Comprehensive Energy Audit
For

Stevens Village Washeteria

Prepared For

Native Village of Stevens

June 17, 2016

Prepared By:

ANTHC-DEHE
4500 Diplomacy Dr.
Anchorage, AK 99508

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PREFACE

This energy audit was conducted using funds from the United States Department of Agriculture Rural Utilities Service as well as the State of Alaska Department of Environmental Conservation. Coordination with the State of Alaska Remote Maintenance Worker (RMW) Program and the associated RMW for each community has been undertaken to provide maximum accuracy in identifying audits and coordinating potential follow up retrofit activities.

The Rural Energy Initiative at the Alaska Native Tribal Health Consortium (ANTHC) prepared this document for The Native Village of Stevens, Alaska. The authors of this report is Kevin Ulrich, Energy Manager-in-Training (EMIT).

The purpose of this report is to provide a comprehensive document of the findings and analysis that resulted from an energy audit conducted in April of 2016 by the Energy Projects Group 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 Energy Projects Group gratefully acknowledges the assistance of Water Treatment Plant Operator Henry Smoke, Remote Maintenance Worker Lee Meckel, and Stevens Village Tribal Administrator Jessica Kozevnikoff.

1. EXECUTIVE SUMMARY

This report was prepared for the Native Village of Stevens. The scope of the audit focused on Stevens Village Washeteria. The scope of this report is a comprehensive energy study, which included an analysis of building shell, interior and exterior lighting systems, heating and ventilation systems, and plug loads.

In the near future, a representative of ANTHC will be contacting the Native Village of Stevens to follow up on the recommendations made in this report. Funding has been provided to ANTHC through a Rural Alaska Village Grant to provide the community with assistance in understanding the report and implementing the recommendations. ANTHC will work to complete the recommendations within the 2016 calendar year.

The total predicted energy cost for the Stevens Village Washeteria is $59,737. Electricity represents the largest portion with an annual cost of approximately $35,740. This included $14,988 paid by the village and $20,752 paid by the Power Cost Equalization program through the State of Alaska. Fuel oil represents the remaining portion with an annual cost of approximately $23,995. There is a heat recovery system present from the power plant to the washeteria that is owned and operated by the Native Village of Stevens. The recovered heat is delivered with zero charge because it is providing a benefit to the same governing body.

The heat recovery system transports heat from the generator cooling loops at the power plant to the circulating glycol loop at the washeteria. The recovered heat in the circulating glycol line at the washeteria is then transferred through additional heat exchangers to the lift station, sewer force main, school, and the multipurpose building. All of these buildings are heated from the central heat source of the washeteria boilers and the heat recovery system.

The table below lists the total usage of electricity, #1 heating oil, and the recovered heat before and after the proposed retrofits.

Table 1.1: Predicted Annual Fuel Usage for Each Fuel Type

Predicted Annual Fuel Use		
Fuel Use	**Existing Building**	**With Proposed Retrofits**
Electricity	32,491 kWh	17,516 kWh
#1 Oil	6,665 gallons	5,625 gallons
Heat Recovery	159.54 million Btu	195.97 million Btu

Benchmark figures facilitate comparing energy use between different buildings. The table below lists several benchmarks for the audited building. More details can be found in section 3.2.2.

Table 1.2: Building Benchmarks for the Stevens Village Washeteria

Building Benchmarks			
Description	**EUI (kBtu/Sq.Ft.)**	**EUI/HDD (Btu/Sq.Ft./HDD)**	**ECI ($/Sq.Ft.)**
Existing Building	513.5	33.07	$26.67
With Proposed Retrofits	445.6	28.70	$17.64
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 Stevens Village Washeteria. Listed are the estimates of the annual savings, installed costs, and two different financial measures of investment return.

Table 1.3: Summarized Priority List of All Energy Recommendations for the Stevens Village Washeteria

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	Lighting: Main Process Room	Replace with new energy-efficient LED lighting and add new Occupancy Sensor	$2,153	$2,540	9.85	1.2	4,079.4
2	Force Main Heat Add	Add controls to force main heat add and lower temperature set point to 50 deg. F. Shut off heat tape and use only for emergency purposes.	$1,401	$2,000	8.87	1.4	5,921.4
3	Setback Thermostat: Mechanical and Process Rooms	Lower the temperature set point to 60 degrees F.	$679	$1,000	8.75	1.5	3,244.7
4	Lighting: Exterior	Replace with new energy-efficient LED lighting.	$804	$1,500	6.30	1.9	1,755.1
5	Lighting: Bathroom Hallway	Replace with new energy-efficient LED lighting	$80	$160	5.79	2.0	139.9

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**
6	Lighting: Big Bathroom Incandescent	Replace with new energy-efficient LED lighting	$24	$50	5.68	2.0	47.0
7	Lighting: 4 Small Bathrooms/Showers	Replace with new energy-efficient LED lighting	$146	$300	5.67	2.1	281.2
8	Setback Thermostat: Washeteria	Implement a Heating Temperature Unoccupied Setback to 60.0 deg F for the Washeteria space.	$621	$2,000	4.00	3.2	2,953.8
9	Lighting: Boiler Room	Replace with new energy-efficient LED lighting and add new occupancy sensor	$454	$1,400	3.77	3.1	877.0
10	Lighting: Boiler Room - Small Fixtures	Replace with new energy-efficient LED lighting	$25	$80	3.62	3.2	48.0
11	Lighting: Office	Replace with new energy-efficient LED lighting	$25	$80	3.60	3.2	47.8
12	Other Electrical: Multipurpose "Freezer" Building Pumps	Replace with Grundfos VFD smart pumps	$932	$4,000	3.34	4.3	1,636.0
13	Lighting: Washeteria Room	Replace with new energy-efficient LED lighting and add new occupancy sensor	$303	$1,380	2.54	4.5	528.6

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
14	Other Load: Multipurpose Building Space Heat	Install Programmable Thermostats and perform minor weatherization on the Multipurpose facility to reduce heating demand.	$1,220	$6,000	1.89	4.9	7,559.7
15	Other Electrical: School/Lagoon Heat Circulation Pumps	Replace with Grundfos VFD smart pumps	$428	$4,000	1.53	9.3	750.0
16	Raw Water Heat Add	Install hydronic heat add system and turn off electric heater in the pump house. Shut off raw water and water intake heat tapes and use only for emergency purposes.	$6,713	$50,000	1.47	7.4	2,646.4
17	Lighting: Big Bathroom T8's	Replace with new energy-efficient LED lighting	$9	$80	1.35	8.6	17.8

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	Heating, Ventilation, and Domestic Hot Water	Downsize boilers, Add new guns and burners, install hi-lo controls, rewire the Tekmar for proper operation, Insulate exposed pipes, Repair leaky shower to prevent waste of water, convert shower heads to low flow units, replace mixing valves in the showers, Replace glycol circulation pump with a VFD equivalent	$3,755	$52,000	1.28	13.8	21,388.7
19	Lighting: Main Process Room - Small Fixtures	Replace with new energy-efficient LED lighting and add new occupancy sensor	$91	$1,160	0.92	12.7	177.2
20	Air Tightening	Weatherize doors and windows, insulate drain holes	$300	$3,000	0.90	10.0	1,444.7
21	Window: Process Room - Broken	Replace existing window with triple pane window.	$48	$1,265	0.62	26.4	229.3
22	Lighting: Plumbing Chase	Replace with new energy-efficient LED lighting	$5	$200	0.27	42.7	9.1
23	Lighting: Water Storage Tank Alcove	Replace with new energy-efficient LED lighting	$0	$80	0.06	179.6	0.8
24	Dryers	Clean dryer vents regularly	$0	$100	0.03	999.9	17.7
	TOTAL, all measures		**$20,218**	**$134,375**	**1.91**	**6.6**	**55,801.3**

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 $20,218 per year, or 33.8% of the buildings' total energy costs. These measures are estimated to cost $134,375, for an overall simple payback period of 6.6 years. If only the cost-effective measures are implemented, the annual utility cost can be reduced by $19,774 per year, or 33.1% of the buildings' total energy costs. These measures are estimated to cost $128,570, for an overall simple payback period of 6.5 years.

Table 1.2 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: Annual Energy Cost Estimate Broken Down by Category

Annual Energy Cost Estimate								
Description	**Space Heating**	**Water Heating**	**Clothes Drying**	**Lighting**	**Other Electrical**	**Raw Water Heat Add**	**Tank Heat**	**Total Cost**
Existing Building	$19,530	$5,375	$513	$6,461	$14,289	$10,919	$2,649	**$59,737**
With Proposed Retrofits	$14,903	$3,601	$438	$1,966	$12,710	$3,814	$2,087	**$39,519**
Savings	$4,627	$1,774	$75	$4,495	$1,579	$7,106	$563	**$20,218**

2. AUDIT AND ANALYSIS BACKGROUND

2.1 Program Description

This audit included services to identify, develop, and evaluate energy efficiency measures at the Stevens Village Washeteria. The scope of this project included evaluating building shell, lighting and other electrical systems, and heating and ventilation 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 and ventilation equipment
- 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 Stevens Village Washeteria 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.

The Stevens Village Washeteria is made up of the following activity areas:

1) Washeteria: 1,096 square feet
2) Mechanical and Process Rooms: 1,000 square feet
3) Lift Station: 144 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; heating and ventilation systems; 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. Stevens Village Washeteria

3.1. Building Description

The 2,240 square foot Stevens Village Washeteria was constructed in 1995, with a normal occupancy of one person for approximately 5 hours per day throughout the week.

The Stevens Village Washeteria serves as the water intake and treatment facility as well as the central location for laundromat and shower services. The washeteria has a watering point with a ½” pipe that provides treated water for collection by the residents of the community. There are 3 washers and 4 dryers in the washeteria, which is always open for use with no active attendant.

Water is pumped from a well approximately 160 ft. from the water treatment plant. The water source is groundwater under the influence of surface water from the Yukon River. After being pumped into the plant, the water enters a 7000 raw water storage tank before going through a sand filter and bag filter. Chlorine is injected both before the raw water settlement tank and after the filters. Once the water has been filtered, some water is diverted for domestic hot water use including washers, showers, and sinks. The remaining water is stored in nine 500-gallon water storage tanks inside the building and a larger 17,000 gallon water storage tank outside of the main facility.

Description of Building Shell

The exterior walls of the water treatment plant are constructed with single stud 2x4 lumber construction with a 16-inch offset. The walls have approximately 3.5 inches of polyurethane foam insulation that is slightly damaged from age. There is approximately 2,040 square feet of wall space in the washeteria building. The lift station walls are single stud, 2x6 lumber construction with a 16-inch offset and 5.5 inches of polyurethane foam insulation. The insulation is slightly damaged and there is approximately 480 square feet of wall space for the lift station.

The washeteria has a cathedral ceiling with 2x6 lumber construction. The roof has standard framing and a 16-inch offset. There is approximately 5.5 inches of polyurethane foam insulation with some damage due to age. There is approximately 2,197 square feet of roof space in the building. The lift station has the same construction in the roof as the washeteria building and has a total of approximately 151 square feet of roof space.

The washeteria is built on pilings with the floor framed from standard lumber. The floor is insulated with 5.5 inches of slightly damaged polyurethane foam insulation and there is approximately 2,096 square feet of floor space in the building. The lift station is built on grade on an elevated gravel pad foundation and has approximately 144 square feet of floor space.

The building has five total windows, each of which has double-pane glass and measurements of 34.5" x 34.5". There are three windows in the washeteria space and two windows in the process room space. The process room windows are south-facing. Additionally, there is a broken window with a plywood cover in the process room that is the same size.

There are insulated metal doors in the washeteria space and the process room space within the building. Each of these doors has some air leakage and visible daylight around the edges. Additionally, due to foundation shifting, both doors are difficult to open fully. The boiler room has a set of wooden double doors that were used to transport the water treatment plant equipment into the building during construction. These doors are no longer use. The lift station has two single insulated metal doors. All doors are 3' x 6'8" except for the process room door, which is 3'6" x 6'8".

<u>**Description of Heating Plants**</u>

The Heating Plants used in the building are:

Boiler 1

Nameplate Information:	Weil McLain 676
Fuel Type:	#1 Oil
Input Rating:	408,000 BTU/hr
Steady State Efficiency:	70 %
Idle Loss:	1.5 %
Heat Distribution Type:	Glycol
Boiler Operation:	All Year
Notes:	3.5 GPH oil fire rate

3358.6 hours

Boiler 2

Nameplate Information:	Weil McLain 676
Fuel Type:	#1 Oil
Input Rating:	408,000 BTU/hr
Steady State Efficiency:	68 %
Idle Loss:	0 %
Heat Distribution Type:	Glycol
Boiler Operation:	All Year
Notes:	3.5 GPH oil fire rate

1611.1 hours

Boiler 3

Nameplate Information: Weil McLain 776
Fuel Type: #1 Oil
Input Rating: 480,000 BTU/hr
Steady State Efficiency: 70 %
Idle Loss: 1.5 %
Heat Distribution Type: Glycol
Boiler Operation: All Year
Notes: 4.25 GPH oil fire rate
659.3 hours

The boilers operate to cover the majority of the heating loads for the washeteria. Two boilers are rated at 408 MBH while Boiler 3 is rated at 480 MBH. At the time of the site visit, Boiler 2 was not in operation.

Figure 1: Existing Fuel Oil Boilers

Heat Recovery

Fuel Type: Heat Recovery
Input Rating: 20,000 BTU/hr
Steady State Efficiency: 95 %
Idle Loss: 0 %
Heat Distribution Type: Glycol
Boiler Operation: All Year

The heat recovery system transfers heat from the generator cooling loops in the power plant to the circulating glycol line in the water treatment plant. The generator loads for the power plant range from around 15-20 kW in the summer to approximately 25 kW in the winter. These are very small loads for the current generators in place.

Figure 2: Heat Recovery Heat Exchanger on the Power Plant Side of the System

Solar Thermal System

Fuel Type:	Solar Thermal heating
Input Rating:	15,000 BTU/hr
Steady State Efficiency:	75 %
Idle Loss:	1.5 %
Heat Distribution Type:	Water
Boiler Operation:	All Year

There is a Heliodyne solar thermal hot water heater that is mounted on the existing hot water heater tank. The solar thermal system provides heat for domestic hot water purposes when available during the summer months and shoulder seasons.

Figure 3: Solar Thermal Water Heater

Toyotomi Oil Miser 148

Fuel Type:	#1 Oil
Input Rating:	148,000 BTU/hr
Steady State Efficiency:	85 %
Idle Loss:	1.5 %
Heat Distribution Type:	Glycol
Boiler Operation:	All Year

There is a Toyotomi Oil Miser 148 that is used specifically for domestic hot water heating. This operates when the solar thermal system is unable to handle the demand, especially in the winter months.

Figure 4: Toyotomi Oil Miser 148 Used for Making Hot Water

Space Heating Distribution Systems

There are 3 unit heaters in the washeteria building and one unit heater in the lift station tthat provide space heat to the facilities. The heaters are listed below with information on heat output, operational status, and location.

Unit Heater 1: 20 MBH rating, Process Room

Unit Heater 2: 20 MBH rating, Process Room

Unit Heater 3: 20 MBH rating, Process Room

Lift Station Unit Heater: 5 MBH, Lift Station

There are also two unit heaters in the Multipurpose “Freezer” Building next to the washeteria. The heating system in the washeteria provides heat for Multipurpose Building, but any electrical loads required are on a separate meter.

Domestic Hot Water System

There is an indirect-fired hot water heater present in the building as well as a Toyotomi Oil Miser 148 direct-fired hot water heater and a Heliodyne solar thermal hot water heater.

Standard operations for the hot water heating include solar thermal heating during the summer months and heating from the Toyotomi unit when the solar thermal is unable to cover the load.

Heat Recovery Information

There is a heat recovery system that transfers heat from the generator cooling loop in the power plant to the circulating glycol loop at the washeteria prior to the boilers. The generators at power plant are underloaded because of the closure of the school, and as a result the current electrical load for the community is less than half of the generator capacity. The generator loads for the power plant range from around 15-20 kW in the summer to approximately 25 kW in the winter.

Lighting

The washeteria space has 11 fixtures with three T8 4ft. fluorescent light bulbs in each fixture. The lights are on approximately four hours per day during the winter and shoulder seasons and are rarely used in the summer. They consume approximately 894 kWh annually.

The hallway to the showers has two fixtures with three T8 4ft. fluorescent light bulbs in each fixture. The lights are on approximately four hours per day during the winter and shoulder seasons and are rarely used in the summer. They consume approximately 163 kWh annually.

The small bathrooms have a combined six incandescent 60W light bulbs that are used periodically throughout the day and are estimated to consume approximately 197 kWh annually.

The big bathroom has one fixture with two T8 4ft. light bulbs as well as one fixture a single 60W incandescent light bulb. These lights are on periodically throughout the day and consume approximately 32 kWh annually.

The office room has one fixture with two T8 4ft. fluorescent light bulbs. The lights are on approximately four hours per day whenever the operator is working and consume approximately 84 Watts annually.

The water storage tank alcove has a single fixture with two T8 4 ft. fluorescent light bulbs. The lights are rarely used with an estimated consumption of 2 kWh annually.

The main process room has 13 fixtures with four T8 4ft. fluorescent light bulbs in each fixture. At the time of the site visit, the switch plate was broken and the lights were being left on constantly. This is a recent development and will be addressed in the recommendations, but it is not reflected in the energy usage numbers for this report. During standard operating hours, the lights are on approximately four hours per day when the operator is working and consume approximately 2,674 kWh annually. The main process room also has two fixtures with two T8 4ft. fluorescent light bulbs in each fixture. The lights are not on the circuit with the broken switch but share the same standard operating hours and consume approximately 168 kWh annually.

The boiler room has five fixtures with four T8 4ft. fluorescent light bulbs in each fixture as well as a single fixture with two T8 4ft. fluorescent light bulbs in each fixture. The lights are on approximately 2-3 hours per day and consume approximately 636 kWh annually.

There are three exterior lights on the washeteria building that operate during the dark hours throughout the winter and shoulder season months. The lights include a 60W incandescent light bulbs, a metal halide 40W light bulb, and a CFL 48 W light bulb. The lights combine to consume approximately 986 kWh annually.

There are four fixtures with 60W incandescent light bulbs in the plumbing chase that are rarely used and consume approximately 6 kWh annually.

Plug Loads

The washeteria has a variety of power tools, a telephone, and some other miscellaneous loads that require a plug into an electrical outlet. The use of these items is infrequent and consumes a small portion of the total energy demand of the building.

Major Equipment

There are two chlorine injection pumps that are used to inject chlorine at two different phases of the treatment process. The pumps are each rated for 168 Watts. Each pump operates when water is being made for approximately one hour per day and they consume approximately 123 kWh annually.

There are two raw water tank pumps that are used to pump water from the raw water settlement tank to the filtration process. Each of these pumps is rated for approximately 2 HP. One of the pumps operates whenever water is being made for approximately one hour per day. They consume approximately 545 kWh annually.

There is a backwash pump that is rated for 5 HP and is used to clean the filters approximately once per month. It consumes approximately 46 kWh annually.

There are two pressure pumps that are used to maintain an operable pressure in the system. Each of the pressure pumps is rated for 2 HP. They operate approximately 5% of the time all year long and consume approximately 580 kWh annually.

There are two pumps associated with the solar thermal heater that are used to circulate water through the solar panels and to transport the heated water through a heat exchanger in the hot water tank. Both pumps operate constantly and combine to consume approximately 2,279 kWh annually.

There are two pumps that are used to pump heated glycol to the Multipurpose Building to heat the facility. Each of the pumps are rated for 130 Watts. One of these pumps operate constantly during the winter heating months and consume approximately 2,980 kWh annually.

There is a heat add pump for the water storage tank that pumps heated glycol through the heat exchanger to heat the water and is rated for 84 Watts. The pump operates during the winter heating months and consumes approximately 115 kWh annually.

There are two pumps that circulate heated glycol to the lift station unit heaters. Each of these pumps are rated for 87 Watts. One of the pumps operates constantly and consume approximately 763 kWh annually. There are also two pumps on the water treatment plant side of this heat exchanger. These pumps are also rated for 87 Watts. One of these pumps runs constantly and consumes approximately 763 kWh annually.

There is a glycol feed pump that is rated for 29 Watts and consumes approximately 13 kWh annually.

There are two pumps that are used to circulate heated glycol to the school and force main heat add systems. Each of the pumps is rated for 1/3 HP. One of these pumps operates constantly during the winter heating months and consumes approximately 1,370 kWh annually.

There are three clothes washers in the washeteria that combine to operate for about four loads per day. Each washer is rated at 1,176 kWh. The washers consume approximately 1,727 kWh annually.

There are two motors associated with each of the four dryers in the washeteria. On each dryer, one motor is used for operating the drum and one motor is used to provide the heated air flow. All eight motors are rated for ¼ HP. They combine to consume approximately 274 kWh annually.

There is a dryer heat-add pump that operates whenever the dryers are in use for approximately two loads per day. The pump is rated for 1.5 HP and consumes approximately 192 kWh annually.

There is a well pump that is rated for 3 HP and is used approximately one hour per day to pump raw water in from the well source to the water treatment plant. The pump consumes approximately 822 kWh annually.

There is a lift station pump in the lift station that is not used much because it is only attached to the washeteria. The pump consumes approximately 411 kWh annually.

There is a building heat circulation pump that operates with the boilers that is used to circulate the heated glycol from the boilers and heat recovery system to the heating loads through the facilities. The pump is rated for 1.5 HP.

There is a circulation pump o the hot water generator that is used to pump heated water to the showers, sinks, and washers when needed. The pump is rated for 440 Watts.

There are three heat tapes that operate constantly during the winter heating months. One heat tape is used to heat the raw water intake line from the well to the pump house. This was measured to use approximately 187 Watts of power. One heat tape is used to heat the raw water pipe between the pump house and the washeteria. This was measured to use approximately 124 Watts of power. The third heat tape is used to heat the force main line from the washeteria to the sewage lagoon and was measured to use approximately 123 Watts. Finally, there is an electric heater in the pump house that is used constantly during the winter heating months. This unit is rated for 1500 Watts.

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 Native Village of Stevens owns and operates the electric utility and power plant for the community. The utility provides electricity to the residents of Stevens Village as well as all commercial and public facilities.

The average cost for each type of fuel used in this building is shown below in Table 3.1. This figure includes all surcharges, subsidies, and utility customer charges:

Table 3.1: Energy Rates for Each Fuel Source in Stevens Village

Average Energy Cost	
Description	**Average Energy Cost**
Electricity	$ 1.10/kWh
#1 Oil	$ 3.60/gallons
Heat Recovery	$ 0.01/million Btu

3.2.1.1 Total Energy Use and Cost Breakdown

At current rates, Native Village of Stevens pays approximately $59,737 annually for electricity and other fuel costs for the Stevens Village Washeteria.

Figure 5 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.

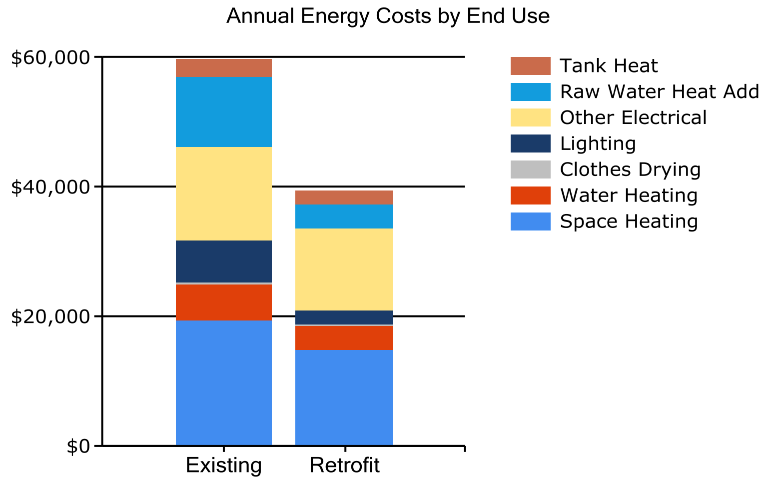


Figure 5: Annual Energy Costs by End Use

Figure 6 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.

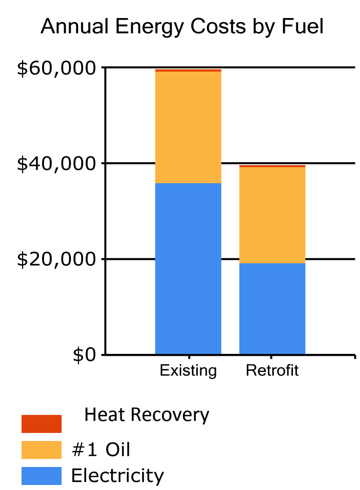


Figure 6: Annual Energy Costs by Fuel Type

Figure 3.3 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.

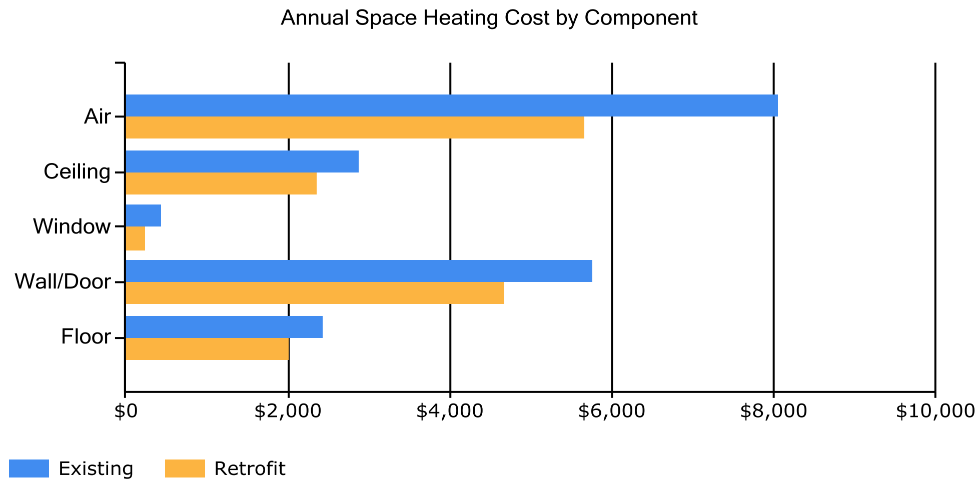


Figure 7: Annual Space Heating Cost by Component

The tables below 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 3.2: Electrical Consumption Records by Category

Electrical Consumption (kWh)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Space Heating	501	387	318	145	61	12	8	26	74	202	353	480
DHW	129	117	129	124	34	33	34	34	81	128	125	129
Lighting	613	559	613	594	325	315	325	325	384	613	594	613
Other Electrical	1330	1212	1330	1287	724	700	724	724	1013	1330	1287	1330
Raw Water Heat Add	1347	1228	1347	1304	0	0	0	0	695	1347	1304	1347
Tank Heat	9	7	5	2	0	0	0	0	0	3	6	8

Table 3.3: Fuel Oil Consumption Records by Category

Fuel Oil #1 Consumption (Gallons)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Space Heating	886	708	624	354	9	0	0	0	107	436	663	854
DHW	101	89	94	88	99	99	102	102	100	91	92	100
Clothes Drying	6	6	6	7	21	21	22	22	12	7	6	6
Tank Heat	154	120	99	40	0	0	0	0	0	56	108	147

Table 3.4: Recovered Heat Consumption Records by Category

Recovered Heat Consumption (Million Btu)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Space Heating	22	18	16	9	1	0	0	0	3	11	16	21
DHW	3	2	3	2	2	1	2	2	2	2	3	3
Tank Heat	4	3	2	1	0	0	0	0	0	1	2	3

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 3.4 for details):

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

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

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

Table 3.5: Stevens Village Washeteria EUI Calculations

Energy Type	Building Fuel Use per Year	Site Energy Use per Year, kBTU	Source/Site Ratio	Source Energy Use per Year, kBTU
Electricity	32,491 kWh	110,892	3.340	370,380
#1 Oil	6,665 gallons	879,813	1.010	888,611
Hot Wtr District Ht	159.54 million Btu	159,544	1.280	204,217
Total		**1,150,250**		**1,463,208**
BUILDING AREA		2,240	Square Feet	
BUILDING SITE EUI		514	kBTU/Ft²/Yr	
BUILDING SOURCE EUI		653	**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 3.6: Stevens Village Washeteria Building Benchmarks

Building Benchmarks			
Description	**EUI (kBtu/Sq.Ft.)**	**EUI/HDD (Btu/Sq.Ft./HDD)**	**ECI ($/Sq.Ft.)**
Existing Building	**513.5**	**33.07**	**$26.67**
With Proposed Retrofits	**445.6**	**28.70**	**$17.64**
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 heating and ventilation systems 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 Stevens Village Washeteria was modeled using AkWarm© energy use software to establish a baseline space heating energy usage. Climate data from Stevens Village 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 Stevens Village. 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: List of Energy Efficiency Recommendations by Economic Priority

PRIORITY LIST – ENERGY EFFICIENCY MEASURES							
Rank	Feature	Improvement Description	Annual Energy Savings	Installed Cost	Savings to Investment Ratio, SIR	Simple Payback (Years)	CO_2 Savings
1	Lighting: Main Process Room	Replace with new energy-efficient LED lighting and add new Occupancy Sensor	$2,153	$2,540	9.85	1.2	4,079.4
2	Force Main Heat Add	Add controls to force main heat add and lower temperature set point to 50 deg. F. Shut off heat tape and use only for emergency purposes.	$1,401	$2,000	8.87	1.4	5,921.4
3	Setback Thermostat: Mechanical and Process Rooms	Lower the temperature set point to 60 degrees F.	$679	$1,000	8.75	1.5	3,244.7
4	Lighting: Exterior	Replace with new energy-efficient LED lighting.	$804	$1,500	6.30	1.9	1,755.1
5	Lighting: Bathroom Hallway	Replace with new energy-efficient LED lighting	$80	$160	5.79	2.0	139.9

PRIORITY LIST – ENERGY EFFICIENCY MEASURES							
Rank	Feature	Improvement Description	Annual Energy Savings	Installed Cost	Savings to Investment Ratio, SIR	Simple Payback (Years)	CO_2 Savings
6	Lighting: Big Bathroom Incandescent	Replace with new energy-efficient LED lighting	$24	$50	5.68	2.0	47.0
7	Lighting: 4 Small Bathrooms/Showers	Replace with new energy-efficient LED lighting	$146	$300	5.67	2.1	281.2
8	Setback Thermostat: Washeteria	Implement a Heating Temperature Unoccupied Setback to 60.0 deg F for the Washeteria space.	$621	$2,000	4.00	3.2	2,953.8
9	Lighting: Boiler Room	Replace with new energy-efficient LED lighting and add new occupancy sensor	$454	$1,400	3.77	3.1	877.0
10	Lighting: Boiler Room - Small Fixtures	Replace with new energy-efficient LED lighting	$25	$80	3.62	3.2	48.0
11	Lighting: Office	Replace with new energy-efficient LED lighting	$25	$80	3.60	3.2	47.8
12	Other Electrical: Multipurpose "Freezer" Building Pumps	Replace with Grundfos VFD smart pumps	$932	$4,000	3.34	4.3	1,636.0
13	Lighting: Washeteria Room	Replace with new energy-efficient LED lighting and add new occupancy sensor	$303	$1,380	2.54	4.5	528.6

PRIORITY LIST – ENERGY EFFICIENCY MEASURES							
Rank	**Feature**	**Improvement Description**	**Annual Energy Savings**	**Installed Cost**	**Savings to Investment Ratio, SIR**	**Simple Payback (Years)**	**CO_2 Savings**
14	Other Load: Multipurpose Building Space Heat	Install Programmable Thermostats and perform minor weatherization on the Multipurpose facility to reduce heating demand.	$1,220	$6,000	1.89	4.9	7,559.7
15	Other Electrical: School/Lagoon Heat Circulation Pumps	Replace with Grundfos VFD smart pumps	$428	$4,000	1.53	9.3	750.0
16	Raw Water Heat Add	Install hydronic heat add system and turn off electric heater in the pump house. Shut off raw water and water intake heat tapes and use only for emergency purposes.	$6,713	$50,000	1.47	7.4	2,646.4
17	Lighting: Big Bathroom T8's	Replace with new energy-efficient LED lighting	$9	$80	1.35	8.6	17.8

PRIORITY LIST – ENERGY EFFICIENCY MEASURES							
Rank	Feature	Improvement Description	Annual Energy Savings	Installed Cost	Savings to Investment Ratio, SIR	Simple Payback (Years)	CO_2 Savings
18	Heating, Ventilation, and Domestic Hot Water	Downsize boilers, Add new guns and burners, install hi-lo controls, rewire the Tekmar for proper operation, Insulate exposed pipes, Repair leaky shower to prevent waste of water, convert shower heads to low flow units, replace mixing valves in the showers, Replace glycol circulation pump with a VFD equivalent	$3,755	$52,000	1.28	13.8	21,388.7
19	Lighting: Main Process Room - Small Fixtures	Replace with new energy-efficient LED lighting and add new occupancy sensor	$91	$1,160	0.92	12.7	177.2
20	Air Tightening	Weatherize doors and windows, insulate drain holes	$300	$3,000	0.90	10.0	1,444.7
21	Window: Process Room - Broken	Replace existing window with triple pane window.	$48	$1,265	0.62	26.4	229.3
22	Lighting: Plumbing Chase	Replace with new energy-efficient LED lighting	$5	$200	0.27	42.7	9.1
23	Lighting: Water Storage Tank Alcove	Replace with new energy-efficient LED lighting	$0	$80	0.06	179.6	0.8
24	Dryers	Clean dryer vents regularly	$0	$100	0.03	999.9	17.7
	TOTAL, all measures		**$20,218**	**$134,375**	**1.91**	**6.6**	**55,801.3**

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 benefits were included in the lighting project analysis.

4.3 Building Shell Measures

4.3.1 Window Measures

Rank	**Location**	**Size/Type, Condition**	**Recommendation**
21	Window/Skylight: Process Room - Broken	Glass: No glazing - broken, missing Frame: Wood\Vinyl Spacing Between Layers: Half Inch Gas Fill Type: Air Modeled U-Value: 0.94 Solar Heat Gain Coefficient including Window Coverings: 0.11	Replace existing window with triple pane window.

Installation Cost	$1,265	**Estimated Life of Measure (yrs)**	20	**Energy Savings (/yr)**	$48
Breakeven Cost	$780	**Savings-to-Investment Ratio**	0.6	**Simple Payback yrs**	26

Auditors Notes: This window is broken and is covered with plywood. The space measures 34.5" x 34.5".

4.3.2 Air Sealing Measures

Rank	**Location**	**Existing Air Leakage Level (cfm@50/75 Pa)**	**Recommended Air Leakage Reduction (cfm@50/75 Pa)**
20		Air Tightness estimated as: 3250 cfm at 50 Pascals	Weatherize doors and windows, insulate drain holes

Installation Cost	$3,000	**Estimated Life of Measure (yrs)**	10	**Energy Savings (/yr)**	$300
Breakeven Cost	$2,688	**Savings-to-Investment Ratio**	0.9	**Simple Payback yrs**	10

Auditors Notes: There are exposed drain holes in the floor that can be insulated to prevent air infiltration. The washeteria entrance doors have air infiltration through the seams and can be sealed with weather stripping.

4.4 Mechanical Equipment Measures

4.4.1 Heating/ Domestic Hot Water Measure

Rank	Recommendation				
18	Downsize boilers, Add new guns and burners, install hi-lo controls, rewire the Tekmar for proper operation, Insulate exposed pipes, Repair leaky shower to prevent waste of water, convert shower heads to low flow units, replace mixing valves in the showers, Replace glycol circulation pump with a VFD equivalent				
Installation Cost	$52,000	**Estimated Life of Measure (yrs)**	20	**Energy Savings (/yr)**	$3,755
Breakeven Cost	$66,471	**Savings-to-Investment Ratio**	1.3	**Simple Payback yrs**	14

Auditors Notes: The existing boilers were designed for a circulating water system of a population four times greater than is currently in the community. Downsizing the boilers will give the washeteria a more appropriate boiler for the current heating demand. Install hi-lo controls and rewire the Tekmar so that the boilers can run more efficiently and the larger boiler can only run as a backup.

There are some uninsulated pipes in the boiler room that can be insulated to prevent excess heat loss. The pipe lengths to be insulated are:

237 inches of ½ - inch pipe
95 inches of ¾ - inch pipe
480 inches of 1-inch pipe
580 inches of 1.5 – inch pipe
351 inches of 2-inch pipe
130 inches of 3-inch pipe.

One of the showers has a leak that is wasting water and could cause damage to the wooden structure supporting the unit. Repair this for more efficient and safer operations.

Convert the shower heads to low-flow units to save on water usage. Replace the mixing valves as some leaks were found in the existing ones.

Replace the glycol circulation pump with a Grundfos Magna VFD equivalent for more efficient operations.

4.4.2 Night Setback Thermostat Measures

Rank	Building Space			Recommendation	
3	Mechanical and Process Rooms			Lower the temperature set point to 60 degrees F.	
Installation Cost	$1,000	**Estimated Life of Measure (yrs)**	15	**Energy Savings (/yr)**	$679
Breakeven Cost	$8,751	**Savings-to-Investment Ratio**	8.8	**Simple Payback yrs**	1

Auditors Notes: The temperature in this room can be lowered because the occupancy schedule is minimal throughout the year. Training on lowering temperature set points is more efficient than installing a programmable thermostat.

Rank	Building Space			Recommendation	
8	Washeteria			Implement a Heating Temperature Unoccupied Setback to 60.0 deg F for the Washeteria space.	
Installation Cost	$2,000	**Estimated Life of Measure (yrs)**	15	**Energy Savings (/yr)**	$621
Breakeven Cost	$7,996	**Savings-to-Investment Ratio**	4.0	**Simple Payback yrs**	3

Auditors Notes: The temperature in this room can be lowered because the occupancy schedule is minimal throughout the year.

4.5 Electrical & Appliance Measures

4.5.1 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.

4.5.1a Lighting Measures – Replace Existing Fixtures/Bulbs

Rank	Location	Existing Condition	Recommendation
1	Main Process Room	13 FLUOR (4) T8 4' F32T8 32W Standard Instant StdElectronic	Replace with new energy-efficient LED lighting and add new occupancy sensor

Installation Cost	$2,540	**Estimated Life of Measure (yrs)**	15	**Energy Savings (/yr)**	$2,153
Breakeven Cost	$25,013	**Savings-to-Investment Ratio**	9.8	**Simple Payback yrs**	1

Auditors Notes: Repair light switch in process room so that the main lights can be easily turned off.

The room has 13 fixtures with four light bulbs to be replaced with two new bulbs in each fixture for a total of 26 light bulbs to replace. An occupancy can also be installed in this room.

Rank	Location	Existing Condition	Recommendation
4	Exterior	3 INCAN A Lamp, Std 60W	Replace with new energy-efficient LED lighting

Installation Cost	$1,500	**Estimated Life of Measure (yrs)**	15	**Energy Savings (/yr)**	$804
Breakeven Cost	$9,449	**Savings-to-Investment Ratio**	6.3	**Simple Payback yrs**	2

Auditors Notes:

Rank	Location	Existing Condition	Recommendation
5	Bathroom Hallway	2 FLUOR (3) T8 4' F32T8 32W Standard Instant StdElectronic	Replace with new energy-efficient LED lighting

Installation Cost	$160	**Estimated Life of Measure (yrs)**	15	**Energy Savings (/yr)**	$80
Breakeven Cost	$926	**Savings-to-Investment Ratio**	5.8	**Simple Payback yrs**	2

Auditors Notes: The room has two fixtures with three light bulbs to be replaced with two new light bulbs in each fixture for a total of four light bulbs to replace.

Rank	Location	Existing Condition	Recommendation
6	Big Bathroom Incandescent	INCAN A Lamp, Std 60W	Replace with new energy-efficient LED lighting

Installation Cost	$50	**Estimated Life of Measure (yrs)**	15	**Energy Savings (/yr)**	$24
Breakeven Cost	$284	**Savings-to-Investment Ratio**	5.7	**Simple Payback yrs**	2

Auditors Notes: The room has a single fixture with one light bulb to replace.

Rank	Location	Existing Condition	Recommendation
7	4 Small Bathrooms/Showers	6 INCAN A Lamp, Std 60W	Replace with new energy-efficient LED lighting

Installation Cost	$300	**Estimated Life of Measure (yrs)**	15	**Energy Savings (/yr)**	$146
Breakeven Cost	$1,702	**Savings-to-Investment Ratio**	5.7	**Simple Payback yrs**	2

Auditors Notes: The room has six fixtures with one light bulb in each fixture for a total of six light bulbs to replace.

Rank	Location	Existing Condition		Recommendation	
9	Boiler Room	5 FLUOR (4) T8 4' F32T8 32W Standard Instant StdElectronic		Replace with new energy-efficient LED lighting and add new occupancy sensor	
Installation Cost	$1,400	**Estimated Life of Measure (yrs)**	15	**Energy Savings (/yr)**	$454
Breakeven Cost	$5,280	**Savings-to-Investment Ratio**	3.8	**Simple Payback yrs**	3
Auditors Notes: The room has five fixtures with four light bulbs to be replaced with two new bulbs in each fixture for a total of ten light bulbs to replace. An occupancy can also be installed in this room.					

Rank	Location	Existing Condition		Recommendation	
10	Boiler Room - Small Fixtures	FLUOR (2) T8 4' F32T8 32W Standard Instant StdElectronic		Replace with new energy-efficient LED lighting	
Installation Cost	$80	**Estimated Life of Measure (yrs)**	15	**Energy Savings (/yr)**	$25
Breakeven Cost	$289	**Savings-to-Investment Ratio**	3.6	**Simple Payback yrs**	3
Auditors Notes: The room has a single fixture with two light bulbs to replace.					

Rank	Location	Existing Condition		Recommendation	
11	Office	FLUOR (2) T8 4' F32T8 32W Standard Instant StdElectronic		Replace with new energy-efficient LED lighting	
Installation Cost	$80	**Estimated Life of Measure (yrs)**	15	**Energy Savings (/yr)**	$25
Breakeven Cost	$288	**Savings-to-Investment Ratio**	3.6	**Simple Payback yrs**	3
Auditors Notes: The room has a single fixture with four light bulbs to be replaced with two new bulbs in the fixture for a total of two light bulbs to replace.					

Rank	Location	Existing Condition		Recommendation	
13	Washeteria Room	11 FLUOR (3) T8 4' F32T8 32W Standard Instant StdElectronic		Replace with new energy-efficient LED lighting and add new occupancy sensor	
Installation Cost	$1,380	**Estimated Life of Measure (yrs)**	15	**Energy Savings (/yr)**	$303
Breakeven Cost	$3,505	**Savings-to-Investment Ratio**	2.5	**Simple Payback yrs**	5
Auditors Notes: The room has 11 fixtures with three light bulbs to be replaced with two new bulbs in each fixture for a total of 22 light bulbs to replace. An occupancy can also be installed in this room.					

Rank	Location	Existing Condition		Recommendation	
17	Big Bathroom T8's	FLUOR (2) T8 4' F32T8 32W Standard Instant StdElectronic		Replace with new energy-efficient LED lighting	
Installation Cost	$80	**Estimated Life of Measure (yrs)**	15	**Energy Savings (/yr)**	$9
Breakeven Cost	$108	**Savings-to-Investment Ratio**	1.3	**Simple Payback yrs**	9
Auditors Notes: The room has two fixtures with four light bulbs to be replaced with two new light bulbs in each fixture for a total of four light bulbs to replace.					

Rank	Location	Existing Condition		Recommendation	
19	Main Process Room - Small Fixtures	2 FLUOR (2) T8 4' F32T8 32W Standard Instant StdElectronic		Replace with new energy-efficient LED lighting and add new occupancy sensor	
Installation Cost	$1,160	**Estimated Life of Measure (yrs)**	15	**Energy Savings (/yr)**	$91
Breakeven Cost	$1,065	**Savings-to-Investment Ratio**	0.9	**Simple Payback yrs**	13
Auditors Notes: The room has two fixtures with two light bulbs each for a total of four light bulbs to replace. An occupancy can also be installed in this room.					

Rank	Location	Existing Condition		Recommendation	
22	Plumbing Chase	4 INCAN A Lamp, Std 60W		Replace with new energy-efficient LED lighting	
Installation Cost	$200	**Estimated Life of Measure (yrs)**	15	**Energy Savings (/yr)**	$5
Breakeven Cost	$55	**Savings-to-Investment Ratio**	0.3	**Simple Payback yrs**	43
Auditors Notes: The room has four fixtures with a single light bulb in each fixture for a total of four light bulbs to replace.					

Rank	Location	Existing Condition		Recommendation	
23	Water Storage Tank Alcove	FLUOR (2) T8 4' F32T8 32W Standard Instant StdElectronic		Replace with new energy-efficient LED lighting	
Installation Cost	$80	**Estimated Life of Measure (yrs)**	15	**Energy Savings (/yr)**	$
Breakeven Cost	$5	**Savings-to-Investment Ratio**	0.1	**Simple Payback yrs**	180
Auditors Notes: The room has a single fixture with two light bulbs to replace.					

4.5.2 Other Electrical Measures

Rank	Location	Description of Existing		Efficiency Recommendation	
12	Multipurpose "Freezer" Building Pumps	Heating Circulation Pumps		Replace with VFD smart pumps.	
Installation Cost	$4,000	**Estimated Life of Measure (yrs)**	20	**Energy Savings (/yr)**	$932
Breakeven Cost	$13,348	**Savings-to-Investment Ratio**	3.3	**Simple Payback yrs**	4
Auditors Notes: The Multipurpose Building has a varied heating load that can best be accommodated with a VFD smart pump to eliminate excess electricity usage.					

Rank	Location	Description of Existing		Efficiency Recommendation	
15	School/Lagoon Heat Circulation Pumps	Heating Circulation Pumps		Replace with VFD smart pumps.	
Installation Cost	$4,000	**Estimated Life of Measure (yrs)**	20	**Energy Savings (/yr)**	$428
Breakeven Cost	$6,128	**Savings-to-Investment Ratio**	1.5	**Simple Payback yrs**	9
Auditors Notes: The school and force main have a varied heating load that can best be accommodated with a VFD smart pump to eliminate excess electricity usage.					

4.5.3 Other Measures

Rank	Location		Description of Existing		Efficiency Recommendation	
2	Force Main		Force Main Heat Add		Add Controls to Force Main heat add and lower temperature set point to 50 deg. F. Shut off heat tape and use only for emergency purposes.	
Installation Cost		$2,000	**Estimated Life of Measure (yrs)**	15	**Energy Savings (/yr)**	$1,401
Breakeven Cost		$17,736	**Savings-to-Investment Ratio**	8.9	**Simple Payback yrs**	1
Auditors Notes: The force main needs a new temperature controller that can allow the heating to increase and reduce the need for the heat tape.						

Rank	Location		Description of Existing		Efficiency Recommendation	
14	Multipurpose Building		Multipurpose Building Space Heat		Install Programmable Thermostats and perform minor weatherization on the Multipurpose facility to reduce heating demand.	
Installation Cost		$6,000	**Estimated Life of Measure (yrs)**	10	**Energy Savings (/yr)**	$1,220
Breakeven Cost		$11,328	**Savings-to-Investment Ratio**	1.9	**Simple Payback yrs**	5
Auditors Notes: The Multipurpose Building is heated by the washeteria heating system and directly affects the fuel consumption by the washeteria boilers. Adding energy efficiency improvements and weatherization can decrease the overall heating demand on the boilers.						

Rank	Location		Description of Existing		Efficiency Recommendation	
16	Pump House		Raw Water Line Heat Add Load		Install hydronic heat add system and turn off electric heater in the pump house. Shut off heat tape and use only for emergency purposes.	
Installation Cost		$50,000	**Estimated Life of Measure (yrs)**	15	**Energy Savings (/yr)**	$6,713
Breakeven Cost		$73,502	**Savings-to-Investment Ratio**	1.5	**Simple Payback yrs**	7
Auditors Notes: There is currently no hydronic heat-add line between the pump house and the washeteria. Adding a hydronic line will eliminate the need for the electric heat tape, allowing the operator to use it only for emergency purposes. The heat add line can also eliminate the need for the electric heater in the pump house ,which has no controls and was driving the pump house temperature to much high temperatures than needed. Below is a picture of the electric heater and of the pump house end of the heat tape and raw water pipe.						

Rank	Location	Description of Existing		Efficiency Recommendation	
24		Dryers - (4 Total Units)		Clean dryer vents regularly	
Installation Cost	$100	**Estimated Life of Measure (yrs)**	15	**Energy Savings (/yr)**	$
Breakeven Cost	$3	**Savings-to-Investment Ratio**	0.0	**Simple Payback yrs**	1000
Auditors Notes: The dryer vents should be cleaned regularly to allow for better heat transfer and more efficient operations of the dryer.					

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 the Native Village of Stevens to follow up on the recommendations made in this report. Funding has been provided to ANTHC through a Rural Alaska Village Grant to provide the community with assistance in understanding the report and implementing the recommendations. ANTHC will work to complete the recommendations within the 2016 calendar year.

APPENDICES

Appendix A – Energy Audit Report – Project Summary

ENERGY AUDIT REPORT – PROJECT SUMMARY	
General Project Information	
PROJECT INFORMATION	**AUDITOR INFORMATION**
Building: Stevens Village Washeteria	**Auditor Company:** ANTHC-DEHE
Address: PO Box 70416	**Auditor Name:** Kevin Ulrich and Lee Menkel
City: Stevens Village **Client Name:** Henry Smoke	**Auditor Address:** 4500 Diplomacy Dr. Anchorage, AK 99508
Client Address: PO Box 70416 Stevens Village, AK 99774	**Auditor Phone:** (907) 729-3237 **Auditor FAX:**
Client Phone: (907) 478-7228 **Client FAX:**	**Auditor Comment:**
Design Data	
Building Area: 2,240 square feet	**Design Space Heating Load:** Design Loss at Space: 58,016 Btu/hour with Distribution Losses: 58,016 Btu/hour Plant Input Rating assuming 82.0% Plant Efficiency and 25% Safety Margin: 88,440 Btu/hour Note: Additional Capacity should be added for DHW and other plant loads, if served.
Typical Occupancy: 0 people	**Design Indoor Temperature:** 68.7 deg F (building average)
Actual City: Stevens Village	**Design Outdoor Temperature:** -54.8 deg F
Weather/Fuel City: Stevens Village	**Heating Degree Days:** 15,528 deg F-days
Utility Information	
Electric Utility: Stevens Village - Commercial - Sm	**Average Annual Cost/kWh:** $1.10/kWh

Annual Energy Cost Estimate								
Description	**Space Heating**	**Water Heating**	**Clothes Drying**	**Lighting**	**Other Electrical**	**Raw Water Heat Add**	**Tank Heat**	**Total Cost**
Existing Building	$19,530	$5,375	$513	$6,461	$14,289	$10,919	$2,649	**$59,737**
With Proposed Retrofits	$14,903	$3,601	$438	$1,966	$12,710	$3,814	$2,087	**$39,519**
Savings	$4,627	$1,774	$75	$4,495	$1,579	$7,106	$563	**$20,218**

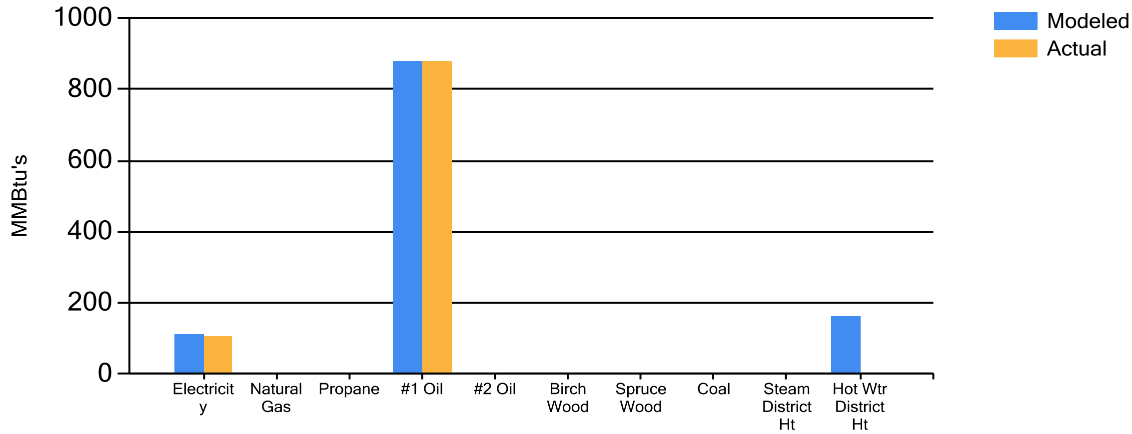
Building Benchmarks			
Description	**EUI (kBtu/Sq.Ft.)**	**EUI/HDD (Btu/Sq.Ft./HDD)**	**ECI ($/Sq.Ft.)**
Existing Building	513.5	33.07	$26.67
With Proposed Retrofits	445.6	28.70	$17.64

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.

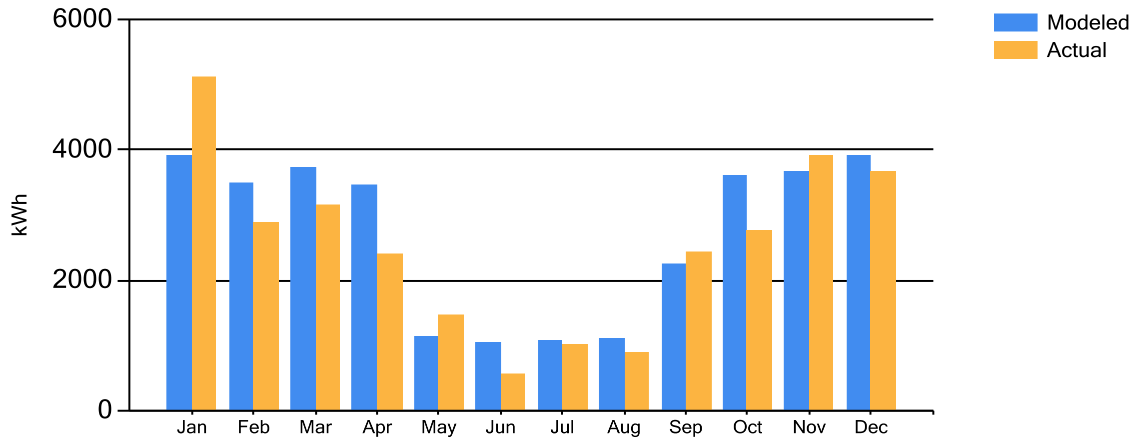
Appendix B – Actual Fuel Use versus Modeled Fuel Use

The Orange bars show Actual fuel use, and the Blue bars are AkWarm's prediction of fuel use.

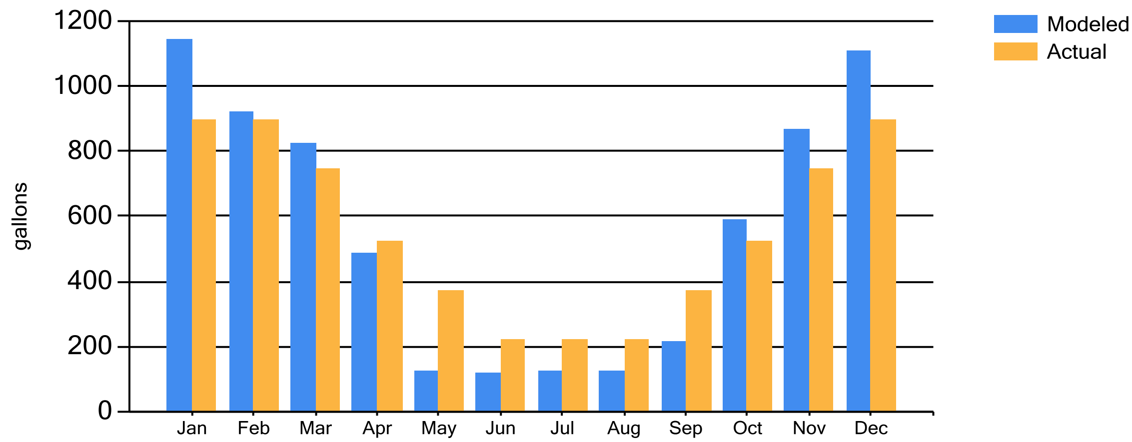
Annual Fuel Use



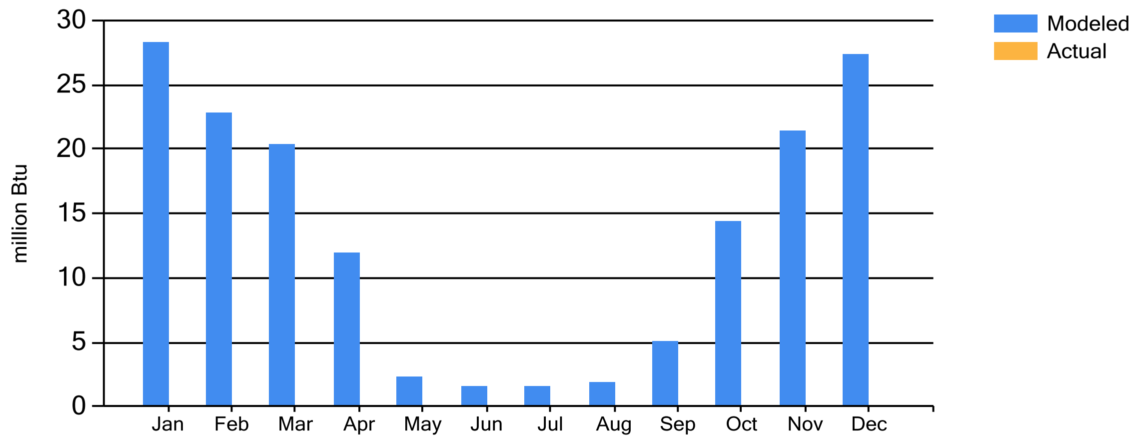
Electricity Fuel Use



#1 Fuel Oil Fuel Use



Heat Recovery Fuel Use


million Btu
30
25
20
15
10
5
0
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Modeled
Actual

Appendix C - Electrical Demands

Estimated Peak Electrical Demand (kW)												
	Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Current	12.7	12.5	12.3	12.0	8.4	8.3	8.3	8.3	10.0	12.1	12.4	12.6
As Proposed	8.5	8.4	8.2	8.0	6.7	6.6	6.6	6.6	7.1	8.0	8.3	8.5

AkWarmCalc Ver 2.5.3.0, Energy Lib 3/7/2016