Comprehensive Energy Audit For

Gulkana Water Treatment Plant

Prepared For

Gulkana Village

December 18, 2017

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PREFACE

This energy audit was conducted using funds provided by the Denali Commission. Coordination with Gulkana Village has been undertaken to provide maximum accuracy in identifying facilities to audit and coordinating potential follow up retrofit activities.

The Rural Energy Initiative at the Alaska Native Tribal Health Consortium (ANTHC) prepared this document for Gulkana Village, Alaska. The author of this report is Kevin Ulrich, Assistant Engineering Project Manager and Certified Energy Manager (CEM).

The purpose of this report is to provide a comprehensive document of the findings and analysis that resulted from an energy audit conducted in July of 2017 by the Rural Energy Initiative of ANTHC. This report analyzes historical energy use and identifies costs and savings of recommended energy conservation measures. Discussions of site-specific concerns, non-recommended measures, and an energy conservation action plan are also included in this report.

ACKNOWLEDGMENTS

The ANTHC Rural Energy Initiative gratefully acknowledges the assistance of Gulkana Village Maintenance Person Ray Spear; Volunteer Water Treatment Plant Operator Frank Vermillion, Tribal Administrator Angela Vermillion, and Administrative Assistant Amanda Maxim.

1. EXECUTIVE SUMMARY

This report was prepared for Gulkana Village. The scope of the audit focused on Gulkana Water Treatment Plant. The scope of this report is a comprehensive energy study, which included an analysis of building shell, interior and exterior lighting systems, HVAC systems, and plug loads.

Based on electricity and fuel prices at the time of the audit, the total predicted energy costs for the Gulkana Water Treatment Plant is approximately $19,956 per year. Electricity represents the largest portion with an annual cost of approximately $12,243. Fuel oil represents the remaining portion of energy costs with an annual cost of approximately $7,713.

Table 1.1 lists the total usage of electricity and #1 heating oil in the Gulkana Water Treatment Plant before and after the proposed retrofits.

Table 1.1: Predicted Annual Fuel Use for the Gulkana Water Treatment Plant

Predicted Annual Fuel Use		
Fuel Use	**Existing Building**	**With Proposed Retrofits**
Electricity	42,660 kWh	17,129 kWh
#1 Oil	3,061 gallons	246 gallons
Spruce Wood	0.00 cords	15.60 cords

Benchmark figures facilitate comparing energy use between different buildings. Table 1.2 lists several benchmarks for the audited building.

Table 1.2: Building Benchmarks for the Gulkana Water Treatment Plant

Building Benchmarks			
Description	**EUI (kBtu/Sq.Ft.)**	**EUI/HDD (Btu/Sq.Ft./HDD)**	**ECI ($/Sq.Ft.)**
Existing Building	280.5	20.87	$10.18
With Proposed Retrofits	190.5	14.18	$5.02
EUI: Energy Use Intensity - The annual site energy consumption divided by the structure's conditioned area. EUI/HDD: Energy Use Intensity per Heating Degree Day. ECI: Energy Cost Index - The total annual cost of energy divided by the square footage of the conditioned space in the building.			

Table 1.3 below summarizes the energy efficiency measures analyzed for the Gulkana Water Treatment Plant. Listed are the estimates of the annual savings, installed costs, and two different financial measures of investment return.

Table 1.3: Summary of Recommended Energy Efficiency Measures

PRIORITY LIST – ENERGY EFFICIENCY MEASURES							
Rank	**Feature**	**Improvement Description**	**Annual Energy Savings**	**Installed Cost**	**Savings to Investment Ratio, SIR[1]**	**Simple Payback (Years)[2]**	**CO_2 Savings**
1	Other Electrical: Polymer Pump	Reduce water-making cycles by repairing the raw water intake to reduce sand collected from the river. *This is a benefit from reduced water making cycles.*	$214	$100	29.65	0.5	1,035.1
2	Raw Water Heat Add	Reduce number of times that intake must be cleaned from once weekly to once monthly with Intake System Repair. *This is a benefit from reduced water making* cycles.	$0 + $3,900 Maint. Savings	$2,000	29.01	0.5	0.0
3	Other Electrical: Raw Water Heat Tape - "To Vault"	Shut off heat tape and use in emergency thaw purposes. This can only be accomplished by removing the intake check valve to construct a drainback system. This is directly tied to retrofit 7.	$4,405	$2,000	25.87	0.5	24,554.9
4	Process Room Unit Heaters	Lower Unit Heater set points to 60 deg. F	$954	$500	25.85	0.5	7,968.0
5	Other Electrical: MIEX Circulation Pump	Reduce water-making cycles by repairing the raw water intake to reduce sand collected from the river. *This is a benefit from reduced water making cycles.*	$138	$100	19.23	0.7	673.1
6	Water Storage Tank	Eliminate necessity of Water Delivery to the residents with WST foundation repair. *This is a direct benefit of the water storage tank foundation repair.*	$0 + $4,000 Maint. Savings	$4,000	11.94	1.0	0.0
7	Other Electrical: Raw Water Heat Tape - "To Intake"	Shut off heat tape and use in emergency thaw purposes. This can only be accomplished by removing the intake check valve to construct a drainback system. This is directly tied to retrofit 3.	$1,468	$2,000	8.62	1.4	8,184.9
8	Ventilation	Add controls to boiler exhaust fan so that it isn't operating when the boilers are not running. Add controls to the chlorine exhaust fan such that it only turns on when the room is unoccupied.	$706	$3,000	3.97	4.2	5,518.9

PRIORITY LIST – ENERGY EFFICIENCY MEASURES							
Rank	**Feature**	**Improvement Description**	**Annual Energy Savings**	**Installed Cost**	**Savings to Investment Ratio, SIR**[1]	**Simple Payback (Years)**[2]	**CO_2 Savings**
9	Setback Thermostat: Water Treatment Plant	Implement a Heating Temperature Unoccupied Setback to 55.0 deg F for the Water Treatment Plant space.	$496	$2,000	3.32	4.0	4,009.7
10	HVAC And DHW	Add a biomass pellet boiler to the heating system to take advantage of locally manufactured wood pellets, clean and tune fuel oil boilers. Consider shutting down boilers in the summer time.	$1,085 + $10,000 Maint. Savings	$60,000	2.97	5.4	44,239.4
11	Lighting: Process Room	Replace with new, energy efficient direct-wire LED lighting and add new occupancy sensor	$323	$1,220	3.09	3.8	2,070.0
12	Other Electrical: Brine Pump	Reduce water-making cycles by repairing the raw water intake to reduce sand collected from the river. *This is a benefit from reduced water making cycles.*	$15	$100	2.19	6.6	97.7
13	Other Electrical: Underdraw Pump	Reduce water-making cycles by repairing the raw water intake to reduce sand collected from the river. *This is a benefit from reduced water making cycles.*	$15	$100	2.19	6.6	97.7
14	Other Electrical: Raw Water Intake Pump	Run intake pump at 16 GPM for shorter time intervals to maximize water intake. *This is a benefit from reduced water making cycles.*	$138	$1,000	2.02	7.2	769.7
15	Other Electrical: Potassium Permanganate Mixer	Reduce water-making cycles by repairing the raw water intake to reduce sand collected from the river. *This is a benefit from reduced water making cycles.*	$12	$100	1.75	8.3	78.1
16	Other Electrical: Polymer Mixer	Reduce water-making cycles by repairing the raw water intake to reduce sand collected from the river. *This is a benefit from reduced water making cycles.*	$12	$100	1.41	8.3	78.1
17	Lighting: Process Room - 2-Lamp Fixture	Replace with new, energy efficient direct-wire LED lighting	$7	$60	1.41	8.3	46.8

PRIORITY LIST – ENERGY EFFICIENCY MEASURES							
Rank	**Feature**	**Improvement Description**	**Annual Energy Savings**	**Installed Cost**	**Savings to Investment Ratio, SIR[1]**	**Simple Payback (Years)[2]**	**CO_2 Savings**
18	Lighting: Entryway	Replace with new, energy efficient direct-wire LED lighting	$22	$180	1.41	8.3	140.4
19	Lighting: Office	Replace with new, energy efficient direct-wire LED lighting	$29	$240	1.41	8.3	187.2
20	Generator Unit Space Heat	Turn down generator unit space heat set points	$9	$100	1.33	11.0	50.7
21	Old Water Plant Space Heat	Turn down old water plant space heat set points	$9	$100	1.33	11.0	50.7
22	Other Electrical: Chlorine Injection Pump	Reduce water-making cycles by repairing the raw water intake to reduce sand collected from the river. *This is a benefit from reduced water making cycles.*	$7	$100	1.05	13.8	46.8
23	Other Electrical: Potassium Permanganate Injection Pump	Reduce water-making cycles by repairing the raw water intake to reduce sand collected from the river. *This is a benefit from reduced water making cycles.*	$7	$100	1.05	13.8	46.8
24	Solar PV	Install new Solar PV system rated for 10 kW. Maint. Savings are solar PV savings from feasibility study	$0 + $5,425 Maint. Savings	$106,485	1.00	19.6	0.0
25	Lighting: Storage/Bench	Replace with new, energy efficient direct-wire LED lighting	$15	$180	0.94	12.4	94.1
26	Lighting Boiler Room	Replace with new, energy efficient direct-wire LED lighting	$14	$240	0.70	16.6	93.6
27	Water Circulation Loop Heat-Add	Replace heat-add circ. pumps with Grundfos Alpha models	$23	$1,000	0.27	43.5	130.6
28	Lighting: Generator Unit	Replace with new, energy efficient direct-wire LED lighting	$3	$240	0.12	95.1	14.1
29	Lighting: Chlorine Room	Replace with new, energy efficient direct-wire LED lighting	$1	$120	0.10	115.7	6.7
30	Lighting: Restroom	Replace with new, energy efficient direct-wire LED lighting	$1	$180	0.05	230.7	5.0
31	Lighting: Old Water Plant Lights	Replace with new, energy efficient direct-wire LED lighting	$0	$180	0.02	475.1	2.1
32	Lighting: Loft	Replace with new, energy efficient direct-wire LED lighting	$0	$180	0.02	581.5	2.0

PRIORITY LIST – ENERGY EFFICIENCY MEASURES							
Rank	Feature	Improvement Description	Annual Energy Savings	Installed Cost	Savings to Investment Ratio, SIR[1]	Simple Payback (Years)[2]	CO_2 Savings
TOTAL			$10,129 + $23,325 Maint. Savings	$188,005	2.68	5.6	100,293.0

Table Notes:

[1] Savings to Investment Ratio (SIR) is a life-cycle cost measure calculated by dividing the total savings over the life of a project (expressed in today's dollars) by its investment costs. The SIR is an indication of the profitability of a measure; the higher the SIR, the more profitable the project. An SIR greater than 1.0 indicates a cost-effective project (i.e. more savings than cost). Remember that this profitability is based on the position of that Energy Efficiency Measure (EEM) in the overall list and assumes that the measures above it are implemented first.

[2] Simple Payback (SP) is a measure of the length of time required for the savings from an EEM to payback the investment cost, not counting interest on the investment and any future changes in energy prices. It is calculated by dividing the investment cost by the expected first-year savings of the EEM.

With all of these energy efficiency measures in place, the annual utility cost can be reduced by $10,129 per year, or 50.8% of the buildings' total energy costs. These measures are estimated to cost $188,005, for an overall simple payback period of 5.6 years.

Table 1.4 below is a breakdown of the annual energy cost across various energy end use types, such as Space Heating and Water Heating. The first row in the table shows the breakdown for the building as it is now. The second row shows the expected breakdown of energy cost for the building assuming all of the retrofits in this report are implemented. Finally, the last row shows the annual energy savings that will be achieved from the retrofits.

Table 1.4: Detailed Breakdown of Energy Costs in the Building

Annual Energy Cost Estimate									
Description	Space Heating	Water Heating	Ventilation Fans	Lighting	Other Electrical	Raw Water Heat Add	Water Circulation Heat	Tank Heat	Total Cost
Existing Building	$6,900	$34	$373	$931	$9,031	$1,188	$330	$1,169	**$19,956**
With Proposed Retrofits	$4,262	$29	$301	$430	$2,483	$1,008	$283	$1,031	**$9,827**
Savings	$2,638	$5	$72	$501	$6,549	$180	$47	$138	**$10,129**

2. AUDIT AND ANALYSIS BACKGROUND

2.1 Program Description

This audit included services to identify, develop, and evaluate energy efficiency measures at the Gulkana Water Treatment Plant. The scope of this project included evaluating building shell, lighting and other electrical systems, and HVAC equipment, motors and pumps. Measures were analyzed based on life-cycle-cost techniques, which include the initial cost of the equipment, life of the equipment, annual energy cost, annual maintenance cost, and a discount rate of 3.0%/year in excess of general inflation.

2.2 Audit Description

Preliminary audit information was gathered in preparation for the site survey. The site survey provides critical information in deciphering where energy is used and what opportunities exist within a building. The entire site was surveyed to inventory the following to gain an understanding of how each building operates:

- Building envelope (roof, windows, etc.)
- Heating, ventilation, and air conditioning equipment (HVAC)
- Lighting systems and controls
- Building-specific equipment
- Water consumption, treatment (optional) & disposal

The building site visit was performed to survey all major building components and systems. The site visit included detailed inspection of energy consuming components. Summary of building occupancy schedules, operating and maintenance practices, and energy management programs provided by the building manager were collected along with the system and components to determine a more accurate impact on energy consumption.

Details collected from Gulkana Water Treatment Plant enable a model of the building's energy usage to be developed, highlighting the building's total energy consumption, energy consumption by specific building component, and equivalent energy cost. The analysis involves distinguishing the different fuels used on site, and analyzing their consumption in different activity areas of the building.

Gulkana Water Treatment Plant has a building area of approximately 1,960 square feet.

In addition, the methodology involves taking into account a wide range of factors specific to the building. These factors are used in the construction of the model of energy used. The factors include:

- Occupancy hours
- Local climate conditions
- Prices paid for energy

2.3. Method of Analysis

Data collected was processed using AkWarm© Energy Use Software to estimate energy savings for each of the proposed energy efficiency measures (EEMs). The recommendations focus on the building envelope; HVAC; lighting, plug load, and other electrical improvements; and motor and pump systems that will reduce annual energy consumption.

EEMs are evaluated based on building use and processes, local climate conditions, building construction type, function, operational schedule, existing conditions, and foreseen future plans. Energy savings are calculated based on industry standard methods and engineering estimations.

Our analysis provides a number of tools for assessing the cost effectiveness of various improvement options. These tools utilize **Life-Cycle Costing**, which is defined in this context as a method of cost analysis that estimates the total cost of a project over the period of time that includes both the construction cost and ongoing maintenance and operating costs.

Savings to Investment Ratio (SIR) = **Savings** divided by **Investment**

Savings includes the total discounted dollar savings considered over the life of the improvement. When these savings are added up, changes in future fuel prices as projected by the Department of Energy are included. Future savings are discounted to the present to account for the time-value of money (i.e. money's ability to earn interest over time). The **Investment** in the SIR calculation includes the labor and materials required to install the measure. An SIR value of at least 1.0 indicates that the project is cost-effective—total savings exceed the investment costs.

Simple payback is a cost analysis method whereby the investment cost of a project is divided by the first year's savings of the project to give the number of years required to recover the cost of the investment. This may be compared to the expected time before replacement of the system or component will be required. For example, if a boiler costs $12,000 and results in a savings of $1,000 in the first year, the payback time is 12 years. If the boiler has an expected life to replacement of 10 years, it would not be financially viable to make the investment since the payback period of 12 years is greater than the project life.

The Simple Payback calculation does not consider likely increases in future annual savings due to energy price increases. As an offsetting simplification, simple payback does not consider the need to earn interest on the investment (i.e. it does not consider the time-value of money). Because of these simplifications, the SIR figure is considered to be a better financial investment indicator than the Simple Payback measure.

Measures are implemented in order of cost-effectiveness. The program first calculates individual SIRs, and ranks all measures by SIR, higher SIRs at the top of the list. An individual measure must have an individual SIR>=1 to make the cut. Next the building is modified and re-simulated with the highest ranked measure included. Now all remaining measures are re-evaluated and ranked, and the next most cost-effective measure is implemented. AkWarm goes through this iterative process until all appropriate measures have been evaluated and installed.

It is important to note that the savings for each recommendation is calculated based on implementing the most cost effective measure first, and then cycling through the list to find the next most cost effective measure. Implementation of more than one EEM often affects the savings of other EEMs. The savings may in some cases be relatively higher if an individual EEM is implemented in lieu of multiple recommended EEMs. For example implementing a reduced operating schedule for inefficient lighting will result in relatively high savings. Implementing a reduced operating schedule for newly installed efficient lighting will result in lower relative savings, because the efficient lighting system uses less energy during each hour of operation. If multiple EEM's are recommended to be implemented, AkWarm calculates the combined savings appropriately.

Cost savings are calculated based on estimated initial costs for each measure. Installation costs include labor and equipment to estimate the full up-front investment required to implement a change. Costs are derived from Means Cost Data, industry publications, and local contractors and equipment suppliers.

2.4 Limitations of Study

All results are dependent on the quality of input data provided, and can only act as an approximation. In some instances, several methods may achieve the identified savings. This report is not intended as a final design document. The design professional or other persons following the recommendations shall accept responsibility and liability for the results.

3. GULKANA WATER TREATMENT PLANT

3.1. Building Description

The 1,960 square foot Gulkana Water Treatment Plant was constructed in 2014. The building houses the water filtration, and circulation services for the community. The water treatment plant is occupied for approximately eight hours per day for three days per week, and two hours day for four days per week.

Water is pumped from the Gulkana River through an intake line that is approximately 800 ft. long to the water treatment plant. Once the water enters the building, it is heated such that it can be properly processed by the MIEX treatment system present in the plant. The MIEX pretreatment system is used to remove Dissolved Organic Compounds (DOC's) from the raw water. DOC's are very common in the Gulkana River, which acts as the water source for the community. After the water is processed through the MIEX system, it is injected with Potassium Permanganate (and processed through a reaction chamber) and Polymer 8185. These chemicals act as coagulants that collect dirt and other particles together to assist with sand filtration. After filtration, the water is injected with chlorine before being stored in a water storage tank. The water is given contact time in the water storage tank for proper contact time with the chlorine for treatment. After the water storage tank, the water is circulated through the distribution loop to the community. The water is circulated through the use of two 1.5 HP circulation pumps in the winter and two ¾ HP pressure pumps in the summer. All of the water in the water storage tank and in the distribution loops is heated to prevent freezing.

Figure 1: Brine Tank

All of the community sewage is handled through a gravity sewer system. The system has one lift station that collects the sewage and pumps it to a sewage lagoon outside of town. The lift station was not visited during the site visit and was not assessed for this energy audit report.

The raw water intake is located in the Gulkana River approximately 800 ft. from the water treatment plant building. The intake is located beneath the gravel bed in the Gulkana River, and a screen is used to filter out the water from the surrounding environment. Sand has migrated through the gravel bed into the screen over time, which has collected in the intake. This has caused many issues with overall water quality as well as equipment maintenance in the water treatment plant. Some of the concerns include:

- Sand has eroded away at the intake pump, causing the need for early replacement.
- The raw water intake is only operated at approximately 9-11 GPM in order to reduce the sand quantity in the water. This causes the intake pump to operate outside of the efficient operating curve.

Additionally, at the time of the site visit the water intake had a check valve that keeps water in the intake pipe even when not pumping, causing the operators to leave the heat tape on for thaw recovery of the water line. This check valve was removed in Fall 2017 after the site visit and the benefits are documented in this report.

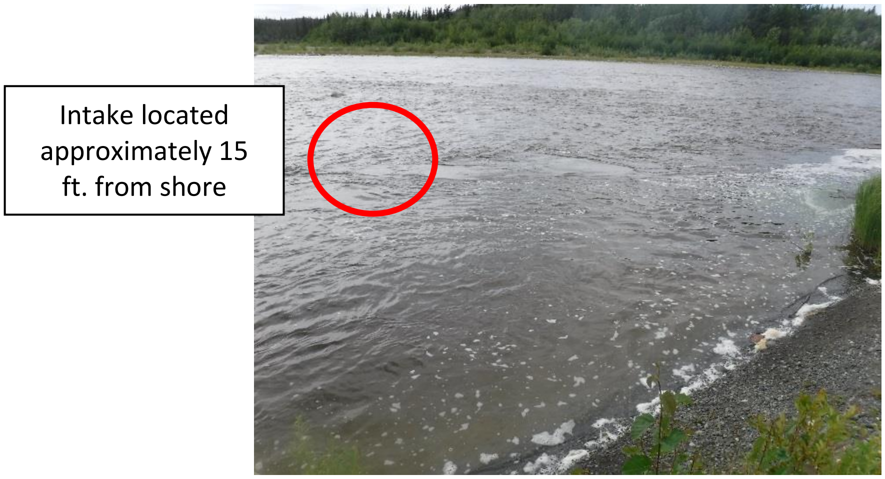


Figure 2: Raw Water Intake Location in the Gulkana River.

The water storage tank foundation is not capable of supporting the full weight of the water storage tank in a vertical position. As a result, the water storage tank is tilted to its side. This leads to the following problems:

- The water storage tank cannot be filled to its maximum capacity for fear of tank collapse, which limits the community water storage and creates a need for water delivery to residents in the winter.
- The limited water storage cannot act as a heat sink effectively, which leads to additional heating being necessary to prevent freezing. Currently, more freeze-ups occur because of this issue.

Figure 3: Water Storage Tank shown leaning to the left

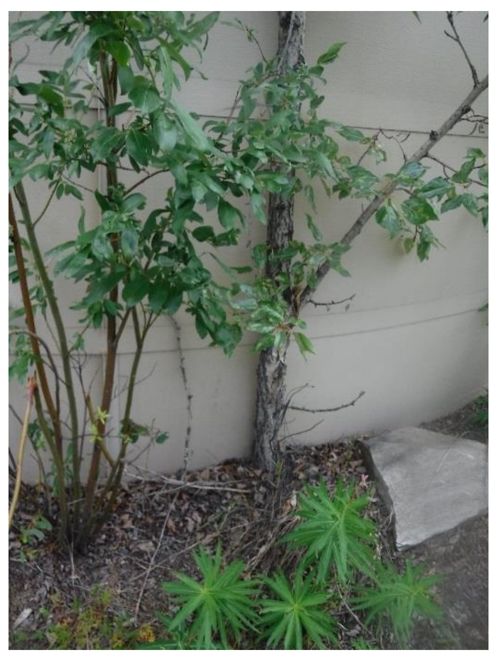


Figure 4: Trees growing in the water storage tank foundation, creating instability in the foundation soil

Figure 5: Level indicator showing the approximate tilting angle of the downhill side of the water storage tank.

Figure 6: Level indicator showing the approximate tilting angle of the uphill side of the water storage tank.

All potential retrofits related to the water processing and heating assume that these issues with the raw water intake and the water storage tank are addressed through a sanitation upgrades project. Without these projects in place, all benefits from retrofits related to the water process and heating are potentially voided.

Figure 7: Raw Water Intake GPM and Water Storage Tank Water Level during the Site Visit

Description of Building Shell

The exterior walls are constructed with 2x6 standard lumber construction with polyurethane spray foam insulation.

The building has a cathedral ceiling that is constructed with 2x6 standard lumber construction and spray foam polyurethane foam insulation. The peak of the ceiling is approximately 16 ft. high and the sides of the building are approximately 12 ft. high.

The building is constructed on a gravel pad foundation with a concrete slab. The slab is insulated with rigid foam board insulation.

There are seven total windows in the building. Four of the windows are located in the main process room and are approximately 4’ x 1’6” each. The other three windows are in the office and entry area and are approximately 3’ x 2’ each. One of these windows is south facing. All of the windows are double-pane glass with vinyl framing.

The only entrance to the building is a single set of double doors with an arctic entry. The doors are insulated metal doors with quarter-lite windows.

Description of Heating Plants

The heating plants used in the building are:

Boiler 1

Nameplate Information:	Weil McLain UO-3
Fuel Type:	#1 Oil
Input Rating:	122,000 BTU/hr
Steady State Efficiency:	81 %
Idle Loss:	0.5 %
Heat Distribution Type:	Glycol
Boiler Operation:	All Year
Notes:	Pump: Grundfos UP-15-42F

Boiler 2

Nameplate Information:	Weil McLain UO-3
Fuel Type:	#1 Oil
Input Rating:	122,000 BTU/hr
Steady State Efficiency:	81 %
Idle Loss:	0.5 %
Heat Distribution Type:	Glycol
Boiler Operation:	All Year
Notes:	Pump: Grundfos UP-15-42F

Figure 8: Water Treatment Plant Boilers

Generator Unit Electric Heater

Nameplate Information:	King Pic-A-Watt
Fuel Type:	Electricity
Input Rating:	0 BTU/hr
Steady State Efficiency:	100 %
Idle Loss:	0 %
Heat Distribution Type:	Air

Figure 9: Generator Unit

Figure 10: Generator Unit Space Heater

Old Water Plant Electric Heater

Fuel Type:	Electricity
Input Rating:	0 BTU/hr
Steady State Efficiency:	100 %
Idle Loss:	0 %
Heat Distribution Type:	Air

Figure 11: Old Water Treatment Plant

Figure 12: Old Water Treatment Plant Space Heater

The two boilers provide heat for all water processing and distribution as well as for building space heat.

The generator unit electric heater and the old water plant electric heater each provide space heat for the two locations. The generator room requires warm temperatures in the event of generator operation in order to ensure proper start-up of the generator. The old water plant has some existing distribution piping as well as access to the water storage tank that must be kept from freezing.

Space Heating Distribution Systems

Space heating for the facility is provided by three space heaters as well as some baseboard distribution. Two of the unit heaters are located in the process room and were both running constantly with a temperature set point of 90 deg. F during the site visit. The room temperature at the time did not match the temperature set point during the site visit. These unit heaters are Beacon-Morris Model HB-048 models and are rated for 34,000 BTU/hr each. There is also a Beacon-Morris model HB-118A model unit heater in the boiler room that is rated for 18,400 BTU/hr. The heated glycol is distributed throughout the facility by Grundfos MAGNA 40-120F heat circulator pumps. These pumps have VFD motors capable of variable speeds to match the building heat demand.

Figure 13: Heating Circulation Pump

Domestic Hot Water System

Hot water for the facility is provided by a Stiebel Electron SHC4 hot water heater with a 4-gallon storage tank. There is a restroom sink, janitor sink, and lab sink that are served by this hot water heater.

Figure 14: Hot Water Heater

Description of Building Ventilation System

There are four total ventilation and exhaust fans used for ventilation of the building. Detailed information on each exhaust fan is listed in Table 3.1 below.

Table 3.1: Summary of Ventilation and Exhaust Fans

Label	Location	Rating (Watts)	CFM
VF-1	Boiler Room Ventilation	100	260
EF-1	Process Room	125	550
EF-2	Chemical Room	20	105
EF-3	Restroom Exhaust	10	70

Figure 15: Boiler Room Exhaust Fan

Figure 16: Chemical Room Exhaust Fan

Lighting

Lighting in the water treatment plant and washeteria consumes approximately 3,243 kWh annually and constitutes approximately 8% of the building's current electrical consumption.

Table 3.2: Breakdown of Lighting by Location and Lamp Type

Location	Lamp Type	Fixtures	Lamps per Fixture	Annual Usage (kWh)
Entryway	Fluorescent T8 4ft. 32W	3	2	315
Storage/Bench	Fluorescent T8 4ft. 32W	3	2	211
Restroom	Fluorescent T8 4ft. 32W	3	2	11
Office	Fluorescent T8 4ft. 32W	4	2	420
Process Room	Fluorescent T8 4ft. 32W	12	4	1,654
Process Room	Fluorescent T8 4ft. 32W	1	2	105
Boiler Room	Fluorescent T8 4ft. 32W	4	2	210
Chlorine Room	Fluorescent T8 4ft. 32W	2	2	15
Loft	Fluorescent T8 4ft. 32W	3	2	5
Exterior	LED 20 Watt	3	1	262
Generator Unit	Fluorescent T8 4ft. 32W	4	2	30
Old Water Plant	Fluorescent T8 4ft. 32W	3	2	5
			Total Energy Consumption	3,243

Major Equipment

Table 3.3 contains the details on each of the major electricity consuming mechanical components found in the water treatment plant. Major equipment consumes approximately 31,469 kWh annually constituting about 74% of the building's current electrical consumption.

Table 3.3: Major Equipment List

Major Equipment	Purpose	Rating	Operating Schedule	Annual Energy Consumption (kWh)
Raw Water Heat Tape "To Vault"	Prevents water intake line from freezing.	3,600 W	Jan. – Jun. Constantly	15,660
Raw Water Heat Tape "To Intake"	Prevents water intake line from freezing.	1,200 W	Jan. – Jun. Constantly	5,220
Raw Water Intake Pump	Pumps water from the river to the water treatment plant	0.5 HP	2.5 Days per Week	1,458
MIEX Circulation Pump	Circulates water through the MIEX pretreatment process	1 HP	2.5 Days per Week	1,878
Brine Pump	Circulates brine resin through the resin chamber	50 W	2.5 Days per Week	194
Underdraw Pump	Circulates water through MIEX system when additional pressure is needed for the process	50 W	2.5 Days per Week	194
Air Compressor	Compresses air for brine resin preservation	5 HP	2.5 Days per Week	196
Polymer Pump	Pumps Polymer into raw water prior to sand filtration	1 HP	2.5 Days per Week	2,916
Polymer Mixer	Mixes Polymer chemical to reach desired chemical ratio	40 W	2.5 Days per Week	156
Chlorine Injection Pump	Injects chlorine in the filtered water prior to entering the water storage tank	24 W	2.5 Days per Week	93
Potassium Permanganate Mixer	Mixes Potassium Permanganate chemical to reach desired chemical ratio	40 W	2.5 Days per Week	156
Potassium Permanganate Injection Pump	Injects Potassium Permanganate in the water prior to entering the sand filters	24 W	2.5 Days per Week	93
Backwash Pump	Cleans out sand filters after one batch of water making	1.5 HP	One hour per Week	58
Air Scour	Removes air from the raw water pipes after backwashing the sand filters.	3 HP	One hour per Week	117
High Capacity Pump	Operates when system requires a boost in pressure or flow	10 HP	Half Hour per Week	195
Pressure Pumps (2)	Pressurizes the circulating water system for proper distribution	0.75 HP	16% of the time per pump (32% of the time total)	763
Circulation Pumps	Circulate water through the distribution loops to the community	1.5 HP	Continuous	1,764
Desktop Computer		75	Building Occupancy	137
Coffee Maker		900 W	Half Hour per Day	195
Belt Grinder		0.5 HP	Half Hour per Week	10
Generator Fuel Pump	Pumps fuel to the generator when operating	0.33 HP	Half Hour per Day	16
			Total Energy Consumption	31,469

Figure 17: MIEX Circulation Pump

Figure 18: MIEX Air Compressor

Figure 19: Chlorine Injection Pump

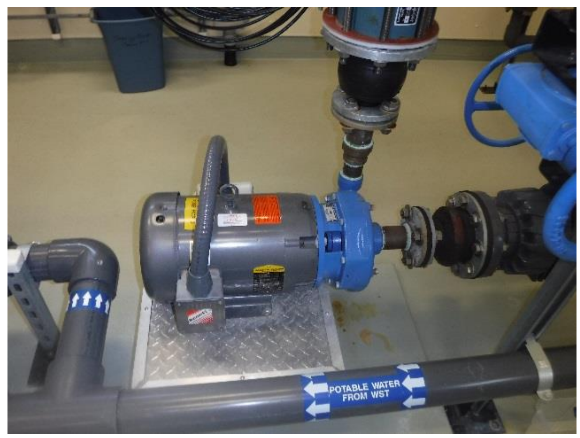


Figure 20: High Capacity Pump

Figure 21: Distribution Loop Circulation Pumps

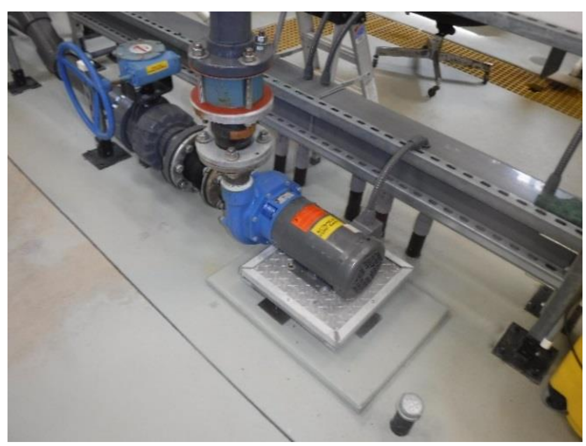


Figure 22: Backwash Pump

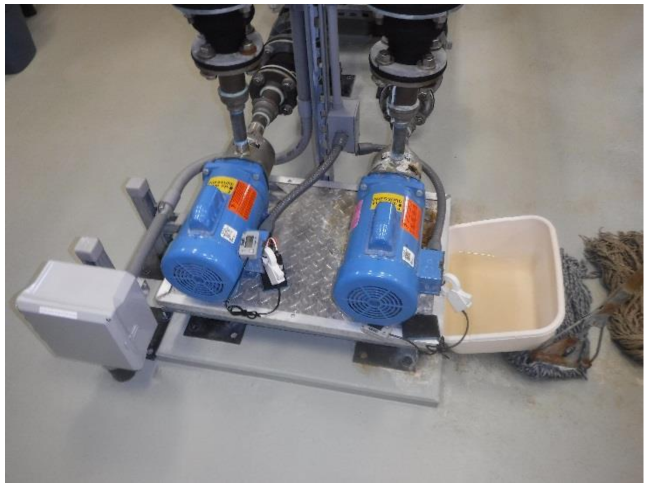


Figure 23: Pressure Pumps

3.2 Predicted Energy Use

3.2.1 Energy Usage / Tariffs

The electric usage profile charts (below) represents the predicted electrical usage for the building. If actual electricity usage records were available, the model used to predict usage was calibrated to approximately match actual usage. The electric utility measures consumption in kilowatt-hours (kWh) and maximum demand in kilowatts (kW). One kWh usage is equivalent to 1,000 watts running for one hour. One KW of electric demand is equivalent to 1,000 watts running at a particular moment. The basic usage charges are shown as generation service and delivery charges along with several non-utility generation charges.

The fuel oil usage profile shows the fuel oil usage for the building. Fuel oil consumption is measured in gallons. One gallon of #1 Fuel Oil provides approximately 132,000 BTUs of energy.

The Copper Valley Electric Association provides electricity to the residents of Gulkana as well as to all public facilities.

The average cost for each type of fuel used in this building is shown below in Table 3.4. This figure includes all surcharges, subsidies, and utility customer charges:

Table 3.4: Energy Cost Rates for Each Fuel Type

Average Energy Cost	
Description	**Average Energy Cost**
Electricity	$ 0.29/kWh
#1 Oil	$ 2.52/gallons

3.2.1.1 Total Energy Use and Cost Breakdown

At current rates, Gulkana Village pays approximately $19,956 annually for electricity and other fuel costs for the Gulkana Water Treatment Plant.

Figure 24 below reflects the estimated distribution of costs across the primary end uses of energy based on the AkWarm© computer simulation. Comparing the "Retrofit" bar in the figure to the "Existing" bar shows the potential savings from implementing all of the energy efficiency measures shown in this report.

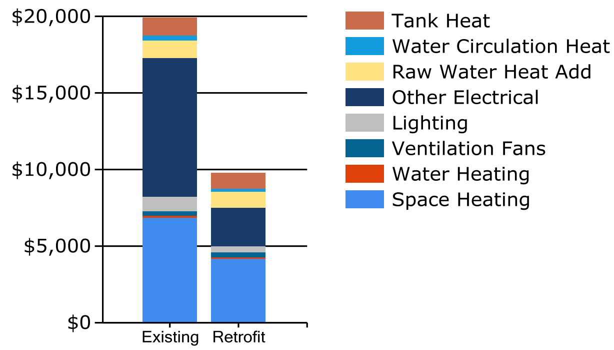


Figure 24: Annual Energy Costs by End Use

Figure 25 below shows how the annual energy cost of the building splits between the different fuels used by the building. The "Existing" bar shows the breakdown for the building as it is now; the "Retrofit" bar shows the predicted costs if all of the energy efficiency measures in this report are implemented.

Figure 25: Annual Energy Costs by Fuel Type

Figure 26 below addresses only Space Heating costs. The figure shows how each heat loss component contributes to those costs; for example, the figure shows how much annual space heating cost is caused by the heat loss through the Walls/Doors. For each component, the space heating cost for the Existing building is shown (blue bar) and the space heating cost assuming all retrofits are implemented (yellow bar) are shown.

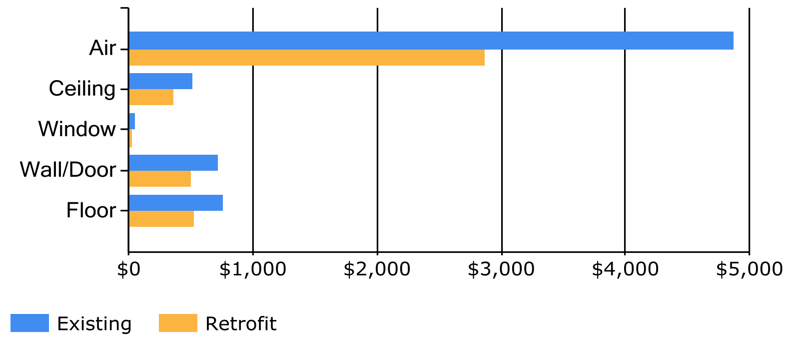


Figure 26: Annual Space Heating Costs

Tables 3.5 and 3.6 show AkWarm's estimate of the monthly fuel use for each of the fuels used in the building. For each fuel, the fuel use is broken down across the energy end uses. Note, in the tables below "DHW" refers to Domestic Hot Water heating.

Table 3.5: Estimated Electrical Consumption by Category

Electrical Consumption (kWh)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Space Heating	653	536	507	375	275	238	243	249	292	431	567	630
Ventilation Fans	131	120	131	127	75	73	75	75	102	131	127	131
Lighting	292	266	292	263	271	245	253	253	263	271	283	292
Other Electrical	4516	4116	4516	4371	4392	4251	821	821	859	945	915	945
Raw Water Heat Add	42	37	38	34	0	0	0	0	17	36	39	42
Water Circulation Heat	35	32	35	34	0	0	0	0	18	35	34	35
Tank Heat	153	139	150	143	0	0	0	0	76	149	147	153

Table 3.6: Estimated Fuel Oil Consumption by Category

Fuel Oil #1 Consumption (Gallons)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Space Heating	380	295	253	145	58	33	34	34	76	187	312	361
DHW	1	1	1	1	1	1	1	1	1	1	1	1
Raw Water Heat Add	98	72	55	17	0	0	0	0	0	29	75	91
Water Circulation Heat	14	12	14	14	0	0	0	0	8	14	13	14
Tank Heat	76	56	42	13	0	0	0	0	0	23	58	70

3.2.2 Energy Use Index (EUI)

Energy Use Index (EUI) is a measure of a building's annual energy utilization per square foot of building. This calculation is completed by converting all utility usage consumed by a building for one year, to British Thermal Units (Btu) or kBtu, and dividing this number by the building square footage. EUI is a good measure of a building's energy use and is utilized regularly for comparison of energy performance for similar building types. The Oak Ridge National Laboratory (ORNL) Buildings Technology Center under a contract with the U.S. Department of Energy maintains a Benchmarking Building Energy Performance Program. The ORNL website determines how a building's energy use compares with similar facilities throughout the U.S. and in a specific region or state.

Source use differs from site usage when comparing a building's energy consumption with the national average. Site energy use is the energy consumed by the building at the building site only. Source energy use includes the site energy use as well as all of the losses to create and distribute the energy to the building. Source energy represents the total amount of raw fuel that is required to operate the building. It incorporates all transmission, delivery, and production losses, which allows for a complete assessment of energy efficiency in a building. The type of utility purchased has a substantial impact on the source energy use of a building. The EPA has determined that source energy is the most comparable unit for evaluation purposes and overall global impact. Both the site and source EUI ratings for the building are provided to understand and compare the differences in energy use.
The site and source EUIs for this building are calculated as follows. (See Table 3.7 for details):

$$\text{Building Site EUI} = \frac{(\text{Electric Usage in kBtu} + \text{Fuel Usage in kBtu})}{\text{Building Square Footage}}$$

$$\text{Building Source EUI} = \frac{(\text{Electric Usage in kBtu X SS Ratio} + \text{Fuel Usage in kBtu X SS Ratio})}{\text{Building Square Footage}}$$

where "SS Ratio" is the Source Energy to Site Energy ratio for the particular fuel.

Table 3.7: Building EUI Calculations for the Gulkana Water Treatment Plant

Energy Type	Building Fuel Use per Year	Site Energy Use per Year, kBTU	Source/Site Ratio	Source Energy Use per Year, kBTU
Electricity	42,660 kWh	145,598	3.340	486,299
#1 Oil	3,061 gallons	403,999	1.010	408,039
Total		**549,598**		**894,338**
BUILDING AREA		1,960	Square Feet	
BUILDING SITE EUI		280	kBTU/Ft²/Yr	
BUILDING SOURCE EUI		456	**kBTU/Ft²/Yr**	
* Site - Source Ratio data is provided by the Energy Star Performance Rating Methodology for Incorporating Source Energy Use document issued March 2011.				

Table 3.8: Building Benchmarks for the Gulkana Water Treatment Plant

Building Benchmarks			
Description	**EUI (kBtu/Sq.Ft.)**	**EUI/HDD (Btu/Sq.Ft./HDD)**	**ECI ($/Sq.Ft.)**
Existing Building	280.5	20.87	$10.18
With Proposed Retrofits	190.5	14.18	$5.02
EUI: Energy Use Intensity - The annual site energy consumption divided by the structure's conditioned area. EUI/HDD: Energy Use Intensity per Heating Degree Day. ECI: Energy Cost Index - The total annual cost of energy divided by the square footage of the conditioned space in the building.			

3.3 AkWarm© Building Simulation

An accurate model of the building performance can be created by simulating the thermal performance of the walls, roof, windows and floors of the building. The HVAC system and central plant are modeled as well, accounting for the outside air ventilation required by the building and the heat recovery equipment in place.

The model uses local weather data and is trued up to historical energy use to ensure its accuracy. The model can be used now and in the future to measure the utility bill impact of all types of energy projects, including improving building insulation, modifying glazing, changing air handler schedules, increasing heat recovery, installing high efficiency boilers, using variable air volume air handlers, adjusting outside air ventilation and adding cogeneration systems.

For the purposes of this study, the Gulkana Water Treatment Plant was modeled using AkWarm© energy use software to establish a baseline space heating energy usage. Climate data from Gulkana was used for analysis. From this, the model was be calibrated to predict the impact of theoretical energy savings measures. Once annual energy savings from a particular measure were predicted and the initial capital cost was estimated, payback scenarios were approximated.

Limitations of AkWarm© Models

• The model is based on typical mean year weather data for Gulkana. This data represents the average ambient weather profile as observed over approximately 30 years. As such, the gas and electric profiles generated will not likely compare perfectly with actual energy billing information from any single year. This is especially true for years with extreme warm or cold periods, or even years with unexpectedly moderate weather.
• The heating load model is a simple two-zone model consisting of the building's core interior spaces and the building's perimeter spaces. This simplified approach loses accuracy for buildings that have large variations in heating loads across different parts of the building.

The energy balances shown in Section 3.1 were derived from the output generated by the AkWarm© simulations.

4. ENERGY COST SAVING MEASURES

4.1 Summary of Results

The energy saving measures are summarized in Table 4.1. Please refer to the individual measure descriptions later in this report for more detail.

Table 4.1: Summary List of Recommended Energy Efficiency Measures Ranked by Economic Priority

PRIORITY LIST – ENERGY EFFICIENCY MEASURES							
Rank	**Feature**	**Improvement Description**	**Annual Energy Savings**	**Installed Cost**	**Savings to Investment Ratio, SIR[1]**	**Simple Payback (Years)[2]**	**CO_2 Savings**
1	Other Electrical: Polymer Pump	Reduce water-making cycles by repairing the raw water intake to reduce sand collected from the river. *This is a benefit from reduced water making cycles.*	$214	$100	29.65	0.5	1,035.1
2	Raw Water Heat Add	Reduce number of times that intake must be cleaned from once weekly to once monthly with Intake System Repair. *This is a benefit from reduced water making* cycles.	$0 + $3,900 Maint. Savings	$2,000	29.01	0.5	0.0
3	Other Electrical: Raw Water Heat Tape - "To Vault"	Shut off heat tape and use in emergency thaw purposes. This can only be accomplished by removing the intake check valve to construct a drainback system. This is directly tied to retrofit 7.	$4,405	$2,000	25.87	0.5	24,554.9
4	Process Room Unit Heaters	Lower Unit Heater set points to 60 deg. F	$954	$500	25.85	0.5	7,968.0
5	Other Electrical: MIEX Circulation Pump	Reduce water-making cycles by repairing the raw water intake to reduce sand collected from the river. *This is a benefit from reduced water making cycles.*	$138	$100	19.23	0.7	673.1
6	Water Storage Tank	Eliminate necessity of Water Delivery to the residents with WST foundation repair. *This is a direct benefit of the water storage tank foundation repair.*	$0 + $4,000 Maint. Savings	$4,000	11.94	1.0	0.0
7	Other Electrical: Raw Water Heat Tape - "To Intake"	Shut off heat tape and use in emergency thaw purposes. This can only be accomplished by removing the intake check valve to construct a drainback system. This is directly tied to retrofit 3.	$1,468	$2,000	8.62	1.4	8,184.9
8	Ventilation	Add controls to boiler exhaust fan so that it isn't operating when the boilers are not running. Add controls to the chlorine exhaust fan such that it only turns on when the room is unoccupied.	$706	$3,000	3.97	4.2	5,518.9

PRIORITY LIST – ENERGY EFFICIENCY MEASURES							
Rank	**Feature**	**Improvement Description**	**Annual Energy Savings**	**Installed Cost**	**Savings to Investment Ratio, SIR[1]**	**Simple Payback (Years)[2]**	**CO_2 Savings**
9	Setback Thermostat: Water Treatment Plant	Implement a Heating Temperature Unoccupied Setback to 55.0 deg F for the Water Treatment Plant space.	$496	$2,000	3.32	4.0	4,009.7
10	HVAC And DHW	Add a biomass pellet boiler to the heating system to take advantage of locally manufactured wood pellets, clean and tune fuel oil boilers. Consider shutting down boilers in the summer time.	$1,085 + $10,000 Maint. Savings	$60,000	2.97	5.4	44,239.4
11	Lighting: Process Room	Replace with new, energy efficient direct-wire LED lighting and add new occupancy sensor	$323	$1,220	3.09	3.8	2,070.0
12	Other Electrical: Brine Pump	Reduce water-making cycles by repairing the raw water intake to reduce sand collected from the river. *This is a benefit from reduced water making cycles.*	$15	$100	2.19	6.6	97.7
13	Other Electrical: Underdraw Pump	Reduce water-making cycles by repairing the raw water intake to reduce sand collected from the river. *This is a benefit from reduced water making cycles.*	$15	$100	2.19	6.6	97.7
14	Other Electrical: Raw Water Intake Pump	Run intake pump at 16 GPM for shorter time intervals to maximize water intake. *This is a benefit from reduced water making cycles.*	$138	$1,000	2.02	7.2	769.7
15	Other Electrical: Potassium Permanganate Mixer	Reduce water-making cycles by repairing the raw water intake to reduce sand collected from the river. *This is a benefit from reduced water making cycles.*	$12	$100	1.75	8.3	78.1
16	Other Electrical: Polymer Mixer	Reduce water-making cycles by repairing the raw water intake to reduce sand collected from the river. *This is a benefit from reduced water making cycles.*	$12	$100	1.41	8.3	78.1
17	Lighting: Process Room - 2-Lamp Fixture	Replace with new, energy efficient direct-wire LED lighting	$7	$60	1.41	8.3	46.8
18	Lighting: Entryway	Replace with new, energy efficient direct-wire LED lighting	$22	$180	1.41	8.3	140.4

PRIORITY LIST – ENERGY EFFICIENCY MEASURES							
Rank	**Feature**	**Improvement Description**	**Annual Energy Savings**	**Installed Cost**	**Savings to Investment Ratio, SIR[1]**	**Simple Payback (Years)[2]**	**CO_2 Savings**
19	Lighting: Office	Replace with new, energy efficient direct-wire LED lighting	$29	$240	1.41	8.3	187.2
20	Generator Unit Space Heat	Turn down generator unit space heat set points	$9	$100	1.33	11.0	50.7
21	Old Water Plant Space Heat	Turn down old water plant space heat set points	$9	$100	1.33	11.0	50.7
22	Other Electrical: Chlorine Injection Pump	Reduce water-making cycles by repairing the raw water intake to reduce sand collected from the river. *This is a benefit from reduced water making cycles.*	$7	$100	1.05	13.8	46.8
23	Other Electrical: Potassium Permanganate Injection Pump	Reduce water-making cycles by repairing the raw water intake to reduce sand collected from the river. *This is a benefit from reduced water making cycles.*	$7	$100	1.05	13.8	46.8
24	Solar PV	Install new Solar PV system rated for 10 kW. Maint. Savings are solar PV savings from feasibility study	$0 + $5,425 Maint. Savings	$106,485	1.00	19.6	0.0
25	Lighting: Storage/Bench	Replace with new, energy efficient direct-wire LED lighting	$15	$180	0.94	12.4	94.1
26	Lighting Boiler Room	Replace with new, energy efficient direct-wire LED lighting	$14	$240	0.70	16.6	93.6
27	Water Circulation Loop Heat-Add	Replace heat-add circ. pumps with Grundfos Alpha models	$23	$1,000	0.27	43.5	130.6
28	Lighting: Generator Unit	Replace with new, energy efficient direct-wire LED lighting	$3	$240	0.12	95.1	14.1
29	Lighting: Chlorine Room	Replace with new, energy efficient direct-wire LED lighting	$1	$120	0.10	115.7	6.7
30	Lighting: Restroom	Replace with new, energy efficient direct-wire LED lighting	$1	$180	0.05	230.7	5.0
31	Lighting: Old Water Plant Lights	Replace with new, energy efficient direct-wire LED lighting	$0	$180	0.02	475.1	2.1
32	Lighting: Loft	Replace with new, energy efficient direct-wire LED lighting	$0	$180	0.02	581.5	2.0
TOTAL			**$10,129 + $23,325 Maint. Savings**	**$188,005**	**2.68**	**5.6**	**100,293.0**

4.2 Interactive Effects of Projects

The savings for a particular measure are calculated assuming all recommended EEMs coming before that measure in the list are implemented. If some EEMs are not implemented, savings for the remaining EEMs will be affected. For example, if ceiling insulation is not added, then savings from a project to replace the heating system will be increased, because the heating system for the building supplies a larger load.

In general, all projects are evaluated sequentially so energy savings associated with one EEM would not also be attributed to another EEM. By modeling the recommended project sequentially, the analysis accounts for interactive affects among the EEMs and does not "double count" savings.

Interior lighting, plug loads, facility equipment, and occupants generate heat within the building. Lighting-efficiency improvements are anticipated to slightly increase heating requirements. Heating penalties were included in the lighting project analysis.

4.3 Mechanical Equipment Measures

4.3.1 Heating/ Domestic Hot Water Measure

Rank	**Recommendation**				
10	Add a biomass pellet boiler to the heating system to take advantage of locally manufactured wood pellets. Clean and tune fuel oil boilers. Consider shutting down boilers in the summer time.				
Installation Cost	$60,000	**Estimated Life of Measure (yrs)**	20	**Energy Savings ($/yr)**	$1,085
Breakeven Cost	$178,214	**Simple Payback (yrs)**	5	**Energy Savings (MMBTU/yr)**	-2.0 MMBTU
		Savings-to-Investment Ratio	3.0	**Maintenance Savings ($/yr)**	$10,000
Auditors Notes: The community is developing a commercial business of biomass production and converting the heating system to a pellet boiler would generate more income for the community and create more cash flow in the community. The savings from this are noted as maintenance savings, which are based on new income from Gulkana pellet-making services: ~51 tons x 4 employees x $50 per hour x one ton/hour There is no need for water heating in the summer as the heating is primarily for freeze protection. Shutting off boilers in the summer will eliminate idle heat loss and save on fuel use.					

4.3.2 Ventilation System Measures

Rank	**Description**			**Recommendation**	
8				Add controls to boiler exhaust fan so that it isn't operating when the boilers are not running. Add controls to the chlorine exhaust fan such that it only turns on when the room is unoccupied.	
Installation Cost	$3,000	**Estimated Life of Measure (yrs)**	20	**Energy Savings ($/yr)**	$706
Breakeven Cost	$11,901	**Simple Payback (yrs)**	4	**Energy Savings (MMBTU/yr)**	31.2 MMBTU
		Savings-to-Investment Ratio	4.0		
Auditors Notes: The boiler room exhaust fan was found to be operating when the boilers were not in operation. The fan is designed to provide ventilation when the boilers are operating and any extra fan operation is more than necessary. Add controls to this fan to minimize use of the exhaust fan when not necessary. The chemical room exhaust fan is designed to provide ventilation for the chemical room when occupied by a person. Currently it is operating constantly. Add controls such that the chemical exhaust fan operates with the room lights, which will make sure the room is only being ventilated when occupied.					

4.3.3 Night Setback Thermostat Measures

Rank	Building Space			Recommendation	
9	Water Treatment Plant			Implement a Heating Temperature Unoccupied Setback to 55.0 deg F for the Water Treatment Plant space.	
Installation Cost	$2,000	**Estimated Life of Measure (yrs)**	15	**Energy Savings ($/yr)**	$496
Breakeven Cost	$6,638	**Simple Payback (yrs)**	4	**Energy Savings (MMBTU/yr)**	23.8 MMBTU
		Savings-to-Investment Ratio	3.3		
Auditors Notes: Lowering the temperature when not occupied can prevent the building from using more heat than necessary.					

4.4 Electrical & Appliance Measures

4.4.1 Lighting Measures

The goal of this section is to present any lighting energy conservation measures that may also be cost beneficial. It should be noted that replacing current bulbs with more energy-efficient equivalents will have a small effect on the building heating loads. The building heating load will see a small increase, as the more energy efficient bulbs give off less heat.

4.4.1a Lighting Measures – Replace Existing Fixtures/Bulbs

Rank	Location	Existing Condition		Recommendation	
11	Process Room	12 FLUOR (4) T8 4' F32T8 32W Standard Instant StdElectronic		Replace with new, energy efficient direct-wire LED lighting and add new occupancy sensor	
Installation Cost	$1,220	**Estimated Life of Measure (yrs)**	15	**Energy Savings ($/yr)**	$323
Breakeven Cost	$3,774	**Simple Payback (yrs)**	4	**Energy Savings (MMBTU/yr)**	0.8 MMBTU
		Savings-to-Investment Ratio	3.1		
Auditors Notes: There are 12 fixtures with four lamps in each fixture to be replaced with two lamps per fixture for a total of 24 replacement lamps. Occupancy sensors will further reduce the runtime of the lights.					

Rank	Location	Existing Condition		Recommendation	
17	Process Room - 2-Lamp Fixture	FLUOR (2) T8 4' F32T8 32W Standard Instant StdElectronic		Replace with new, energy efficient direct-wire LED lighting	
Installation Cost	$60	**Estimated Life of Measure (yrs)**	15	**Energy Savings ($/yr)**	$7
Breakeven Cost	$84	**Simple Payback (yrs)**	8	**Energy Savings (MMBTU/yr)**	0.0 MMBTU
		Savings-to-Investment Ratio	1.4		
Auditors Notes: There is one fixture with two lamps in the fixture to be replaced.					

Rank	Location	Existing Condition		Recommendation	
18	Entryway	3 FLUOR (2) T8 4' F32T8 32W Standard Instant StdElectronic		Replace with new, energy efficient direct-wire LED lighting	
Installation Cost	$180	**Estimated Life of Measure (yrs)**	15	**Energy Savings ($/yr)**	$22
Breakeven Cost	$253	**Simple Payback (yrs)**	8	**Energy Savings (MMBTU/yr)**	0.0 MMBTU
		Savings-to-Investment Ratio	1.4		
Auditors Notes: There are three fixtures with two lamps in each fixture to be replaced for a total of six lamps.					

Rank	Location	Existing Condition		Recommendation	
19	Office	4 FLUOR (2) T8 4' F32T8 32W Standard Instant StdElectronic		Replace with 4 LED (2) 17W Module StdElectronic	
Installation Cost	$240	**Estimated Life of Measure (yrs)**	15	**Energy Savings ($/yr)**	$29
Breakeven Cost	$337	**Simple Payback (yrs)**	8	**Energy Savings (MMBTU/yr)**	0.1 MMBTU
		Savings-to-Investment Ratio	1.4		
Auditors Notes: There are four fixtures with two lamps in each fixture to be replaced for a total of eight replacement lamps.					

Rank	Location	Existing Condition		Recommendation	
25	Storage/Bench	3 FLUOR (2) T8 4' F32T8 32W Standard Instant StdElectronic		Replace with new, energy efficient direct-wire LED lighting	
Installation Cost	$180	**Estimated Life of Measure (yrs)**	15	**Energy Savings ($/yr)**	$15
Breakeven Cost	$169	**Simple Payback (yrs)**	12	**Energy Savings (MMBTU/yr)**	0.0 MMBTU
		Savings-to-Investment Ratio	0.9		
Auditors Notes: There are three fixtures with two lamps in each fixture to be replaced for a total of six lamps.					

Rank	Location	Existing Condition		Recommendation	
26	Boiler Room	4 FLUOR (2) T8 4' F32T8 32W Standard Instant StdElectronic		Replace with new, energy efficient direct-wire LED lighting	
Installation Cost	$240	**Estimated Life of Measure (yrs)**	15	**Energy Savings ($/yr)**	$14
Breakeven Cost	$169	**Simple Payback (yrs)**	17	**Energy Savings (MMBTU/yr)**	0.0 MMBTU
		Savings-to-Investment Ratio	0.7		
Auditors Notes: There are four fixtures with two lamps in each fixture to be replaced for a total of eight lamps.					

Rank	Location	Existing Condition		Recommendation	
28	Generator Unit	4 FLUOR (2) T8 4' F32T8 32W Standard Instant StdElectronic		Replace with new, energy efficient direct-wire LED lighting	
Installation Cost	$240	**Estimated Life of Measure (yrs)**	15	**Energy Savings ($/yr)**	$3
Breakeven Cost	$30	**Simple Payback (yrs)**	95	**Energy Savings (MMBTU/yr)**	0.0 MMBTU
		Savings-to-Investment Ratio	0.1		
Auditors Notes: There are four fixtures with two lamps in each fixture to be replaced for a total of eight lamps.					

Rank	Location	Existing Condition		Recommendation	
29	Chlorine Room	2 FLUOR (2) T8 4' F32T8 32W Standard Instant StdElectronic		Replace with new, energy efficient direct-wire LED lighting	
Installation Cost	$120	**Estimated Life of Measure (yrs)**	15	**Energy Savings ($/yr)**	$1
Breakeven Cost	$12	**Simple Payback (yrs)**	116	**Energy Savings (MMBTU/yr)**	0.0 MMBTU
		Savings-to-Investment Ratio	0.1		
Auditors Notes: There are four fixtures with two lamps in each fixture to be replaced for a total of eight lamps.					

Rank	Location	Existing Condition		Recommendation	
30	Restroom	3 FLUOR (2) T8 4' F32T8 32W Standard Instant StdElectronic with Occupancy Sensor		Replace with new, energy efficient direct-wire LED lighting	
Installation Cost	$180	**Estimated Life of Measure (yrs)**	15	**Energy Savings ($/yr)**	$1
Breakeven Cost	$9	**Simple Payback (yrs)**	231	**Energy Savings (MMBTU/yr)**	0.0 MMBTU
		Savings-to-Investment Ratio	0.1		
Auditors Notes: There are three fixtures with two lamps in each fixture to be replaced for a total of six lamps.					

Rank	Location	Existing Condition		Recommendation	
31	Old Water Plant Lights	3 FLUOR (2) T8 4' F32T8 32W Standard Instant StdElectronic		Replace with new, energy efficient direct-wire LED lighting	
Installation Cost	$180	**Estimated Life of Measure (yrs)**	15	**Energy Savings ($/yr)**	$
Breakeven Cost	$4	**Simple Payback (yrs)**	475	**Energy Savings (MMBTU/yr)**	0.0 MMBTU
		Savings-to-Investment Ratio	0.0		
Auditors Notes: There are three fixtures with two lamps in each fixture to be replaced for a total of six lamps.					

Rank	Location	Existing Condition		Recommendation	
32	Loft	3 FLUOR (2) T8 4' F32T8 32W Standard Instant StdElectronic		Replace with new, energy efficient direct-wire LED lighting	
Installation Cost	$180	**Estimated Life of Measure (yrs)**	15	**Energy Savings ($/yr)**	$
Breakeven Cost	$4	**Simple Payback (yrs)**	581	**Energy Savings (MMBTU/yr)**	0.0 MMBTU
		Savings-to-Investment Ratio	0.0		
Auditors Notes: There are three fixtures with two lamps in each fixture to be replaced for a total of six lamps.					

4.4.2 Other Electrical Measures

Rank	Location	Description of Existing		Efficiency Recommendation	
1	Polymer Pump	Chemical Injection Process		Reduce water-making cycles by repairing the raw water intake to reduce sand collected from the river. *This is a benefit from reduced water making cycles.*	
Installation Cost	$100	**Estimated Life of Measure (yrs)**	20	**Energy Savings ($/yr)**	$214
Breakeven Cost	$2,965	**Simple Payback (yrs)**	0	**Energy Savings (MMBTU/yr)**	0.3 MMBTU
		Savings-to-Investment Ratio	29.6		
Auditors Notes: The raw water intake has problems with collecting sand and mud from the river because of sand that has migrated through the gravel bed past the raw water intake screen. As a result, water plant operations have been altered to minimize this effect and existing equipment have shorter useful lives. Repairing the intake will allow for less sand and mud to be picked up and will change the water making operations by having fewer cycles at a higher intake GPM. This retrofit is the documentation of a direct benefit from reduced water-making cycles and lower quantities of sand and mud in the intake water.					

Rank	Location	Description of Existing		Efficiency Recommendation	
3	Raw Water Heat Tape - "To Vault"	Heat Tape		Shut off heat tape and use in emergency thaw purposes. This can only be accomplished by removing the intake check valve to construct a drainback system. This is directly tied to retrofit 7.	
Installation Cost	$2,000	**Estimated Life of Measure (yrs)**	15	**Energy Savings ($/yr)**	$4,405
Breakeven Cost	$51,738	**Simple Payback (yrs)**	0	**Energy Savings (MMBTU/yr)**	52.4 MMBTU
		Savings-to-Investment Ratio	25.9		

Auditors Notes: The raw water intake has a check valve that keeps water in the line even when not actively making water. As a result, the water is prone to freezing during the winter and clogging the raw water intake pipe. This is actively heated by a heat tape to prevent freezing. Removing the check valve would allow the operators to minimize the heat tape to emergency purposes only and save on electricity costs.

This retrofit was completed in Fall 2017. The benefits are documented in this report.

Rank	Location	Description of Existing		Efficiency Recommendation	
5	MIEX Circulation Pump	MIEX Chemical Treatment Process		Reduce water-making cycles by repairing the raw water intake to reduce sand collected from the river. *This is a benefit from reduced water making cycles.*	
Installation Cost	$100	**Estimated Life of Measure (yrs)**	20	**Energy Savings ($/yr)**	$138
Breakeven Cost	$1,923	**Simple Payback (yrs)**	1	**Energy Savings (MMBTU/yr)**	0.2 MMBTU
		Savings-to-Investment Ratio	19.2		

Auditors Notes: The raw water intake has problems with collecting sand and mud from the river because of sand that has migrated through the gravel bed past the raw water intake screen. As a result, water plant operations have been altered to minimize this effect and existing equipment have shorter useful lives. Repairing the intake will allow for less sand and mud to be picked up and will change the water making operations by having fewer cycles at a higher intake GPM. This retrofit is the documentation of a direct benefit from reduced water-making cycles and lower quantities of sand and mud in the intake water.

Rank	Location	Description of Existing		Efficiency Recommendation	
7	Raw Water Heat Tape - "To Intake"	Heat Tape		Shut off heat tape and use in emergency thaw purposes. This can only be accomplished by removing the intake check valve to construct a drainback system. This is directly tied to retrofit 3.	
Installation Cost	$2,000	**Estimated Life of Measure (yrs)**	15	**Energy Savings ($/yr)**	$1,468
Breakeven Cost	$17,246	**Simple Payback (yrs)**	1	**Energy Savings (MMBTU/yr)**	17.5 MMBTU
		Savings-to-Investment Ratio	8.6		

Auditors Notes: The raw water intake has a check valve that keeps water in the line even when not actively making water. As a result, the water is prone to freezing during the winter and clogging the raw water intake pipe. This is actively heated by a heat tape to prevent freezing. Removing the check valve would allow the operators to minimize the heat tape to emergency purposes only and save on electricity costs.

This retrofit was completed in Fall 2017. The benefits are documented in this report.

Rank	Location		Description of Existing		Efficiency Recommendation	
12	Brine Pump		MIEX Chemical Treatment Process		Reduce water-making cycles by repairing the raw water intake to reduce sand collected from the river. *This is a benefit from reduced water making cycles.*	
Installation Cost		$100	**Estimated Life of Measure (yrs)**	20	**Energy Savings ($/yr)**	$15
Breakeven Cost		$219	**Simple Payback (yrs)**	7	**Energy Savings (MMBTU/yr)**	0.0 MMBTU
			Savings-to-Investment Ratio	2.2		

Auditors Notes: The raw water intake has problems with collecting sand and mud from the river because of sand that has migrated through the gravel bed past the raw water intake screen. As a result, water plant operations have been altered to minimize this effect and existing equipment have shorter useful lives. Repairing the intake will allow for less sand and mud to be picked up and will change the water making operations by having fewer cycles at a higher intake GPM. This retrofit is the documentation of a direct benefit from reduced water-making cycles and lower quantities of sand and mud in the intake water.

Rank	Location		Description of Existing		Efficiency Recommendation	
13	Underdraw Pump		MIEX Chemical Treatment Process		Reduce water-making cycles by repairing the raw water intake to reduce sand collected from the river. *This is a benefit from reduced water making cycles.*	
Installation Cost		$100	**Estimated Life of Measure (yrs)**	20	**Energy Savings ($/yr)**	$15
Breakeven Cost		$219	**Simple Payback (yrs)**	7	**Energy Savings (MMBTU/yr)**	0.0 MMBTU
			Savings-to-Investment Ratio	2.2		

Auditors Notes: The raw water intake has problems with collecting sand and mud from the river because of sand that has migrated through the gravel bed past the raw water intake screen. As a result, water plant operations have been altered to minimize this effect and existing equipment have shorter useful lives. Repairing the intake will allow for less sand and mud to be picked up and will change the water making operations by having fewer cycles at a higher intake GPM. This retrofit is the documentation of a direct benefit from reduced water-making cycles and lower quantities of sand and mud in the intake water.

Rank	Location		Description of Existing		Efficiency Recommendation	
14	Raw Water Intake Pump		Raw Water Pump		Run intake pump at 16 GPM for shorter time intervals to maximize water intake. *This is a benefit from reduced water making cycles.*	
Installation Cost		$1,000	**Estimated Life of Measure (yrs)**	20	**Energy Savings ($/yr)**	$138
Breakeven Cost		$2,017	**Simple Payback (yrs)**	7	**Energy Savings (MMBTU/yr)**	1.6 MMBTU
			Savings-to-Investment Ratio	2.0		

Auditors Notes: Run intake pump at 16 GPM for shorter time intervals to maximize water intake. The operators currently run the intake pump at 9-11 GPM, which is outside of the efficient operating range for the pump. Changing to 16 GPM would allow the pumps to run for shorter cycles at a higher GPM and efficiency. This is related to the silty intake that is preventing the raw water intake pump from running at maximum capacity.

Rank	Location		Description of Existing		Efficiency Recommendation	
15	Potassium Permanganate Mixer		Chemical Injection Process		Reduce water-making cycles by repairing the raw water intake to reduce sand collected from the river. *This is a benefit from reduced water making cycles.*	
Installation Cost		$100	**Estimated Life of Measure (yrs)**	20	**Energy Savings ($/yr)**	$12
Breakeven Cost		$175	**Simple Payback (yrs)**	8	**Energy Savings (MMBTU/yr)**	0.0 MMBTU
			Savings-to-Investment Ratio	1.8		

Auditors Notes: The raw water intake has problems with collecting sand and mud from the river because of sand that has migrated through the gravel bed past the raw water intake screen. As a result, water plant operations have been altered to minimize this effect and existing equipment have shorter useful lives. Repairing the intake will allow for less sand and mud to be picked up and will change the water making operations by having fewer cycles at a higher intake GPM. This retrofit is the documentation of a direct benefit from reduced water-making cycles and lower quantities of sand and mud in the intake water.

Rank	Location		Description of Existing		Efficiency Recommendation	
16	Polymer Mixer		Chemical Injection Process		Reduce water-making cycles by repairing the raw water intake to reduce sand collected from the river. *This is a benefit from reduced water making cycles.*	
Installation Cost		$100	**Estimated Life of Measure (yrs)**	15	**Energy Savings ($/yr)**	$12
Breakeven Cost		$141	**Simple Payback (yrs)**	8	**Energy Savings (MMBTU/yr)**	0.0 MMBTU
			Savings-to-Investment Ratio	1.4		

Auditors Notes: The raw water intake has problems with collecting sand and mud from the river because of sand that has migrated through the gravel bed past the raw water intake screen. As a result, water plant operations have been altered to minimize this effect and existing equipment have shorter useful lives. Repairing the intake will allow for less sand and mud to be picked up and will change the water making operations by having fewer cycles at a higher intake GPM. This retrofit is the documentation of a direct benefit from reduced water-making cycles and lower quantities of sand and mud in the intake water.

Rank	Location		Description of Existing		Efficiency Recommendation	
22	Chlorine Injection Pump		Chemical Injection Process		Reduce water-making cycles by repairing the raw water intake to reduce sand collected from the river. *This is a benefit from reduced water making cycles.*	
Installation Cost		$100	**Estimated Life of Measure (yrs)**	20	**Energy Savings ($/yr)**	$7
Breakeven Cost		$105	**Simple Payback (yrs)**	14	**Energy Savings (MMBTU/yr)**	0.0 MMBTU
			Savings-to-Investment Ratio	1.1		

Auditors Notes: The raw water intake has problems with collecting sand and mud from the river because of sand that has migrated through the gravel bed past the raw water intake screen. As a result, water plant operations have been altered to minimize this effect and existing equipment have shorter useful lives. Repairing the intake will allow for less sand and mud to be picked up and will change the water making operations by having fewer cycles at a higher intake GPM. This retrofit is the documentation of a direct benefit from reduced water-making cycles and lower quantities of sand and mud in the intake water.

Rank	Location	Description of Existing		Efficiency Recommendation	
23	Potassium Permanganate Injection Pump	Chemical Injection Process		Reduce water-making cycles by repairing the raw water intake to reduce sand collected from the river. *This is a benefit from reduced water making cycles.*	
Installation Cost	$100	**Estimated Life of Measure (yrs)**	20	**Energy Savings ($/yr)**	$7
Breakeven Cost	$105	**Simple Payback (yrs)**	14	**Energy Savings (MMBTU/yr)**	0.0 MMBTU
		Savings-to-Investment Ratio	1.1		
Auditors Notes: The raw water intake has problems with collecting sand and mud from the river because of sand that has migrated through the gravel bed past the raw water intake screen. As a result, water plant operations have been altered to minimize this effect and existing equipment have shorter useful lives. Repairing the intake will allow for less sand and mud to be picked up and will change the water making operations by having fewer cycles at a higher intake GPM. This retrofit is the documentation of a direct benefit from reduced water-making cycles and lower quantities of sand and mud in the intake water.					

4.4.3 Other Measures

Rank	Location	Description of Existing		Efficiency Recommendation	
2		Raw Water Heat Add		Reduce number of times that intake must be cleaned from once weekly to once monthly with Intake System Repair. *This is a benefit from relocation of the raw water river intake*.	
Installation Cost	$2,000	**Estimated Life of Measure (yrs)**	20	**Energy Savings ($/yr)**	$
Breakeven Cost	$58,022	**Simple Payback (yrs)**	1	**Energy Savings (MMBTU/yr)**	0.0 MMBTU
		Savings-to-Investment Ratio	29.0	**Maintenance Savings ($/yr)**	$3,900
Auditors Notes: The operators must currently clean the intake out on a weekly basis to clear the intake pipe of sand and mud. This must occur to allow proper flow of the raw water in the intake. Moving the raw water river intake will result in less sand and mud being collected and fewer required intake cleanings. Maintenance savings from 2 workers x 2 hours per cleaning x 52 weeks reduced to 12 months.					

Rank	Location	Description of Existing		Efficiency Recommendation	
4		Process Room Unit Heaters		Lower Unit Heater set points to 60 deg. F	
Installation Cost	$500	**Estimated Life of Measure (yrs)**	15	**Energy Savings ($/yr)**	$954
Breakeven Cost	$12,927	**Simple Payback (yrs)**	1	**Energy Savings (MMBTU/yr)**	49.6 MMBTU
		Savings-to-Investment Ratio	25.9		
Auditors Notes: The unit heaters are set to 90 deg. F and are operating constantly. Lower the unit heaters to 60 deg. Fwill reduce unit heater runtime and limit any unnecessary space heating.					

Rank	Location	Description of Existing		Efficiency Recommendation	
6		Water Storage Tank Heat Add		Eliminate necessity of Water Delivery to the residents with WST foundation repair. *This is a direct benefit of the water storage tank foundation repair.*	
Installation Cost	$4,000	**Estimated Life of Measure (yrs)**	15	**Energy Savings ($/yr)**	$
Breakeven Cost	$47,752	**Simple Payback (yrs)**	1	**Energy Savings (MMBTU/yr)**	0.0 MMBTU
		Savings-to-Investment Ratio	11.9	**Maintenance Savings ($/yr)**	$4,000
Auditors Notes: The water storage tank foundation failure is limiting the potential water storage for the community. It also causes the storage tank to provide less pressure for the system, which makes water distribution difficult in the winter months. As a result, some residential customers had to resort to water being delivered from the Water Works company in the nearby town of Glennallen. This retrofit documents the benefit of reduced water deliveries that would occur with a repair of the water storage tank foundation.					

Rank	Location	Description of Existing		Efficiency Recommendation	
20		Generator Unit Space Heat		Turn down generator unit space heat set points	
Installation Cost	$100	**Estimated Life of Measure (yrs)**	20	**Energy Savings ($/yr)**	$9
Breakeven Cost	$133	**Simple Payback (yrs)**	11	**Energy Savings (MMBTU/yr)**	0.1 MMBTU
		Savings-to-Investment Ratio	1.3		
Auditors Notes: The generator unit space heater only needs to be set for freeze protection. Lowering the thermostat will save on excess heating costs.					

Rank	Location	Description of Existing		Efficiency Recommendation	
21		Old Water Plant Space Heat		Turn down old water plant space heat set points	
Installation Cost	$100	**Estimated Life of Measure (yrs)**	20	**Energy Savings ($/yr)**	$9
Breakeven Cost	$133	**Simple Payback (yrs)**	11	**Energy Savings (MMBTU/yr)**	0.1 MMBTU
		Savings-to-Investment Ratio	1.3		
Auditors Notes: The old water plant space heater only needs to be set for freeze protection. Lowering the thermostat will save on excess heating costs.					

Rank	Location	Description of Existing		Efficiency Recommendation	
24		New Solar PV System		Install new Solar PV system rated for 10 kW. Maint. Savings are solar PV savings from feasibility study	
Installation Cost	$106,485	**Estimated Life of Measure (yrs)**	30	**Energy Savings ($/yr)**	$
Breakeven Cost	$106,332	**Simple Payback (yrs)**	20	**Energy Savings (MMBTU/yr)**	0.0 MMBTU
		Savings-to-Investment Ratio	1.0	**Maintenance Savings ($/yr)**	$5,425
Auditors Notes:					

Rank	Location	Description of Existing		Efficiency Recommendation	
27		Water Circulation Loop Heat Add		Replace heat-add circ. pumps with Grundfos Alpha models	
Installation Cost	$1,000	**Estimated Life of Measure (yrs)**	15	**Energy Savings ($/yr)**	$23
Breakeven Cost	$270	**Simple Payback (yrs)**	43	**Energy Savings (MMBTU/yr)**	0.2 MMBTU
		Savings-to-Investment Ratio	0.3		
Auditors Notes: The existing circulation loop heat-add pumps are running constantly to provide heat to the system. Changing these pumps to VFD smart pumps will allow for modulation of the heat delivered to match the required heating demand. This will reduce the total heating use for this process.					

5. ENERGY EFFICIENCY ACTION PLAN

Through inspection of the energy-using equipment on-site and discussions with site facilities personnel, this energy audit has identified several energy-saving measures. The measures will reduce the amount of fuel burned and electricity used at the site. The projects will not degrade the performance of the building and, in some cases, will improve it.

Several types of EEMs can be implemented immediately by building staff, and others will require various amounts of lead time for engineering and equipment acquisition. In some cases, there are logical advantages to implementing EEMs concurrently. For example, if the same electrical contractor is used to install both lighting equipment and motors, implementation of these measures should be scheduled to occur simultaneously.

In the near future, a representative of ANTHC will be contacting Gulkana Village to follow up on the recommendations made in this report. ANTHC will provide assistance in understanding the report and implementing the recommendations as desired by the Village.

APPENDICES

Appendix A – Scanned Energy Billing Data

1. Electricity Billing Data
2. Billing Data for the following Fuel Types
    - Electricity
    - #1 Oil

Appendix B – Energy Audit Report – Project Summary

ENERGY AUDIT REPORT – PROJECT SUMMARY

General Project Information

PROJECT INFORMATION	AUDITOR INFORMATION
Building: Gulkana Water Treatment Plant	**Auditor Company:** ANTHC-DEHE
Address: PO Box 254	**Auditor Name:** Kevin Ulrich
City: Gulkana	**Auditor Address:** 4500 Diplomacy Dr. Anchorage, AK 99508
Client Name: Ray Spear	
Client Address: P.O. Box 254 Gulkana, AK 99586	**Auditor Phone:** (907) 729-3237
	Auditor FAX:
Client Phone: (907) 259-3740	**Auditor Comment:**
Client FAX:	

Design Data

Building Area: 1,960 square feet	**Design Space Heating Load:** Design Loss at Space: 113,871 Btu/hour with Distribution Losses: 113,871 Btu/hour Plant Input Rating assuming 82.0% Plant Efficiency and 25% Safety Margin: 173,584 Btu/hour Note: Additional Capacity should be added for DHW and other plant loads, if served.
Typical Occupancy: 0 people	**Design Indoor Temperature:** 60 deg F (building average)
Actual City: Gulkana	**Design Outdoor Temperature:** -39.4 deg F
Weather/Fuel City: Gulkana	**Heating Degree Days:** 13,439 deg F-days

Utility Information

Electric Utility: Copper Valley Electric Associationn	**Average Annual Cost/kWh:** $0.29/kWh

Annual Energy Cost Estimate

Description	Space Heating	Water Heating	Ventilation Fans	Lighting	Other Electrical	Raw Water Heat Add	Water Circulation Heat	Tank Heat	Total Cost
Existing Building	$6,900	$34	$373	$931	$9,031	$1,188	$330	$1,169	**$19,956**
With Proposed Retrofits	$4,262	$29	$301	$430	$2,483	$1,008	$283	$1,031	**$9,827**
Savings	$2,638	$5	$72	$501	$6,549	$180	$47	$138	**$10,129**

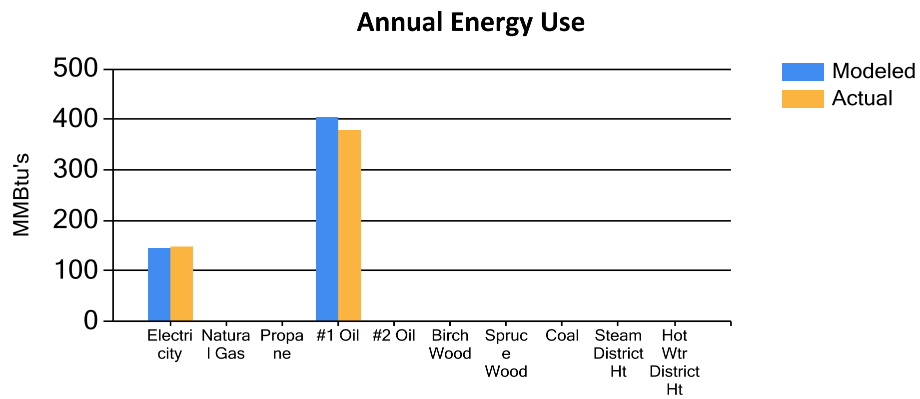
Building Benchmarks

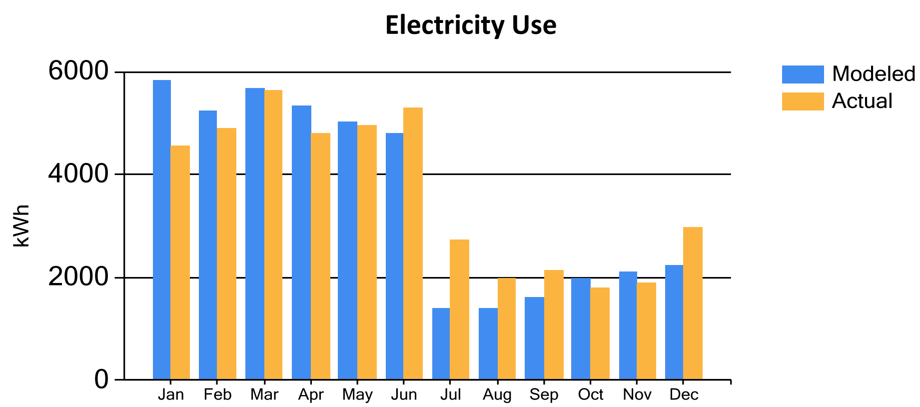
Description	EUI (kBtu/Sq.Ft.)	EUI/HDD (Btu/Sq.Ft./HDD)	ECI ($/Sq.Ft.)
Existing Building	280.5	20.87	$10.18
With Proposed Retrofits	190.5	14.18	$5.02

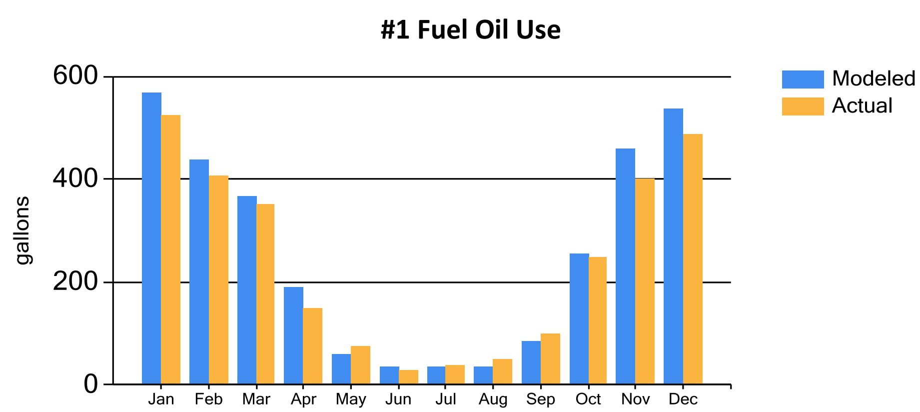
EUI: Energy Use Intensity - The annual site energy consumption divided by the structure's conditioned area.
EUI/HDD: Energy Use Intensity per Heating Degree Day.
ECI: Energy Cost Index - The total annual cost of energy divided by the square footage of the conditioned space in the building.

Appendix C – Actual Fuel Use versus Modeled Fuel Use

The graphs below show the modeled energy usage results of the energy audit process compared to the actual energy usage report data. The model was completed using AkWarm modeling software. The orange bars show actual fuel use, and the blue bars are AkWarm's prediction of fuel use.







Appendix D - Electrical Demands

Estimated Peak Electrical Demand (kW)												
	Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Current	16.0	15.8	15.6	15.4	14.6	14.6	9.8	9.8	10.2	10.6	10.9	10.9
As Proposed	10.0	9.9	9.8	9.6	8.9	8.8	8.7	8.7	9.1	9.5	9.8	9.8

AkWarmCalc Ver 2.7.1.0, Energy Lib 3/3/2017