DESIGN ANALYSIS REPORT

TULUKSAK WASTEWATER COLLECTION & DISPOSAL

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SEPTEMBER 2010

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Executive Summary

This Design Analysis Report (DAR) provides detailed information for each design element required to complete the Tuluksak wastewater collection, treatment, and disposal system. The system will provide piped utility service to the existing serviceable 53 homes, five commercial facilities, and structures that will be constructed during the 20-year design horizon at Tuluksak, Alaska. Design rationale, proposed configuration, permitting, construction phasing, and detailed project costs are included in the report.

In this process, feasible options were identified and evaluated to determine the most appropriate design for Tuluksak.

Components of the proposed system include:

- 9,400 linear feet (lf) of buried gravity wastewater collection system designed for sub-arctic conditions in rural Alaska.
- Two sewage pumping or “lift” stations and 4,252 lf (3,740 + 512) of force main piping with provisions for freeze protection.
- Two-cell, 4-acre wastewater treatment facility that provides a lined wastewater treatment cell and percolation cell with no discharge to surface waters.
- Replacement of the existing honeybucket dump site with a new facility at the wastewater lagoon to allow free flow of liquids to the treatment cell and periodic removal of solids.

The work is divided into five phases of construction that allows a systematic transition from existing limited honeybucket services to the proposed fully piped system. The phases of system development are discussed in detail and shown in *Figures 1 through 4*, provided in the Figures tab. *Figure 5*, Wastewater Collection System Layout, shows detailed collection system configuration and approximate depth of bury of system components. *Figure 6* presents the Survey Control Drawing and *Figure 7* shows the Housing Summary Table and Map. The total estimated cost of the wastewater improvements is $7.7 million (in 2009 dollars).

Geotechnical investigations, site control documents, permits, design analysis and calculations, specifications and manufactures data sheets and, cost estimates are included in the appendices at the end of this report.

For cost estimating purposes, the DAR assumes a systematic construction of a wastewater collection system concurrently with related piped water distribution system improvements, serving the same areas within the community.

Section 1 - Introduction

1.1 Scope

The Tuluksak Wastewater Collection and Disposal DAR provides engineering analysis (design rationale, design criteria, and design computations and analysis) for design of the proposed wastewater collection, treatment, and disposal system for the Tuluksak Native Community (TNC). The DAR addresses applicable design elements such as wastewater collection piping, lift station locations and sizing, pumping and horsepower calculations, thermodynamic calculations, power requirements, hydraulic calculations, treatment design calculations, capital and operating cost calculations, and pipeline sizing.

A Sanitation Facilities Preliminary Study Supplement #1 dated January 2000 and a Preliminary Engineering Report (PER) dated June 2006 presented some of these elements. These reports provided the framework for the proposed piped utility system and included a detailed wastewater collection system configuration that was approved by TNC.

The DAR will further develop the conceptual design described in the PER by analyzing and documenting the design approach, design requirements, and construction considerations. The DAR establishes the design criteria. In addition, the DAR will document site control, construction and operating permits, construction schedule including phases of construction, capital, and operation and maintenance cost estimates.

The final DAR is the decision document for the project and the basis of the final project design.

Section 2 - Background

Residents of the Kuskokwim River community of Tuluksak (population 471, 2009 State estimated) obtain water for in-home use by hauling buckets from the community watering point, collecting rainwater, or from natural water bodies. Human waste generated in the home is collected in "honeybuckets" (five gallon plastic pails lined with plastic bags). Laundry and showers are available at the community washeteria. Solid waste is hauled by residents to an open dump at the edge of town.

The Village Safe Water (VSW) Program completed a Sanitation Facilities Preliminary Engineering Study for Tuluksak in June 1995. At that time, the Community did not reach a consensus on the best option for improved sanitation. A truck haul system or piped utilities were being considered.

In June 1999 CE2 Engineers, Inc. (CE2) was retained by TNC, under a $25,000 grant from the VSW Program funded by EPA 1994 Indian Set-Aside Funds, to provide technical advice on sanitation options and to facilitate community selection of a preferred sanitation option. The truck haul system and piped utilities were examined in detail. Other options, including on-site wells and septic tanks were briefly reviewed, but rejected.

Members of a local study team traveled to St. Mary's and Napakiak to observe the operation of a piped system and a haul system.

Concepts were developed for serving the entire community by truck haul and by piped utilities. A preliminary piped water and sewer system layout drawing was developed. Component elements for both types of systems were identified and defined. Capital and operation and maintenance (O&M) costs were estimated.

The community passed a resolution to close the individual honeybucket pits and implement a community wide honeybucket haul system, as an interim measure, until the piped utility system can be completed.

In the fall of 2000, TNC approved a plan to co-locate their power plant, bulk fuel storage, community water source, water treatment plant, and water storage tank to an area approximately one-quarter mile south of the community. This area is now known as the utility core site. A piped wastewater collection system and disposal lagoon located approximately 1,000 feet east of the utility core site was also selected.

A lease agreement for the utility core site, from the property owner Tulkisarmute, Inc. to TNC has been signed and recorded. Refer to Section 7 – Site Control for details.

Additionally, on June 2, 2010 the TNC passed a resolution to re-locate the proposed lagoon further south of the community. The TNC decided it would be prudent to move the proposed lagoon further from the developed community as a new airport road has been built and future housing developments have been identified nearer the previous proposed lagoon site. This decision is discussed in detail in Section 7.

Currently, only limited wastewater collection services are available within the community. Existing services include:

Honeybucket wastewater collection system with self-haul to collection points scattered throughout the community. Collected wastes are transported by TNC in 80-gallon HDPE (high density polyethylene) containers to a honeybucket disposal pit located approximately 2,000 feet south of the community.

A washeteria constructed in the 1980's provides wastewater services (toilets, shower, and laundry) to community residents. Wastewater is transported from the facility through a 700 lf 4-inch above ground arctic gravity sewer main and disposed in a percolating wastewater lagoon, directly south of the community and adjacent to the community garbage dump site.

The Yupiit School District (YSD) operates a percolating wastewater lagoon directly east of the school facility and near existing residential housing.

2.1 Location

Tuluksak lies on the south bank of the Tuluksak River approximately 1.5 miles upstream of its junction with the Kuskokwim River. The village is 35 miles northeast of Bethel (Sec. 27, T012N, R066W, Seward Meridian). Tuluksak lies at 61.1025° north latitude and 160.96167° west longitude and is located in the Bethel Recording District.

2.2 Existing Conditions

The overall condition of the existing wastewater collection system is poor. Many of the existing honeybucket collection bins are missing lids that prevent wastewater from splashing out during transport. The bins are unsanitary and are not cleaned often. The bin haul trailer and metal frames are rusted and show signs of field repairs.

The poorly restrained 4-inch above ground gravity drain from the washeteria to the sewage lagoon has failed at gasketed couplings approximately six times during the past eight years. When this occurs, wastewater is discharged into the adjacent traveled way. The drain has also plugged causing wastewater to flood the water treatment plant and washeteria facility.

While both the school and the washeteria lagoon are still percolating, neither is permitted and both are completely overgrown with brush and trees up to 6-inches in diameter. Due to their small size, neither lagoon is adequate to allow the expansion of the collection system. The two lagoons are located close to the developed areas of the community and should not be expanded.

2.2.1 Geotechnical

Tuluksak lies on the south bank of the Tuluksak River at its junction with the Kuskokwim River. The undisturbed areas are forested with black spruce, some mature white spruce, and willow brush. The village itself is partially forested.

General near surface geology at the site is primarily the result of reworked floodplain deposits. A thin layer of organic soil overlays the silt or silty sand at depth. Discontinuous permafrost is present throughout the project area and was found in approximately 20 percent of the test pits. Where permafrost was encountered, it was normally at a depth of 8 feet or greater and the material was generally dense sand.

The groundwater level generally matches the river water surface level, in thawed areas. The record flood level is elevation 30.23 feet (see Section 3.2.1 Survey). Soils are suitable for direct bury piping; however, running sands may be encountered when digging below the water table. The water table fluctuates with the river level and normally varies between elevation 10 and 15 feet. The proposed sewer system, other than the lower portion of the lift station wet wells, will be constructed above the water table and thereby require minimum dewatering and should not encounter running sands during construction.

The Tuluksak area has silty-sand fill material available for the construction of the lagoon embankments. In 2003 Duane Miller Associates (DMA) collected a material sample from the existing borrow site and tested its gradation. The results show the fill material is silty, fine-grained sand with slightly over 12 percent finer than the 0.02 mm size. DMA's report of the 21 test pits along the utility corridor alignments, other logs and findings, is attached in Appendix A. Additional information describing the borrow site and fill material is discussed in Section 8.

DMA's geotechnical investigations in October 2003 and December 2004 determined that the proposed utility core site contained several areas of discontinuous or remnant permafrost. However, nothing was found to indicate that buried utilities would not function well.

In March 2010 the community requested relocation of the proposed lagoon. Additional soils and percolation testing was completed in April 2010 for an alternate lagoon site.

Excerpts from the Tuluksak Alternate Wastewater Lagoon Site Soils Investigation Data Summary Report July 2010 and other geotechnical reports referenced here are attached in Appendix A.

2.2.2 Climate

Annual precipitation averages 16 inches in the Tuluksak area, with snowfall of 50 inches and approximately 12 inches of pan evaporation. Summer temperatures range from 82° to 42° Fahrenheit; winter temperatures range from 40° to -42°.

Weather conditions appear to be getting warmer. In 1999, Duane Miller Associates (DMA) reviewed the climate records for 15 different weather stations in Alaska including Bethel. At each station DMA found a significant warming after 1977. For Bethel the average annual temperature after 1977 is 2°F warmer than for the previous 30 years. Table 2.1 compares climatic data for the Kuskokwim Bay area from the Environmental Atlas of Alaska by Hartman and Johnson (1978), with values DMA recommended for Tuluksak based on their 1999 analysis:

Table 2.1: Comparison of Climatic Data for Tuluksak, Alaska

Index	H & J, 1978	DMA, 1999
Average Air Temperature	30.0°F	31.5°F
Average Freezing Index	2600°F-days	2100°F-days
Design Freezing Index	3800°F-days	3800°F-days
Average Thawing Index	2300°F-days	2500°F-days
Design Thawing Index	3200°F-days	3400°F-days

2.3 Project Summary

The transition to a piped utility system will be constructed in four phases as described below.

Phase I: Wastewater service to the core area (see *Figure 1*). The project scope includes:

- Two-cell facultative wastewater lagoon and disposal facility
- Construction of a 2,630 lf by 14 ft wide lagoon access/maintenance road
- Construction of a new honeybucket dump site as part of the lagoon construction and closure of the existing dumpsite.

Phase II: Wastewater service to the community core area (see *Figure 1*) includes:

- Primary community lift station (Lift Station #1) and 3,540 lf force main (Force Main #1) from the lift station to the new lagoon, with a hydronic heat trace and waste heat recovery system from the TNC power plant
- 1,350 lf of buried gravity wastewater collection main from the community core area to Lift Station #1
- 512 lf force main (Force Main #2) from near the school to the gravity collection line flowing to Lift Station #1.
- Five (5) sewer service lines to the washeteria facility, clinic, construction camp, and community center, and the store
- Closure of existing washeteria and school wastewater disposal lagoons

Completion of Phase II wastewater system improvements will provide wastewater service to part of the central housing area. It will also allow removal of the existing dilapidated aboveground wastewater piping from the washeteria to the community lagoon. These wastewater improvements are not dependent on any other sanitation system upgrades and will be fully functional when they are installed.

Phase III: Wastewater collection service to the central housing area (see *Figure 2*). The project scope includes:

- 2,950 lf buried arctic gravity sewer main
- 26 sewer service lines
- 26 house plumbing upgrades

Operation of the Phase III wastewater collection system upgrades depend on completion of water system upgrades to provide piped water service to the central housing area served in this phase.

Phase IV: Wastewater collection service to the west and east housing areas (see *Figure 3*). The project scope includes:

- 4,200 lf buried arctic gravity sewer main
- Lift station (Lift Station #2)
- 27 sewer service lines
- 27 house plumbing upgrades

Operation of the Phase IV wastewater collection system upgrades is dependent upon completion of water system upgrades to provide piped water service to the same service area

Phase V: Wastewater collection service to the existing runway (after completion of the new airport facility, see *Figure 4*). The project scope includes:

- 900 lf buried arctic gravity sewer main

The Phase V wastewater collection system upgrade depends on completion of new housing and water system upgrades to provide water service to the old airport runway area. It is assumed the developer will provide the required house plumbing and sewer services lines to connect to the TNC wastewater collection system.

With completion of the expansion of the core system to the west and east housing areas (Phase IV) nearly all of the existing eligible houses will receive piped wastewater collection service, including house plumbing improvements. It is expected that only eligible houses that request service will be served. This is estimated to be approximately 90 percent of the total eligible houses. Houses that are not adjacent to the proposed collection system will not be served due to the high cost of the service to a single house, elevation differences requiring pumping, and the increased potential for freezing due to low flows. Figure 5 shows the entire system proposed to be constructed.

Note: It is assumed associated water distribution facilities will be constructed concurrently with wastewater improvements to provide full service to utility customers. This activity is not detailed in the wastewater DAR.

Section 3 - Design Requirements and Considerations

3.1 Treatment and Regulatory Requirements

According to State of Alaska, Department of Environmental Conservation (ADEC) Lagoon Construction Guidelines, a wastewater treatment and disposal lagoon system should meet the following requirements:

- Service life shall be a minimum of 20 years
- 5-day biochemical oxygen demand (BOD_5) of 38 lbs/acre-day maximum loading rate of the treatment cell. (Provided by ADEC, April 2009)
- Total suspended solids (TSS) and BOD_5 removal of 85% or greater
- Minimum hydraulic retention time of 40 to 60 days
- Erosion protection and revegetation is required on both the interior and exterior areas of the dike structure
- Nitrate monitoring of the discharge from a percolation cell

3.2 Site Civil and Geotechnical

On February 14, 2005, DMA completed a geotechnical investigation of:

- Utility core site area
- Sewer and water alignments throughout the community
- Wastewater treatment area/proposed sewage lagoon site

The August 19, 2005 report by DMA amended the February 2005 report and recommended the foundation system for the future water treatment plant and water storage tank. Both reports are attached in Appendix A. Organic material found near the surface should be removed and not allowed to contaminate any materials used beneath the proposed piping as bedding material. A bearing pressure of 2,000 pounds per square foot can be used for sustained loads. DMA found discontinuous permafrost exists throughout the community and determined the soils are suitable for direct bury arctic piping.

3.2.1 Survey

A detailed control survey was completed in 2005 and is attached as *Figure 6*. During this work, the US Army Corps of Engineers flood water gauge was measured as:

High Water Mark Elevation: 30.23 Feet

Recommended Building Elevation: 32.23 Feet

The basis of vertical control is brass capped Bureau of Land Management monument marking corner #2, US Survey 875, Tract B as 23.63 feet.

While a detailed building elevation survey has not been completed, most of the homes in the central and easterly portions of the community are well above the recommended building elevation. Most of the homes located in the westerly part of the community near the existing runway have flooded and are likely constructed below the recommended building elevation.

3.3 Structural, Electrical, and Mechanical

3.3.1 Building Heating Loads and Details

Lift station structures should be equipped with an electric resistance heater that is only operated for freeze protection. Assuming use of the standard VSW/ANTHC lift station structure design, the walls are constructed with R-21 insulation and the roof with R-38. Using 1500-watt electric resistance heaters, the total heat loss is calculated as 34,000 MBtu/hr/year (34,000,000 Btu/hr-year).

All other heating loads will be associated with emergency thawing and freeze protection of the force main during very low flow periods.

3.3.2 Electrical Loads

Electrical wastewater collection loads will be limited to lift station effluent pumps, heaters, lights, receptacles, and fans. At both lift station sites, three-phase 208 Volt AC power is available.

The total instantaneous electrical load at each lift station is estimated to be less than 20,000 volt-amps (VA). The load summary is as follows:

Load	Equipment
13,000 VA	Pump Control Panels
2,800 VA	Heaters
1,100 VA	Lights
240 VA	NEMA 7 Supply Air Fan (wet well room)
1,000 VA	NEMA 1 Supply Air Fan (control room)
900 VA	Receptacles
19,040 VA	Total Maximum Instantaneous Load

Section 4 - Wastewater Collection

4.1 Service Area

The proposed gravity sewer collection system, as shown in *Figure 5*, will serve most existing occupied structures capable of being served by piped gravity sewer in Tuluksak. Homeowners who request utility service and are adjacent to the wastewater collection system will be served by this project.

Additional housing is planned to be constructed near the existing Tuluksak River Subdivision and possibly along the old airport runway. The collection system will be capable of serving these areas.

The 2000 Sanitation Facilities Preliminary Engineering Study concluded that a piped utility system was the preferred option for providing wastewater service at Tuluksak. It was understood that it will not be possible to serve every structure. It is not cost effective to serve the most outlying houses; the length of collection piping required cannot be justified for single houses. Also, the potential for freezing of that portion of the collection system is increased with very low flows.

4.2 Design Life

All major system components shall be sized to meet future demands and constructed with materials and methods for the expected 20-year design life. The 20-year design horizon will begin based on year 2010, and the end of the horizon will be year 2030.

4.3 Design Population

The population history (from the U.S. Census) for Tuluksak is provided below.

Year	Population
1880	150
1890	62
1900	0
1910	0
1920	73
1930	96
1940	88
1950	116
1960	137
1970	195
1980	235
1990	358
2000	428

Census data is used as an indicator of the annual population growth rate. The design population annual growth rate (i) is set at 1.5%. Year 2000 population was certified by the State of Alaska Department of Commerce and Economic Development (DCED) at 428 persons.

- For year 2010, population P2010 = P2000 x $(1 + i)^n$ = 428 x $(1 + 0.015)^{10}$ = 497 persons
- For year 2030, population P2030 = P2000 x $(1 + i)^n$ = 428 x $(1 + 0.015)^{30}$ = 669 persons

4.4 Average Daily Per Capita Demand and Wastewater Flow

Based upon water consumption data from other communities in western Alaska, 50 gallons per capita per day (gpcd) was selected as the average daily water demand. For the purposes of this DAR consumptive use of water (lawn watering/car washing) will be considered minimal. Therefore, it will be assumed that the amount of wastewater generated in the community is equal to the amount of domestic water used. This would equal 23.2 GPM or 33,450 gallons per day in the design year of 2030.

4.5 Peak Hourly Wastewater Flow

The peak hourly wastewater flow is calculated as:

Q_{2030PK} = PF * $Q_{2030\ Avg}$

Where:

Q_{2030PK} = Peak hourly flow rate at year 2030, gallons per minute

PF = Peak hourly flow factor, 3.9 (from the Wastewater Facilities Design Standards - 2003, Chapter 18C, Appendix 12-A)

$Q_{2030\ Avg}$ = Average Daily Wastewater Produced

Q_{2030PK} = 3.9 * 23.2 GPM = **90.5 GPM**

4.6 Design Criteria and Design Assumptions

4.6.1 Collection System Types

Several types of wastewater collection systems were considered for Tuluksak. These include:

- Haul – The existing self/community wastewater haul system was considered and rejected during the 2000 planning effort. After discussing a haul system and a piped utility system, the community unanimously selected a piped wastewater collection (and water distribution) system to best serve the needs of the community.
- Gravity – A gravity wastewater collection system is a simple method for collecting wastewater and requires no moving parts. Sewer components are normally buried and include pipes placed at constant slope with access points or manholes at each intersection or change in direction. Manholes and or clean-outs are spaced no greater than 400 lf intervals and allow for monitoring of the systems performance and access ports for system operators to clean the system. Maintaining a constant slope of all system gravity piping, usually with a minimum grade that provides at least two feet per second flow velocity when the pipe is flowing full is critical to providing trouble-free system performance.

  Wastewater will flow to the lowest point in the system which is typically the wastewater treatment and disposal area and the sewer main is generally only partially full.

- Gravity with effluent pumping stations – When using a gravity collection system, the site specific topography must be carefully considered. Normally, there is a practical limit, based on the equipment available and the construction technique for how deep a sewer main is buried. When this depth is exceeded, wastewater is pumped or “lifted” to the next high point through a pressure sewer main (force main) where gravity flow to the next low point begins.

Effluent pumping stations or lift stations are equipped with specialized pumps capable of passing solids, and control equipment. Pumps normally cycle on and off pumping effluent out of the station at a sufficient rate to create scour velocities in the pressure sewer main. The cycle rate of the pumps is in direct relationship to the wastewater flow rate in the system.

- Pressure – Pressure sewer systems normally use smaller wastewater pumping stations at each home or cluster of homes that pump wastewater into a common pressure sewer main. Grade of the pipe and minor variations in elevation are not critical.

  Wastewater flow only occurs when actively being pumped and scour velocities to keep solids from settling out does not normally occur.

- Vacuum – Vacuum systems use mixed air and water to transport wastewater.

The selected system is gravity sewer with effluent pumping stations. The topography of Tuluksak does not allow a full gravity system, and the use of a more complex pressure sewer or vacuum system is not warranted. Maintaining grade on the sewer system is not expected to be a problem.

4.6.2 Selected Collection System Configuration

The proposed wastewater collection system, presented in *Figure 5*, was carefully developed using actual ground topography, collection system service area, depth of bury and placement of effluent pumping stations through this process, it was determined that using primarily gravity wastewater collection and two strategically placed effluent pumping stations and associated force mains would provide piped wastewater collection to the community. A spreadsheet detailing the manhole depths and reaches is provided in Appendix D. Previous proposed system layouts varied and showed up to four effluent pumping stations.

Future housing areas and development patterns have been addressed. Assumptions should be reviewed at each future design phase.

4.6.3 Component Type, Sizing and Installation Parameters

- Arctic sewer and force main piping – A composite aluminum-jacketed pre-insulated arctic pipe with polyurethane foam insulation and HDPE (PE 3409) core pipe section meeting the VSW/ANTHC standard specifications for an arctic sewer main is recommended. (Note: An HDPE-jacketed pipe was considered but rejected in favor of the more robust aluminum-jacketed pipe.) Sample specifications are attached in Appendix E.
- Depth of Bury – The depth of bury for gravity sewer main will vary. For the silty soils found in Tuluksak, with a recommended sustained soil-bearing pressure of 2,000 pounds per square foot, a minimum of three feet of cover should be provided where normal vehicle loading is expected (AASHTO H-20 based on an axle load of 32,000 pounds or 16,000 pounds distributed over the tire contact area).
- Empirical testing completed by ANTHC (ca. 2000) found that the composite arctic pipe section was very robust and reacted similarly to 16 gauge corrugated aluminum pipe. In addition, the Cold Regions Utilities Monograph, Third Edition, Section 9.4.1, Page 9-11 recommends a minimum depth of bury of 12 inches,

which is consistent with most corrugated pipe suppliers minimum recommended depth of bury.

- Gravity sewer mains shall have a minimum diameter of eight inches with a minimum slope of 0.4%, per the Great Lakes-Upper Mississippi River Board of State and Provincial Public Health and Environmental Managers (GLUMRB) "10-States" Recommended Standard for Wastewater Facilities, Chapter 30 Design of Sewers [The capacity of an 8-inch gravity sewer main at 0.4 percent grade, flowing full, is approximately 389 GPM. This is more than adequate to meet the highest peak demand of 90.5 GPM. See the design calculations in Appendix D.
- While sewer main placed at 0.4 percent grade has more than adequate capacity, melting permafrost and potential thaw settlement may cause local areas to deflect. To counteract this, the grade of the proposed sewer was increased from a minimum of 0.4% to 0.5%. And in certain areas where the cover allowed the grade was increased to 0.7%. Multiple iterations balancing the sewer grade and depth of bury were completed to obtain the best overall fit for the wastewater collection system.
- Gravity sewer service lines shall have a minimum diameter of four inches (local standard) and placed at a 2% slope per the 2003 Uniform Plumbing Code, Section 708.0.

4.6.4 Collection System Freeze Protection

- Wastewater temperatures vary but generally range between 50-59°F (Cold Regions Utilities Monograph, Third Edition, Section 9.4.1, Page 9-10).
- Ambient soil temperature will vary with the winter air temperatures, depth of bury, and snow cover. Using the Design Freezing Index of 3,800°F days and a 36-inch depth of bury, soil temperature is calculated to be no colder than 15°F. Using these conditions, the arctic sewer main will lose less than 5 Btu/LF-Hr.
- All sewer main joints shall be sealed and pressure-tested to ensure water tightness. A four pounds per square inch (psi) air test is common. Hydrostatic tests are also used.
- Manholes shall be fully sealed and insulated with a minimum of four inches of polyurethane foam to 30 inches above the invert. Manholes should be placed on four inches of extruded 40 psi minimum polystyrene board foam. (Per VSW/ANTHC standard design specifications.

4.6.5 Residential Plumbing

Residential plumbing will consist of industry standard gravity type fixtures and ABS drain-waste-vent (DWV) plumbing. Houses generally require a custom installation that uses standard gravity or pressure assisted flush toilets (1.6 gallons per flush), five-foot tub or shower with integral surround, lavatory sink, kitchen sink, and where practical, a hook-up for a washing machine.

Extreme caution should be used when evaluating the proposed plumbing layout. Inspection of the home should include:

- Type and quality of house construction

- Floor elevation relative to existing ground and the estimated flood elevation
- Heat source (Many funding agencies require a thermostatically-controlled heat source.)

Areas to avoid when selecting plumbing improvements include:

- Plumbing along exterior walls
- Plumbing in semi-heated areas
- Floor penetrations near any P-trap
- Unvented concealed plumbing

Vents located near the floor and ceiling that induce warm air circulation near the plumbing are generally required. Active circulation is required in certain installations.

4.6.6 Lift Station

Duplexed submersible pump lift stations with a single wet well are proposed to be constructed. Electrical controls will be located above the Corps of Engineers (USACE) recommended building elevation (Elev. 32.23), and meeting the VSW/ANTHC standard lift station design. System curves and proposed pump selections for Lift Stations 1 and 2 are included in Appendix D

- Minimum lift station effluent pump run time: one minute (two minutes preferred), and an average of less than four starts per hour.
- Pump OFF, Lead Pump ON, Lag Pump ON, and High Level Alarm level controls shall be provided.
- Audible and visual alarms.
- Foundation footings should be buried a minimum of 60 inches and insulated (R-19 or greater) with polystyrene foam board (Insulfoam II or equal) in accordance with the recommendations of the American Society of Civil Engineers (ASCE) Design and Construction of Frost-Protected Shallow Foundations.
- Sustained soil loading should be restricted to 2,000 pounds per square foot.
- Weight of lift station wet well shall be adequate to resist high groundwater uplift(see calculations in Appendix D).

4.6.7 Force Main

- Four or six-inch diameter HDPE, SDR 11 (160 psi) with a 16 gauge aluminum jacket.
- The minimum flow velocity shall be 3.5 feet per second. (2.5 – 3.25 is recommended in the Cold Regions Utility Monograph, Third Edition, pg. 9-21. However, per ADEC 3.5 feet per second has been found to re-suspend settled solids in the intermittent pump scenario proposed in Tuluksak.)
- Electrical self-limiting heat trace producing eight watts per linear foot for emergency thawing or five watts per foot for freeze protection applications.
- 36-inch minimum depth of bury
- Wastewater temperature 50°F; Ambient soil temperature 15°F
- Two-inch HDPE piping (for closed loop heating systems) operating with 50/50 propylene glycol and water hydronic heat trace (for emergency thawing or freeze

protection). Glycol circulation rate should be less than 2-1/2 feet per second. (Higher velocities require increased pumping energy.)

4.6.8 Force Main Heat Requirements

Force Main #1 – Primary Lift Station #1 to the wastewater treatment lagoon.

At the design flow rate, actual heat loss of Force Main #1 (3,540 lf) at an ambient soil temperature of 15°F is expected to be minor when compared to the normal heat input of the wastewater flow stream. The estimated heat loss from the force main is approximately 17,640 Btu/hour. Heat loss calculations for Phase I only, Phase I and II, Full Build-Out, and Scour Velocity are included in Appendix D.

Prior to Phase III improvements, Force Main #1 will operate with an average of 3,000 gallons of daily wastewater flow, resulting in an average temperature drop from the lift station to the treatment lagoon of approximately 10.1°F. Heat addition may be required to prevent freezing, because of the variable wastewater flow.

For this type of freeze protection and emergency thawing, it is common that the glycol heat trace be capable of delivering at least four times the required heat or 70,560 Btu/hour.

This heat trace will be circulated by pumps mounted in the radiator room and heated by waste heat at the existing TNC power generation facility. The power plant is configured to accept this equipment and has ample heat available. Additionally, this glycol heat trace should be integrated into the proposed water treatment plant when that facility is constructed.

Phase III will increase the daily wastewater flow through the station to an estimated 10,480 gallons per day and will provide greater flow diversity instead of being heavily dependent on school activities. This will result in a 2.7°F temperature drop and will likely eliminate the need to operate the glycol heat trace in a freeze protection mode.

At design full system build-out, wastewater temperatures will drop approximately 1°F during normal pumping operations.

Force Main #2 –Lift Station #2 to the gravity sewer main located south of the school complex.

Prior to Phase II, when the school is the only entity pumping through the force main, the average heat loss is estimated to be 1.2°F. During normal operation, and periods when the soil temperatures are warmer, no additional heat will be required. However, wastewater flows from the school decreases dramatically during holiday breaks resulting in extended periods when inadequate amounts of warm wastewater will be pumped through the system. A glycol heat trace, primarily for emergency thaw, is recommended. The heat trace should be circulated and heated by YSD School facility (the only user) until Phase III improvements have been completed. Heat loss calculations for Phase I and Scour Velocity are included in Appendix D.

After completion of Phase III, the heat loss in Force Main #2 (512 lf), at an ambient soil temperature of 15°F, is estimated to be approximately 0.6°F from the lift station to the connection to the gravity collection system. No additional freeze protection heat source is needed.

The glycol heat trace should be left in-place in the event that an emergency thaw is required. If normal wastewater flow is interrupted, or if the lift station pumps do not operate, for 18-hours the force main heat trace should be activated immediately. (Note that the wastewater will begin to freeze after approximately 24-hours of no flow.). *Table 4.6* on the next page details the lift station and force main operation summary.

Table 4.6: Lift Station and Force Main Operation Summary

Lift Station	**1**	**1**	**1**	**2**	**2**
Phase of Development	**II**	**III**	**2030**	**IV**	**Ph. IV - FBO**
Homes Served Design Year (2030)			124		42
Average Household Size (DCCED)			5.37		5.37
Average GPCD			50		50
Total Residential Daily Flow (Gal)			33294		11277
Commercial/School Daily Flow (Gal)			3500		3000
Total Est. Daily Flow (Gal)			36794		14277
Average Flow Rate (GPM)			25.55		9.91
Peak Hour Flow Rate (GPM)			90.5		38.6
Design Year	**2011**	**2012**	**2013**	**2011**	**2013**
Homes Served	0	26	93	0	16
Average Household Size (DCCED)		5.37	5.37	5.37	5.37
Average GPCD		50	50		50
Total Residential Daily Flow (Gal)	0	6981	24971	0	4296
Commercial/School Daily Flow (Gal)	3000	3500	3500	2500	2500
Total Est. Daily Flow (Gal)	3000	10481	28471	2500	6796
Average Flow Rate (GPM)	2.08	7.28	19.77	1.74	4.72
Force main Length (Ft)	3740	3740	3740	512	512
OD (Inches)	6.625	6.625	6.625	4.500	4.500
ID (Inches)	5.420	5.420	5.420	3.682	3.682
Drain-back Freeze Protection (Y/N)	N	N	N	N	N
Pumping Cycles/Hr.	0.50	1.50	4.00	0.75	2.00
Design Pumping Rate, 3.25 FPS (GPM)	233	233	233	108	108
Volume Pumped @ FBO			233		108
Pump Run Time @ FBO (Min.)			1.64		2.75
Volume Pumped @ Design Year	233	233	233	139	142
Pump Run Time @ Design Year (Min.)	1.07	1.25	1.27	1.29	1.31
Note: Pump Run Time calculations assume no wastewater inflow during pump run time. Incorporating the inflow will increase the pump run time and decrease the cycle time.					
Wetwell Diameter (Ft)	6	6	6	6	6
Working Volume/LF (Gal)	211.4	211.4	211.4	211.4	211.4
Working Level 2030 (Ft.)			1.50		1.41
Working Level--Lead Pump Off/On (Ft.)	1.50	1.50	1.50	0.66	0.67
Pump Headloss (Ft.)	50.16	50.16	50.16	20.57	20.57
Pumping Duration 2030 (Hrs/Day)			2.63		2.20
Pumping Duration (Hrs/Day)	0.21	0.75	2.04	0.39	1.05
Average Operating Costs ($0.75/KWH, Eff. = 0.3)					
Pumping Costs @ FBO ($)	$ -	$ -	$4,368	$ -	$842
Pumping Costs Phases($)	$356	$1,244	$3,380	$147	$401

Definition: FBO = Full System Build-out

4.6.9 Gravel Roads

- Design vehicle – Single Axle Load - 10,000 pounds. (Note that this is less than the AASHTO H-20 loading used to evaluate the arctic pipe. In Tuluksak, the soil profile is expected to limit vehicle loading.) Heavier loads should be evaluated on a case-by-case basis. The only road with a gravel surface course is the airport access road. All other roads are constructed with local silty sand.
- Minimum Lane Width – 10 Feet. Lagoon Access Road to have 7 foot lanes.
- AASHTO Guidelines for Geometric Design of Very Low-Volume Local Roads (Average Daily Traffic < 400 vehicles per day), latest edition

Section 5 - Wastewater Treatment Process

5.1. Regulations

ADEC is the primary agency in Alaska responsible for enforcement of wastewater treatment regulations, through agreements with the United States Environmental Protection Agency (EPA).

5.1.1 Treatment Options Considered

Several wastewater treatment and disposal options have been investigated for use in Tuluksak. Options include:

- Two-Cell, Treatment and Percolation Lagoon – A lined treatment cell, level control structure and percolation cell. Proximity to the water source and seasonal high groundwater are concerns. Also, decreasing percolation rates over time may require percolation cell to be reconditioned. Nitrate monitoring is also required.
- Community Septic Tanks with Subsurface Disposal – Soils at the proposed lagoon site are suitable and percolate, a high groundwater was verified during the spring and early summer which eliminated this option. In addition, proximity to the nearby new community water wells and lack of any evidence a hydraulic gradient/groundwater flow away from the wells raised concerns of potential contamination of the community's drinking water source. Monitoring wells, required nitrate testing, and sludge removal will be required with this system.
- Mechanical Wastewater Treatment with Discharge to Surface Waters – While the quality of treatment can be very good the high cost of operation, required maintenance (access to replacement parts), and lack of trained operators typically cause this type of system to fail leading to a concentrated discharge of untreated wastewater.
- Lined Facultative Lagoon with Seasonal Discharge to Wetlands – This type of lagoon provides an adequate level of protection from the community drinking water source and requires only a minimal amount of effort to insure proper operation. Subsistence uses in the seasonal discharge area will be restricted. Site control, signage and possibly fencing will be used to define the discharge area.

The Two-Cell, Treatment and Percolation Lagoon option was selected. A cursory review of the community septic tanks and mechanical treatment process indicated that they would require a higher level of operator interface, more expensive to operate and less forgiving to fluctuations in maintenance schedules and variations in wastewater flow rates when compared to the treatment/percolation option. A lined lagoon with seasonal discharge to wetlands was also seriously considered but rejected due to public use concerns near the discharge area generally southeast of the proposed lagoon area. Additionally, because the footprint would be larger this option would have higher capital costs.

5.1.2 Recommended Treatment and Disposal Process

Treatment Cell Surface Area – The treatment cell size is based on a design BOD_5 loading of 38 lbs/acre-day (approved by ADEC in May 2009 at a meeting with Bill Reith, P.E. and VSW personnel). At a generation rate of 0.17 pounds of BOD_5 per capita-day and a design population of 669, the treatment cell size is calculated as 3.0 acres. Volume calculations are included in Appendix D.

Treatment Cell Hydraulic Retention Time and Freeze Protection – A minimum of 30 days hydraulic retention time was approved by ADEC in May 2009 at a meeting with Bill Reith, P.E. and VSW personnel. However, when meeting the surface area requirement the average lagoon depth with an allowance for sludge holding results in only a 2.84 foot lagoon depth. This is not adequate to allow winter operation with an expected 2 to 3 foot ice layer. Therefore, a seven foot lagoon depth is assumed (4.5 foot operating depth plus 2.5 foot ice depth)

Treatment Cell Liner Options – A bentonite admixture liner is selected to provide the necessary lagoon containment. The existing silt was measured to have a permeability of 1.4×10^{-6} cm/sec (3.3×10^{-5} inch/min) by DMA. The DMA Permeability Memorandum is included in Appendix D. The addition of approximately 5% by weight of high-swelling bentonite clay is expected to provide the required 8.5×10^{-8} inch/min (DRAFT ADEC Lagoon Construction Guidelines, dated February 2009). This mixture and the hydraulic permeability must be verified at the time of construction. Adjustments to the percentage of bentonite added may be required depending on the actual dike material.

A synthetic liner system was also evaluated but was rejected. A line item cost comparison is included in Appendix D and the specifications with a material quote are included in Appendix E. The cost of the synthetic liner is more than the cost of the admixture option. A synthetic liner is also more vulnerable to physical and environmental damage. Ultraviolet, cold temperatures, ice, and physical abuse often cause premature liner failure.

Level Control Structure – A transfer structure from the bentonite lined treatment cell to the percolation cell will regulate the treatment cell level. Other options were considered but the simple overflow level control with continuous flow and flooded outlet were all essential requirements. An overflow channel from the treatment cell to the percolation cell was rejected because it does not provided the flooded outlet protected from icing.

Sludge Capacity – The treatment cell depth of 7 feet provides adequate sludge holding capacity for the 20 year design life. It is not expected that sludge will need to be pumped from the facility during the design life. Sludge Volume calculations are included in Appendix D.

Percolation/Saturation Test Data – Three percolation tests completed within the initially proposed lagoon area are included in Appendix D. A long-term saturation test was also completed in the initial lagoon area with an average 40 min/inch percolation rate. Based on this data, the application rate is 0.90 Gal/Sq.Ft.-Day. (per the Great Lakes-Upper Mississippi River Board of State and Provincial Public Health and Environmental Managers (GLUMRB) "10-States" Recommended Standard for Individual Septic Systems). Additional saturation testing in the relocated lagoon area are included in the Geotechnical Investigation Report in Appendix A.

Percolation Cell Sizing – Based on a total wastewater generation of 33,450 gallons per day and hydraulic loading rate of 0.90 Gal/Sq.Ft.-Day, the percolation area is calculated to be 1.0 Acres.

Nitrate Monitoring – Nitrate monitoring at the perimeter of the disposal area will be required (18 AAC 72.260(5)).

The modeling calculations (Included in Appendix D) indicate that the nitrate concentrations will reach 26 mg/l, which is greater than the required 5 mg/l (18 AAC 72.260(5)) at the property line of the lagoon site. This calculated high concentration is due to an apparent flat hydraulic gradient (0.000135 ft/ft). This gradient was based on only two monitoring points. If these two points were on the same isoplane, they may not be representative of the actual groundwater gradient and expected nitrate concentrations at the monitoring point/property boundary. Therefore, additional property may need to be obtained to move the monitoring point further from the lagoon. It is the goal that nitrate concentrations are within the acceptable limits at the property boundary.

Honeybucket Disposal Cell – A new 20’ x 80’ by 10’ deep Honeybucket disposal cell will be constructed at the wastewater lagoon and the existing site closed. Based on historical use, this cell will initially require solids removal every three to five years. As more houses are served with piped service, honeybucket disposal site use is expected to decline. Specifications for the proposed bin wall design are included in Appendix E

Winter Operation – It is assumed that snow cover and continuous flow will protect the treatment cell and percolation area from freezing. No change in operation from summer to winter is expected.

Groundwater and Flood Control – The seasonal high groundwater was measured in June at Elevation 16.0 feet. The proposed percolation cell is at Elevation 20.0 feet or four feet above the seasonal high water. Flood control inlet and outlet structures are required to insure safe operation during flood events. Two 12” inlets/outlet will be provided for the treatment cell and one for the percolation cell. These should all be opened during the event of extreme high flood waters that may destabilize the dikes by an imbalanced loading.

Table 5.2: Lagoon Wastewater Treatment Design Parameters

Design Criteria		
Assumptions	**Quantity & Units**	**Notes**
2010 Design Population	497 People	
2030 Design Population	669 People	Growth Rate of 1.5% per year
Design Flow Rate	50 Gal/Cap-Day	Assumed
BOD	0.17 lbs/Cap-Day	ADEC Lagoon Construction Guidelines (2/09)
Treatment Cell BOD Loading (Maximum)	38 lbs/acre	Approved by Bill Reith, P.E., ADEC May 2009
Treatment Cell Hydraulic Retention Time (HRT)	60 Days	ADEC Lagoon Construction Guidelines (02/09)
Treatment Cell Maximum Depth	10 Feet	ADEC Lagoon Construction Guidelines (02/09)
Percolation Days Per Year	365 Days	Assumed
2030 Design Conditions		
Average Daily Flow	36,950 Gallons	669 persons x 50gpcd + 3,000gal Commercial Contribution
BOD/day production	113.7 lbs	0.17#/cd x 669 persons
Treatment Cell Size (based on BOD Loading)	3.0 Acres	113.7# / 38#/acre
Required Treatment Cell Volume (Based on HRT)	2,771,244 Gallons	HRT plus 20% Capacity
Treatment Cell Average Depth	2.84 Feet	2,771,244 gallons / (3ac x 43,560ft^2/ac) / 7.48 gal/ft^3. Use 8 Foot depth for freeze protection.
Required Percolation Cell Holding Volume (non-perk Days)	- Gallons	
Percolation Calculations		
Average Perc Rate	5.6 min./in.	Measured average of 3 perc tests
Saturation Test Loading	40 min./in.	Measured
Daily Loading Rate	0.90 Gal/SqFt-Day	Loading Rate from the 10-States Standard for Individual Sewage Systems, 1980 Edition, for Percolation Rates of 6-10 min./in.
Required Holding Cell Floor Area	41,055 Sq. Ft	36,950 gal/day / 0.9 gal/day/ft^2
Design Conditions (After Completion of Phase II)		
Service Area	26 Houses	Based on existing occupied homes located in the core of the community
Served population	140 people	26 houses x 5.37 persons/house (DCEED)
Average Daily Flow	10,000 Gal/Day	(50gpcd x 140)+3,000gal commercial contribution
BOD/day production	23.8 lbs	140 persons x 0.17#/cd
Primary Cell BOD Loading	8.0 lbs/acre	OK. Does not include Honeybucket Loading waste stream.

Proposed Lagoon Sizing		
Treatment Cell Size	3.0 Acres	113.7# / 38#/acre
Treatment Cell Volume	5,995,315 Gallons	3 acre floor with 3 to 1 side slopes/rounded corners and 8 ft depth
Treatment Cell Calculated HRT	162 Days	5,995,315 gallons / 36,950 gal/day
Percolation Bed Size	0.94 Acres	Use 1.0 Acre

Section 6 - House Plumbing

6.1 Arctic Wastewater Collection Service

Standard 4-inch by 12-inch buried gravity arctic pipe sewer service lines are proposed for Tuluksak. Minimum slope will be two percent to the collection main per the 2003 Uniform Plumbing Code.

6.2 Plumbing Fixtures

Plumbing fixtures are appliances installed within a building which receive potable water from a piping system, facilitates the use of that water to satisfy a human sanitation need and provides for used water to be discharged into the piped wastewater collection system. The following plumbing fixtures and appurtenances will be installed in Tuluksak houses as part of the piped utility improvement program:

- Flush toilet, gravity type
- Shower or tub/shower combination
- Lavatory
- Kitchen sink
- Clothes washer connection only (Washers and dryers are generally not provided by the water and sewer project but provisions will be made to allow a homeowner install one if desired.)

Low water use plumbing fixtures (i.e. 1.6 gallons per flush toilets) are preferred over ultra-low water use fixtures. Heat input into the wastewater collection system is based on a water use rate of 50 gallons per capita day. Lower flow rates may not provide an adequate amount of flow and heat to prevent freezing. Water heaters will also be provided as part of the water distribution system upgrades.

Section 7 - Site Control

7.1 Easements and Rights-of-Way

The proposed wastewater collection system will be located in existing platted rights-of-way and in easements obtained from Tulkisarmute, Inc and/or other owners.

A utility easement across a narrow section of Native allotment USS 4435, Lot 2 is required for collection piping. This area will be approximately 30-feet wide and will provide wastewater flow from the River Subdivision to Lift Station #2. This property is managed by the Bureau of Indian Affairs for the benefit of the owner, therefore, a lengthy acquisition process including an application, an appraisal, a survey to BIA and BLM stipulations, an environmental report, and an archeological report are necessary.

Additional utility easements will be required for wastewater collection piping located near the existing airport runway. This land is primarily owned by either the State of Alaska Department of Transportation or the Moravian Church. The existing runway is being replaced in 2010. While final disposition of the existing airport property has not been determined, it will likely be transferred to the Native corporation, Tulkisarmute, Inc. or TNC.

7.2 Lease Agreements

In March, 2010, the TNC and Tulkisarmute, Inc. reevaluated the initial proposed lagoon location for the following reasons:

- The previous water and sewer planning process was completed prior to identification and construction of the new airport access road (constructed in 2009-2010);
- Future housing developments have been identified near the originally proposed lagoon site;
- Previous soils investigation work completed in 2007 may not have been extensive enough to locate “better ground” to the south.

The community decided it was prudent to move the proposed lagoon further from the developed community. Subsequently, the Village Safe Water program funded the collection of additional soil samples and land status information to determine if other sites were suitable.

A soils investigation was undertaken in April, 2010. The investigation targeted areas generally south of the existing power plant facility. Areas to the north and west of the community are restricted by the Tuluksak River and the new airport is to the east. The investigation encompassed two areas and found the second area most suitable for the lagoon site. The soils and percolation rates in this area were found to be equal or superior to the originally proposed lagoon site. (See Appendix A for soils data)

The Tuluksak Native Community passed a resolution on June 2, 2010 identifying a new location for the proposed lagoon (Appendix B). The new lagoon location is within Sections 27 and 34, Township 12N, Range 66W, Seward Meridian (see Figures 1A & B).

The TNC and the ANSCA village corporation, Tulkisarmute, Inc., entered into lease agreement for the sewage lagoon site and access road (Force Main #1 alignment) in May of 2010 (see Appendix B, Lease Agreement, recorded 8/26/2010 in the Bethel Recording District). This lease is an interim measure, recognizing that the land will eventually be conveyed to the TNC under the provisions of ANSCA Section 14(c)(3).

The Tuluksak Native Community purchased the subsurface rights to the new lagoon location from Calista Corporation at the price of $250.00 per acre. The recorded deed can be found in Appendix B.

A Lease agreement between the Yupiit School District and the Tuluksak Native Community for lift station and force main #2 has been signed and was recorded on September 1, 2010 in the Bethel Recording District. A copy of this lease agreement can be found in Appendix B.

7.3 Land Status

A Property Status Map identifying homes that may be served and owners of record as of August 2010 is provided as Figure 7. In addition, the following site control documents either have or are in the process of being obtained:

- A lease agreement between Tulkisarmute, Inc. (Lessor) and Tuluksak Native Community (Lessee) was recorded on February 25, 2005 in the Bethel Recording District (Appendix B) containing 4.24 acres for the utility core consisting of the power plant, proposed water treatment plant, proposed water storage tank, two proposed water wells, and a future bulk fuel storage site.

- A lease agreement between Tulkisarmute, Inc. (Lessor) and Tuluksak Native Community (Lessee) was recorded on February 25, 2005 in the Bethel Recording District (Appendix B) containing 2.32 acres for right of way for the access road to the utility core and the previously proposed sewage lagoon and landfill site. Additional utility easement is necessary for lift station #1 at this site; the draft of this document is attached in Appendix B.

- A lease agreement between Tulkisarmute, Inc. (Lessor) and Tuluksak Native Community (Lessee) was recorded on February 22, 2005 in the Bethel Recording District (Appendix B) containing 15 acres for the previously proposed landfill and sewage lagoon. This lease agreement will need to be rescinded.

Section 8 - Material Source

Fill material required for pipe bedding, lagoon embankments, and road upgrades is locally available. Borrow sites have been identified northeast of the proposed sewage lagoon and near the existing honeybucket dumping station. No gravel or quality road topping exists locally.

The local Native corporation, Tulkisarmute, Inc., owns the surface estate for the material source area and Calista Corporation owns the subsurface material rights. The existing Material Sales Agreement (dated September 9, 2009) for extracting up to 35,000 cubic yards of sandy material will expire September 16, 2010 and will be renewed as necessary.

Unusable “spoil” material generated during utility installation can be placed in the existing community dumpsite area or at the proposed lagoon site to thicken the outer perimeter of the lagoon embankments.

Section 9 - Heavy Equipment

The existing equipment fleet in Tuluksak consists of a hydraulic excavator; two dozers and a loader that are available to construct the proposed project. The loader and excavator are owned by the Tuluksak Native Community (TNC) and have an unsatisfied purchase agreement existing on them. The excavator is in poor condition. Regular hydraulic system and engine failures have been problematic. The undercarriage is presently at 30-40 percent of remaining life expectancy.

A 4 cubic yard articulated loader, 25-ton articulated all-terrain end-dump, and a self-propelled vibratory compactor will also be required to efficiently construct the project. A replacement excavator should also be considered.

The equipment currently available is listed below.

Table 9.1: Heavy Equipment Currently Available at Tuluksak

MAKE	DESCRIPTION	MODEL	SERIAL NUMBER	OWNER	CONDITION
CAT	Rubber-tired Loader	950F	4DJ690	TNC	Good
Hitachi	Tracked Excavator	EX300LC-3	15L8585	TNC	Poor
CAT	Tracked Dozer	D8		Project	Good
John Deere	Tracked Dozer	JD450G	793517	Project	Poor

Table 9.2: Project Heavy Equipment Requirements

Item	Equipment Description of piece	Number of pieces anticipated	Minimum HP required	Oldest Model Year	Maximum Engine Hours/Tires	Minimum % of New Undercarriage or Tires Remaining	Additional Requirements and Required Attachments	Estimated Purchase Price
1	3 CY Hydraulic Excavator, 80,000#	1	268	2006	1,000 hours	75	36" wide GP bucket w/thumb	$160,000
2	Tractor w/ 6-way blade, 15,000#	1	70	2006	1,500 hours	75	6-way blade	$55,000
3	4 CY Articulated Wheel Loader	1	220	2006	1,500 hours	75	Quick coupler w/ GP bucket and fork attachment w/ 8' forks	$150,000
4	25-Yard Articulated End Dump	1	140	2004	2,000 hours	60	Off-road tire tread	$140,000
5	Self-propelled Vibratory Compactor 15,000#	1	70	2004	2,000 hours	70	Smooth Drum	$40,000

Section 10 - Permit Requirements

The following permits, reviews, and concurrences have been or must be acquired for this project, as noted:

- The Department of the Army (DOA authorized placement of approximately 55,670 cubic yards of fill material into 24.4 acres with permit POA-2003-64-M1. This permit was recently renewed by VSW and expires on March 31, 2014. The DOA was informed about the proposed lagoon relocation on June 28, 2010 and required a new permit application due to discharge of material outside the original design footprint authorized by the original permit. (See Appendix C for new permit application and current permit)
- The Office of Project Management and Permitting (now Division of Coastal and Ocean Management, Alaska Coastal Management Program (DCOM/ACMP) issued a Final Consistency Response on July 5, 2005 for the project (State ID # AK 0505-06AA). A new Coastal Project Questionnaire was filed with the DCOM/ACMP in conjunction with the DOA permit application, as required. (See Appendix C for 2005 Final Consistency Review and Coastal Project Questionnaire)
- The State Historic Preservation Office (SHPO) issued their concurrence that the project will have no affect to historic properties on June 26, 2003 in accordance with Section 106 of the National Historic Preservation Act; and concurred with the lagoon relocation on July 1, 2010. (See SHPO letters, Appendix C)
- The Alaska Department of Environmental Conservation (ADEC) Approval to Construct the wastewater collection piping, lift stations, treatment and the relocated lagoon was issued on July 30, 2010. (See Appendix C).
- The ADEC Approval to Operate will be required and should be applied for upon completion of construction and testing.
- Stormwater Pollution Prevention Plan (SWPPP): The required Notice of Intent (NOI) was filed with the Environmental Protection Agency (EPA) on August 17, 2009. The SWPPP was submitted to ADEC for review on September 18, 2009. To date no reply has been received from ADEC. The SWPPP was amended on June 30, 2010 to reflect the proposed lagoon relocation. (The NOI and EPA acknowledgement of receipt is included in Appendix C)
- National Pollution Discharge Elimination System (NPDES) permit is required for the lagoon treatment and disposal of wastewater. A Notice of Intent (NOI) will be submitted to the Alaska Department of Environmental Conservation (ADEC), Division of Water, Wastewater Discharge Authorization. The EPA has granted the ADEC primacy in the process of permit issuance.

Section 11 - Wastewater System Costs

Capital

The estimated wastewater system construction costs are provided in *Table 11-1* below and a detailed cost estimate as Appendix I.

Table 11.1: Capital Construction Cost Estimate

TULUKSAK WASTEWATERWATER COLLECTION SYSTEM CONSTRUCTION COST ESTIMATE - PHASES I, II, III and IV					
ITEM	**ACTIVITY**	**UNIT**	**UNIT PRICE**	**QTY**	**COST***
Phase I					
1	Removal of unusable organics, grading for lagoon	Ac.	$40,000	4.0	$ 160,000
2	Dual Cell Wastewater Lagoon (4 Ac. footprint) Civil Sitework	Ac.	$92,000	4	$ 368,000
3	Lagoon Liner - Bentonite Clay	Ac.	$105,000	3	$ 315,000
4	Lagoon Access Security Fence	LF	$80	2,400	$ 192,000
				Phase I Subtotal	**$ 1,035,000**
				Engineering & Administration (10%)	$ 103,500
				Construction Administration (8%)	$ 82,800
				Contingency (8%)	$ 103,500
				Phase I Total	**$ 1,324,800**
Phase II					
1	Lift Station	EA	$370,000	1	$ 370,000
2	Force Main (FM1 & FM2)	LF	$190	3,269	$ 621,110
3	Gravity Wastewater Collection	LF	$200	1,350	$ 270,000
4	Manholes	EA	$10,000	7	$ 70,000
5	Sewer Service Lines	Ea	$15,000	4	$ 60,000
6	Power Line Extension to WW Lagoon	LF	$50	1,000	$ 50,000
7	Power plant waste heat recovery system	LS	$60,000	1	$ 60,000
				Phase II Subtotal	**$ 1,501,110**
				Engineering & Administration (10%)	$ 150,111
				Construction Administration (8%)	$ 120,089
				Contingency (8%)	$ 150,111
				Phase II Total	**$ 1,921,421**
Phase III					
1	8 x 15 Gravity sewer	LF	$208	2,950	$ 613,600
2	House Plumbing (sewer)	EA	$15,000	26	$ 390,000
3	4-inch gravity sewer services	EA	$14,000	26	$ 364,000
4	Manholes	EA	$11,000	12	$ 132,000
5	Close-out Existing Lagoon	Ea	$95,000	1	$ 95,000
				Phase III Subtotal	**$ 1,594,600**
				Engineering & Administration (10%)	$ 159,460
				Construction Administration (8%)	$ 127,568
				Contingency (8%)	$ 159,460
				Phase III Total	**$ 2,041,088**

Phase IV						
1	8 x 15 Gravity sewer	LF	$200	4,200	$	840,000
2	House Plumbing (sewer)	EA	$14,000	27	$	378,000
3	4-inch gravity sewer services	EA	$14,000	27	$	378,000
4	Manholes	EA	$12,000	14	$	168,000
5	Lift Station	EA	$350,000	1	$	350,000
			Phase IV Subtotal		**$**	**2,114,000**
			Engineering & Administration (10%)		$	211,400
			Construction Administration (8%)		$	169,120
			Contingency (8%)		$	211,400
			Phase IV Total		**$**	**2,705,920**
Phase V						
1	8 x 15 Gravity sewer	LF	$215	900	$	193,500
2	Manholes	EA	$13,000	3	$	39,000
			Phase IV Subtotal		**$**	**232,500**
			Engineering & Administration (10%)		$	23,250
			Construction Administration (8%)		$	18,600
			Contingency (8%)		$	23,250
			Phase V Total		**$**	**297,600**
	*2010 dollars assuming force account construction / local wages		**Project Total Cost**		**$**	**8,290,829**
	updated 3/1/2010 - l.persson					

11.2 Operation and Maintenance

The primary costs associated with operation and maintenance of the wastewater collection system will be labor and electricity. The table below estimates operation and maintenance costs of the system after completion of wastewater improvements phase I and II.

Table 11.3: Expected O&M Costs

Expense Category	Annual Estimate
Administration	$4,860
Labor	$16,600
Miscellaneous Materials	$500
Electricity	$7,980
Heating Fuel	$1,000
Water Treatment	$ -
Sewage Treatment	$1,000
Insurance	$1,500
Repair and Replacement	$4,000
Other	$1,500
Total Annual Expenses	**$38,940**

Administration	
Administrator	$3,360
Clerk	$-
Office Supplies	$500
Postage	$500
Occupancy Costs	$500
Total Administration	**$4,860**

Labor	
Operator I (10 Hrs/Week)	$10,400
Operator II (5 Hrs/Week)	$2,700
Training	$3,500
Washeteria Attendant	$ -
Other	$ -
Total Labor	**$16,600**

Miscellaneous Materials	
Cleaning Supplies	$500
Other	$ -
Total Miscellaneous Materials	**$500**

Electricity	
Lift Sta. 2000 KWH @ $0.75	$1,500
Hydronic Circ 8640 KWH @ $0.75	$6,480
Total Electricity	**$7,980**

Heating Fuel	
Fuel - minimal	$1,000
Freight	$ -
Other	$ -
Total Fuel	**$1,000**

Water or Water Treatment	
Chemicals/ Testing	$ -
Postage/Freight	$ -
Other	$ -
Total Water/Water Treatment	**$ -**

Sewer or Sewage Treatment	
Chemicals	$ -
Testing	$1,000
Total Sewer/Sewage Treatment	**$1,000**

Insurance	
Building Insurance	$900
Liability Insurance	$600
Other	$ -
Total Insurance	**$1,500**

Other	
Vehicle Expense	$1,500
	$ -
	$ -
Total Other	**$1,500**

Figures

Figures 1A & 1B:	Phase I & II Wastewater System Improvements
Figure 2:	Phase III Wastewater System Improvements
Figure 3:	Phase IV Wastewater System Improvements
Figure 4:	Phase V Wastewater System Improvements
Figure 5:	Wastewater Collection System Layout and Worksheet
Figure 6:	Survey Control Drawing
Figure 7:	Property Status Map

Appendices

Appendix A: Geotechnical Investigations

Appendix B: Site Control Documentation

Appendix C: Regulatory Permits, Reviews, and Concurrences

Appendix D: Design Data and Calculations

Appendix E: Specifications and Manufactures Data Sheets

Appendix F: Cost Estimate – Project Funding Level