PRELIMINARY ENGINEERING REPORT

WATER TREATMENT PLANT AND WASHETERIA FACILITY IMPROVEMENTS

TULUKSAK, ALASKA

Prepared for:

Tuluksak Native Community

Under the Direction of:

State of Alaska, Department of Environmental Conservation
Division of Water, Village Safe Water Program
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DRAFT – MAY 14, 2014

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1. Executive Summary

1.1. Overview of Recommendations

The recommended alternative for Water Treatment Plant and Washeteria Facility Improvements in Tuluksak is Alternative 2 – New WTP/Washeteria Facility at the Utility Core Site, south of the community. This alternative also includes a new water distribution loop and new services to key facilities centrally located within the community. Alternative 2 consists of the following components:

- Two wells at Utility Core Site (2005 wells);
- Raw water transmission line from wells to new WTP/W facility;
- New WTP/W facility at the Utility Core Site consisting of:
    - Water treatment plant with chemical and mechanical rooms,
    - Washeteria with laundry and shower facilities,
    - Water distribution pumps and piping,
    - Community watering point,
    - Lift station and forcemain piping,
    - Office and storage space.
- 20,000-gallon insulated WST with fill and draw piping;
- 5,000-gallon bulk fuel storage tank and 25-gallon day tank;
- Standby Generator;
- Circulating water distribution loop with service connections to the health clinic, store, teen center, school and teacher housing, and the construction camp.

1.2. Construction Plan with Costs and Requirements

Construction of the selected alternative, a new WTP/Washeteria Facility at the Utility Core Site, will require a dedicated multi-year effort. The estimated capital construction costs for each option include a proposed multi-year funding plan. This proposed phasing plan will undoubtedly need to be adapted to the availability of funding. In addition, the influence of other community and regional projects on limited local hire workforce will have to be considered. All cost estimates in this document are based on 2014 dollars.

1.3. Sustainability of Facilities

A WTP/W facility needs to be affordable for the community to operate and maintain. One of the most common causes of system ineffectiveness, or system failure, is a community's inability to pay for critical components and consumable materials needed to properly operate their facilities. Sustainable utility management practices include environmental, social, and economical benefits that aid in creating a dependable facility.

Alternative 2 will construct a reliable and affordable sanitation facility for Tuluksak. The annual O&M and repair and replacement costs are estimated to fall within the revenue generating capabilities of the community. The proposed treatment system will be relatively simple for operators, requiring less oversight during treatment than the existing batch process. The proposed system falls under the Class II treatment system classification. Primary and back-up operators must have a “Water Treatment II” certification to operate the proposed treatment system.

2. Introduction

2.1.Background

CRW Engineering Group, LLC (CRW) was hired to prepare this Preliminary Engineering Report (PER) in conjunction with the Tuluksak Native Community (TNC) and the State of Alaska Department of Environmental Conservation, Village Safe Water Program (VSW). The purpose of this PER is to identify, examine, and recommend improvements for water treatment plant and washeteria (WTP/W) facilities in Tuluksak, Alaska. A pilot study will also be conducted to test lavatory and toilet products that do not require piped water. All proposed improvements will consider sustainability and energy conservation measures.

Upgrading sanitation facilities in Tuluksak has been an ongoing effort for nearly 20 years. Available records detail investigations into community wide sanitation improvements in 1995, 1999, and 2006. From these investigations, a piped water and sewer system was recommended and accepted by the community. In subsequent reviews by potential funding agencies, the community's capacity for operating and managing these systems was considered. From this assessment, it was determined that additional analysis of alternatives was needed before the funding could be provided for a fully piped system.

Accordingly, in January 2013, the community contracted with CRW to perform this additional evaluation in the form of a Feasibility Study. In November 2013, the scope of the feasibility study was modified to a PER for WTP/W facility improvements only.

2.2.Community Contacts

A list of local, regional, and state contacts is provided in Table 1 below.

Table 1 – Community Contacts

AGENCY	CONTACT(S)
ANTHC Tribal Utility Support Services 1901 Bragaw, Suite 200 Anchorage, AK 99508	John Sims III Phone: (866) 800-2872
Association of Village Council Presidents PO Box 219 Bethel, AK 99559	Phone: (907) 543-3521
AVCP Regional Housing Authority PO Box 767 Bethel, AK 99559	Phone: (907) 543-3121
Calista Corporation 301 Calista Court #A Anchorage, AK 99518	Phone: (907) 279-5516

AGENCY	CONTACT(S)
Lower Kuskokwim Economic Development Council PO Box 2021 Bethel, AK 99559	Phone: (907) 543-5967
Tulkisarmute Incorporated PO Box 65 Tuluksak, AK 99679	Joe Demantle, President Phone: (907) 695-6854
Tuluksak Native Community PO Box 95 Tuluksak, AK 99679	Peter Andrew, President Phone: (907) 695-6420
Tuluksak School PO Box 115 Tuluksak, AK 99679	Gene Burke, Principal Phone: (907) 695-5600
Tuluksak Traditional Power Utility PO Box 95 Tuluksak, AK 99679	Phone: (907) 695-6420
Village Safe Water 555 Cordova Street Anchorage, AK 99501	Susan Randlett, P.E. Phone: (907) 269-7614 E-Mail: susan.randlett@alaska.gov
Yukon-Kuskokwim Health Corporation PO Box 528 Bethel, AK 99559	Bob White, RMW Phone: (907)543-6428 E-Mail: robert_white@ykhc.org
Yupiit School District PO Box 51190 Akiachak, AK 99551	Phone: (907) 825-3600 Email: klangton@yupiit.org

2.3.Planning Process

This project originally began as a water and sewer feasibility study for the entire community of Tuluksak but was modified to a PER for the WTP/W facility only. In late January 2013 representatives from VSW, CRW, EDC, Reid Middleton, and YKHC traveled to Tuluksak to meet with the TNC Council and to inspect the existing WTP/W facility.

At this time (DRAFT Submittal) the following planning milestones are anticipated for this project:

- May 14, 2014 – Draft PER submitted to VSW and the TNC for review and comment. Copies also distributed to Bob White (YKHC RMW).
- May 27, 2014 – Draft PER review meeting with the community, VSW, and the RMW.

- June 20, 2014 – Comments from the review meeting incorporated into the PER document and final PER submitted to VSW, the TNC, and the RMW.

In addition to these meetings and submittals, frequent correspondence between CRW, VSW, and the TNC occurred throughout the development of this PER.

2.4.Identification of Community Goals and Objectives

From the various planning documents referenced in this report, we understand the following goal and objectives of the community:

- Complete new forcemain and wastewater treatment lagoon.
- Provide a washeteria facility. A temporary facility could be provided before completing the permanent facility featured in this PER.
- Provide affordable, reliable service and convenient access to potable water and shower facilities.
- An upgraded bulk fuel facility has been identified as a community need.
- Provide new access road to new barge landing area.

3. Project Planning Area

3.1.Location and Access

Tuluksak is located 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. It lies at approximately 61.1025˚ North Latitude and 160.9617˚ West Longitude and is located in the Bethel Recording District (Section 27, Township 012N, Range 066W, Seward Meridian). The area encompasses 3.1 square miles of land and 0.1 square miles of water. See Figure 1 – Location and Vicinity Map and Figure 2 – Community Map, presented in Appendix A.

Tuluksak can be accessed by a state-owned 2,461-foot long by 30-foot wide gravel airstrip year-round. There are no docking facilities, although cargo barges deliver during the summer. Residents use fishing boats, skiffs, snowmachines, and ATVs for local transportation.

3.2.History and Culture

Tuluksak is a traditional Yupik Eskimo village with a fishing and subsistence livelihood. The name was first published in 1861 as "Tul'yagmyut", an Eskimo word meaning "related to loon." The 1880 United States (US) Census noted a population of 150 living in the village. A city government was formed in 1970 but was dissolved in 1997.

The sale, importation, or possession of alcohol is banned in the village. The primary employers are the school, village government, and local services. Some commercial fishing occurs. Subsistence activities provide most of the food for the community.

3.3.Population

The population of Tuluksak is 380, as estimated by the Alaska Department of Labor and Workforce Development (AKDOL) in 2013. Population projections for the 20-year design life are presented in Section 4.

3.4.Environmental Resources Present

3.4.1. Climate and Weather

Annual precipitation averages 16 inches per year in this area, with 50 inches of snowfall per year. Summer temperatures range from 62˚ to 42˚ Fahrenheit; winter temperatures are generally between 19˚ and -2˚ Fahrenheit.

3.4.2. Wetlands

Wetlands have not been mapped in or near Tuluksak; however the United States Army Corps of Engineers (USACE) assumes that they exist in much of the community. Proposed improvements will require coordination with USACE to confirm that wetland permitting for the proposed alternative has been secured.

3.4.3. Surface Hydrology

According to the USACE and the residents of Tuluksak, the community is subject to flooding. The USACE report "Alaska Communities Flood Hazard Data 1998", has published flood of record which occurred in the 1970's with a flood elevation of 3.9 feet (31.05 feet based upon DCCED's Community Profile Mapping vertical control). The flood of record was based on water marks on the pilings under the old school. A flood gauge was placed on an upstream piling of the old National Guard Armory at the 31.05-foot mark. The USACE recommended building elevation is 5.9 feet. The estimated 100-year flood elevation is 30.23 feet (NAVD 88). The community does not participate in the National Flood Insurance Program. See Appendix B for a copy of the USACE Alaska Communities Flood Hazard Data sheet for Tuluksak.

3.4.4. Geology and Soil Conditions

General near-surface geology in Tuluksak is primarily the result of reworked floodplain deposits. The ground surface is typically covered by a thin layer (6 to 12 inches thick) of organic soil over silt with silty sand at depth. Sporadic permafrost is present throughout the project area. Where permafrost was encountered, it was normally at a depth of 8 feet below grade or greater and the material was generally dense sand.

The Utility Core Site is underlain by an organic mat and organic silt that extends to depths of 2 to 5.5 feet. The organic soils are underlain by fine-grained sand with trace to some silt content (8% to 20% finer than the #200 sieve size). Where frozen, the organic silt is icy. Based on the average moisture content of the frozen sand, the material has a thaw strain potential of 2% to 8% with the average value about 4%. Therefore, for every foot of sand that thaws, about 0.5 inches of settlement would be expected.

3.4.5. Endangered Species and Critical Habitats

Tuluksak does not contain any threatened or endangered species and is not located within a designated critical habitat area. A review of the United States Fish and Wildlife Service (USFWS) Information, Planning, and Conservation System website did not produce any endangered species or critical habitats in or around Tuluksak. In addition, an email from Kimberly Klein, an Endangered Species Biologist with the US Fish and Wildlife Service, in March of 2014 states that "there are no listed species there" and that "no further consultation with USFWS for this project is needed." See Appendix B for a copy of the email.

3.4.6. Historic Sites

An archaeological survey of the proposed community wide piped water and sewer system, conducted in May 2003, concluded that "no historic properties that would have been potentially eligible for inclusion on the National Register of Historic Places or any other cultural indicators other than those associated with the modern occupation of the village were observed anywhere in the project's area of potential effect." Additional archaeological survey work, performed in April of 2014 for the wastewater lagoon project, confirmed that no historic properties eligible for inclusion in the National Register of Historic Places exist in Tuluksak. Additional archaeological information is presented in Appendix B.

3.4.7. Groundwater

The groundwater level in Tuluksak generally matches river water surface in thawed areas. The water table fluctuates with the river level and normally varies between elevation 10 and 15 feet.

3.4.8. Topography

The area surrounding Tuluksak is flat with wet tundra areas. The undisturbed areas of Tuluksak are forested with black spruce, some mature white spruce, and willow brush. The community itself is partially forested.

3.4.9. Seismic Hazards

Tuluksak is located in Seismic Zone 1 and seismic hazards are low, as reported by the Alaska Earthquake Information Center and in the Structural Condition Survey, presented in Appendix E. Code prescribed seismic forces for the existing WTP/W facility, under current codes, are slightly higher than for what the building was originally designed. However, as previously stated, Tuluksak is in an area of low seismic activity, such that wind pressures will control the design of lateral support systems for the building.

4. Growth and Future Projects

4.1. Population Forecast

According to the State of Alaska's demographer, Tuluksak has a youthful population which would generally point to a good chance for population growth. While the precise growth rate for Tuluksak is difficult to predict, it can be reasonably assumed to follow Bethel Census Area population projections. Tuluksak currently comprises 2.13% of the Bethel Census Area population.

Using the State's population projections for the Bethel Census Area and linear extrapolation, the population of Tuluksak in the design year 2034 is estimated at 456 people. Population forecast information and calculations are presented in Appendix C.

4.2. Growth Areas

Community growth will be predominantly residential, east of the school facility; additional homes were identified as a community need in the Tuluksak Community Plan. A youth center/multi-purpose facility was recently constructed and houses the youth center, social services offices, and the local Post Office. The health clinic was built in 1996, and a new K-12 school and teacher housing were completed in 2004.

5. Land Status

5.1. Ownership/Land Use

Major land owners in the community include Tulkisarmute, Inc. (the Alaska Native Claims Settlement Act village corporation), Tuluksak Native Community (the Bureau of Indian Affairs recognized local governing body), and the Moravian Mission Church. The State of Alaska Department of Transportation and Public Facilities (DOTPF) currently holds title to the old Tuluksak Airport, a large tract of land directly adjacent to the developed community. Land use in the project area is primarily residential with some public facilities, such as the school and teacher housing, clinic, teen center, and several commercial establishments. See Figure 3 – Land Status Map.

5.2. Land Status Mapping

Community mapping, including land status and aerial photography, was performed in 2007 in cooperation with the State of Alaska Department of Commerce, Community, and Economic Development (DCCED). Ownership status of plats and subdivisions is also included. This data can be obtained by visiting http://commerce.alaska.gov/dnn/dcra/PlanningLandManagement.aspx or by contacting George Plumley at DCCED, Phone: (907) 269-4546.

5.3. Land Owners in Proposed Project Areas

A lease agreement between Tulkisarmute, Inc. (Lessor) and the TNC (Lessee) was recorded on February 25, 2005 in the Bethel Recording District containing 4.24 acres for the Utility Core Site consisting of the power plant, proposed WTP/W facility, proposed WST, two proposed water wells, and a future bulk fuel storage site. Rent on the lease is $1 per year for 30 years. The lease is an interim measure, recognizing that the land will eventually be conveyed to the TNC under the provisions of Section 14(c)(3) of ANSCA.

A lease agreement between Tulkisarmute, Inc. (Lessor) and the TNC (Lessee) was recorded on February 25, 2005 in the Bethel Recording District containing 2.32 acres for right-of-way for the access road to the Utility Core Site and the proposed landfill site. Rent on the lease is $1 per year for 30 years.

A lease agreement between the City of Tuluksak (Lessor) and the Association of Village Council Presidents (AVCP) Regional Housing Authority (Lessee) was recorded on August 27, 1986 in the Bethel Recording District containing the property on which the existing WTP/W facility is located. Information on the terms and duration of the lease agreement has been requested from AVCP; however nothing has been received at the time of this submittal.

It is anticipated that the old Tuluksak Airport property, adjacent to the Utility Core Site, will be transferred to the Tulkisarmute or the TNC, however it is not known when this transfer will take place. Site control documents are provided in Appendix D.

5.4. Traditional Use Areas

Traditional use areas for subsistence activities exist in and around Tuluksak. However, these areas are not shown specifically on the Tuluksak Community Profile Maps, which focus on the community core area, or any other available maps of the community.

6. Existing Facilities and Planning Conditions

6.1. History of WTP/Washeteria Facility Improvements

The community's existing WTP/W was designed by the Indian Health Service (IHS) and constructed in the early 1980s to provide sanitation facilities to serve 27 new Department of Housing and Urban Development (HUD) units and the 39 pre-existing homes. This project, completed in 1982 and still in use today, provides a well and a WTP/W facility, including 10,000-gallon raw and treated water storage tanks, and a watering point. Groundwater is batch-treated to remove high levels of iron, manganese, and arsenic. In 2003, the water treatment process was optimized with the addition of a higher capacity well pump, raw water preheat, static mixers, and raw and treated water storage tank liners. The school, teacher housing, and a construction camp are directly connected to the existing WTP/W facility with piped water.

In the mid-1990s, a feasibility study analyzed options for improving the water and sewer system, and the community selected a piped water and sewer system. In 2005, as part of a phased plan, two groundwater wells were installed approximately 1,200 feet south of the existing WTP/W in an area called the Utility Core Site. These wells, while both still relatively high in iron, manganese, arsenic, and organics, produce better quality water and in higher quantity than the existing well. The community has affirmed their desire that these new wells be developed and incorporated in the improved water system.

In 2006, water and sewer system alternatives were again evaluated. A piped water and sewer system was recommended and accepted by the community. In subsequent reviews by the funding agencies, the community’s capacity for operating and managing these systems was considered. From this assessment, it was determined that additional analysis of alternatives was needed before the funding could be provided for sanitation improvements. Accordingly, in January 2013, the community contracted with CRW to perform this additional evaluation.

Currently, a wastewater collection, treatment, and disposal system is being constructed via the VSW force account method. Buried gravity and forcemain pipe, a lift station, and a treatment lagoon are expected to be completed in 2014 or 2015. Existing sanitation facilities in Tuluksak are shown on Figure 4 – Existing Sanitation Facilities Map.

6.2. Evaluation of Existing Facilities

Key components of the existing WTP/W facility are described in the following subsections. Each subsection summarizes numerous inspections, site visits, studies, and reports in Tuluksak. Trip and inspection reports are presented in Appendix E.

6.2.1. Water Source

The existing well, located adjacent to the WTP/W Facility, has been in use since it was constructed in the early 1980s. This well water is high in iron, and moderate in manganese and color. Arsenic is present in the raw water as well.

The location of the well does not provide the minimum separation distance from existing bulk fuel storage tanks, honeybucket hoppers, and other possible sources of contamination. Grading around the well is not adequately protected from flooding. It is located in a low area and there is no grading in place to keep water from collecting near the well. The well is shallow (screened from 34-49 feet), making it even more susceptible to contamination.

Although it is currently designed as a groundwater source, it is likely this well could be reclassified as groundwater under the direct influence of surface water, which would subject it to additional regulatory requirements.

6.2.2. Water Treatment and Storage

The existing Class I water treatment process consists of raw water preheat and potassium permanganate injection prior to pumping to a 10,000-gallon settling tank located inside the WTP building. Water is allowed to settle overnight in the tank. The following day, water is transferred from the settling tank, through multimedia filters, and into a 10,000-gallon water storage tank also located inside the WTP building. Chlorine disinfectant is injected downstream of the filters prior to entering the storage tank.

A pressure pump draws water off the bottom of the storage tank and supplies water to the watering point, washeteria, construction camp, and school and teacher housing. The WTP produces approximately 5,000 gallons of water per day. Production is limited by settling rates in the raw water treatment (settling) tank.

Most of the water treatment piping appears to have been either modified, repaired, or added to over the last 30 years and the resulting plant is a jumble of pipes, valves, and pumps, some clearly not operable. Other significant deficiencies include an insufficient air gap on the water to waste line that allows for possible backwash contamination, lack of backflow prevention on the water lines used for mixing chemical dilutions, potential for chemical overdose due to the lack of a flow switch on the Permanganate line, and a cross-connection threat related to a single wall heat exchanger at the boilers.

6.2.3. Water Distribution

Water is distributed to the community through a watering point located on the northwest corner of the WTP/W facility and a water service line to the school and teacher housing. The construction camp also has piped water.

6.2.4. Washeteria Facility

The washeteria side of the building is also showing signs of its age and the laundry equipment and shower facilities have limited operational capability. Only one of the toilets is functioning and only a few of the washers and dryers are available for use.

6.2.5. Water Treatment Plant/Washeteria Building

In general, the existing WTP/W building is in an aged and deteriorating condition. Some equipment is inoperable and several sections of the floor and subfloor are rotted through. The rot is caused by water penetrating from the washing machines in the washeteria and by leaks from the boilers (see Photo 1).

Photo 1 – Rotting Floor near Boilers

Condensation on the two interior water storage tanks has also contributed to the rotting floor. Water stains on the roof beams indicate a possible leak, and the water storage tanks have been known to leak as well. The boilers are near the end of their useful life, with substantial corrosion damage (see Photo 2).

Photo 2 – Corrosion Damage on Boiler and Piping

The building's main electrical disconnect is inaccessible due to a collapsed landing. In addition, there is no central control panel and each system is individually controlled using discreet components. Few of the original equipment identification labels remain and blue stickers with undecipherable letter and number designations have been provided in their place, making it difficult to order replacement parts.

6.2.6. Wastewater Collection, Treatment, and Disposal

Currently, only limited wastewater collection services are available within the community. Honeybuckets are self-hauled to collection points scattered throughout the community. Collected wastes are transported by the TNC in 80-gallon HDPE containers to a honeybucket disposal pit located approximately 2,000 feet south of the community. Some residents dump greywater next to their homes to reduce the amount of wastewater that must be transported to the honeybucket collection stations.

Wastewater from the WTP/W facility is piped from the facility through a 700 linear foot, 4-inch diameter HDPE arctic pipe gravity sewer main and disposed in a percolating wastewater lagoon, directly south of the community and adjacent to the community solid waste dump site. The Yupiit School District (YSD) operates a percolating wastewater lagoon directly east of the school complex and near existing residential housing.

The overall condition of existing wastewater facilities in Tuluksak is poor. Many of the honeybucket collection containers are damaged and missing lids that would otherwise prevent wastewater from splashing out during transport. The containers are unsanitary and are not cleaned often. The gravity sewer main from the washeteria to the sewage lagoon has failed multiple times, discharged wastewater into the adjacent travel way. The backwash line from the WTP/W facility to the gravity sewer main has a significant leak at the connection to the building (see Photo 3).

Photo 3 – Leaking WTP Backwash Line

While both the school and in-town lagoons are still percolating, neither is permitted and both are completely overgrown with brush and trees up to 6 inches in diameter.

7. Community and Financial Status

A new WTP/W facility needs to be affordable for the TNC to operate and maintain and affordable for the community to use. One of the most common causes of system ineffectiveness, or system failure, is a community's inability to pay for critical components and consumable materials needed to properly operate their facilities.

7.1. Administration

Currently, the TNC owns the well, WTP/W facility, and watering point. Piped water is supplied to the school, teacher housing, and construction camp. The TNC provides the electrical power and an operator at the plant. The TNC is also responsible for water distribution (watering point) to the public from the WTP/W facility. The YSD contributes $60,000 per year ($15,000 per quarter) to the TNC for WTP/W facility operations.

7.2. Utility Management

The most recent State of Alaska Rural Utility Business Advisor (RUBA) Status Report shows that the Tuluksak utility system does not meet all the RUBA essential and sustainable indicators for management capacity. A copy of the Status Report, dated 4/3/14, is provided in Appendix B.

There are two operators in Tuluksak with current certificates for water treatment. Robert Allain holds a "Small Water System Treated" certificate which expires on December 31, 2015. Jack Kinegak holds "Water Distribution 1" and "Water Treatment 1" certificates, both of which expire on December 31, 2014. Additional certification(s) will most likely be required to operate the recommended WTP/W facility.

7.3. Operation and Maintenance

The current rate schedule is $40 per household per month for honeybucket disposal services and $0.25 per gallon for water dispensed from the watering point at the WTP/W facility. The watering point has no meter and no minimum purchase requirements. Current washeteria rates are $5.00 per washer load, $4.00 per dryer load, and $2.00 per shower.

Annual operation and maintenance (O&M) expenses and revenues for the WTP/W facility are presented in Table 2 below as reported by TNC. Table 2 summarizes financial data obtained from profit and loss reports for the TNC from April 2013 thru March 2014.

Table 2 – Existing WTP/W Facility Annual O&M Costs and Revenues

DESCRIPTION	COST
Expenses	
Personnel Services	$ 61,360
Travel	$ 1,108
Facility Expenses	$ 938
Supplies	$ 5,013
Equipment	$ 1,970
Other Operating Expenses	$ 3,587
SUBTOTAL	**$ 73,975**
Revenues	
Washeteria Facility	$ 18,886
Water Treatment Plant	$ 31,509
SUBTOTAL	**$ 50,396**
BALANCE	**$ (23,580)**

As presented in Table 2, the existing WTP/W facility is not profitable and the TNC is losing approximately $23,580 per year in O&M expenses.

When analyzing the price to do a load of laundry at home vs. doing a load of laundry at a central facility like a washeteria, several considerations need to be made. From a monetary perspective, the comparative cost of electricity, water, and gas to transport clothes or water to and from the home need to be included. In addition, the expected life of the components is not equal. While the type of washing machine used in the washeteria may have a higher cost, the cost to replace it can be shared with the entire community, whereas replacing a washing machine at home is the sole responsibility of each household. Non-monetary considerations include the amount of time it takes to transport clothes and water and the time and it takes to maintain appliances at home. After comparing the cost per pound of laundry at home ($0.74) vs. the cost per pound of laundry at the washeteria ($0.28), the cost per pound at home is nearly three times more than the cost to wash at the washeteria. See Appendix C for quantitative calculations.

8. Need for Project

Like many other communities, the TNC is actively seeking to improve the quality of life for its residents. A significant part of this endeavor is improving the community's sanitation facilities, including the WTP/W facility. The project under consideration for funding will improve health and safety conditions, and meet anticipated growth for the 20-year planning period.

8.1. Health, Sanitation, and Security

Many residents obtain drinking water by collecting rainwater or from other natural sources. Sampling studies in other rural Alaska communities have found alarming degrees of bacteria, specifically E. coli bacteria, when home drinking water supplies are analyzed. Water source, handling procedures, lack of disinfection, and storage vessel cleanliness are the most likely factors leading to contamination of the resident's drinking water. One can reasonably assume that if a home water sampling study was conducted in Tuluksak, similar results would be found.

All of the problems with the current facility, as detailed in Section 6, are health and safety risks for the community. Residents of Tuluksak need a dependable, safe, and accepted source of drinking water, and a washeteria with the capacity to serve the community. Improving or replacing the WTP/W facility is a dire sanitation need.

8.2. Aging Infrastructure

The condition of the existing WTP/W facility, constructed in 1982, is substandard, at best. The age of the equipment causes frequent breakdowns at the facility and it does not have adequate equipment to monitor the treatment process. The treatment process is inefficient and the WTP is only capable of producing approximately 5,000 gallons of treated water per day.

Operation and maintenance of the WTP/W is extremely important in providing continuous water treatment. The current treatment system is old and labor intensive, requiring frequent backwashing to continue efficient running of the filters. Poor raw water quality means that the nuances of the existing system require significant operational oversight to provide water that meets drinking water standards. A simple and effective water treatment system leads to better, more consistent water quality.

The introduction of new treatment technology, using new equipment, will have the greatest impact on the ability of the TNC to provide adequate volumes of treated water and washeteria facilities to the community.

8.3. Reasonable Growth

As presented in Section 4, the population of Tuluksak will likely increase over the 20-year design life. The existing WTP/W facility does not have the capacity to consistently meet current maximum demands, and therefore the system does not have the capacity to serve future utility customers.

9. WTP/Washeteria Facility Alternatives

9.1. Description

The alternatives formulated for this PER were developed by considering the relative feasibilities of various WTP/W options in Tuluksak. These considerations were largely qualitative, being based on the inputs and experience of rural Alaska sanitation professionals and members of the community, and on engineering judgment. This evaluation does not intend to develop alternatives by process of elimination for all possible options. It instead considers a limited number of options that appear to be reasonably promising for use in Tuluksak.

9.2. Alternatives

The following WTP/W facility alternatives were presented and discussed with the TNC and VSW:

- Alternative 1 – No-Build
- Alternative 2 – New WTP/Washeteria Facility at Utility Core Site
- Alternative 3 – Rehabilitate Existing WTP/Washeteria Facility
- Alternative 4 – Separate WTP and Washeteria Facilities

Each alternative is evaluated and the capital costs, operation and maintenance costs, life-cycle costs, complexity, and longevity are calculated and presented in Section 10.

9.3. Design Criteria and Assumptions

All major system components will be sized to meet future demands and constructed with materials and methods to provide a minimum 20-year life.

Design criteria for a WTP/W facility include the following:

9.3.1. General

- Current Population 380 (2013)
- Design Population 456 (2034)
- Freezing Index 2,100˚F-days
- Design Freezing Index 3,800˚F-days
- Thawing Index 2,500˚F-days
- Design Thawing Index 3,400˚F-days
- Piped water services include the school, teacher housing, health clinic, construction camp, store, and teen center.

9.3.2. Design Water Demand

Based on water consumption data from other communities with similar water and sewer systems (i.e. honeybuckets, a watering point, and limited piped water and sewer) and the World Health Organization's minimum requirement for Intermediate access to water service, 13 gallons per capita per day was used to design the water treatment and size the water storage tank (i.e. on average each person is presumed to use 13 gallons of water each day in Tuluksak)[1]. Intermediate access is defined as "Consumption-assured; Hygiene-all basic personal and food hygiene assured, laundry and bathing should also be assured". In addition, water use at the WTP, washeteria, school, teacher housing, health clinic, construction camp, store, and teen center will also contribute to the future water demand. Table 3 below summarizes the current and future (design) water demand for Tuluksak to the year 2034. Water demand calculations are presented in Appendix C.

Table 3 – Design Water Demand

System	Current Demand (2014) GPD	Future Demand (2034) GPD
Ordinary Water Usage	830	1,660
WTP (Backwash)	600	240
Washeteria	1,110	1,340
School and Teacher Housing	1,650	2,120
Health Clinic	N/A	50
Store	N/A	50
Teen Center	N/A	25
Total Average Daily Demand	**4,190**	**5,485**

N/A: Not Applicable because these facilities are not directly connected to the Water Plant.

9.3.3. Water Source

In 2003, two wells were drilled on the old Tuluksak Airport property, to the west of the Utility Core Site. It was subsequently learned that the State of Alaska was unable to grant an easement for these wells. In 2011 a new airport was opened east of the community and the old Tuluksak Airport decommissioned. Final disposition of the old Tuluksak Airport property has not been determined; however it will likely be transferred to Tulkisarmute, Inc. or the TNC. Should this property become available to the TNC, the 2003 wells might be considered as a potential water source, although analysis of the contents and treatability would be required prior to considering them a viable water source.

In 2005, two 6-inch wells were drilled to approximately 190 feet below grade at the Utility Core Site, approximately 1,350 linear feet southeast of the existing WTP/W facility and well. Test pumping provided a sustained pumping rate of 75 gallons per minute with a specific capacity of 5.14 gallons per minute per linear foot for each well. The main contaminants found in these wells were iron, manganese, arsenic, and color. A 2007 water treatment study found the water from the 2005 wells to be of relatively good quality and readily treatable using a conventional process[2].

[1] 2003 World Health Organization – Domestic Water Quality, Service, Level and Health
[2] 2007 Water Treatment Study by CE2 Engineers, Inc..

9.3.4. Raw Water Transmission

The raw water transmission line, from the selected wells to the WTP is anticipated to be 3-inch diameter HDPE, SDR 11 (160 PSI) PE-3408 and must meet the requirements of the National Sanitation Foundation (NSF) Standard 61. Regardless of the recommended alternative, the transmission line will include a circulating glycol heat trace loop for freeze protection and emergency thawing purposes.

9.3.5. Water Treatment

The water treatment plant must be sized to meet existing and future water demands and must be designed to meet all existing and near future water treatment regulations. In addition to removing contaminants found in groundwater such as iron, manganese, arsenic, color, and turbidity, ground waters used for drinking water are required to meet all Environmental Protection Agency (EPA) and State of Alaska ADEC groundwater requirements. The treatment process must also remove organic contaminants to prevent the formation of disinfection byproducts (DBPs) which have been shown to cause cancer when present in significant quantities.

The proposed water treatment process in Tuluksak, as presented in Figure 5 – Water Treatment Process Schematic, is conventional treatment. This process meets all State and Federal treatment requirements. The proposed process includes the following steps/operations:

1. Pump raw water from the wells to the WTP at approximately 40 gallons per minute, alternating operation of the pumps.
2. Preheat incoming well water with a heat exchanger to 50˚F for more effective treatment.
3. Inject an oxidizer, such as potassium permanganate, into the process stream followed by an in-line static mixer.
4. The process stream enters a detention tank for 40 minutes of detention time. Having oxidation take place inside a pressure vessel will prevent the water from being in contact with air, which would oxidize some of the iron in the water, and possibly cause a potassium permanganate overdose.
5. Inject a coagulant, such as polymer, into the process stream to better capture particles during filtration, followed by an in-line static mixer.
6. The process stream enters a package filtration plant where flocculation, sedimentation, and filtration take place.
7. After filtration, inject a disinfectant, such as chlorine, into the process stream followed by an in-line static mixer.
8. If required, inject a pH adjuster, such as soda ash, into the process stream followed by an in-line static mixer.
9. Pump treated water to the WST where it remains for the required chlorine contact time and for storage.
10. Potable water is drawn back to the WTP were it is connected to a distribution manifold. A pressure pump and hydropneumatic tanks regulate the water pressure in the distribution system.

11. The distribution manifold includes service connections to the WTP, the washeteria, and the water distribution loop. The distribution loop serves the clinic, store, teen center, school, teacher housing, and construction camp.
12. Water in the distribution loop is circulated by a circulator pump located in the WTP. A heat exchanger on the return line of the distribution loop regulates the temperature of the water leaving the plant.

Water treatment will occur in the recommended WTP alternative, either at the Utility Core Site or at the existing WTP/W facility. The proposed water treatment system will be a Class II system[3].

The proposed system falls under the Class II treatment system classification. Primary and back-up operators must have a "Water Treatment II" certification to operate the proposed treatment system. The Utility Manager must have successfully completed a utility management training course approved by the DCCED and validated by the RUBA. They must also be knowledgeable about the utility systems and experience managing the day to day operations of the proposed WTP/W facility.

9.3.6. Water Storage

The WST will be sized for at least 3 days of storage, based on 13 GPCD ordinary water use, and must meet chlorine contact time requirements. Based on these requirements, the proposed volume of the WST is 20,000 gallons. Calculations for WST sizing are presented in Appendix C. The tank will be located at the recommended WTP alternative, either at the Utility Core Site or adjacent to the existing WTP/W facility.

9.3.7. Water Distribution

Water distribution lines to the store, construction camp, health clinic, teen center, school, and teacher housing facilities will be through 2 each 2-inch HDPE SDR 11 circulating water lines (supply and return). The water distribution lines will be housed in a 6-inch by 12-inch HDPE SDR 11 arctic carrier pipe with an electric heat trace line for freeze protection.

Water service lines to the store, construction camp, health clinic, teen center, facilities will be 1-inch HDPE SDR 11 pipe (supply and return) and 2-inch diameter for the school and teacher housing complex. The water service lines will be housed in a 6-inch by 12-inch HDPE SDR 11 arctic carrier pipe with an electric heat trace line for freeze protection.

A new watering point will be constructed at the recommended washeteria facility location.

9.3.8. Washeteria Facility

Sizing the proposed washeteria facility was based on washeteria facilities in other communities similar to Tuluksak in population and infrastructure[4]. Proposed laundry facilities include 6 washers and 4 dryers. Proposed wash facilities include 2 unisex bathrooms with a shower, toilet, sink, vanity, and bench. Both bathrooms will be Americans with Disabilities Act (ADA) compliant.

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[3] 18 Alaska Administrative Code 74, Water and Wastewater Operator Certification and Training, Nov. 2010
[4] Cold Regions Utility Monograph

Ozone injection systems for the washers will be considered an alternative for the washeteria facility. Ozone is an oxidant that acts as a disinfectant and is reported to breakdown soil on contact. Ozone can activate the detergent chemicals in cold water and provide disinfection instead of doing both by using hot water at 140-160˚F. Ozone injection systems can therefore substantially reduce the amount of hot water needed per load of laundry, which in turn reduces energy costs to treat and heat the water. Reductions on the order of 65% for hot water consumption and 15% for total water consumption have been reported in Alaska for systems using ozone injection. Additional savings in fuel oil, electricity, chemicals, and labor are also possible. A return on investment of one year or less has also been reported for ozone injection systems in Alaska. The use of ozone is assumed for all considered alternatives.

9.3.9. Water Treatment Plant/Washeteria Building

The recommended alternative will include either a new building, an upgrade to the existing WTP/W facility building, or a combination of both. In any case, minimum separation distances for equipment and aisle-way requirements for egress will be met as required by the International Building Code.

The new building foundation will be an elevated pad constructed of select local sand with a post and pad foundation, placing the finished floor at least 3 feet[5] above the estimated 100-year flood elevation of 30.23 feet. The new building will be constructed of structural insulated panels (SIPs) with an insulation thickness of 8-inches and a metal roof and siding.

Rehabilitating the existing facility will include recommendations detailed in the Structural Condition Survey Report, presented in Appendix E. These recommendations include tightening the foundation bracing, replacing the flooring in the boiler room, and replacing the railing system, stair treads, and all windows.

It is anticipated that a minimum of three smaller energy-efficient boilers will be installed in each alternative to provide heat for the building(s), treatment process, washeteria facilities, and the water distribution loop. Each boiler will be operated at 40% for a total capacity of 120%.

9.3.10. Wastewater Collection, Treatment, and Disposal

In a predominantly residential community like Tuluksak, consumptive use of water without a community-wide piped distribution system is typically minimal. It is conservatively assumed that the amount of wastewater generated in the community is equal to the amount of domestic water used.

It is assumed that the majority of residents in Tuluksak will use the watering point for domestic water, and wastewater generated in the community will continue to be disposed of in the existing honeybucket disposal pit.

Wastewater from the recommended WTP/W alternative and the store, construction camp, health clinic, teen center, school, and teacher housing services will be collected and disposed of through a piped wastewater collection system, which is currently under construction in Tuluksak.

[5] Three feet is typically prescribed by USDA-RD.

The wastewater treatment lagoon, currently under construction, was sized for a community-wide piped water and sewer system, and will have more than adequate capacity to receive and treat future wastewater volumes from the recommended WTP/W alternative and new services connections.

9.3.11. Waste-Heat Recovery

The waste-heat recovery system will be based on available waste-heat generation from the existing power plant, which is located within the Utility Core Site. According to the mechanical inspection report, provided in Appendix E, approximately 180,000 to 200,000 BTUs per hour of waste-heat could be recovered from the power plant.

Currently, there are plans to install a circulating glycol heat trace loop for the new forcemain to the new wastewater treatment lagoon, utilizing waste-heat from the power plant. However, the total forcemain heat demand is estimated at 21,600 BTUs per hour, leaving nearly 160,000 BTUs per hour of recoverable heat at the power plant.

Potential uses for waste-heat include heating the WTP/W facility building, estimated at 50,000 BTUs per hour, and heating the water distribution loop, estimated at 25,000 BTUs per hour.

10. Alternatives Analysis

10.1. Alternative 1 – No-Build

10.1.1. Description

This alternative includes continued operation of the existing WTP/W facility to supply water to the washeteria and watering point, school, teacher housing, and construction camp. It assumes routine repairs to the facility. The community well, WTP, watering point, washeteria, and honeybucket collection and disposal would all continue in operation. Piped water would continue to be supplied to the school and teacher housing and the construction camp. All other users would continue to obtain domestic water by hauling it in buckets from the community watering point, from natural water bodies, or by collecting rainwater.

Wastewater from the school complex would continue to be piped to the fenced lagoon east of the school and wastewater from the washeteria and construction camp to the lagoon on the south side of the community. Domestic wastewater from homes, the health clinic, the store, and the teen center would continue to be collected in honeybuckets. The community's honeybucket collection service and central disposal facility, located south of the community, would continue to be used. Figure 4 – Existing Facilities Map presents the layout for this alternative.

10.1.2. Cost Estimates (Capital, O&M, and Life-Cycle)

No capital costs are expected for Alternative 1 as this alternative features no new development. Estimated annual O&M expenses (assuming 2034 demands) and a life-cycle cost analysis for Alternative 1 are presented below. See Appendix F for detailed cost estimates.

Table 4 – Alternative 1 Annual O&M Expenses

Item	Cost
Operator Labor	$ 45,225
Electricity and Utilities	$ 29,301
Heating Fuel	$ 107,954
Chemicals, Supplies, Freight, and Expendables	$ 26,420
Office and Administrative	$ 8,246
Equipment Replacement	$ 25,074
Estimated Annual O&M Cost	**$ 243,000**

The estimated life cycle cost for Alternative 1, in 2014 dollars, assuming uniform series present worth based on a 20 year design life is $4,132,000.

10.1.3. Environmental Impacts

No additional environmental impacts are anticipated as this alternative features no new development. However, there are several existing conditions not addressed by this alternative that could have potentially negative environmental impacts. These conditions include the proximity of the existing water well to fuel storage tanks and honeybucket collection points, aging gravity sewer lines prone to failure, and on-site greywater dumping. These, and other potentially negative conditions, are detailed in Section 6 – Existing Facilities and Planning Conditions.

10.1.4. Land Requirements

No additional land requirements are anticipated as this alternative features no new development.

10.1.5. Potential Construction Challenges

No construction problems are anticipates as this alternative features no new development.

10.1.6. Sustainability Considerations

Alternative 1 would not construct a reliable and affordable sanitation facility for the community. This alternative requires more operator attention and expertise than the other alternatives to operate the existing batch treatment system. This alternative does not address the issue of aging equipment replacement and continued deterioration of the facility.

Revenues generated by this alternative will not support the existing facility as the estimated annual O&M expenses exceed annual revenues, as presented in Table 4. In addition, this alternative does not produce enough water to meet the future demands of the community, as presented in Table 3.

10.1.7. Advantages and Disadvantages

The primary advantages of Alternative 1 include:

- No capital costs.

The primary disadvantages of Alternative 1 include:

- Substandard conditions will remain.
- Sanitation facilities and equipment will continue to deteriorate.
- Community will not experience the beneficial health and environmental effects associated with a functional and properly sized WTP, WST, washeteria facility, and water distribution system.
- Not a sustainable facility as currently operated.

10.2. Alternative 2 – New WTP/Washeteria Facility at Utility Core Site

10.2.1. Description

Alternative 2 will construct a new WTP/W facility at the Utility Core Site, south of the community, and will construct water distribution and services to key facilities centrally located within the community. Alternative 2 consists of the following components:

- Two wells at Utility Core Site (2005 wells);
- Raw water transmission line from wells to new WTP/W facility;
- New WTP/W facility at the Utility Core Site consisting of:
  - Water treatment plant with chemical and mechanical rooms,
  - Washeteria with laundry and shower facilities,
  - Water distribution pumps and piping,

- Community watering point,
    - Lift station and forcemain piping,
    - Office and storage space.
- 20,000-gallon insulated WST with fill and draw piping;
- 5,000-gallon bulk fuel storage tank and 25-gallon day tank;
- Standby Generator;
- Circulating water distribution loop with service connections to the health clinic, store, teen center, school and teacher housing, and the construction camp.

A preliminary site plan and floor plan for Alternative 2 are presented in Figures 6 and 7, respectively.

10.2.2. Cost Estimates (Capital, O&M, and Life-Cycle)

Estimated construction (capital) costs, annual O&M expenses (assuming 2034 demands), and a life-cycle cost analysis for Alternative 2 are presented below. See Appendix F for detailed cost estimate calculations.

Table 5 – Alternative 2 Capital Costs

Item	Activity	Cost
1	Mobilization and Demobilization	$240,000
2	New WTP/Washeteria Building and Associated Costs	$2,107,000
2	Water Treatment Process	$723,000
	Subtotal	$3,070,000
	20% Construction Contingency	$614,000
	Subtotal with Contingency	$3,684,000
	8% Design (Primary, Subs & Specialists)	$295,000
	10% Construction Management	$369,000
	8% VSW/Admin	$295,000
	Estimated Total *	**$4,642,000**

* Values have been rounded up to the nearest $10,000

Table 6 – Alternative 2 Annual O&M Expenses

Item	Cost
Operator Labor	$ 43,461
Electricity and Utilities	$ 30,026
Heating Fuel	$ 73,496
Chemicals, Supplies, Freight, and Expendables	$ 26,420
Office and Administrative	$ 8,246
Equipment Replacement	$ 17,606
Estimated Annual O&M Cost	**$ 200,000**

The estimated life cycle cost for alternative 2, in 2014 dollars, assuming uniform series present worth based on a 20 year design life is $8,043,000.

10.2.3. Environmental Impacts

Potential impacts and proposed mitigation measures for Alternatives 2, 3, and 4 are identified in Table 9.

Table 7 – Environmental Impacts and Mitigation Measures

Potential Environmental Impact	Proposed Mitigation Measures
Wetlands Impact	All work in wetlands will be permitted by the USACE.
Discovery of Unexpected Archaeological Artifacts	Stop all work completely, contact officials of TNC and the State Archaeologist's office and follow their recommended procedures.
Air Quality	Fugitive dust from construction activities will be mitigated by watering and other dust control measures as required.
Noise	Mufflers will be maintained on all construction equipment. Normal work hours will be 7:00 AM to 6:30 PM, Monday thru Saturday.
Transportation Diversion and Interruption	Traffic detours and interruptions will be publicly noticed ahead of time and marked with traffic cones and signage during construction and after-hours.
Accidental Discharge of Heavily Chlorinated Liquids from Disinfection of New Waterlines	Dam and contain the liquids, then dechlorinate with sodium thiosulfate prior to discharge into a sewer or to surface water.
Other Potential Impacts	Follow established response procedures. Obtain additional assistance from the State of Alaska Department of Environmental Conservation as prudent.

10.2.4. Land Requirements

No additional land requirements are anticipated for this alternative. Site control documents are provided in Appendix D.

10.2.5. Potential Construction Challenges

Construction issues include the potential for areas of discontinuous permafrost underlying the Utility Core Site, which will require careful consideration in locating the WTP/W facility building and the WST at the site. The existing WTP/W facility will continue to operate and serve the community during construction of the new facility.

10.2.6. Sustainability Considerations

Alternative 2 will construct a reliable and affordable sanitation facility for Tuluksak. This alternative will generate enough revenue annually to cover the estimated annual O&M and repair and replacement costs presented in Table 6. Other sustainability considerations include:

- New buildings will be energy efficient, decreasing energy and resources used.
- Shorter water transmission and distribution lines will reduce energy and heat requirements.
- Use of local materials will reduce transportation costs.
- Generally simpler technologies tent to be more affordable to operate, but often at the expense of the best possible performance. More complicated technologies may offer superior results, but may also require extra operator attention and more expensive replacement parts and consumables. The proposed treatment process is the "best of both worlds" in that it is operator friendly and provides superior treatment compared to the existing system.

10.2.7. Advantages and Disadvantages

The primary advantages of Alternative 2 include:

- Brand new combined facility, long life, cheaper and easier to operate and maintain.
- Building is in an excellent location, close to existing and proposed community infrastructure.
- Utilization of the existing wells will be convenient, short raw water transmission line.
- Access to waste-heat from the adjacent power plant, potentially reducing energy costs.

The primary disadvantages of Alternative 2 include:

- Further from town than existing WTP/W facility, longer water haul route.
- Long water distribution loop, more energy to circulate and heat water.

10.3. Alternative 3 – Rehabilitate Existing WTP/Washeteria Facility

10.3.1. Description

Alternative 3 will rehabilitate the existing WTP/W facility at its current location, and will construct a water distribution loop and services to key facilities centrally located within the community. Alternative 3 consists of the following components:

- Two wells at Utility Core Site (2005 wells);
- Raw water transmission line from wells to existing WTP/W facility;
- Rehabilitated WTP/W facility at current location consisting of:
    - Water treatment plant with chemical and mechanical rooms,
    - Washeteria with laundry and shower facilities,
    - Water distribution pumps and piping,
    - Community watering point,
    - Lift station and forcemain piping,
    - Office and storage space.
- 20,000-gallon insulated WST with fill and draw piping;

- 5,000-gallon bulk fuel storage tank and 25-gallon day tank;
- Standby Generator;
- Circulating water distribution loop with service connections to the health clinic, store, teen center, school and teacher housing, and the construction camp.

A preliminary site plan and floor plan for Alternative 3 are presented in Figures 8 and 9, respectively.

10.3.2. Cost Estimates (Capital, O&M, and Life-Cycle)

Estimated construction costs, annual O&M expenses (assuming 2034 demands), and a life-cycle cost analysis for Alternative 3 are presented below. See Appendix F for detailed cost estimate calculations.

Table 8 – Alternative 3 Capital Costs

Item	Activity	Cost
1	Mobilization and Demobilization	$240,000
2	Rehabilitate Existing WTP/Washeteria Building and Associated Costs	$1,972,000
3	Water Treatment Process	$722,500
	Subtotal	$2,935,000
	20% Construction Contingency	$587,000
	Subtotal with Contingency	$3,521,000
	8% Design (Primary, Subs & Specialists)	$282,000
	10% Construction Management	$353,000
	8% VSW/Admin	$282,000
	Estimated Total *	**$4,436,000**

* Values have been rounded up to the nearest $10,000

Table 9 – Alternative 3 Annual O&M Expenses

Item	Cost
Operator Labor	$ 43,461
Electricity and Utilities	$ 30,006
Heating Fuel	$ 75,615
Chemicals, Supplies, Freight, and Expendables	$ 26,420
Office and Administrative	$ 8,246
Equipment Replacement	$ 17,606
Estimated Annual O&M Cost	**$ 202,000**

The estimated life cycle cost for alternative 3, in 2014 dollars, assuming uniform series present worth based on a 20 year design life is $7,871,000.

10.3.3. Land Requirements

No additional land requirements are anticipated for this alternative. Site control documents are provided in Appendix D.

10.3.4. Potential Construction Challenges

This alternative will be challenging to construct while keeping the building operational. This could be addressed by constructing the new WTP in the space now dedicated to the washeteria while the existing WTP in still in operation. Following completion of the new WTP, the old WTP would be "gutted" and a new washeteria facility installed in its place.

10.3.5. Sustainability Considerations

Alternative 3 will construct a reliable and affordable sanitation facility for Tuluksak. This alternative will generate enough revenue annually to cover the estimated annual O&M and repair and replacement costs presented in Table 9. Other sustainability considerations include:

- Shorter water transmission and distribution lines will reduce energy and heat requirements.
- Use of local materials will reduce transportation costs.
- Generally simpler technologies tent to be more affordable to operate, but often at the expense of the best possible performance. More complicated technologies may offer superior results, but may also require extra operator attention and more expensive replacement parts and consumables. The proposed treatment process is the "best of both worlds" in that it is operator friendly and provides superior treatment compared to the existing system.

10.3.6. Advantages and Disadvantages

The primary advantages of Alternative 3 include:

- Existing facility is centrally located in the community, familiar to residents.
- Existing foundation, exterior walls, and roof will be reused if possible.
- Short water distribution loop.

The primary disadvantages of Alternative 3 include:

- Construction could be complicated, trying to replace/upgrade the floor and internal rooms, while keeping the building intact and operational.
- Temporary systems may be necessary to provide treated water to the community during construction.
- Longer raw water transmission main, more energy to circulate and heat.
- Access to waste-heat is not feasible.
- Large investment in a building that is over 30 years old.

10.4. Alternative 4 – Separate WTP and Washeteria Facilities

10.4.1. Description

Alternative 4 will rehabilitate the existing washeteria facility at its current location and will construct a new WTP at the Utility Core Site, south of the community. This alternative will also construct water distribution and services to key facilities centrally located within the community. Alternative 4 consists of the following components:

- Two wells at Utility Core Site (2005 wells);
- Raw water transmission line from wells to new WTP facility;
- New WTP building at the Utility Core Site consisting of:
    - Water treatment plant with chemical and mechanical rooms,
    - Water distribution pumps and piping,
    - Lift station and forcemain piping,
    - Office and storage space.
- Rehabilitated washeteria facility at current location consisting of:
    - Washeteria with laundry and shower facilities,
    - Community watering point,
    - Office and storage space,
    - Multi-purpose area.
- 20,000-gallon insulated WST with fill and draw piping;
- 5,000-gallon bulk fuel storage tank and 25-gallon day tank;
- Standby Generator;
- Circulating water distribution system with service connections to the washeteria and watering point, health clinic, store, teen center, school and teacher housing, and the construction camp.

A preliminary site plan and floor plans for Alternative 4 are presented in Figures 10, 11 and 12, respectively.

10.4.2. Cost Estimates (Capital, O&M, and Life-Cycle)

Estimated construction costs, annual O&M expenses (assuming 2034 demands), and a life-cycle cost analysis for Alternative 4 are presented below. See Appendix F for detailed cost estimate calculations.

Table 10 – Alternative 4 Capital Costs

Item	Activity	Cost
1	Mobilization and Demobilization	$240,000
2	Rehabilitate Existing Washeteria and Associated Costs	$1,468,000
3	New WTP Building and Associated Costs	$742,000
4	Water Treatment Process	$723,000
	Subtotal	$3,173,000
	20% Construction Contingency	$635,000
	Subtotal with Contingency	$3,807,000
	8% Design (Primary, Subs & Specialists)	$305,000
	10% Construction Management	$381,000
	8% VSW/Admin	$305,000
	Estimated Total *	**$4,797,000**

* Values have been rounded up to the nearest $10,000

Table 11 – Alternative 4 Annual O&M Expenses

Alternative 4 - Separate WTP and Washeteria Facilities	
Item	**Cost**
Operator Labor	$ 44,111
Electricity and Utilities	$ 30,216
Heating Fuel	$ 74,027
Chemicals, Supplies, Freight, and Expendables	$ 26,620
Office and Administrative Costs	$ 8,246
Equipment Replacement Costs	$ 18,306
Estimated Annual O&M Cost	**$ 202,000**

The estimated life cycle cost for alternative 4, in 2014 dollars, assuming uniform series present worth based on a 20 year design life is $8,232,000.

10.4.3. Land Requirements

No additional land requirements are anticipated for this alternative. Site control documents are provided in Appendix D.

10.4.4. Potential Construction Challenges

This alternative will be challenging to construct while keeping the building operational. This could be addressed by constructing the new WTP at the Utility Core Site while the existing WTP in still in operation. Following completion of the new WTP, the old WTP would be "gutted" and a new washeteria facility installed in its place.

Construction issues at the Utility Core Site include the potential for areas of discontinuous permafrost underlying the site, which will require careful consideration in locating the WTP and WST.

10.4.5. Sustainability Considerations

Alternative 4 will construct a reliable and affordable sanitation facility for Tuluksak. This alternative will generate enough revenue annually to cover the estimated annual O&M and repair and replacement costs presented in Table 11. Other sustainability considerations include:

- New buildings will be energy efficient, decreasing energy and resources used.
- Shorter water transmission and distribution lines will reduce energy and heat requirements.
- Use of local materials will reduce transportation costs.
- Generally simpler technologies tent to be more affordable to operate, but often at the expense of the best possible performance. More complicated technologies may offer superior results, but may also require extra operator attention and more expensive replacement parts and consumables. The proposed treatment process is the "best of both worlds" in that it is operator friendly and provides superior treatment compared to the existing system.

10.4.6. Advantages and Disadvantages

The primary advantages of Alternative 4 include:

- Existing washeteria facility is centrally located in the community, familiar to residents.
- Existing washeteria foundation, exterior walls, and roof will be reused if possible.
- Utilization of the existing wells will be convenient, short raw water transmission line.
- Access to waste-heat from the adjacent power plant, potentially reducing energy costs.

The primary disadvantages of Alternative 4 include:

- Two separate facilities will require more labor and will be more expensive to operate and maintain.
- The multi-purpose area of the washeteria facility will need to be heated even when not in use.
- Long water distribution loop is more expensive to circulate and heat

11. Selection of an Alternative

The following table presents a Life Cycle cost comparison of the four alternatives:

Table 12 – Comparison of Alternatives

Alternative	Capital Costs	Annual O&M Cost	Life Cycle Cost (Present Worth)*
Alt 1 - No Build	$0	$243,000	$4,132,000
Alt 2 - New WTP/W Facility at Core Utility Site	$4,642,000	$200,000	$8,043,000
Alt 3 - Rehabilitate WTP/W Facility	$4,436,000	$202,000	$7,871,000
Alt 4 - Separate WPT and Washeteria Facilities	$4,797,000	$202,000	$8,232,000

*Rounded to the nearest $10,000

Note: Uniform Series Present Worth based on 20 years design

As presented in Table 12, Alternative 1 has the lowest Life Cycle cost of the three alternatives. However, this alternative does not address any of the community's needs and has the greatest estimate annual O&M costs. In addition, there are numerous non-monetary factors that need to be considered when selecting an alternative. These factors are analyzed in the Selection Matrix in the next section.

11.1. Selection Matrix

As is often the case, alternatives have various advantages and disadvantages which can complicate the selection process. To simplify the evaluation and selection process, a selection matrix was developed to compare the alternatives.

The selection matrix, presented in Table 16 below, was prepared to focus the decision making process. The left column contains criteria thought to be important to making a selection between the alternatives. Next to each criterion is a Weight factor that assigns a relative importance (1 low to 3 high) to each of the criterion. Each alternative was given a Score (1 poor to 5 excellent) for each of the criterion. The Weight and Score were multiplied to give a "Weighted Score" for each criterion and then summed for each alternative to give the Total Score.

Table 13 – Selection Matrix

		Alternative 1 No-Build		Alternative 2 New WTP/W Facility		Alt 3 Rehab WTP/W Facility		Alt 4 Separate WTP and W	
Criteria	**Weight**	Score	**Weighted Score**	Score	**Weighted Score**	Score	**Weighted Score**	Score	**Weighted Score**
Operator Requirements	2	1	**2**	3	**6**	2	**4**	2	**4**
Environmental Impacts	2	1	**2**	3	**6**	5	**10**	3	**6**
Land Requirements/ Site Control	1	5	**5**	5	**5**	5	**5**	5	**5**
Construction Challenges	2	5	**10**	4	**8**	1	**2**	2	**4**
Capital Costs	3	5	**15**	3	**9**	3	**9**	3	**9**
O&M Costs	3	3	**9**	5	**15**	4	**12**	2	**6**
Sustainability	3	1	**3**	4	**12**	3	**9**	2	**6**
Facility Location	3	1	**3**	3	**9**	4	**12**	5	**15**
Future Needs	1	1	**1**	4	**4**	4	**4**	4	**4**
Community Preference	3	1	**3**	5	**15**	3	**9**	3	**9**
Raw Score/Total Score		24	**53**	39	**89**	34	**76**	31	**68**

The recommended alternative for Water Treatment Plant and Washeteria Facility Improvements in Tuluksak is Alternative 2 – New WTP/Washeteria Facility at the Utility Core Site. As presented in the Selection Matrix, Alternative 2 has the highest Total Score of the four alternatives considered.

12. Conclusions and Recommendations (Proposed Project)

The recommended alternative for WTP/W improvements, as presented in Section 11 – Selection of an Alternative, is Alternative 2 – New WTP/W Facility at Utility Core Site.

12.1. Preliminary Project Design

12.1.1. Water Supply

Water will be supplied from groundwater sources. Two 6-inch diameter wells were drilled to depths of approximately 190 feet near the recommended WTP/W facility, on Utility Core Site property. These wells will be more than adequate to provide the design flow rate of 40 gallons per minute to the WTP on a sustained basis. Raw water from these wells is of relatively good quality and readily treatable using a conventional process

12.1.2. Water Treatment

The proposed WTP will have the capacity to provide at least 5,500 gallons of treated water per day to meet the design water demand. The design of the facility will provide for the removal of contaminants in the raw water, such as iron, manganese, arsenic, and color. Specific treatment processes will be tailored to the water quality but will generally follow a conventional treatment process with a packaged filtration unit. Filtered water will be disinfected with chlorine prior to entering the WST and distribution system.

12.1.3. Water Storage

Sizing the WST included considerations for 3 days of water storage based on the average daily demand of the community. An insulated, bolted steel WST with a 20,000-gallon capacity is proposed to be located adjacent to the WTP/W facility at the Utility Core Site. The WST foundation will be an elevated select material sand pad with an on-grade tank foundation ring wall, constructed at least 3 feet above the estimated 100-year flood elevation of 30.23 feet.

12.1.4. Water Distribution

The proposed water distribution system includes service connections to the WTP, the washeteria, the watering point, and the water distribution loop. The distribution loop, consisting of 6-inch by 12-inch HDPE arctic pipe with 2 each 2-inch HDPE circulation water lines (supply and return), will serve the health clinic, store, teen center, school, teacher housing, and construction camp. Individual service lines consist of 1 or 2-inch HDPE circulating lines (supply and return) housed in 4 or 6-inch by 12-inch HDPE arctic pipe. Both the distribution loop and service lines will have electric heat trace lines for freeze protection.

12.1.5. Washeteria Facility

The proposed washeteria facility contains 6 washers and 4 dryers. It includes 2 unisex bathrooms with a shower, toilet, sink, vanity, and bench in each. Both bathrooms will be ADA compliant. In addition, the proposed facility has a dedicated office and a room for storage.

Reductions/savings on the order of 65% for hot water consumption and 15% for total water consumption have been reported in Alaska for systems using ozone injection. Additional savings in fuel oil, electricity, chemicals, and labor could reasonably be expected. A return on investment of one year or less has also been reported for ozone injection systems in Alaska. Ozone injection systems for the washers are included in the capital cost estimate and potential savings are included in the O&M cost estimate for the recommended alternative.

12.1.6. Water Treatment Plant/Washeteria Building

The new building will be constructed of structural insulated panels with 8 inches of insulation and a metal roof and siding. The economy of a pre-fabricated building was reviewed; however there were no apparent cost savings when compared to building the facility on-site. In addition, pre-fabricated buildings have size and layout restrictions on what can be built and shipped. The building foundation will be an elevated select material sand pad with a post and pad substructure, placing the finished floor at least 3 feet above the estimated 100-year flood elevation of 30.23 feet.

Three boilers will be installed to provide heat for the new building, the treatment process, and the water distribution and washeteria systems. Each boiler will be operated at 40% for a total capacity of 120%. Minimum separation distances for equipment and aisle-way requirements for egress will be met.

12.1.7. Wastewater Collection, Treatment, and Disposal

The majority of domestic wastewater generated in the community will continue to be collected in honeybuckets and self-hauled to collection points scattered throughout the community, and will continue to be disposed of by the TNC at the honeybucket disposal site, located approximately 2,000 feet south of the community. Wastewater from the store, construction camp, health clinic, teen center, school, and teacher housing services will be collected and disposed of through a piped wastewater collection system, which is currently under construction in Tuluksak.

Wastewater from the proposed WTP/W facility will be collected in a lift station located beneath the facility and pumped, via a new 4-inch by 12-inch HDPE arctic pipe forcemain, to a forcemain connecting a community lift station and the wastewater treatment lagoon. The community lift station, forcemain, and wastewater treatment lagoon are currently under construction in Tuluksak. The treatment lagoon was sized for a community-wide piped water and sewer system, and will have more than adequate capacity to receive and treat the wastewater from the proposed WTP/W facility and new services connections.

12.1.8. Waste-Heat Recovery

The waste-heat recovery system will be based on available waste-heat generation from the existing power plant, which is located within the Utility Core Site. According to the mechanical inspection report, provided in Appendix E, approximately 180,000 to 200,000 BTUs per hour of waste-heat could be recovered from the power plant.

There are plans to install a circulating glycol heat trace loop for the new forcemain to the new wastewater treatment lagoon, utilizing waste-heat from the power plant. However, the total forcemain heat demand is estimated at 21,600 BTUs per hour, leaving nearly 160,000 BTUs per hour of recoverable heat at the power plant.

Potential uses for waste-heat include heating the WTP/W facility building, estimated at 50,000 BTUs per hour, and heating the water distribution loop, estimated at 25,000 BTUs per hour. Other potential uses for waste-heat include raw water pre-heat, glycol heat trace, and the washeteria equipment (washers and dryers).

12.2. Total Project Cost Estimate

The total project cost estimate for the proposed alternative is presented in Table 5. Cost estimate calculations are presented in Appendix F.

12.3. Annual Operating Budget

The estimated annual operating budget for the proposed alternative is presented in Table 14. Cost estimate calculations are presented in Appendix F.

Table 14 – Annual Operating Budget

Revenue	
Watering Point Self Haul	$87,840
Water Distribution Fees	$60,000
Washeteria	$101,844
Total Revenue	$249,700
Expenses	
Annual Operation and Maintenance	$200,000
Annual Repair and Replacement Costs	$45,000
Total Expenses	$245,000
Net Operating Income (Loss)	$4,700

The Annual Operating Budget is based on user fees of $4.50 per wash load, $6.50 per dryer load, $2.00 per shower, and a rate of $0.20 per gallon at the watering point self-haul. Additional revenue is generated from utility fees for the school and teacher housing complex, health clinic, construction camp, teen center, and the store. Detailed calculations are presented in Appendix F.

12.4. Permit Requirements

It is anticipated that the following agencies will need to be contacted, and permitting secured, prior to construction of the proposed WTP/W facility:

- United States Army Corps of Engineers – Wetlands Permitting
- State Historic Preservation Office – Historic Properties
- United States Fish and Wildlife Service – Endangered Species
- Alaska Department of Fish and Game – Endangered Species
- Federal Aviation Administration – Hazard Determination
- State of Alaska Department of Transportation and Public Facilities – Utility Permit
- State of Alaska Department of Environmental Conservation – Approval to Construct
- State of Alaska Department of Natural Resources – Water Rights
- State of Alaska Fire Marshall – Building Fire Marshall Approval

12.5. Sustainability Considerations

A WTP/W facility needs to be affordable for the community to operate and maintain. One of the most common causes of system ineffectiveness, or system failure, is a community's inability to pay for critical components and consumable materials needed to properly operate their facilities. Sustainable utility management practices include environmental, social, and economical benefits that aid in creating a dependable facility.

Alternative 2 will construct a reliable and affordable sanitation facility for Tuluksak. This alternative will generate enough revenue annually to cover the estimated annual O&M and repair and replacement costs presented in Table 7. The proposed treatment system is operator friendly, requiring less oversight during treatment.

12.6. Project Schedule

Construction of the selected alternative, a new WTP/Washeteria Facility at the Utility Core Site, will require a dedicated multi-year effort. The proposed facility could be constructed in multiple phases with the WTP, chemical, mechanical, and storage rooms being built first as a self-contained facility, with the existing washeteria facility still in operation. The washeteria side of the facility would be constructed in the future, as funding allows.

This proposed phasing plan will undoubtedly need to be adapted to the availability of funding. In addition, the influence of other community and regional projects on limited local hire workforce will have to be considered.