with a pressure filter, two bag filters, a backwash pump, pressure pumps, and a hydropneumatic tank.
- A bunkhouse room.
- A kitchen/laboratory.

A 50,000-gallon WST stands adjacent to the building.

The equipment within the building has deteriorated to a point that the facility can no longer serve its intended purpose with any reliability. Of the laundry equipment only one working washer remains and both dryers have been removed. The toilet/shower rooms have missing fixtures and are no longer usable. Drain piping where fixtures have been removed has been left open or is closed with makeshift materials – such as plastic bags stuffed in the opening. This has a potential to allow sewer gasses into the building and to create a health hazard if a drain were to clog and back up. Only one of the two pressure pumps work to deliver water to the washeteria, clinic, and watering points. The system designed to circulate water to the watering point distribution piping is no longer operational, because both pumps have been fully or partially removed. Circulation is the main source of heating for the pipelines, with electrical heat tracing being a backup heat source. The heat trace controllers do not appear to operate, so with no circulation or heat, the pipelines are vulnerable to freezing.

The building envelope is severely deteriorated, contributing to higher fuel consumption to offset high heat losses. Contributing to high heat losses are leaking window frames and broken windows replaced with single panes of Plexiglas or plywood, as well as roof leaks around the boiler stacks that have caused deterioration of insulation and finishes. The public watering point on the south side of the building has been abandoned, with the insulation value of the wall compromised.

Numerous building code violations exist, including an exit door from the boiler room that has been sealed shut and a fuel tank located within 5 feet of the building. The standby heater installation is not proper, with the stack located too close to combustible materials. It is unknown whether the heater is operational. The heat exchanger for the WST is a single-wall design, which is not allowed by current codes due to the possibility of contamination of the water from the glycol heating fluid in the event of leakage.

The heating boilers are both obsolete models (last produced 10 to 15 years ago) and are deteriorated beyond economical repair. Boiler 1 has jacket corrosion caused by acidic flue gasses leaking through firebox section gaskets. Boiler 2 is off-line with a disassembled burner, no expansion tank, and evidence of firebox leakage at the burner mounting plate. Direct combustion air piping to the boiler burners has been disconnected, and the plastic piping to the Boiler 2 burner housing has been melted. The boiler stack caps are missing and the stacks are dented above the roof line.

3.1.2 Electrical

The existing electrical service for the WTP/Washeteria building includes a 200 amp, 240 volt, alternating current (VAC), single-phase meter/main panel with an overhead drop from the adjacent village utility. The incoming service feeder is routed through a manual transfer switch connected to a 75 kilowatt (KW) diesel-fired engine generator. The main distribution for the building is provided from Panel 'B' at 100 amp, 240VAC, single-phase. Panel 'B' sub-feeds Panel 'A' with a 100 amp, 240VAC circuit breaker.

The majority of electrical equipment within the building has deteriorated past its useful life. Given the observed level of deterioration, the facility can no longer serve its intended purpose with any reliability.

Lighting fixtures were found to be in poor condition. A number of the fixtures were disconnected or deteriorated beyond repair. All of the code-required exit and emergency lighting fixtures were not functioning and present a hazard to life safety in the facility.

The power distribution and utilization equipment showed signs of significant deterioration due to corrosion, resulting in potential hazards to equipment and personnel.

The stand-by diesel-fired engine generator set was not functioning at the time of the May 2010 site visit. The system had not been maintained and tested in compliance with industry standards and showed signs of deterioration due to age and local environment.

Control systems for the WST/washeteria mechanical equipment appear to be non-functioning. Equipment enclosures and components show signs of deterioration due to corrosion.

Numerous building code violations were found throughout the facility in the power distribution and lighting systems. These violations represent a significant hazard to maintenance personnel working in the facility.

3.1.3 Structural

The WTP/washeteria building is approximately 30 feet by 60 feet (approximately 1,800 square feet in area). The building consists of a wood frame shell with T-11 plywood siding and metal roofing. The building has a poured concrete floor and sits on a post-pad foundation. The building is in very poor structural condition (see photos in Appendix B) due to severe weathering conditions, normal aging (nearly 40 years), deterioration, and apparent lack of maintenance.

The building appears to lack adequate insulation and is not weather tight. Overall, the building shows obvious signs of serious exterior deterioration, with a foundation system that has not been adjusted to compensate for building movement due to frost heave and permafrost degradation. The watering point and backwash waste discharge have contributed to erosion of the building foundation, which has settled along the south side of the building.

3.2 WATER SOURCE AND TREATMENT PROCESS

The existing community water treatment system is operated on a periodic basis to maintain a reserve of treated water in the 50,000 gallon WST. These intermittent operations include pumping source water from the Unnamed Creek Intake Structure to the WTP located at the washeteria, source water treatment, and filling the WST with treated water.

From the WST, treated water is withdrawn, pressurized, and distributed to the clinic, washeteria, and community watering points.

The WTP is comprised of the following unit processes:

- Granular Media Filtration
- Bag Filtration, nominal 5 and 1.5 micron bags
- Hypochlorination
- Storage and Disinfection Contact Time
- Distribution System Pressure and Circulation Pumping

The WTP is in poor physical condition and disrepair. The WTP does not meet current drinking water regulations for Cryptosporidium removal.

At the time of this report, the WTP only provides service to the clinic and washeteria. The community watering points are frozen and/or otherwise non-functional.

3.3 WATER STORAGE TANK

The WST consists of a steel-bolted, insulated, aboveground WST. The tank has a reported capacity of 50,000 gallons – apparently the tank volume is sufficient for the current limited water production rate for the WTP, but may be inadequate in size to accommodate future demand.

The tank is located adjacent to the WTP/washeteria building with a “dog house” attachment between the tank and the WTP that accommodates the insulated water supply and discharge lines. It has been reported that the tank experiences leakage (unknown rate), which was not visible during the May 2010 site visit.

The foundation for the WST is in very poor condition as noted in the photos presented in Appendix B. The tank exterior has obvious signs of physical deterioration. The WST appears to be unsuitable for reconditioning or upgrade. The condition of the tank interior is unknown, but the current operator noted the tank's interior has not been inspected nor cleaned for many years.

3.4 WATER SOURCES

3.4.1 Muskox Creek Intake Structure

The Muskox Creek Intake Structure is:

- In poor physical condition.
- Located over a drainage swale, presumably Muskox Creek that appeared to be very nearly dry during the May 2010 visit to the community.
- No longer used by community.

The raw water pipeline connecting the Muskox Creek Intake Structure to the Unnamed Creek Intake Structure is:

- An above-grade Arctic pipe system.
- Subject to freezing.
- No longer used by the community.
- The water pipeline appeared to be salvageable for possible reuse.

3.4.2 Unnamed Creek Intake Structure

The Unnamed Creek Intake Structure is:

- In poor physical condition.
- Located downgradient of nearby existing and potential future new residential structures and, therefore, subject to contamination from fuel and/or wastewater stored on those properties.
- Subject to seasonal burial from drifting snow.
- Subject to infrastructure freezing from:
  - Breaches in the integrity of the existing building structure.
  - Inability to add heat to the existing structure.
- Subject to aufeis formation in the creek immediately below the intake structure
- Subject to flooding and immersion of the building structure components

The raw water pipeline connecting the Unnamed Creek and the washeteria is:

- An above-grade Arctic pipeline.
- Subject to seasonal movement and realignment of support cribbing.

- Currently functional.

TTC has applied for funding assistance from the Coastal Villages Regional Funds (CVRF) for possible relocation of the intake structure further upstream on Unnamed Creek in order to be upgradient of residential contamination sources.

3.5 WATERING POINTS

3.5.1 Mechanical

The watering point design included buried Arctic piping, with a valve pit at each watering point location. The enclosures were designed with electric heaters in the aboveground portion and also in the valve pit. Heat tracing power points and controls were also included at each watering point location. Of the six watering points located in the village, only one showed signs of being usable. All of the watering points' enclosures were deteriorated, with damage to the access doors and floors, including:

- Watering Point #1 nearest the Tribal Council Store #1 was boarded up due to vandalism.
- Watering Point #2 was accessible with non-operational heaters and heat trace controllers.
- Watering Point #3 had snow and ice inside the enclosure and valve pit, indicating possible freeze-up of the piping. The electrical panel face had been removed and heat trace controls had been disconnected. The enclosure heater had failed.
- Watering Point #4 could not be entered because of snow and ice built up inside.
- Watering Point #5 could not be entered because of snow and ice built up inside. The bottom of the door was severely corroded, which let blowing snow inside.
- Watering Point #6 had been boarded up and was not inspected.

Because of the non-operational circulation pumps and heat trace controls (both at the WTP and watering points), the distribution piping has a high potential to freeze as winter weather progresses.

3.5.2 Electrical

The existing services for the watering point buildings/enclosures include an overhead drop from the adjacent village utility pole to an interior 100 amp, 240VAC, single-phase main disconnect switch. The incoming service feeder is routed through the disconnect switch to an interior 100 amp, 240VAC, single-phase branch circuit panel.

The majority of electrical equipment within the watering point enclosures has deteriorated past its useful life. Given the observed level of deterioration, the facility can no longer serve its intended purpose with any reliability and safety. See mechanical for a list of watering point enclosures available for inspection.

The watering point enclosures interior and exterior lighting fixtures were found to be in poor condition. A number of the fixtures were disconnected or damaged beyond repair.

The power distribution and utilization equipment at the watering point enclosures showed signs of significant deterioration due to corrosion, resulting in potential hazards to equipment and personnel. Many of the dead-front panel board covers have been removed, exposing live parts to personnel entering the building/enclosure. This represents a significant life safety hazard and the covers that should be replaced as soon as possible. Exposed wiring was also present within the enclosures and should be re-installed in the existing junction boxes for safety.

Heat tracing power points and controls at the enclosures were found to be in very poor condition. A number of the units were disconnected or damaged beyond repair.

3.6 WATER DISTRIBUTION LINES

The treated water distribution lines from the WTP to the six community watering points that serve the community consists of buried circulating water lines. These circulating water lines are reported to be 3-inch diameter and have been in continuous use for the past 40 years. The water distribution piping consists of high-density polyethylene (HDPE) insulated Arctic pipe that is heat traced; however, the heat tracing appeared to be non-functional during the time of the May 2010 site visit.

According to verbal comments from the WTP operator, the water distribution lines appear to be functioning as originally designed and provide adequate flow to the downstream watering points. The physical condition of the water lines is unknown and assumed to be adequate for the current water demand conditions; however, the water demand is very limited due to the defective watering points. The community hauls most of its drinking water from the school well watering point. Consequently, additional investigation work is needed to determine the physical condition of the water lines. The investigative work should include line leakage testing and measurement of flow rate.

3.7 WASTEWATER DISPOSAL SYSTEMS

3.7.1 Septic Tank System Serving the Washeteria and School

The septic tank and soil absorption system serving the Paul T. Albert School, teacher housing complex and washeteria consists of a 4,000-gallon septic tank and a 30-foot by 30-foot drainfield. The septic tank system is located down-slope of the washeteria and school in a level area a few feet above the high water mark along Tununak Bay.

According to the findings reported in the 1993 *Tununak Sanitation Feasibility Study*, the records available from the U.S. Public Health Service on the original installation of the septic tank system are of questionable accuracy. The septic tank system is approximately 30 years old and appears to be undersized to handle the typical daily wastewater flow.

The operation of the septic tank system was assessed during the May 2010 site visit. The liquid levels in the septic tank pump out pipes and drainfield observation pipes were measured. All of the liquid levels were found to be at or near the surrounding ground surface. These measurements indicated the drainfield was in hydraulic failure. Depending on the rate of incoming sewage, the hydraulic overload could cause blockage of the upstream sewer lines and/or discharge of raw sewage onto the ground surface via the pump-out pipes and drainfield observation pipes.

Apparently, based on discussions with the operators of the septic tank system, hydraulic failure occurs frequently. The operators temporarily relieve the hydraulic overload by pumping effluent from the drainfield observation pipes to the nearby septic tank system serving the FTH system.

3.7.2 Septic Tank System Serving Flush Tank and Haul System (Co-Water System)

The community currently has 18 homes that are served by the FTH system installed by Co-Water. The septic tank system that handles the sewage effluent collected by the FTH system consists of an "In-complete Septic System". This descriptive term "in-complete" was used in the 1993 *Tununak Sanitation Feasibility Study*, because the septic tanks were originally to be connected to the non-operational sewer system serving the 23 homes in the U.S. Department of Housing and Urban Development subdivision. However, the sewer line from the non-functional sewage pump station was never connected to septic tanks; hence, the term "in-complete" was used to describe the condition of the septic system.

The "In-complete Septic System" is located approximately 100 feet north of the septic tank system serving the washeteria and school and consists of two 6,000-gallon septic tanks, siphon operated dosing tanks, and three 60-foot by 100-foot drainfields. The septic tanks are not connected to an incoming community sewer line, except for the gravity discharge line from the FTH dumping station that is located a few feet from the septic tanks.

During the May 2010 site visit, MWH assessed the operation of the "In-complete Septic System." The following site observation comments on the operation of the FTH septic tank system were provided in the MWH site visit trip report dated June 3, 2010:

> *We met on-site with Christopher, the current operator of the flush haul system. Christopher informed us of the problem that occurred this morning where the community tank trailer had gotten stuck in the mud while attempting to discharge its effluent at the septic tank system.*
>
> *A second issue that was brought to our attention was that septic tank system for the flush haul system failed last fall due to blockage in one or both septic tanks. We learned the septic tanks had not been pumped because of the lack of a pumper truck. In checking the septic tanks, it was noted that the tanks' contents were frozen. Consequently, the operator has been disposing the flush tank haul effluent for the past several months directly into a shallow trench located next to the septic tank.*

The site observations reported above confirmed the septic tanks are currently in a state of failure. Consequently, the operators of FTH system have been dumping their haul contents of raw sewage in an open trench located next to the septic tanks. The trench was observed to be easily accessible to the public and animals (especially loose dogs) in the community.

During the project kick-off meeting that was held on May 18, 2010, comments were received from homeowners who are served by the FTH system. According to information provided by Co-Water, the FTH operates as follows:

> *Fresh water is collected from a watering point and delivered to the home by a water haul tank and "pumped" into the in-house holding tank. Each house or building is supplied with an indoor fresh water storage tank. Inside the home, the water is delivered around the house through normal water pipes by a pressure system consisting of a small pump, filter, and pressure tank. This system provides water to various connected plumbing fixtures, including toilet, hand basin, bath/shower, and kitchen sink.*
>
> *The sanitation system consists of the sewer piping and venting system that collects the wastewater from the various plumbing fixtures, including the toilet, and delivers the sewage to a specially designed sewage holding tank that is located outside the home. When the holding tank is full, the sewage is evacuated into the sewage haul tank using the sewage vacuum blower, which puts a vacuum on the haul tank to draw the sewage into the haul tank.*

The homeowners attending the Project Kick-Off Meeting expressed their frustration and dissatisfaction with the current operation of the FTH system. They explained that many of the operational problems were primarily associated with the failure of valves. Overall, the community was overwhelmingly opposed to continued use and expansion of the FTH system. These issues and concerns necessitate further investigation to determine the extent and nature of the operational problems with the FTH system.

3.7.3 Honey Bucket Disposal Bunkers

With the exception of the 18 homes served by the FTH system and the piped water and sewer system serving the school and associated teacher housing, the remainder of homes and businesses in the community use honey buckets. It is estimated 64 households currently rely on the use of honey buckets.

Residents and businesses using honey buckets typically self-haul their water. The honey bucket waste is self-hauled and disposed of in several sewage bunkers that are located in near proximity to the homes throughout the community.

The bunkers consist of buried wooden structures with open bottoms – basically the bunkers serve as cesspools. Most – if not all – of these bunkers are overflowing with raw sewage. It was noted that every bunker observed during the 2010 site visit appeared to be functioning improperly, i.e., in a state of failure. Nearly all of them had sewage overflowing the bunker's manhole openings and accessible to direct contact by animals and humans.

4.0 SANITARY FACILITY QUESTIONNAIRE

During the May 2010 Project Kick-off Meeting, residents expressed a lack of trust in the quality of water produced in the existing WTP. During the meeting's discussion it was noted that the last sanitary questionnaire conducted in the community was nearly 20 years ago. The MWH design team suggested a new questionnaire be conducted to update the old questionnaire and obtain current information from the residents regarding their current water supply and sewage disposal methods. Also, the questionnaire would be used to obtain feedback from the residents on their desire for future improvements to the sanitary facilities serving Tununak.

Subsequent to the kick-off meeting, MWH prepared a new questionnaire that requested residents provide information on the following sanitary issues:

- Present water source (broken down for seasons and source type).
- Present water consumption.
- Present sewage disposal method.
- Preference for future sewage disposal (allowed for ranking of preferences).
- Preference for future water improvements (allowed for ranking of preferences).
- Use of home washing machine.
- Use of the existing Washeteria.
- Desired user fees for piped water and sewer services, use of new washeteria and new watering point.

The questionnaire was reviewed by VSW and then sent out to the community for distribution. TTC arranged for the solicitation of questionnaire input from the residents during the early summer months of 2010. A copy of a blank questionnaire, housing survey map, and a spreadsheet summary of the questionnaire data are provided in Appendix C.

Overall, the questionnaire was successful in obtaining valuable information on the community's response to the above listed sanitary issues. Most important, the questionnaire had an excellent return rate that represented nearly 75 percent (%) of the residential population and over 60% of the housing units.

The following provides a summary of the questionnaire findings:

- Average water use per person per day 2.3 gallons/day
- Total water use per day (represents 226 persons surveyed) 395 gallons/day
- Percent of residents using BIA School Well 100%
- Total number of honey bucket users 40 households
- Total number of households served by the FTH system 11 households
- Percentage desiring honey buckets 8%
- Percentage desiring FTH system 8%

•	Percentage desiring sewer lines	81%
•	Percentage desiring new washeteria	52%
•	Percentage desiring piped water	33%
•	Percentage desiring new watering points	13%
•	Percentage current users of existing washeteria	75%
•	Average desired user fee for piped water and sewer	$42.30 per month
•	Average desired user fee for new washeteria washer	$4.68 per wash load
•	Average desired user fee for new washeteria shower	$1.69 per shower
•	Average desired user fee for new watering point	$22.18 per month

One of the most important findings of the questionnaire was that 100% of the residents obtain their drinking water from the BIA school well rather than the water produced by the existing WTP. Given the numerous issuances of "boil water" notices, the residents apparently do not have confidence in the quality of water provided at the community watering points. Future upgrades to the community's water supply system need to be done so that the water system gains respect and trust by the public. A safe and reliable year-round source of water needs to be developed that is protected from contamination and has good natural water quality.

After reviewing the above questionnaire findings, an adjustment was made to account for the "reasonable cost" residents were willing to pay for new services, i.e., many respondents indicated they wanted piped water and sewer, but listed unreasonable low monthly user fees (less than $100 per month). The respondents that indicated their first choice was a piped water and sewer system but submitted very low (unreasonable) user rates were replaced with their second choice – a new washeteria. The adjusted percentage of those who favor a new washeteria increased from 52% to 77%.

It is recommended that a follow up questionnaire be completed during the next phase of design work to solicit input from residents on their preferred choice of future sanitation facility improvements. The questionnaire needs to provide detailed estimates on the associated costs for operation and maintenance of the proposed improvements.

5.0 RECOMMENDED PLAN OF ACTION

5.1 WATER SOURCE

5.1.1 Candidate Sources of Potable Water

Candidate sources of water for Tununak are reviewed below.

5.1.1.1 Surface Fresh Water Sources

Fresh (non-saline) surface waters in the vicinity of Tununak include Muskox Creek, Un-named Creek, the Tununak River, and local artesian spring water. These are reviewed below.

Muskox Creek. This is a small creek to the east of the community with drainage basin of approximately 0.5 to 0.75 square miles on the south side of Ugchirnak Mountain. It is up-gradient of the community, but as previously noted, it appeared to be virtually dry during the May 2010 visit.

Un-named Creek. Like Muskox Creek, the drainage basin for Un-named Creek is also on the south side of Ugchirnak Mountain, but is somewhat larger – perhaps on the order of 1 to 1.5 square miles. During the May 2010 site visit, this creek was flowing both at the existing intake structure near existing community housing, as well as further up in the drainage basin.

Upper Tununak River. The Tununak (spelling per U.S. Geological Survey [USGS] Mapping) River is the largest, most productive source of fresh water in the area, but tidally influenced and potentially brackish near the community. Tide extremes in the area reported for Nome and St. Paul are between -1 and 4 feet mean sea level (MSL). Topographic mapping for the region shows the rivers' forks flow through a 25-foot elevation contour between 1.3 and 3.4 miles from the community's existing washeteria site. This suggests fresh water extraction would require an extended transmission pipeline across relatively flat and marshy terrain.

Local Spring Water. Reports received during the May 2010 site visit suggested the occurrence of one or more natural springs originating out of the hillside to the northeast of the community. However, no springs were encountered during a limited reconnaissance of the hillside during the May 2010 visit, nor was there evidence of a spring found on aerial photography recorded in 2004 for the region. It may be that such springs are limited to only seasonal flows.

5.1.1.2 Groundwater Sources

Groundwater resources developed within the community are limited to the BIA's well, which was drilled for the community school in 1964. The log for the well indicates the well to be shallow, cased to 31 feet, and screened to a total depth of 36.5 feet. Static water was reported to be 10 feet below ground surface with a well yield of 6 gallons per minute (gpm).

The well, located on the northeastern end of the spit below a bluff, is subject to potential contamination from the septic systems, sewage haul disposal system, and fuel oil storage tanks.

It is also a likely candidate for classification as a groundwater under the influence of surface water. As such this well, or others within its vicinity, are not good candidates for a community water source.

Similarly, on the southeast end of the spit across the bridge from the community, is an area that may have groundwater reserves similar to those tapped by the existing school well. However, this area is currently used as the community landfill and, as such, would potentially be subject to unacceptable levels of contamination.

Developing groundwater from upland locations within the area may be successful. However, upland areas that would provide physical separation from existing sources of contamination are likely underlain by permafrost and, as such, may not yield the quantities of fresh water required by the community.

5.1.1.3 Brackish or Sea Water Sources

The lower reaches of the Tununak River offer plentiful quantities of water with relative close proximity to water consumers within the community. However, the water quality is expected to be influenced by sea water salinity, as well as contaminants leaching into the water from nearby honey bucket bunkers located along the banks of the river.

Bearing Sea water is similar to the lower reaches of the Tununak River, in that it too is conveniently close to the community. However, intake structures to collect it, whether open ocean submerged diffusers or sub-seabed intake galleries, would all be subject to physical damage from sea ice floe movements along the nearshore areas of tidewater.

Desalination of brackish and/or marine source waters is common enough, but energy intensive, and therefore usually adopted only if freshwater sources cannot be developed or are temporarily unavailable.

5.1.2 Source Water Regulatory Issues

Regulatory issues regarding candidate source water development for the community are addressed below.

5.1.2.1 Source Water Protection

The 1996 Amendments to the Safe Drinking Water Act included requirements to establish a Source Water Protection Program to protect the quality of waters used to produce potable water, including both groundwater and surface water sources. The U.S. Environmental Protection Agency’s (EPA’s) requirements of the program include:

1. Identification of a source water protection boundary suitable for protection of the community’s water supply source.
2. Inventory of known or potential sources of contamination for the community source water within the boundaries established for the protected area.

3. Determination of whether the source water is susceptible to these sources of contamination.
4. Development of public involvement program that involves public notification of:
   - Limits of the source water protection area.
   - Identified sources of contamination within protected area.
   - Steps needed for protection of water from identified contaminants.
5. Implementation of local management plans to reduce the risks of source water contamination.
6. Development of contingency plans for implementation in the event of source water contamination.

The State of Alaska is responsible for implementation of local source water protection programs. Under 18 Alaska Administrative Code (AAC) 80.015(c), public water systems are required to report data to the State related to Items 1 through 3 above.

Under 18 AAC 80.020, the State requires water wells used as a public water source be separated from sources of contamination according to distances published in that regulation. Generally, this distance is 200 feet, and applies to wastewater storage, conveyance, treatment and disposal infrastructure, and landfills.

5.1.2.2 Regulatory Requirements for Treatment of Source Water

New water sources must be tested for quality and, after treatment, found to be in compliance with the maximum contaminant levels (MCLs) referenced in 18 AAC 80.300 and 40 Code of Federal Regulations (CFR) 141. To facilitate achieving this goal, and to satisfy State plan review requirements for use of new sources, the water quality parameters listed in Table B of 18 AAC 80.205 must be identified, including:

- Total coliform bacteria
- Inorganic chemicals
- Nitrate
- Nitrite
- Volatile organic chemicals
- Secondary contaminants

In addition to source water testing required by 18 AAC 80, the Groundwater Rule as published in the Federal Register on November 8, 2006, also requires new groundwater systems brought on line after November 30, 2009, to monitor and report the microbial quality of the water produced by the well. Under the Groundwater Rule, testing is to include evaluation for microbial organisms that are indicators of fecal contamination including *E. coli*, Enterococci, or Coliphage. If the source is found to have a positive response to one of these tests, one of several steps must be taken. These include removing the source of contamination and/or providing a minimum of 4 log inactivation of viruses in the well water treatment system.

Similar to groundwater sources, under EPA regulations, new surface water sources are also to be tested for their microbial quality. Those sources with a higher concentration of target pathogens are required to provide more extensive treatment for microbial quality control.

In particular, the Long Term 2 Enhanced Surface Water Treatment Rule (Federal Register, January 5, 2006) requires systems using surface water as their source water to collect 24 samples for microbial analysis. Smaller, filtered systems serving less than 10,000 people must monitor for *E. coli* every 2 weeks for 12 months. For source waters that are lakes or impoundments, if the monitoring results in an annual mean *E. coli* concentration of less than 10 per 100 milliliters, no further monitoring is required and the treatment system must only meet 2-log Cryptosporidium reduction requirements. If annual *E. coli* monitoring results equal or exceed 10 per 100 milliliters, the system must begin source water monitoring for Cryptosporidium, which may lead to higher microbial removal treatment requirements for the treatment system.

In addition to monitoring source waters for microbial quality, EPA regulations require treated water quality distributed by public water systems meet MCLs for contaminants referred to as disinfection byproducts (DBPs). While these rules do not require source water monitoring, they do address minimum requirements for treated water quality, and therefore should be evaluated as part of the source water quality evaluations noted below.

5.1.3 Work Plan for Developing a Water Source

The following sections identify recommendations for advancing the planning, design, and development of upgrades to the community water source system.

5.1.3.1 Hydrologic and Geotechnical Evaluations

It is our understanding that Tununak is scheduled for a relocation of its airfield. The Alaska Department of Transportation and Public Facilities (ADOT/PF) has a year 2012 line item budget for this of $24 million. It would seem that with this project, a gravel source borrow pit could be developed that, upon completion of gravel extraction efforts, could serve as an impoundment for collection and supply of surface water for the community. Such an effort would, necessarily, have to be coordinated with ADOT/PF, including soils investigations to assess upland bedrock deposits for suitability as airfield embankments, and hydrologic investigations to assess runoff and yield of drainage basins upgradient of the borrow pit.

The community is located within a region of Alaska that is subject to a significant degree of snow drifting. As a result, snow fencing would be an option to improve capture of snow in upland drainage basins for purposes of improving yields of seasonal runoff.

5.1.3.2 Source Water Schematics

Possible source water developments on the upland areas northeast of the community are discussed in the following paragraphs. This area of development is selected because:

- It avoids crossing the Tununak River with a pipeline.
- It minimizes crossing wetland marsh areas of the Tununak River with water system infrastructure.
- It has relatively close proximity to the existing community's existing water system infrastructure.
- It would be relatively easy to serve additional development planned for this area of the existing community.

One alternative source water configuration (Appendix D, Figure D-1) is an impoundment with a free water surface elevation of 300 feet MSL. This could enable a gravity supply of treated water to flow to the community, supplying a minimum static pressure of 50 pounds per square inch to housing at elevation 50 feet MSL, which is approximately the elevation of the highest, newest housing within the community.

The size of the impoundment would depend upon several factors, including:

- Demands for potable water in the community:
  - Domestic use for a new washeteria and hauling of drinking water is assumed to be 50 gallons per person per day for a population of 500 people, or 25,000 gallons per day in 30 years, which yields an estimated annual demand of 9.1 million gallons (MG).
  - Commercial use (fish processing plant), currently estimated to be 15,000 gallons per season, and possibly increased to 100,000 gallons per season in 30 years.
  - Total annual demand of 9.2 MG in 30 years.
- Characteristics of precipitation, and runoff in the drainage basin. Preliminary estimates might include:
  - Five (5) feet average snow depth with the use of catchment basin snow fencing.
  - One (1) square mile drainage basin area.
  - Thirty percent (30%) snow conversion to water.
  - Sixty percent (60%) loss to evaporation and infiltration.
  - Annual net runoff of 125 MG.

To accommodate an impoundment with a water surface elevation of 300 MSL, and sustain projected demands, the impoundment would need to contain approximately 40 MG. With a 15-foot average water depth, and width of 50 feet, the impoundment would be an average of 6,500 feet long at mid-depth of the water column. Available drainage basin area above the 300-foot contour on existing topographic mapping presented on Figure D-2 (Appendix D).

An alternative source water impoundment configuration is presented in Appendix D, Figure D-3. In this alternative, the impounded water supply is lower in elevation and provides only a gravity flow of water to a community WTP, watering point, and washeteria, but does not include a gravity-fed piped water distribution system. For this alternative, a continuous flow of source water would be delivered to the WTP, as needed, for both potable water demands and year-round water supply freeze protection. Un-treated source water used for raw water transmission main freeze protection would be shunted to the existing creek for natural drainage to the Tununak River.

5.2 WATER TREATMENT PROCESS

Should the project advance adopting the concept of developing an upland surface water impoundment, the quality of surface water runoff from the drainage basin should be evaluated for the following parameters:

- pH
- Alkalinity
- Total dissolved solids
- Total organic carbon
- Dissolved organic carbon
- Ultra-violet absorption
- Inductively-coupled plasma/mass spectrometry scan for metals
- Nitrates/Nitrites (NO2/NO3)
- Volatile organic compounds

In addition, bench or pilot scale testing should be conducted to simulate performance of candidate treatment alternatives, especially as applies to achieving compliance with the DBP rules, using a simulated distribution system DBP evaluation for the source water.

Based on past water quality analyses collected in the past for Unnamed Creek Well House, it appears a direct filtration treatment system with hypochlorination may be suitable for the upland water source. However, this needs to be confirmed during the next phase of water source investigation. A conceptual sketch of the water treatment process is provided in Appendix D, Figure D-4.

5.3 WATER TREATMENT PLANT AND WASHETERIA

The existing WTP/washeteria building and water system have severely deteriorated and would be extremely expensive to repair. In addition, any repairs would add little additional functional life to the facility. Its current operation is limited to one washer, delivery of water to the clinic, and (possibly) delivery of water to the public watering points – assuming that the pipelines have not suffered freezing damage.

Assuming that a good quality water source could be connected to the WTP and washeteria, extensive repairs, including installation of functioning circulating pumps, checkout and rehabilitation of the pipeline heat tracing systems, replacement of non-functioning watering point heaters, and repairs to the WTP boilers would be required to be able to supply water to the public watering points. The washeteria function would still be limited to one washer, unless additional machines were purchased and installed.

These improvements or repairs do not seem justified given the existing condition of the facility. The recommended course of action is to abandon the existing facility and construct a new WTP and washeteria facility. The watering point piping should be checked for freeze damage, and if none is found, the aboveground portion of the watering points should be demolished and reconstructed – with emphasis on weather-tightness of the structures and security from vandalism.

For preliminary consideration purposes, two sketches of conceptual WTP/Washeteria building floor plans are provided in Appendix D, Figures D-5 and D-6. Given the 20-year population projection, it is assumed a new building with an interior area of approximately 3,000 square feet will be sufficient to accommodate a WTP and washeteria for the community. The conceptual floor plans show the following items:

- Five (5) washers
- Five (5) dryers
- A clothes folding counter
- A waiting area
- An office/laboratory
- Two (2) women showers and bathrooms (including handicap accommodations)
- Two (2) men showers and bathrooms (including handicap accommodations)
- Mechanical, plenum/maintenance, and storage rooms
- A WTP (direct filtration treatment system with hypochlorination)
- A community watering point on building exterior

The two conceptual floor plans provide two different layouts of the same items listed above.

The building foundation is undetermined at this time, and will require geotechnical consideration to identify issues of permafrost and thaw possibly. It is assumed the new WTP/washeteria will be located in the same footprint area of the existing WTP building. A possible design approach for the building's foundation may include the use of sleepers and beams similar to that used for the existing building. An alternative design is one that incorporates the use of thermal piles with gravel pads, geofabric and board insulation.

The new building service will be approximately 200 to 300 amp, 240VAC, single-phase served from an adjacent, overhead utility pole. The main distribution for the building will be provided from a 240VAC, single-phase main distribution panelboard (MDP) which will sub-feed 100-amp, 240VAC branch panels within the facility.

Lighting will be provided in accordance with the Illuminating Engineering Society of North America (IESNA) Lighting Handbook and industry standards. The majority of interior lighting will be provided with energy-saving fluorescent fixtures. Exterior fixtures will be High Pressure Sodium (HPS) type. All fluorescent ballasts will have less than 10% Total Harmonic Distortion (THD). Interior lighting will be controlled through manual and automatic means. Where practical, occupancy sensor lighting control will be provided to improve energy efficiency.

Manual switches will be used in areas where the above techniques do not provide an economical or practical solution.

Emergency lighting will be provided to comply with the National Electrical Code, International Building Code (IBC), and the National Fire Protection Association (NFPA) 101 and will use wall mounted units with batter backup. Exit signs will be the energy-saving type with integral battery backup.

Receptacle devices include general receptacles, special receptacles, and other components required to provide convenient points for connection of appliances and/or equipment to power sources. A maximum of six receptacles per circuit will be provided.

Mechanical equipment serving the heating, ventilation, and air conditioning systems will include disconnects, motor starters, and/or thermal manual motor starters to meet the needs of the equipment and sequence of operations. Motor control centers, or stand alone starter units, will be incorporated to suit the physical layout of spaces and number of motors within the space. Motors over 1/2-horsepower (hp) will be served from individual branch circuits or motor control center modules. Unless special considerations require selection of other types of starters, starters will be FVNR (Full Voltage, Non-Reversible) hp-rated and will consist of toggle-type manual starters for fractional hp motors and full NEMA size units sized for those motors greater than 1/2-hp in size or of 3-phase configuration. Variable speed or frequency drives, or reduced voltage starting equipment complying with utilities requirements, will be provided for mechanical system motor loads exceeding 20-hp or as required by mechanical sequences.

A stand-by, diesel-fired engine generator set will be used to provide power to the facility during the loss of normal utility power.

5.4 WATER STORAGE TANK

It is proposed that a bolted steel WST will be provided for Tununak. Current design anticipates that a 100,000-gallon tank will be required. The materials, accessories, and design incorporated into the WST should comply with American Water Works Association (AWWA) D103 and the following specifications:

- Design Loads
  - Specific Gravity: 1.0
  - Wind velocity per International Building Codes/AWWA
  - Shape Factor: 0.6
  - Allowable Soil: to be determined
  - Roof Snow Load: 25 pounds per square foot
  - Seismic per IBC/AWWA

The WST would be prefabricated at a manufactures facility what would incorporate fusion bond coatings for resistance to internal and external tank corrosion. Insulation and an aluminum jacket protective cover would also be specified. A bolted tank is selected for ease of shipping and construction, with assistance of a local force account.

The foundation for the WST is undetermined at this time and will require geotechnical consideration to identify issues of permafrost and, possibly, thaw. A ring wall is anticipated. However, thermal piles may need to be incorporated into the foundation design, along with gravel pads, geofabric, and board insulation. Another design approach for the tank's foundation may include the use of sleepers and beams similar to that used for the existing WST.

5.5 WATER DISTRIBUTION AND WATERING POINTS

It is assumed the existing water distribution system from the existing WTP to the watering points will remain, subject to satisfactory findings of a future investigation. The new WTP will provide a means for adequate pumping for recirculation purposes and heat-add for thermal protection.

The existing watering points are currently inadequate and need replacement. The new watering points are assumed to be located at the same locations as the existing watering points, which are located strategically throughout the community.

The replacement watering points will be designed to ensure ease of operation and safety for residential use. The same design features will be incorporated in the community watering point proposed for the new WTP/washeteria building.

The new watering point enclosure services will be similar to the existing and include an overhead drop from the adjacent village utility pole to an interior 100 amp, 240VAC single-phase main disconnect switch. An interior 100 amp, 240VAC, single-phase branch panelboard will provided. The panel will feed all loads within the enclosure, including lighting, heaters, receptacles, heat trace, etc.

Exterior lighting will be high pressure sodium wall packs. Interior lighting will be incandescent industrial type fixtures with guards.

5.6 WASTEWATER DISPOSAL SYSTEMS

5.6.1 On-Site Septic Tank System for School, Teacher Housing and Washeteria

The existing septic tank system serving the school, teacher housing, and washeteria was found to be in a state of failure during the May 2010 field trip visit completed by MWH. The septic tank and drainfield is approximately 30 years old and appears to be beyond repair. It is recommended the existing septic system be abandoned in-place and the sewer line re-routed to flow by gravity to the proposed upgraded septic tank system that currently serves the FTH system as described below.

A conceptual sketch for the proposed sewer improvements is provided in Appendix D, Figure D-7. Flow from the proposed new WTP/washeteria, school, and teacher housing would flow by gravity through Manhole #1 to Manhole #2, located at the toe of the hillside west of the School.

Manhole #2 would be modified to accommodate a new, 8-inch diameter sewer line that would take flow northerly along the base of the hillside by gravity to the upgraded septic tanks for the FTH drainfield system. The new sewer line would include a new manhole midway between Manhole #2 and the FTH septic tanks.

5.6.2 On-Site Septic System for Co-Water FTH System

It was noted by MWH during the May 2010 site visit, that the existing septic tank system used for the disposal of tank pumping from the Co-Water FTH system was in a state of failure. The failure is apparently caused by a blockage in the multi-compartment septic tanks. Based on the limited field observations, there is a possibility that the blockage could be corrected and the septic tanks placed back into operation.

However, it is essential that a more comprehensive site investigation be conducted in order to accurately assess the structural condition of the septic tanks to ensure their continued use. Also, the hydraulic adequacy of the existing drainfield needs to be determined. Apparently, the drainfield has had limited use over the years, and may be capable of handling the flow of clarified sewage discharged from the septic tanks. Given the size of the drainfield according to VSW records, the drainfield may be adequate in absorption area to handle the combined flow from the FTH system and the effluent from the school, teacher housing, and new washeteria. The assessment of the hydraulic capacity of the drainfield needs to be completed as soon as possible.

5.6.3 Honey Bucket Disposal and Conversion to a Community-Wide FTH System

All of the existing honey bucket disposal bunkers in the community are filled to capacity. Their continued use is an obvious and serious health hazard to the residents, including their pets. It is understandable that the residents who are currently using honey buckets desire a piped sewer system, but due to funding constraint, the continued use of honey buckets appears to be a necessity for the near term.

Unless significant funding for a piped sewer system is obtained in the immediate future, it is recommended for the interim that an alternative, cost-effective method of disposing the honey bucket wastes in a sanitary method be developed in the immediate future – subject to the availability of funding. However, as a practical long term alternative, MWH recommends the expansion of the FTH system to serve all of the households in Tununak currently on the honey bucket system. These households would be upgraded to accommodate interior plumbing improvements that are compatible to accommodate the use of FTH system.

Until funding is provided for expansion of the FTH system, it is recommended that honey bucket waste is disposed of in new transfer stations that are located in convenient and strategic locations throughout the community where honey buckets are used. Residents would self-haul their honey bucket waste to in “sanitary bags” to special hoppers that are contained in the waste transfer stations. The hoppers would be equipped with sealed covers to contain the bags for temporary storage.

A service would be set up by TTC to routinely inspect the waste transfer stations and empty the hoppers into a transport container that would haul the contents by an all-terrain vehicle to a community-wide disposal facility. This facility would be located at an approved site, possibly near the current landfill (dump) located south of the airfield. The honey bucket disposal site would consist of a large, fenced-in sewage bunker similar to ones used in other remote villages. The bunker would be designed to allow for sequential expansion as portions of the bunker are filled and properly buried.

In addition, the existing honey bucket bunkers need to be properly closed out and limed for final burial. It is recommended the bunkers that are currently overflowing be properly abandoned immediately.

6.0 COST ESTIMATE FOR RECOMMENDED SANITATION IMPROVEMENTS

The following provides a breakdown of the estimated costs for the construction of the proposed sanitation improvements that were recommended in Section 5.0 of this report. Given the limited scope of the investigation completed by the MWH design team, the cost estimates are qualified as conceptual and should only be used for preliminary planning and scoping purposes. It is understood the cost estimates will be used for requesting initial funding to provide a financial means to pursue the development of these urgently needed sanitation improvements for the community.

As recommended in Section 5.0, a more comprehensive investigation on the site conditions should be conducted in order to verify the cost estimates. On the other hand, the future investigation(s) and studies may discover favorable site conditions that could reduce the cost estimates, especially in regard to the development of the water source. It is noted due to project scope limitations that the following cost estimate does not include the estimated cost to expand the FTH system to serve the households currently using the honey bucket disposal system.

Proposed Sanitation Improvements	Construction Cost
New Water Source (Hillside Impoundment)	$1,000,000
New WTP and Washeteria (includes demolition of existing structures)	$3,050,000
100,000-gallon WST	$550,000
Watering Points (five community Locations)	$150,000
Honey Bucket Collectors and Disposal Facility	$350,000
Upgraded Septic Tank System (For School, WTP/Washeteria and FTH System, and Includes Septic Tank Pumper Truck)	$350,000
Total Construction Cost Estimate	$5,450,000
Design and Construction Management (20%)	$1,090,000
Contingency (20%)	$1,308,000
TOTAL COST ESTIMATE	**$7,848,000**

7.0 RECOMMENDATIONS AND CONCLUSIONS

The recommended plan of action presented herein provides a simplistic, yet useable, preliminary "guide" for the development of the proposed water and sewer improvements. These improvements were shown in conceptual sketches and drawings to depict fundamental features of the design components. This plan of action included two conceptual floor plans for the replacement WTP and washeteria that show configurations of laundry equipment, bathrooms, showers, mechanical, water treatment equipment and offices. These sketches serve as points of reference for planning and discussion purposes.

Potential water sources were identified, screened, and evaluated. Screening criteria considerations for the candidate sources included: community perception of the source as a supply of public water, the potential for contamination from past or current development, individual source water quality and quantity, and rough cost estimates for complying with applicable rules/requirements for treatment.

The community's sanitation problems identified in this investigation are considered by the MWH design team to be an imminent risk to the health and welfare of its residents. All of the essential components of the water and sewer systems currently serving the community, with the exception of the BIA school well, were found to be in extremely poor operational condition.

In summary, the design team recommends the following sanitation improvements be further evaluated for development as soon as practical:

- Replace the Unnamed Creek water intake with an upgradient (hillside) water source.
- Replace the WTP.
- Replace the washeteria.
- Replace the existing WST with a 100,000-gallon tank.
- Replace the community watering points.
- Expand the FTH system to serve all households in the community. This recommendation involves the installation of interior plumbing to connect to the FTH tank in existing households that currently use honey buckets. Also, the FTH system will need additional upgrades to the water and sewage haul equipment and expansion of the on-site septic tank/drainfield system.
- As an interim corrective action measure until such time the honey bucket use homes are upgraded with interior plumbing to accommodate the use of the FTH system, we recommend the installation of honey bucket transfer stations and construct disposal facility at a suitable location outside of the residential area.
- Upgrade the septic tank system for the FTH system, new WTP, new washeteria, school, and school housing.

It is recommended the first priority is to develop a new "safe" water source. A site investigation for evaluating alternative, suitable water sources should be completed as the first step in addressing sanitation needs of Tununak. The design of a new WTP will depend on the quality and flow capability of the new water source.

Concurrent with the water source investigation, it is recommended a site investigation be conducted to evaluate the condition of the septic tanks and drainfield at the “In-complete septic system” for upgrade to use in the immediate future.

APPENDIX A

ADCRA Community maps of Tununak

FILE: D:\CAD\Proj\VSW - village safe water\TUNUNAK\Washeteria-Water Treatment Facility\draft\FIG A-1 ADCRA Tununak area map.dgn

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Anchorage, Alaska

FIGURE A-1

VILLAGE SAFE WATER
TUNUNAK - WASHETERIA/ WATER TREATMENT FACILITY DESIGN

ADCRA TUNUNAK AREA MAP

MAP NOTES

This map was prepared by the Coastal Villages Region Fund Inc. in cooperation with the Alaska Department of Commerce, Community and Economic Development (Commerce) using funding from Commerce, the Alaska Tribal Native Health Consortium, (Village of Tununak) and funding from the Initiative for Accelerated Infrastructure Development (IAID). The IAID is supported by grants from the Denali Commission, USDA Rural Development, Alaska Department of Transportation and Public Facilities and Commerce. The Coastal Villages Region Fund contracted with Global Positioning Services, Inc. in June of 2004 to prepare the map.

This map should not be construed as a survey. On-site surveys should be conducted prior to engineering or construction.

This map was compiled to meet horizontal and vertical accuracy in accordance with national map accuracy standards.

Property and utility information has been generated from readily available sources with limited accuracy checks. Property information is not intended to represent a title search of the Recorders Office record. Utility location is approximate and shows only the main lines as the service lines have been omitted for clarity. Generally, the information is current as of December 2004.

The Alaska Native Tribal Health Consortium provided sanitation facility records.

This map is based on photography acquired on October 2, 2004, at a nominal scale, of 1 in = 800 ft.

AeroMap U.S. prepared the orthophoto and topographic mapping. The orthophoto is an aerial photo which has been corrected, by rectification to ground control stations, to remove distortions and warpage due to ground topography and aircraft tilt and trim.

HORIZONTAL AND VERTICAL CONTROL

The horizontal control monument for the digital orthophoto was NGS OPUS solution for GPS Inc. TBM "BASE 2". The horizontal datum NAD 1983 coordinates for this TBM are North 60° 34' 38.6757" and West 165° 16' 19.4250". The NAVD-88 elevation for this monument is 5.56 feet.

The Village of Tununak has been adjusted to this control using high-precision GPS methods and the adjusted coordinates and elevation for Base 2 Monument "USS 4054 L1", were calculated to establish a local control reference. The NAD 1983 coordinates for this monument are North 60° 34' 38.6757" and West 165° 16' 19.4250" and the NAVD-88 elevation is 58.11 feet.

The contours were prepared at two (2) foot contour intervals with index contours every ten (10) feet.

FORMER CITY LANDS TRANSFERRED TO TUNUNAK TRADITIONAL COUNCIL

Memorandum of Agreement/QuitClaim Deed to Tununak Traditional Council recorded at Book 74, Pages 652-692 on 2/8/1997 Bethel Recording District.

Lots 1, 2, and 3, Block 1; Lot 7, Block 2; Lots 1 and 6, Block 3; Lots 4, 5, 7, and 8, Block 4; Lots 2, 4, 5, 9, and 10, Block 5; Lots 1, 3, and 4, Block 6; Lots 3, 6, and 7, Block 7; Lots 1, 3, 4, and 5, Block 8; Lot 2, Block 9; Lots 1, 2, and 3, Block 10; of Tract A; of U.S. Survey 4028. Lots 1, 2, 3, and 5, Block 1; Lots 1, 2, 3, 4, and 5, Block 2; Lots 1, 2, and 3, Block 3; Lots 1 through 15, Block 4; All of Block 5; of Tract B; of U.S. Survey 4028. Lots 1 through 16, Block 1 and All of Blocks 2 and 3 of Tract C; of U.S. Survey 4028.

All of Tract "D" as shown on the official plat of U.S. Survey 4029, excepting: 1) Tract D-2 as shown on Plat No. 79-12 which was deeded to the AVCP Housing Authority by quitclaim deed dated June 1, 1974 and recorded at Book 27, Page 363, Bethel Recording District. 2) A conveyance to United Utilities, Inc. dated August 11, 1981, and recorded in Book 31, Page 6, Bethel Recording District. 3) Lots 1, 2, 3, 4, and 5, Block 1; Lots 1, 2, 3, 4, 5, and 6, Block 2, a Subdivision of D-1, U.S. Survey 4029, according to the Tununak Subdivision North Addition plat filed under 89-5, Bethel Recording District which were deeded to the AVCP Housing Authority.

Community Map
TUNUNAK

60° 35' 10" N 165° 15' 10" W (NAD 83)
Approximate Elevation: 5'
Townships 5 & 6 North, Range 91 West, S.M., AK
U.S.G.S. Quadrangle "NUNIVAK ISLAND (C-1)," Alaska
BETHEL RECORDING DISTRICT

LEGEND

- Residential Building
- Commercial Building
- Public Building
- Basis of Coordinates Base 2 Monument USS 4054-L1
- Power Poles
- Fuel Line
- Sewer Line
- Water Line
- Power & Telephone
- Telephone
- Electric
- Berrypicking Area
- Erosion Barrier
- Boat Storage Area

0 100 200
SCALE IN FEET

SCALE: 1"=100'
Date of Photography: October, 2 2004
Magnetic Declination computed by U.S.G.S. Geomag
Program using AK-2000.COF model as of November 3, 2004

SHEET 1 of 3

BUILDING KEY

9. Tununak IRA Council Office
10. Old Tununak Clinic Building
11. Tununak Traditional Elders Office
12. Visitinig Priest's Residence
13. Public Watering Point
14. St. Joseph Church
15. Public Watering Point
16. Public Watering Point
17. National Guard Armory Army Site
18. CVRF Office
19. TRC Store #1
20. Public Watering Point
21. LKSD Storage and Powerhouse
22. LKSD Teacher Housing
23. TRC Store #2
24. Tununak Gas Station
25. Power House (Generator)
26. LKSD School
27. PHS Laundromat
28. AVEC Power House
29. Tununak Native Store (ANICA)
30. Public Safety Bldg
31. Tununak New Clinic Bldg
32. GCI Utility Bldg
33. Repair Shop
34. New Construction, Home Built After 2004 Photograph.

TUNUNAK COMMUNITY MAP SHEET 1 1"=100' (2004 PHOTOGRAPHY)

FILE: D:\CAD\Proj\VSW - village safe water\TUNUNAK\Washeteria-Water Treatment Facility\draft\FIG A-2 ADCRA Tununak community map.dgn

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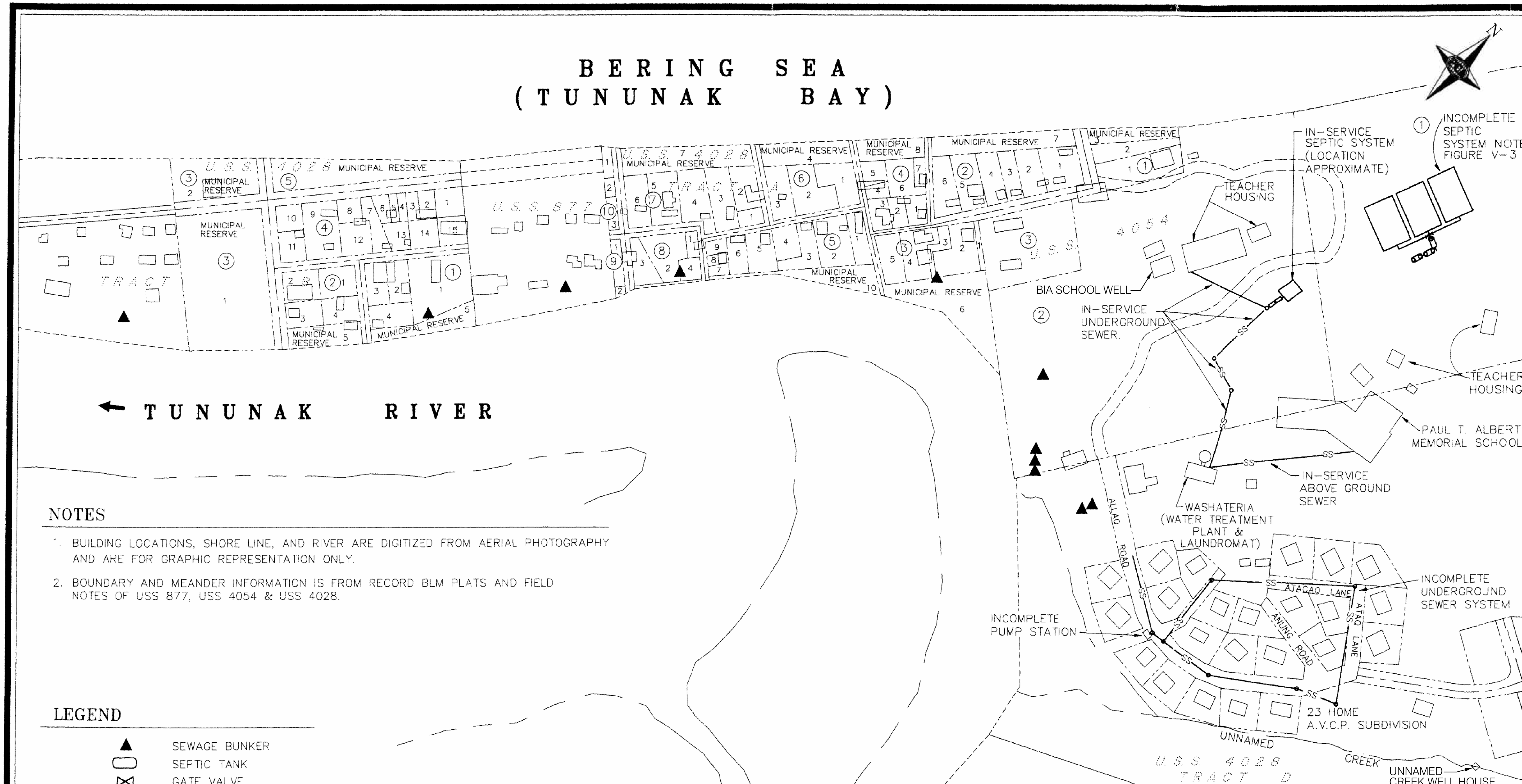
Anchorage, Alaska

FIGURE A-2

VILLAGE SAFE WATER
TUNUNAK - WASHETERIA/ WATER TREATMENT FACILITY DESIGN

ADCRA TUNUNAK COMMUNITY MAP



NOTES

1. BUILDING LOCATIONS, SHORE LINE, AND RIVER ARE DIGITIZED FROM AERIAL PHOTOGRAPHY AND ARE FOR GRAPHIC REPRESENTATION ONLY.
2. BOUNDARY AND MEANDER INFORMATION IS FROM RECORD BLM PLATS AND FIELD NOTES OF USS 877, USS 4054 & USS 4028.

LEGEND

- ▲ SEWAGE BUNKER
- SEPTIC TANK
- GATE VALVE
- SEWER MAN HOLE
- —SS— EXISTING SEWER LINE
- RECORD BOUNDARY
- RECORD CENTERLINE
- BLM RECORD MEANDERS
- (3) U.S. SURVEY BLOCK

PHUKAN CONSULTING ENGINEERS & ASSOCIATES, INC.

Civil Geotechnical • Surveying • Environmental

PCA

Telephone: (907)272-7111 Fax: (907)272-3177

203 West 15th Avenue Suite 104 Anchorage, AK 99501

TUNUNAK SANITATION FEASIBILITY STUDY
EXISTING SANITATION FACILITIES

DRAWN	GRID	COMP FILE NO. 516V-1	FIGURE V-1
SCALE 1"=200'	DATE 12-21-92	FILE DRAWER NO.	
F.B. PG.	W.O. H92516		

FILE: D:\CAD\Proj\VSW - village safe water\TUNUNAK\Washeteria-Water Treatment Facility\draft\FIG A-3.dgn

TIME: 09-DEC-2010 11:52

JOB No. 1008675.040101

MWH Anchorage, Alaska

FIGURE A-3

VILLAGE SAFE WATER
TUNUNAK - WASHETERIA/ WATER TREATMENT FACILITY DESIGN

EXISTING SANITATION FACILITIES

APPENDIX B

Site Photographs Taken During the May 2010 Field Trip

Photo 1: South side of the Water Treatment Plant Washeteria Abandoned watering point drainage area (circled). Boarded-up door to boiler room. Arctic pipeline to clinic in background.

Photo 2: Detail of undermined building cribbing below abandoned watering point.

Photo 3: Abandoned watering point showing erosion of building footings. Arctic pipe from water source previously buried has been exposed.

Photo 4: Another footing eroded along south wall of water treatment plant building.

Photo 5: Discharge from filter backwash above Arctic pipes.

Photo 6: Deteriorated tank foundation.

Photo 7: Rotted window frames and replaced glass with single pane Plexiglas or plywood.

Photo 8: Rotted window frames and replaced glass with single pane Plexiglas or plywood.

Photo 9: Rotted window frames and replaced glass with single pane Plexiglas or plywood.

Photo 10: Showing disconnected drainage piping improperly sealed.

Photo 11: Boiler 2 burner showing firebox leakage and melting of combustion air inlet piping.

Photo 12: Building fuel supply tank located too close to building. Piping is not properly connected. Fill access is at rear contributes to fuel spill potential.

Photo 13: Backwash pump (foreground) and pressure pumps (only one serviceable).

Photo 14: Abandoned watering point at south side of WTP showing deterioration of insulation and building envelope. Exterior siding is visible from building interior.

Photo 15: Watering point distribution piping circulation pumps (foreground) dismantled and inoperative.

Photo 16: Exterior of Watering Point #2. Typical of all watering points.

Photo 17: Interior of Watering Point # 2. Inoperative heater at bottom of photo.

Photo 18: Valve pit of Watering Point #3. Snow packed with heat trace power and sensor wiring connections exposed.

Photo 19: Valve Pit heater for Watering Point #2.

Photo 20: Valve pit of Watering Point #2.
Heat trace power and sensor wiring.

Photo 21: Bottom of Watering Point #5 door.
Corrosion is typical of most watering points.

Photo 22: Interior condition of flooded well casing in Un-Named Creek well house.

Photo 23: Flood conditions around Un-Named Creek well house.

Photo 24: Water transmission line from Un-Named Creek well through HUD subdivision, with Paul T. Albert Memorial School in background.

Photo 25: Honey bucket bunker.

Photo 26: Overflowing honey bucket bunker.

Photo 27: Snow drifts around community watering point.

Photo 28: Musk Ox Creek Well House and water transmission line.

Photo 29: Frost heave damage to Musk Ox Well House.

Photo 30: FTH holding tank at HUD subdivision home.

Photo 31: Open stream channel upstream of existing well house on Un-Named Creek drainage near 100 feet MSL elevation.

Photo 32: Upland drainage area of exposed rock debris on Un-Named Creek drainage basin near 300 feet MSL elevation.

Photo 33: Stream channel on Un-Named Creek drainage near 150 feet MSL elevation.

Photo 34: Deteriorated 50,000-gallon bolted steel water storage tank on timber foundation.

Photo 35: WTP/Washeteria connection to water storage tank.

Photo 36: Frozen outlet in dosing tank on the In-Complete septic system.

Photo 37: FTH trailer stuck in mud at off-loading ramp on In-Complete septic system.

Photo 38: Ice blocked outlet baffle in septic tank #1 on the In-Complete septic system.

Photo 39: Open trench used for disposal of FTH hauled waste located near off-loading ramp on the In-Complete septic system.

Photo 40: Overflowing sewage in observation pipe on the drainfield serving the Washeteria, teacher housing, and school.

Photo 41: Overflowing sewage in manhole on septic tank serving the Washeteria, teacher housing, and school.

Photo 42: Exposed section of 4-inch steel well serving the former BIA school water system. Note the duct tape well cover.

Photo 43: Tununak Washeteria interior.

Photo 44: Tununak water treatment plant.

APPENDIX C

Sanitary Facility Questionnaire

MWH
BUILDING A BETTER WORLD

Sanitary Facility Survey
Tununak, Alaska 2010

House # ______

Household Owner Name ____

Number of Household Occupants ______

I. Present Water Source (Check all that Apply):

WINTER

____ Haul from BIA Well
____ Haul from Washeteria
____ Haul from River, Creek, or Lake
____ Delivered by Flush Tank & Haul
____ Other, please describe:
____

SUMMER

____ Haul from BIA Well
____ Haul from Washeteria
____ Haul from River, Creek, or Lake
____ Delivered by Flush Tank & Haul
____ Collect Rain Water
____ Other, please describe:
____

II. Present Water Consumption:

Average number of gallons per week used in household: _______ gallons

III. Present Sewage Disposal Method:

_____ Flush Tank & Haul
____ Sewage Bunker
____ Other, please describe: _______________________
____

IV. Preference for Future Sewage Disposal (Prioritize: 1 for highest, 3 for lowest):

____ Flush Tank & Haul ____ Sewer Lines ____ Honey Buckets with New Bunkers

V. Preference for Future Water Improvements (Prioritize: 1 for highest, 3 for lowest):

_____ New Washeteria _____ Piped Water _____ New Community Watering Point

---

Do you use a washing machine in your home? Circle: YES NO

Do you use the washeteria for clothes washing? Circle: YES NO

How much are you willing to pay monthly for piped water & sewer? $______ per month

How much are you willing to pay to use a Washeteria? $ ______ per load, $ ______ per shower

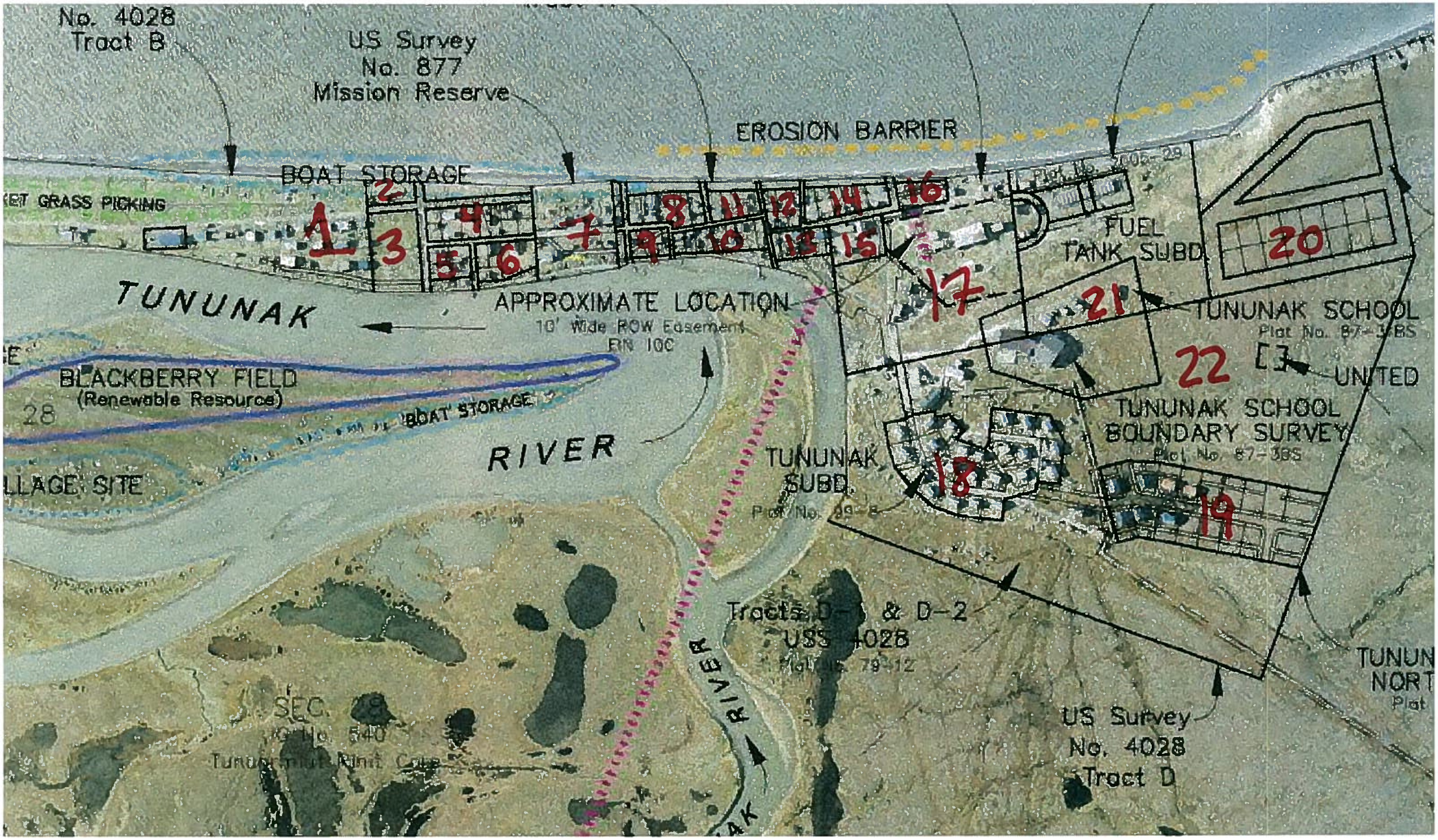
How much are you willing to pay monthly for a new watering point? $ ______ per month

Sanitary Facility Questionnaire for Tununak, Alaska 2010

Household Location (Refer to Housing Area Map)	Number of Household Occupants	Current Water Source	Household Weekly Water Use (gal/week)	Water Use Per Person (gal/day)	Current Sewage Disposal Method	Future Sewage Disposal Method (1st choice)	Future Water Improvement (1st choice)	Use Washing Machine in Home	Use Existing Washerteria	Willing to Pay Piped Water and Sewer Per Month	Willing to Pay Washeteria per Wash Load	Willing to Pay Washeteria Per Shower	Willing to Pay New Watering Point per Month	Comments
1	1	BIA Well	40	5.7	Honeybucket	Sewer Lines	New Washeteria	No	Yes	$ 50.00	$ 2.50	$ 2.00	$ 25.00	
4	1	BIA Well	20	2.9	Honeybucket	Flush Tank Haul	New Washeteria	No	Yes	open	$ 5.00	?	?	Only use creek in summer
1	8	BIA Well	20	0.4	Honeybucket	Sewer Lines	Piped Water	Yes	Yes	$ 25.00	$ 5.00	?	$ 25.00	Also use creek in summer
1	6	BIA Well	200	4.8	Honeybucket	Sewer Lines	New Washeteria	Yes	Yes	$ 100.00	$ 5.00	?	?	
1	4	BIA Well	300	10.7	Honeybucket	Sewer Lines	New Washeteria	Yes	Yes	$ 80.00	$ 2.50	?	$ 10.00	Also use rain water
1	7	BIA Well	65	1.3	Honeybucket	Sewer Lines	New Washeteria	No	Yes	$ 20.00	$ 3.00	$ 1.00	?	Also use creek in summer
1	1	BIA Well	5	0.7	Honeybucket	Honeybucket	New Water Point	Yes	Yes	?	$ 5.00	$ 5.00	?	
1	7	BIA Well	70	1.4	Honeybucket	Sewer Lines	New Washeteria	Yes	Yes	$ 50.00	$ 5.00	$ 2.00	$ 50.00	Equal Priority of New H2O
1	4	BIA Well	150	5.4	Honeybucket	Sewer Lines	New Washeteria	Yes	Yes	$ 25.00	$ 3.00	$ 1.00	$ 0.50	Equal Priority H2O/Sewer
1	7	BIA Well	12	0.2	Honeybucket	Honeybucket	New Washeteria	Yes	Yes	?	?	?	?	Equal Priority of New H2O
1	4	BIA Well	64	2.3	Honeybucket	Flush Tank Haul	New Water Point	Yes	Yes	?	?	?	?	Use creek & rain in summer
4	6	BIA Well	?	?	Honeybucket	Sewer Lines	New Water Point	Yes	No	?	$ 5.00	$ 1.00	?	
4	4	BIA Well	70	2.5	Honeybucket	Sewer Lines	New Washeteria	Yes	No	$ 100.00	?	?	$ 50.00	Equal Priority of New H2O
4	4	BIA Well	25	0.9	Honeybucket	Sewer Lines	New Washeteria	Yes	Yes	$ 25.00	$ 3.00	$ 1.00	$ 25.00	Also use rain water
4	8	BIA Well	65	1.2	Honeybucket	Flush Tank Haul	New Water Point	Yes	Yes	$ 25.00	$ 5.00	$ 3.00	$ 25.00	Also use rain water
5	1	BIA Well	3	0.4	Honeybucket	Flush Tank Haul	New Water Point	Yes	No	$ 50.00	$ 2.00	?	$ 25.00	Also use rain water & creek
7	4	BIA Well	21	0.8	Honeybucket	Honeybucket	Piped Water	No	Yes	$ 100.00	$ 3.00	$ 1.50	$ 25.00	Also use creek in winter
7	8	BIA Well	30	0.5	Flush Tank Haul	Sewer Lines	New Washeteria	Yes	Yes	?	$ 10.00	?	$ 20.00	
10	6	BIA Well	60	1.4	Honeybucket	Honeybucket	New Washeteria	Yes	Yes	?	$ 5.00	$ 1.75	?	
10	5	BIA Well	20	0.6	Honeybucket	Sewer Lines	New Washeteria	Yes	Yes	$ 25.00	$ 3.00	$ 1.75	$ 20.00	Also use rain water
10	2	BIA Well	20	1.4	Flush Tank Haul	Sewer Lines	New Washeteria	No	No	$ 25.00	?	?	?	Also favors Piped Water
10	2	BIA Well	50	3.6	Honeybucket	Sewer Lines	New Washeteria	Yes	Yes	$ 25.00	$ 5.00	?	$ 25.00	Also favors Piped Water
13	1	BIA Well	25	3.6	Honeybucket	Sewer Lines	Piped Water	Yes	No	$ 100.00	?	?	$ 50.00	
14	7	BIA Well	32	0.7	Honeybucket	Sewer Lines	New Washeteria	Yes	Yes	$ 25.00	$ 2.00	$ 1.00	?	Also uses creek & rain H2O
14	2	BIA Well	20	1.4	Honeybucket	Sewer Lines	Piped Water	Yes	Yes	?	?	?	?	Also uses rain water
15	9	BIA Well	40	0.6	Honeybucket	Sewer Lines	Piped Water	Yes	Yes	?	?	?	?	
?	2	BIA Well	5	0.4	Honeybucket	Sewer Lines	New Washeteria	Yes	Yes	?	$ 5.00	$ 5.00	$ 5.00	
6	2	BIA Well	20	1.4	Honeybucket	Sewer Lines	Piped Water	Yes	?	?	?	?	?	
11	3	BIA Well	40	1.9	Honeybucket	Sewer Lines	New Washeteria	Yes	Yes	$ 25.00	$ 2.50	?	?	
?	1	BIA Well	15	2.1	Honeybucket	Sewer Lines	Piped Water	Yes	No	$ 25.00	$ 1.50	$ 0.50	$ 5.00	
?	2	BIA Well	15	1.1	Honeybucket	Sewer Lines	Piped Water	Yes	Yes	$ 1.00	$ 5.00	$ 1.00	?	Also uses creek & rain H2O
?	2	BIA Well	12	0.9	Honeybucket	Sewer Lines	Piped Water	Yes	No	?	$ 5.00	$ 2.00	$ -	Also uses rain water
?	8	BIA Well	200	3.6	Honeybucket	Sewer Lines	Piped Water	Yes	Yes	$ 70.00	$ 30.00	?	$ 25.00	Also uses rain water
?	8	BIA Well	110	2.0	Flush Tank Haul	Sewer Lines	New Washeteria	Yes	Yes	$ 20.00	$ 10.00	?	$ -	Also uses rain water
?	3	BIA Well	50	2.4	Flush Tank Haul	Sewer Lines	New Washeteria	Yes	Yes	$ 25.00	$ 3.00	$ 1.00	?	Also uses creek & rain H2O
14	7	BIA Well	?	?	Flush Tank Haul	Sewer Lines	New Washeteria	Yes	Yes	?	$ 1.00	$ 0.50	?	Also uses rain water
?	3	BIA Well	35	1.7	Honeybucket	Sewer Lines	Piped Water	Yes	Yes	?	$ 2.00	$ 1.00	$ 5.00	Also uses creek & rain H2O
19	3	BIA Well	40	1.9	Flush Tank Haul	Sewer Lines	Piped Water	Yes	Yes	$ 70.00	$ 5.00	$ 2.00	$ 35.00	Also uses rain water
?	7	BIA Well	60	1.2	Honeybucket	Sewer Lines	New Washeteria	Yes	Yes	$ 25.00	$ 3.00	$ 1.00	$ 20.00	Also uses creek & rain H2O
?	1	BIA Well	10	1.4	Honeybucket	Honeybucket	New Water Point	No	No	?	?	?	?	
21	2	BIA Well	350	?	Septic Tank Sys	Sewer Lines	New Water Point	Yes	No	$ 50.00	$ 3.00	$ 1.50	$ 50.00	
?	3	BIA Well	20	25.0	Honeybucket	Sewer Lines	Piped Water	Yes	Yes	$ 50.00	$ 5.00	$ 2.00	$ 20.00	Also uses all sources
?	1	BIA Well	12	1.7	Honeybucket	Sewer Lines	New Washeteria	Yes	No	?	?	?	?	Only use rain H2O in summer
9	4	BIA Well	25	0.9	Honeybucket	Sewer Lines	New Washeteria	Yes	Yes	?	$ 5.00	?	$ 75.00	
?	5	BIA Well	55	1.6	Honeybucket	Sewer Lines	Piped Water	Yes	No	$ 15.00	$ 3.00	$ 0.75	$ -	Also uses rain water
6	5	BIA Well	15	0.4	Honeybucket	Sewer Lines	Piped Water	Yes	Yes	$ 100.00	$ 3.00	$ 1.50	$ 15.00	Also uses rain water
?	6	BIA Well	10	0.2	Flush Tank Haul	Sewer Lines	New Washeteria	Yes	Yes	$ 25.00	$ 5.00	$ 1.00	$ 20.00	
?	2	BIA Well	30	2.1	Honeybucket	Sewer Lines	Piped Water	Yes	Yes	$ 20.00	$ 5.00	?	$ 15.00	
?	6	BIA Well	60	1.4	Flush Tank Haul	Sewer Lines	New Water Point	Yes	No	$ 25.00	$ 1.00	$ 3.00	?	Also uses creek & rain H2O
?	5	BIA Well	20	0.6	Flush Tank Haul	Sewer Lines	Piped Water	No	Yes	?	?	?	?	
?	8	BIA Well	30	0.5	Flush Tank Haul	Sewer Lines	New Washeteria	Yes	Yes	$ -	$ 5.00	$ 1.50	$ -	Also uses creek & rain H2O
?	8	BIA Well	100	1.8	Flush Tank Haul	Sewer Lines	New Washeteria	Yes	Yes	?	$ 5.00	?	?	Also uses creek & rain H2O

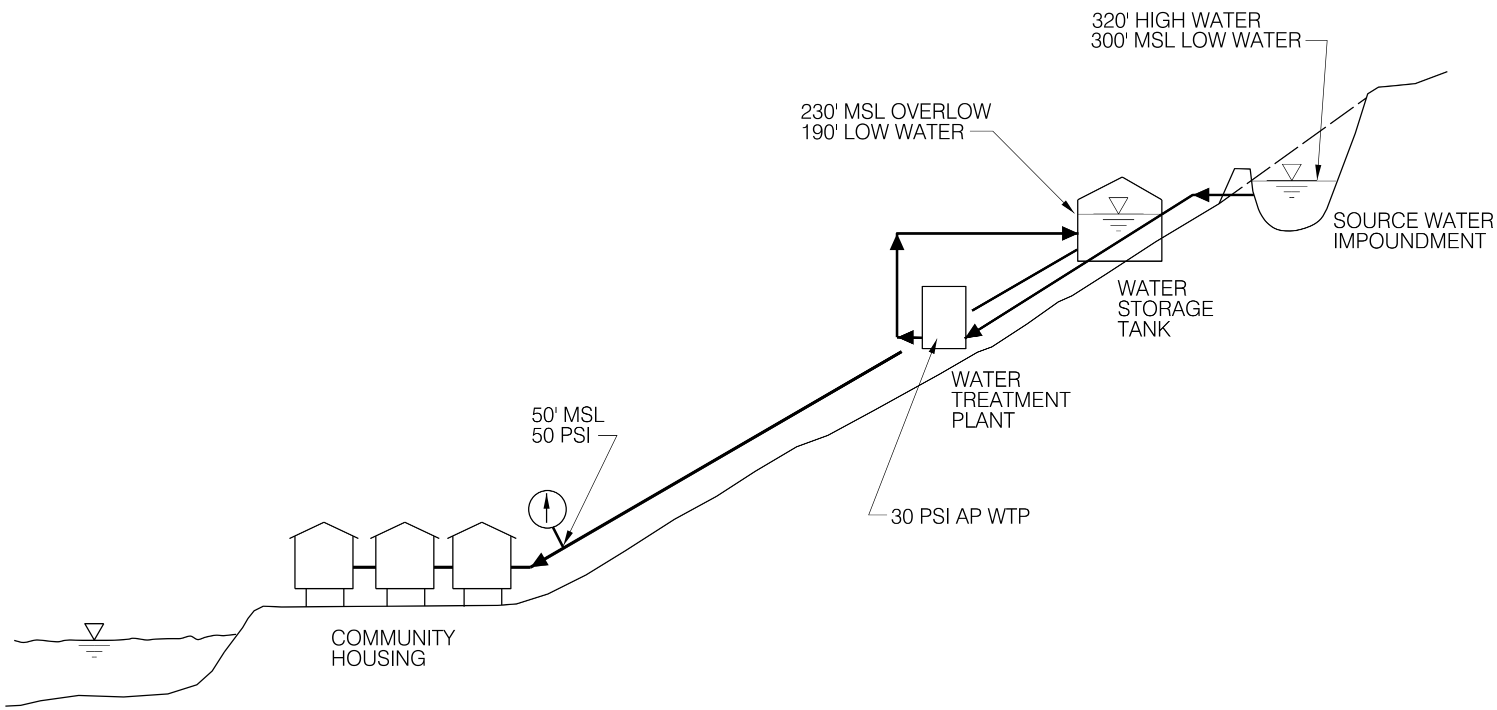
Summary of Tununak 2010 Sanitary Facility Questionnaire

Number of Househo	52
Total Persons Serve	226
Average Water Use Per Person Per Day (gal/cap/day)	2.3
Total Water Use Per Day (gal/day)	395
Well	100%
Total Honeybucket Users	40
Total Flush Tank Haul Users	11
% Desires Honeybucket	8%
% Desires Flush Tank Haul	8%
% Desires Sewer Lines	81%
% Desires New Washeteria	52%
% Desires Piped Water	33%
% Desires New Water Point	13%
% Users of Washeteria	75%
Average Monthly Cost for Willing to pay for piped water & sewer	$ 42.30
Average Cost for Willing to pay for washer load at washeteria	$ 4.68
Average Cost for Willing to pay for shower at washeteria	$ 1.69
Average Cost for Willing to pay for new watering point	$ 22.18
Adjusted % Favor New Washeteria based on lack of willingness to pay at least $100 per month for piped water system	77%


No. 4028
Tract B
US Survey
No. 877
Mission Reserve
EROSION BARRIER
BOAT STORAGE
GRASS PICKING
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
FUEL
TANK SUBD.
TUNUNAK
APPROXIMATE LOCATION
10' Wide ROW Easement
TUNUNAK SCHOOL
UNITED
BLACKBERRY FIELD
(Renewable Resource)
28
BOAT STORAGE
RIVER
TUNUNAK SCHOOL
BOUNDARY SURVEY
TUNUNAK
SUBD.
LLAGE SITE
Tracts D-1 & D-2
USS 4028
RIVER
SEC. 28
US Survey
No. 4028
Tract D

APPENDIX D

Figures



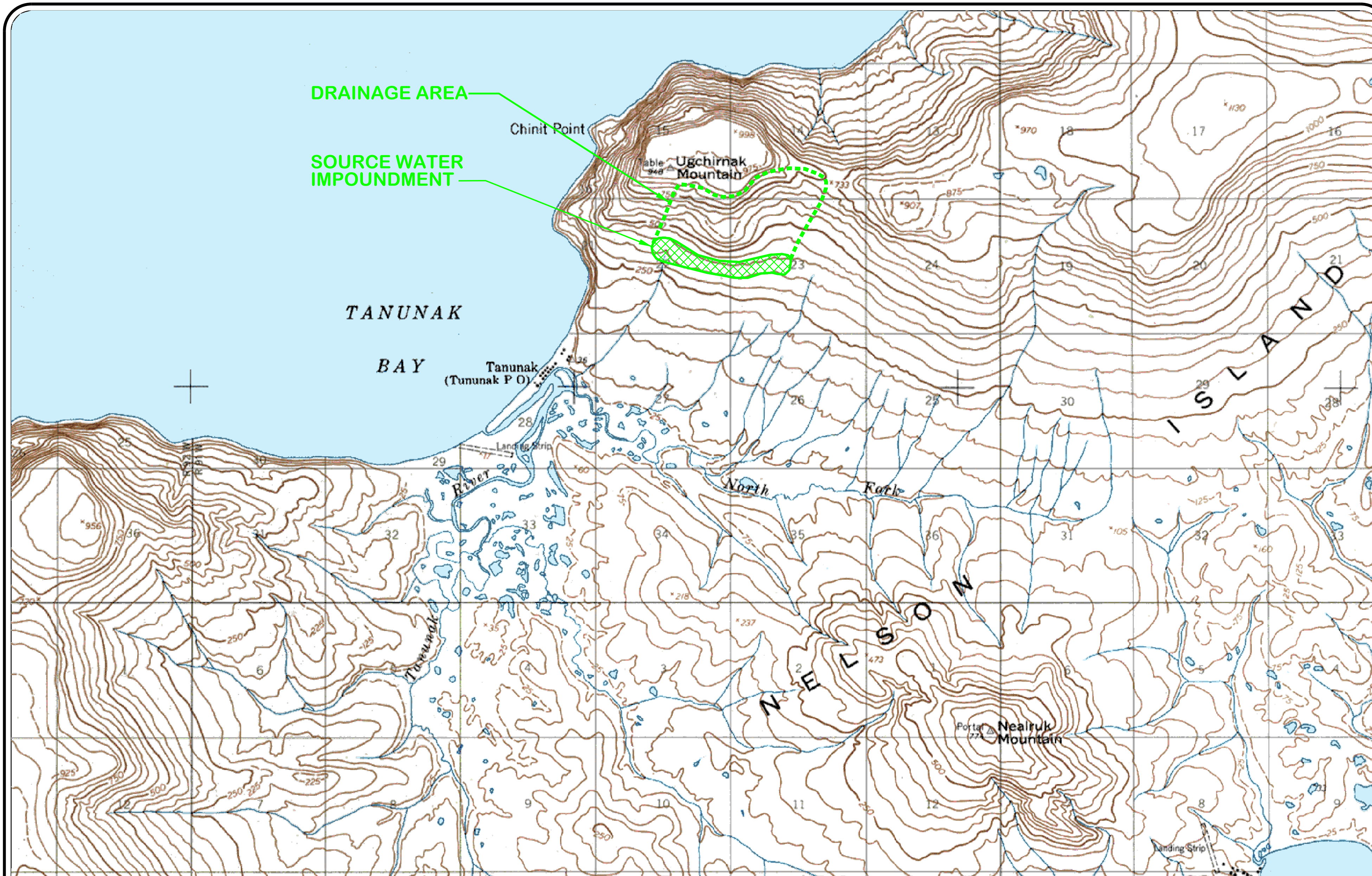
MWH
Anchorage, Alaska

FIGURE D-1

VILLAGE SAFE WATER
TUNUNAK - WASHETERIA/ WATER TREATMENT FACILITY DESIGN

PROPOSED SURFACE WATER IMPOUNDMENT AT 300 FEET MSL

JOB No. 1008675.040101 TIME: 11-NOV-2010 14:30 FILE: D:\CAD\Proj\VSW - village safe water\TUNUNAK\Washeteria-Water Treatment Facility\draft\FIG D-2_topographic map.dgn



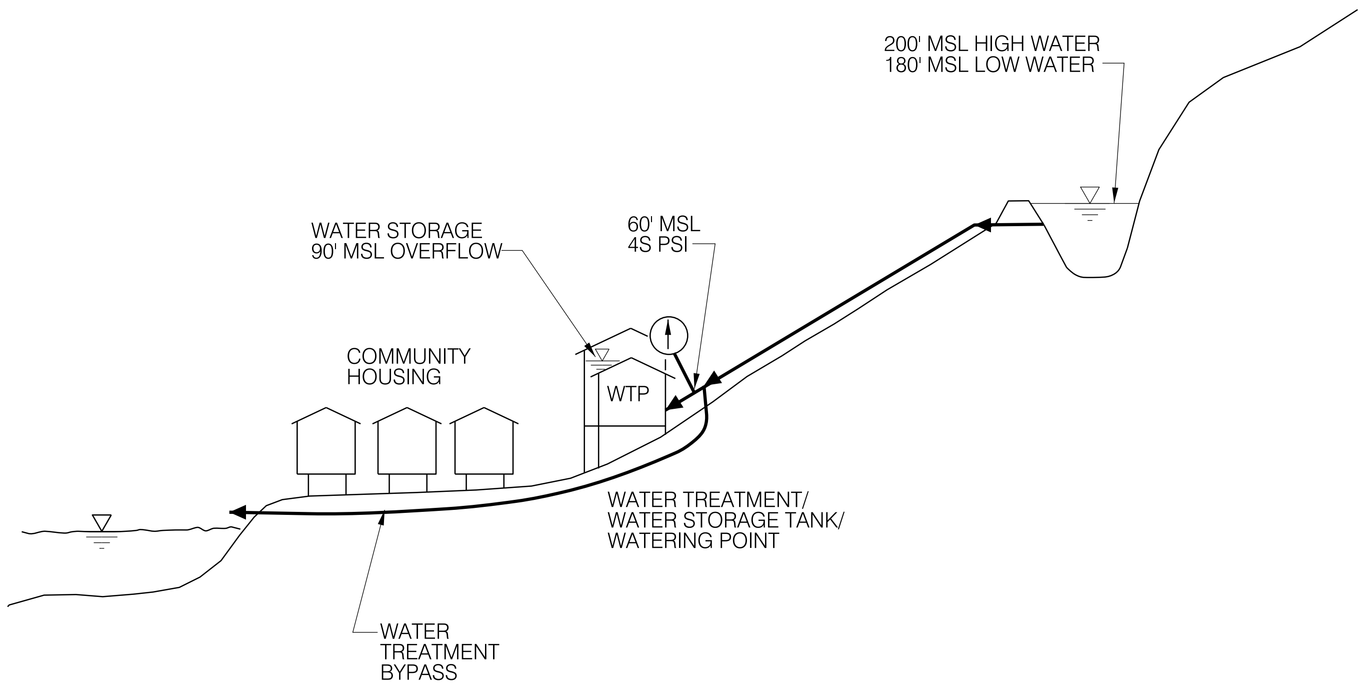
MWH
Anchorage, Alaska

FIGURE D-2

VILLAGE SAFE WATER
TUNUNAK - WASHETERIA/ WATER TREATMENT FACILITY DESIGN

TOPOGRAPHIC MAP OF PROPOSED SURFACE WATER IMPOUNDMENT

JOB No. 1008675.040101 TIME: 11-NOV-2010 14:31 FILE: D:\CAD\Proj\VSW - village safe water\TUNUNAK\Washeteria-Water Treatment Facility\draft\FIG D-3_water source upstream.dgn



MWH
Anchorage, Alaska

FIGURE D-3

VILLAGE SAFE WATER
TUNUNAK - WASHETERIA/ WATER TREATMENT FACILITY DESIGN

PROPOSED SURFACE WATER SOURCE UPSTREAM ON UN–NAMED CREEK

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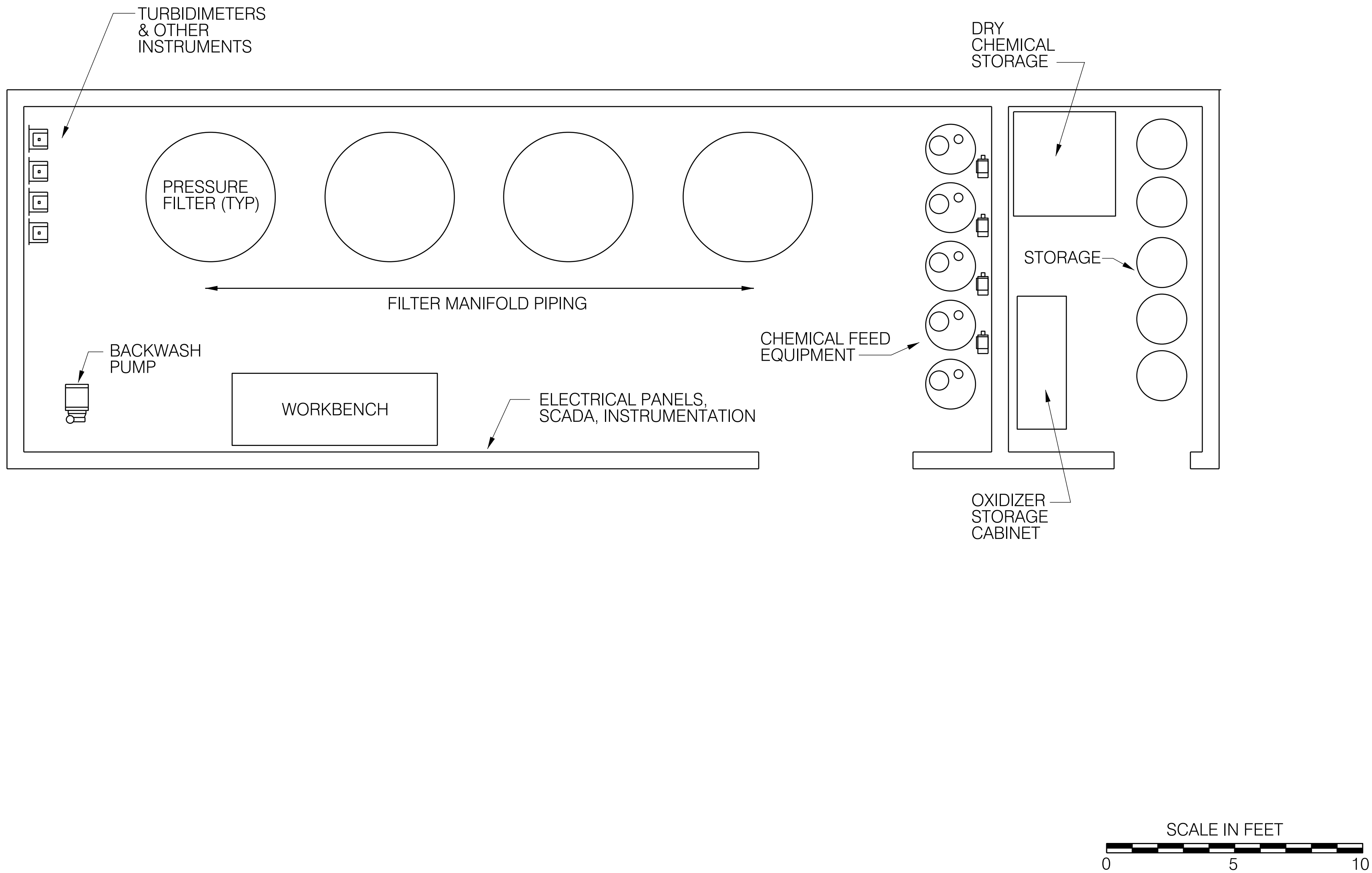

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FIGURE D-4

VILLAGE SAFE WATER
TUNUNAK - WASHETERIA/ WATER TREATMENT FACILITY DESIGN

CONCEPTUAL LAYOUT OF DIRECT FILTRATION TREATMENT SYSTEM

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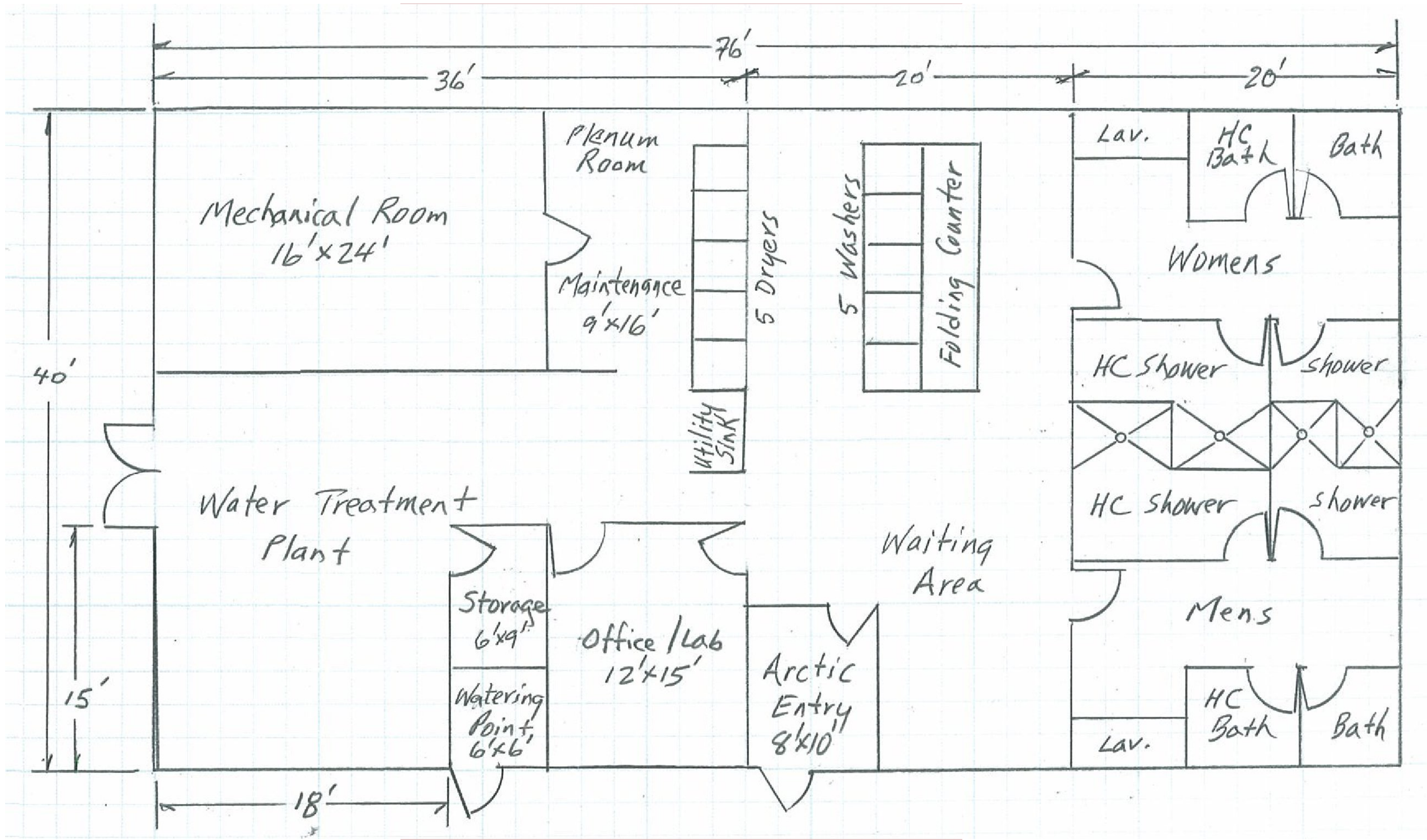

WASHETERIA = 3,040 SF

SCALE IN FEET
0 10

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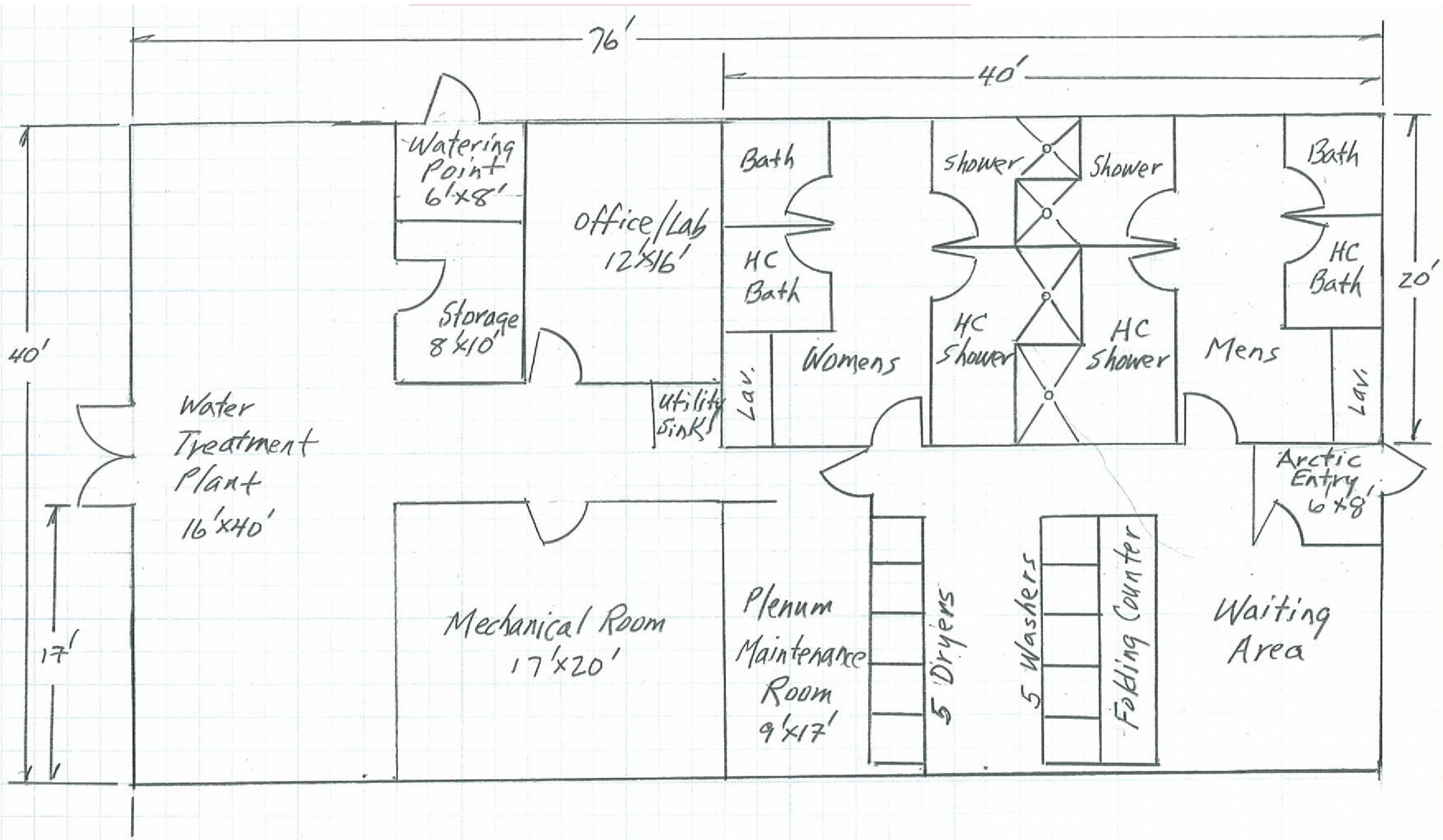
FIGURE D-5

VILLAGE SAFE WATER
TUNUNAK - WASHETERIA/ WATER TREATMENT FACILITY DESIGN

WATER TREATMENT PLANT & WASHETERIA (ALTERNATIVE #1)

JOB No. 1008675.040101 TIME: 11-NOV-2010 14:32 FILE: D:\CAD\Proj\VSW - village safe water\TUNUNAK\Washeteria-Water Treatment Facility\draft\FIG D-6_waheteria - alt 2.dgn



WASHETERIA = 3,040 SF

SCALE IN FEET
0 10

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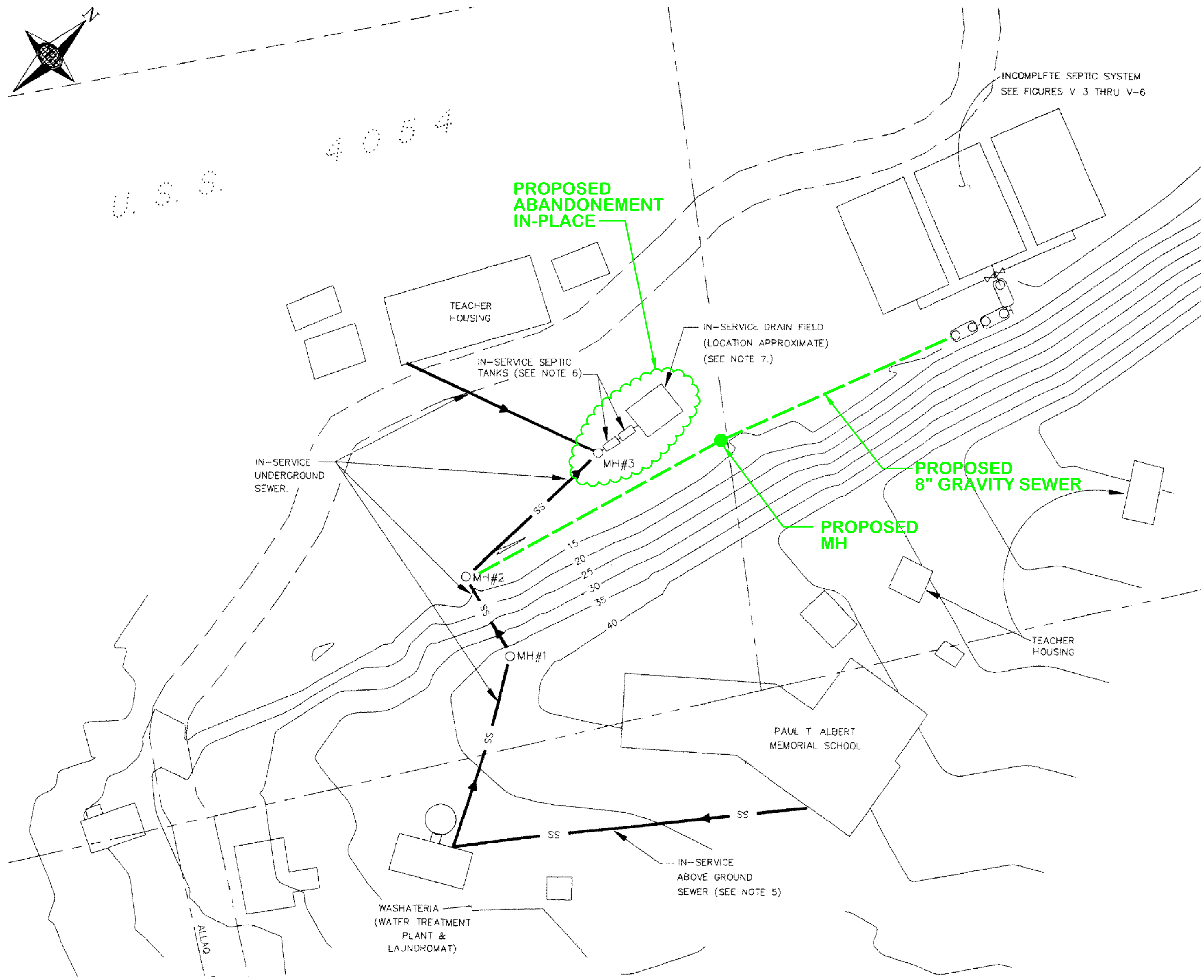
Anchorage, Alaska

FIGURE D-6

VILLAGE SAFE WATER
TUNUNAK - WASHETERIA/ WATER TREATMENT FACILITY DESIGN

WATER TREATMENT PLANT & WASHETERIA (ALTERNATIVE #2)

JOB No. 1008675.040101 TIME: 11-NOV-2010 14:32 FILE: D:\CAD\Proj\VSW - village safe water\TUNUNAK\Washeteria-Water Treatment Facility\draft\FIG D-7_septic system.dgn



NOT TO SCALE

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FIGURE D-7

VILLAGE SAFE WATER
TUNUNAK - WASHETERIA/ WATER TREATMENT FACILITY DESIGN

PROPOSED SEWER IMPROVEMENTS FOR ON–SITE SEPTIC SYSTEM