



Comprehensive Energy Audit For Rampart Washeteria & Water Treatment Plant



Prepared For
Rampart Village

August 6, 2015

Prepared By:

**ANTHC-DEHE
3900 Ambassador Dr Suite 301
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 Energy Projects Group at the Alaska Native Tribal Health Consortium (ANTHC) prepared this document for Rampart Village. The authors of this report are Carl Remley, Certified Energy Auditor (CEA) and Certified Energy Manager (CEM) and 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 June of 2015 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 Mike Wiehl, Energy Specialist Patty Wiehl, and First Chief and Tribal Administrator Floyd Green.

1. EXECUTIVE SUMMARY

This report was prepared for the Rampart Village. The scope of the audit focused on the Rampart Washeteria & 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, heating and ventilation systems, and plug loads.

In the near future, a representative of ANTHC will be contacting both the Rampart Village and the water treatment plant operator to follow up on the recommendations made in this audit report. Funding has been provided to ANTHC through a Rural Alaska Village Grant and the Denali Commission to provide the village with assistance in understanding the report and implementing the recommendations. ANTHC will work to complete the recommendations within the 2015 calendar year.

The total predicted energy cost of the Rampart Washeteria & Water Treatment Plant is \$45,254 per year. Electricity represents the largest portion with an annual cost of \$36,353. Fuel oil represents the remaining portion of the building energy consumption with an annual cost of \$8,901.

The State of Alaska provides a subsidy to rural communities across the state to lower the electricity costs and make energy in Alaska affordable. Rampart currently does not receive the PCE subsidy. Use of the PCE subsidy for the electricity needs of the Rampart Washeteria & Water Treatment Plant would produce approximately \$26,600 per year in additional savings after the findings of this report are implemented. Please note that ANTHC would be glad to work with the community to do what is necessary to obtain the PCE subsidy for the water plant.

The table below lists the total usage of electricity and #1 oil in the water treatment plant and washeteria before and after the proposed retrofits.

Predicted Annual Fuel Use		
Fuel Use	Existing Building	With Proposed Retrofits
Electricity	45,441 KWH	36,980 KWH
#1 Oil	1,780 gallons	1,421 gallons

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.

Building Benchmarks			
Description	EUI (kBtu/Sq.Ft.)	EUI/HDD (Btu/Sq.Ft./HDD)	ECI (\$/Sq.Ft.)
Existing Building	181.6	11.69	\$21.07
With Proposed Retrofits	146.1	9.41	\$17.08
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 1.1 below summarizes the energy efficiency measures analyzed for the Rampart Washeteria & Water Treatment Plant. Listed are the estimates of the annual savings, installed costs, and two different financial measures of investment return.

Table 1.1 PRIORITY LIST – ENERGY EFFICIENCY MEASURES							
Rank	Feature	Improvement Description	Annual Energy Savings	Installed Cost	Savings to Investment Ratio, SIR¹	Simple Payback (Years)²	CO₂ Savings
1	Other Electrical - Controls Retrofit: Lift Station Electric Heat	Lower temperature setting to 50 deg. F when unoccupied.	\$1,474	\$500	34.63	0.3	4,053.5
2	Other Electrical - Controls Retrofit: Sewr Line Heat Tape	Shut off heat tape and use only for emergency purposes.	\$2,930	\$2,500	13.77	0.9	8,058.1
3	Ventilation	Rewire thermostat from heating to cooling.	\$264	\$300	11.50	1.1	1,006.2
4	Lighting - Power Retrofit: Exterior Lighting	Replace with new energy-efficient lighting	\$838	\$1,200	10.20	1.4	2,304.9
5	Lighting - Power Retrofit: Main Washeteria Lighting	Replace with new energy-efficient lighting	\$717	\$1,020	9.96	1.4	1,807.0
6	Lighting - Power Retrofit: Rest Room & Shower CFL	Replace with new energy-efficient lighting	\$92	\$180	7.24	2.0	232.0
7	Lighting - Power Retrofit: Rest Room & Shower 4 Ft T8	Replace with new energy-efficient lighting	\$127	\$300	5.99	2.4	319.8
8	Heating, Ventilation, and Domestic Hot Water	Add a Tekmar controller to operate the boilers based on water treatment plant demand. Re-commission the dryer plenum dampers.	\$1,802	\$7,500	4.19	4.2	7,619.4
9	Lighting - Power Retrofit: Main WTP Lighting	Replace with new energy-efficient lighting	\$301	\$1,080	3.95	3.6	755.9
10	Lighting - Power Retrofit: Office Lighting	Replace with new energy-efficient lighting	\$8	\$60	1.97	7.2	20.9
11	Lighting - Power Retrofit: Generator Room Lighting	Replace with new energy-efficient lighting	\$13	\$140	1.26	11.2	31.4
	TOTAL, all measures		\$8,567	\$14,780	7.89	1.7	26,209.1

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 \$8,567 per year, or 18.9% of the buildings' total energy costs. These measures are estimated to cost \$14,780, for an overall simple payback period of 1.7 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 1.2

Annual Energy Cost Estimate							
Description	Space Heating	Water Heating	Ventilation Fans	Clothes Drying	Lighting	Other Electrical	Total Cost
Existing Building	\$5,586	\$2,427	\$117	\$3,742	\$6,077	\$27,304	\$45,254
With Proposed Retrofits	\$5,493	\$1,660	\$58	\$2,808	\$3,767	\$22,900	\$36,687
Savings	\$93	\$767	\$58	\$934	\$2,310	\$4,404	\$8,567

2. AUDIT AND ANALYSIS BACKGROUND

2.1 Program Description

This audit included services to identify, develop, and evaluate energy efficiency measures at the Rampart Washeteria & Water Treatment Plant. 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

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 Rampart Washeteria & 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.

Rampart Washeteria & Water Treatment Plant is classified as being made up of the following activity areas:

- 1) Washeteria: 1,248 square feet
- 2) Water Treatment Plant: 900 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; 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 $SIR \geq 1$ 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. Rampart Washeteria & Water Treatment Plant

3.1. Building Description

The 2,148 square foot Rampart Washeteria & Water Treatment Plant was constructed in 1998. The number of hours of operation for this building is approximately 7.5 hours per day, considering all seven days of the week.

The Rampart Washeteria & Water Treatment Plant serves as the water gathering point for the residents of the community and as a location for laundromat and shower services. There is one watering point with a ¾" pipe that provides treated water for community pickup. There are four washers and four dryers in the washeteria that are available for public use. At the time of the energy audit, two of the four washers were in operation.

Water is pumped into the water treatment plant from the raw water intake that draws water from a nearby well. The water is pumped through two pressure filters before receiving an addition of chlorine and entering the 4,000 gallon water storage tank. Pressure pumps are used to keep the pressure up for use in the washeteria and showers. The facility has a single watering point that is used by the residents to collect their own water supply. The rest of the water is used in the washing machines and restrooms.

Description of Building Shell

The exterior walls are constructed from stressed skin panel construction with 5.5 inches of polyurethane foam insulation. The insulation has some moderate damage and there is approximately 1,840 square feet of wall space.

The roof of the building has a cathedral ceiling that is constructed with standard 24" lumber framing and 5.5 inches of polyurethane foam insulation. The insulation has some moderate damage and there is approximately 2,215 square feet of roof space.

The building is built on pilings with approximately 48 inches of clearance between the building and the ground. The floor is framed with standard lumber and has 9.5 inches of polyurethane foam insulation. There is approximately 2,148 square feet of floor space.

There are six windows in the building that are not south-facing and three windows that are south-facing. The six windows that are not south-facing are all triple-paned windows and combine to have approximately 36 square feet of window space. The three south-facing windows are all double-paned windows and combine to have approximately 18 square feet of window space. All the windows in the building have wooden window frames.

There are three exterior doors present in the building. Each door is made of metal with a fiberglass insulation core. The doors combine to have approximately 63 square feet of door space.

Description of Heating Plants

The Heating Plants used in the building are:

Boiler 1

Nameplate Information:	Weil McLain 678
Fuel Type:	#1 Oil
Input Rating:	559,000 BTU/hr
Steady State Efficiency:	78 %
Idle Loss:	0.9 %
Heat Distribution Type:	Glycol
Boiler Operation:	All Year

Boiler 2

Nameplate Information:	Weil McLain-678
Fuel Type:	#1 Oil
Input Rating:	559,000 BTU/hr
Steady State Efficiency:	78 %
Idle Loss:	0.9 %
Heat Distribution Type:	Glycol
Boiler Operation:	All Year

Space Heating Distribution Systems

There are three unit heaters in the building that circulate heat through the building. There is one unit heater that provides heat to the water treatment plant main room and produces approximately 5000 BTU/hr. There is a second unit heater in the attic that also acts as a dryer plenum and produces approximately 41,000 BTU/hr. There is a third unit heater in the washeteria main room that circulates heat through the occupied part of the washeteria and produces approximately 27,000 BTU/hr. The hydronic system also has a circulation pump that circulates heated glycol through a hydronic loop to the different heat loads. The pump is rated at ½ HP.

Domestic Hot Water System

There is a hot water heater that provides hot water to the washers and showers. A circulation pump is used to pump hot water throughout the building. The pump is rated at ½ HP.

Description of Building Ventilation System

There is an exhaust fan in the washeteria that is used to circulate the air from the interior of the building to the exterior of the building. The fan is currently wired opposite of its intended function such that it attempts to heat the room when it should be cooling and it attempts to cool the room when it should be heating. The fan circulates approximately 100 CFM of air.

Lighting

The main washeteria room has 17 fixtures with two T8 fluorescent light bulbs in each fixture.

The main water treatment plant room has 18 fixtures with two T8 fluorescent light bulbs in each fixture.

The generator room has three fixtures with two T8 fluorescent light bulbs in each fixture.

The office has one fixture with two T8 fluorescent light bulbs in each fixture.

The rest rooms and shower rooms combine to have five fixtures with two T8 fluorescent light bulbs in each fixture. The rest rooms and shower rooms also combine to have nine fixtures with a 20 Watt CFL light bulb in each fixture.

The exterior of the building has three fixtures with a 150 Watt high pressure sodium light bulb in each fixture.

Plug Loads

The water treatment plant 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 is a heat tape that is used to protect the sewer line from freezing and consumes approximately 18,314 KWH annually.

There is a heat tape that is used to protect the well line from freezing and consumes approximately 3,450 KWH annually.

There is an electric heater in the lift station that is used to provide heat and prevent the sewage from freezing. The heater consumes approximately 4,935 KWH annually.

There is a pump in the lift station that is used to pump the community sewage to the sewage lagoon. The pump consumes approximately 3,143 KWH annually.

There is a well pump that is used to pump raw water from the well into the water treatment plant. The pump consumes approximately 263 KWH annually.

There is a back wash pump that is used to backwash the pressure filters during the water treatment process. The backwash pump consumes approximately 263 KWH annually.

There are two pressure pumps that are used to pressurize the water in the treatment process. The pumps consume approximately 526 KWH annually.

There is a small pump that is used to circulate heat to the watering point to prevent freezing. The pump consumes approximately 261 KWH annually.

There are two clothes washers that are currently in operation in the washeteria. The washers combine to consume approximately 731 KWH.

There are five exhaust fans in the rest rooms with one fan per room that provide ventilation to the rooms when they are in use. The fans combine to consume approximately 274 KWH annually.

There are a variety of miscellaneous pumps and controls within the building that are used to operate the water treatment plant and washeteria in their basic functions. This equipment consumes approximately 1,972 KWH annually.

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 following is a list of the utility companies providing energy to the building and the class of service provided:

Electricity: Rampart Village Power Plant

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 – Average Energy Cost	
Description	Average Energy Cost
Electricity	\$ 0.80/KWH
#1 Oil	\$ 5.00/gallons

3.2.1.1 Total Energy Use and Cost Breakdown

At current rates, Rampart Village pays approximately \$45,254 annually for electricity and other fuel costs for the Rampart Washeteria & Water Treatment Plant.

Figure 3.1 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 3.1
Annual Energy Costs by End Use

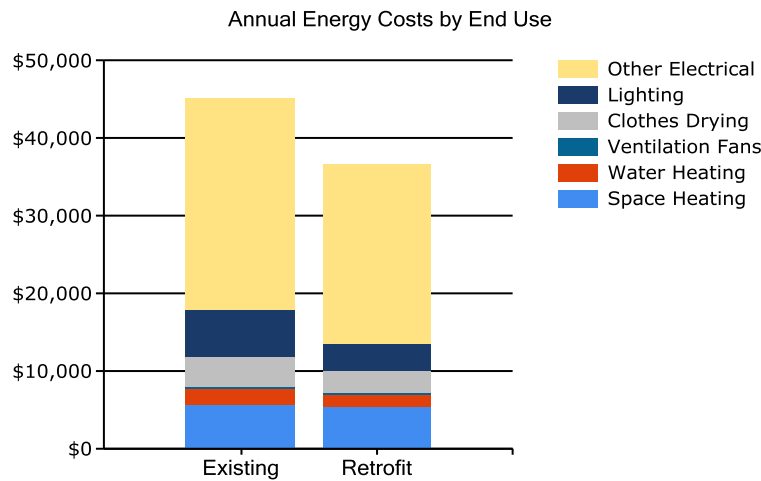


Figure 3.2 below shows how the annual energy cost of the building splits between the different fuels used by the building. The “Existing” bar shows the breakdown for the building as it is now; the “Retrofit” bar shows the predicted costs if all of the energy efficiency measures in this report are implemented.

Figure 3.2
Annual Energy Costs by Fuel Type

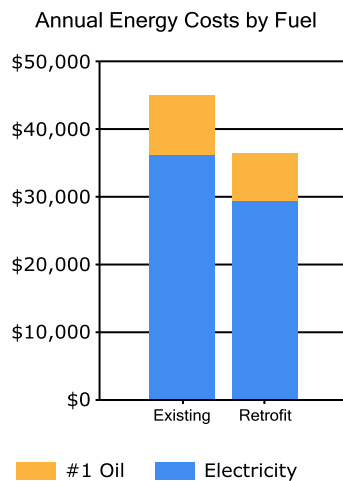
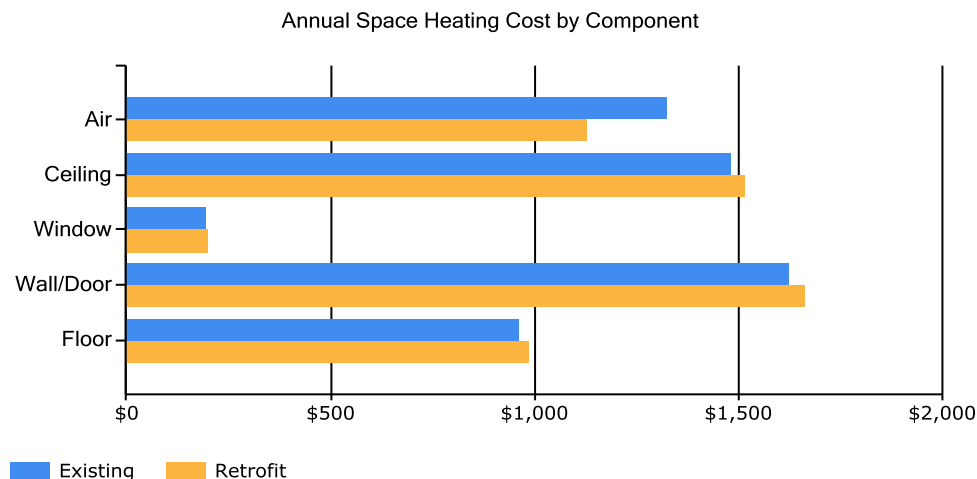


Figure 3.3 below addresses only Space Heating costs. The figure shows how each heat loss component contributes to those costs; for example, the figure shows how much annual space heating cost is caused by the heat loss through the Walls/Doors. For each component, the space heating cost for the Existing building is shown (blue bar) and the space heating cost assuming all retrofits are implemented (yellow bar) are shown.

Figure 3.3
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.

Electrical Consumption (KWH)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Space_Heating	307	269	278	169	9	2	1	4	128	260	277	304
DHW	30	27	30	30	32	31	33	32	31	31	29	30
Ventilation_Fans	12	11	12	12	12	12	12	12	12	12	12	12
Clothes_Drying	101	92	101	99	102	99	102	102	99	101	98	101
Lighting	716	652	716	602	528	511	528	528	693	716	693	716
Other_Electrical	4198	3826	4198	3771	1962	654	676	676	1952	3955	4063	4198

Fuel Oil #1 Consumption (Gallons)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Space_Heating	169	131	105	34	4	0	0	0	10	61	120	163
DHW	25	24	28	37	45	46	48	47	42	34	26	25
Clothes_Drying	47	42	46	49	50	45	46	48	48	47	44	46

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):

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

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

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

Table 3.4
Rampart Washeteria & Water Treatment Plant 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	45,441 KWH	155,090	3.340	517,999
#1 Oil	1,780 gallons	234,982	1.010	237,332
Total		390,072		755,331
BUILDING AREA		2,148	Square Feet	
BUILDING SITE EUI		182	kBTU/Ft ² /Yr	
BUILDING SOURCE EUI		352	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 3.5

Building Benchmarks			
Description	EUI (kBtu/Sq.Ft.)	EUI/HDD (Btu/Sq.Ft./HDD)	ECI (\$/Sq.Ft.)
Existing Building	181.6	11.69	\$21.07
With Proposed Retrofits	146.1	9.41	\$17.08
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 Rampart Washeteria & Water Treatment Plant was modeled using AkWarm© energy use software to establish a baseline space heating and cooling energy usage. Climate data from Rampart 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. Equipment cost estimate calculations are provided in Appendix D.

Limitations of AkWarm© Models

- The model is based on typical mean year weather data for Rampart. 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 model does not model heating and ventilation systems that simultaneously provide both heating and cooling to the same building space (typically done as a means of providing temperature control in the space).

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 Rampart Washeteria & Water Treatment Plant, Rampart, Alaska 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	Other Electrical - Controls Retrofit: Lift Station Electric Heat	Lower temperature setting to 50 deg. F when unoccupied.	\$1,474	\$500	34.63	0.3	4,053.5
2	Other Electrical - Controls Retrofit: Sewer Line Heat Tape	Shut off heat tape and use only for emergency purposes.	\$2,930	\$2,500	13.77	0.9	8,058.1
3	Ventilation	Rewire thermostat from heating to cooling.	\$264	\$300	11.50	1.1	1,006.2
4	Lighting - Power Retrofit: Exterior Lighting	Replace with new energy-efficient lighting	\$838	\$1,200	10.20	1.4	2,304.9
5	Lighting - Power Retrofit: Main Washeteria Lighting	Replace with new energy-efficient lighting	\$717	\$1,020	9.96	1.4	1,807.0
6	Lighting - Power Retrofit: Rest Room & Shower CFL	Replace with new energy-efficient lighting	\$92	\$180	7.24	2.0	232.0

Table 4.1 Rampart Washeteria & Water Treatment Plant, Rampart, Alaska PRIORITY LIST – ENERGY EFFICIENCY MEASURES							
Rank	Feature	Improvement Description	Annual Energy Savings	Installed Cost	Savings to Investment Ratio, SIR	Simple Payback (Years)	CO₂ Savings
7	Lighting - Power Retrofit: Rest Room & Shower 4 Ft T8	Replace with new energy-efficient lighting	\$127	\$300	5.99	2.4	319.8
8	Heating, Ventilation, and Domestic Hot Water	Add a Tekmar controller to operate the boilers based on water treatment plant demand. Re-commission the dryer plenum dampers.	\$1,802	\$7,500	4.19	4.2	7,619.4
9	Lighting - Power Retrofit: Main WTP Lighting	Replace with new energy-efficient lighting	\$301	\$1,080	3.95	3.6	755.9
10	Lighting - Power Retrofit: Office Lighting	Replace with new energy-efficient lighting	\$8	\$60	1.97	7.2	20.9
11	Lighting - Power Retrofit: Generator Room Lighting	Replace with new energy-efficient lighting	\$13	\$140	1.26	11.2	31.4
	TOTAL, all measures		\$8,567	\$14,780	7.89	1.7	26,209.1

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. When the building is in cooling mode, these items contribute to the overall cooling demands of the building; therefore, lighting efficiency improvements will reduce cooling requirements in air-conditioned buildings. Conversely, lighting-efficiency improvements are anticipated to slightly increase heating requirements. Heating penalties and cooling benefits were included in the lighting project analysis.

4.3 Mechanical Equipment Measures

4.3.1 Heating /Domestic Hot Water Measure

Rank	Recommendation				
8	Add a Tekmar controller to operate the boilers based on water treatment plant demand. Re-commission the dryer plenum dampers.				
Installation Cost	\$7,500	Estimated Life of Measure (yrs)	20	Energy Savings (/yr)	\$1,802
Breakeven Cost	\$31,407	Savings-to-Investment Ratio	4.2	Simple Payback yrs	4
Auditors Notes: Add a Tekmar 268 controller with outdoor reset to control the two boilers and main circulation pumps. The Tekmar would have a demand signal override for both the dryers and hot water heater. Also, re-commission the dryer plenum dampers on the gable end of the building.					

4.3.2 Ventilation System Measures

Rank	Description		Recommendation		
3			Rewire thermostat from heating to cooling.		
Installation Cost	\$300	Estimated Life of Measure (yrs)	15	Energy Savings (/yr)	\$264
Breakeven Cost	\$3,450	Savings-to-Investment Ratio	11.5	Simple Payback yrs	1
Auditors Notes: Convert line voltage thermostat from heating to cooling. The fan is currently wired in backwards and needs to be rewired so that the fan operates in the proper mode.					

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 cooling load will see a small decrease from an upgrade to more efficient bulbs and the 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	
4	Exterior Lighting	3 HPS 150 Watt StdElectronic with Manual Switching		Replace with new energy-efficient lighting	
Installation Cost	\$1,200	Estimated Life of Measure (yrs)	20	Energy Savings (/yr)	\$838
Breakeven Cost	\$12,245	Savings-to-Investment Ratio	10.2	Simple Payback yrs	1
Auditors Notes: Replace 150 watt HPS wall pack fixtures with 25 watt LED wall pack fixtures.					

Rank	Location	Existing Condition		Recommendation		
5	Main Washeteria Lighting	17 FLUOR (2) T8 4' F32T8 32W Standard Instant StdElectronic with Manual Switching		Replace with new energy-efficient lighting		
Installation Cost		\$1,020	Estimated Life of Measure (yrs)	20	Energy Savings (/yr)	\$717
Breakeven Cost		\$10,159	Savings-to-Investment Ratio	10.0	Simple Payback yrs	1
Auditors Notes: Convert T8 fluorescent fixtures to 17 watt LED and remove ballast.						

Rank	Location	Existing Condition		Recommendation		
6	Rest Room & Shower CFL	9 FLUOR CFL, A Lamp 20W with Manual Switching		Replace with new energy-efficient lighting		
Installation Cost		\$180	Estimated Life of Measure (yrs)	20	Energy Savings (/yr)	\$92
Breakeven Cost		\$1,303	Savings-to-Investment Ratio	7.2	Simple Payback yrs	2
Auditors Notes: Convert 4 decorative 40 Watt incandescent and 5 26 watt CFLs to 10 watt LED A lamps.						

Rank	Location	Existing Condition	Recommendation		
7	Rest Room & Shower 4 Ft T8	5 FLUOR (2) T8 4' F32T8 32W Standard Instant StdElectronic with Manual Switching	Replace with new energy-efficient lighting		
Installation Cost	\$300	Estimated Life of Measure (yrs)	20	Energy Savings (/yr)	\$127
Breakeven Cost	\$1,797	Savings-to-Investment Ratio	6.0	Simple Payback yrs	2
Auditors Notes: Convert T8 fluorescent to 17 watt LED and remove ballast.					

Rank	Location	Existing Condition		Recommendation		
9	Main WTP Lighting	18 FLUOR (2) T8 4' F32T8 32W Standard Instant StdElectronic with Manual Switching		Replace with new energy-efficient lighting		
Installation Cost		\$1,080	Estimated Life of Measure (yrs)	20	Energy Savings (/yr)	\$301
Breakeven Cost		\$4,264	Savings-to-Investment Ratio	3.9	Simple Payback yrs	4
Auditors Notes: Convert T8 fluorescent to 17 watt LED and remove ballast.						

Rank	Location	Existing Condition	Recommendation			
10	Office Lighting	FLUOR (2) T8 4' F32T8 32W Standard Instant StdElectronic with Manual Switching	Replace with new energy-efficient lighting			
Installation Cost		\$60	Estimated Life of Measure (yrs)	20	Energy Savings (/yr)	\$8
Breakeven Cost		\$118	Savings-to-Investment Ratio	2.0	Simple Payback yrs	7
Auditors Notes: Convert T8 fluorescent to 17 watt LED and remove ballast.						

Rank	Location	Existing Condition		Recommendation		
11	Generator Room Lighting	3 FLUOR (2) T8 4' F32T8 32W Standard Instant StdElectronic with Manual Switching		Replace with new energy-efficient lighting		
Installation Cost		\$140	Estimated Life of Measure (yrs)	20	Energy Savings (/yr)	\$13
Breakeven Cost		\$177	Savings-to-Investment Ratio	1.3	Simple Payback yrs	11
Auditors Notes: Convert T8 fluorescent to 17 watt LED and remove ballast.						

4.4.2 Other Electrical Measures

Rank	Location	Description of Existing	Efficiency Recommendation
1	Lift Station Electric Heat	Lift Station Electric Heat with Manual Switching	Lower temperature setting to 50 deg. F when unoccupied.
Installation Cost	\$500	Estimated Life of Measure (yrs)	15
Energy Savings (/yr)			\$1,474
Breakeven Cost	\$17,314	Savings-to-Investment Ratio	34.6
Simple Payback yrs			0
Auditors Notes: Thermostat that controls electric heater in lift station is presently set at 70 degrees in heating season. It should do fine with setting to 50 degrees.			

Rank	Location	Description of Existing	Efficiency Recommendation
2	Sewer Line Heat Tape	3 Sewer Line Heat Tape with Manual Switching	Shut off heat tape and use only for emergency purposes.
Installation Cost	\$2,500	Estimated Life of Measure (yrs)	15
Energy Savings (/yr)			\$2,930
Breakeven Cost	\$34,420	Savings-to-Investment Ratio	13.8
Simple Payback yrs			1
Auditors Notes: Add a temperature sensor to the above ground section of heat tape and shut it off with a temperature controller when the outside temperature is above freezing.			

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 both the Rampart Village and the water treatment plant operator to follow up on the recommendations made in this audit report. Funding has been provided to ANTHC through a Rural Alaska Village Grant and the Denali Commission to provide the city with assistance in understanding the report and implementing the recommendations. ANTHC will work to complete the recommendations within the 2015 calendar year.

APPENDICES

Appendix A – Energy Audit Report – Project Summary

ENERGY AUDIT REPORT – PROJECT SUMMARY	
General Project Information	
PROJECT INFORMATION	AUDITOR INFORMATION
Building: Rampart Washeteria & Water Treatment Plant	Auditor Company: ANTHC-DEHE
Address: PO Box 29	Auditor Name: Carl Remley & Kevin Ulrich
City: Rampart	Auditor Address: 3900 Ambassador Dr Suite 301 Anchorage, AK 99508
Client Name: Mike Wiehl	Auditor Phone: (907) 729-3543
Client Address: PO Box 29 Rampart, AK 99767	Auditor FAX:
Client Phone: (907) 358-	Auditor Comment:
Client FAX:	
Design Data	
Building Area: 2,148 square feet	Design Space Heating Load: Design Loss at Space: 34,970 Btu/hour with Distribution Losses: 36,811 Btu/hour Plant Input Rating assuming 82.0% Plant Efficiency and 25% Safety Margin: 56,114 Btu/hour Note: Additional Capacity should be added for DHW and other plant loads, if served.
Typical Occupancy: 0 people	Design Indoor Temperature: 70 deg F (building average)
Actual City: Rampart	Design Outdoor Temperature: -54.8 deg F
Weather/Fuel City: Rampart	Heating Degree Days: 15,528 deg F-days
Utility Information	
Electric Utility: Self Generated Power (oil) - Residential	Natural Gas Provider: None
Average Annual Cost/KWH: \$0.80/KWH	Average Annual Cost/ccf: \$0.000/ccf

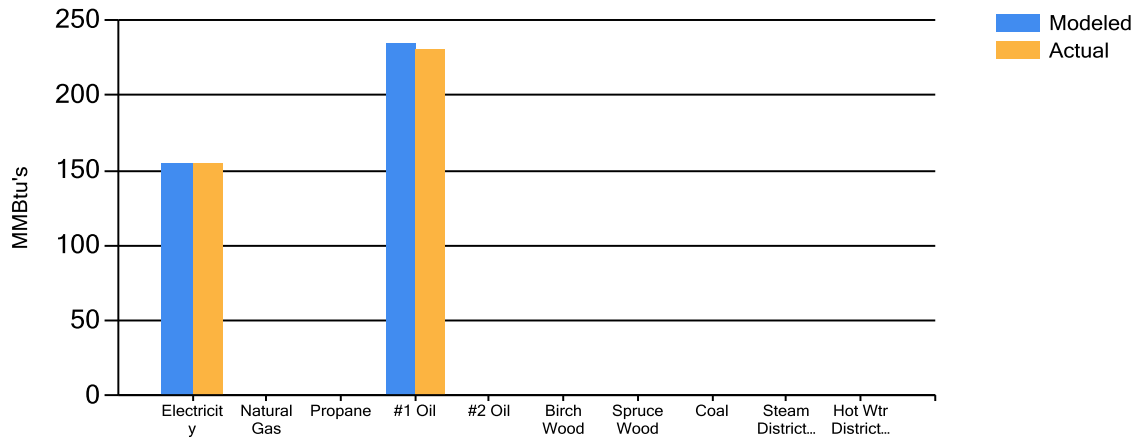
Annual Energy Cost Estimate							
Description	Space Heating	Water Heating	Ventilation Fans	Clothes Drying	Lighting	Other Electrical	Total Cost
Existing Building	\$5,586	\$2,427	\$117	\$3,742	\$6,077	\$27,304	\$45,254
With Proposed Retrofits	\$5,493	\$1,660	\$58	\$2,808	\$3,767	\$22,900	\$36,687
Savings	\$93	\$767	\$58	\$934	\$2,310	\$4,404	\$8,567

Building Benchmarks			
Description	EUI (kBtu/Sq.Ft.)	EUI/HDD (Btu/Sq.Ft./HDD)	ECI (\$/Sq.Ft.)
Existing Building	181.6	11.69	\$21.07
With Proposed Retrofits	146.1	9.41	\$17.08
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.			

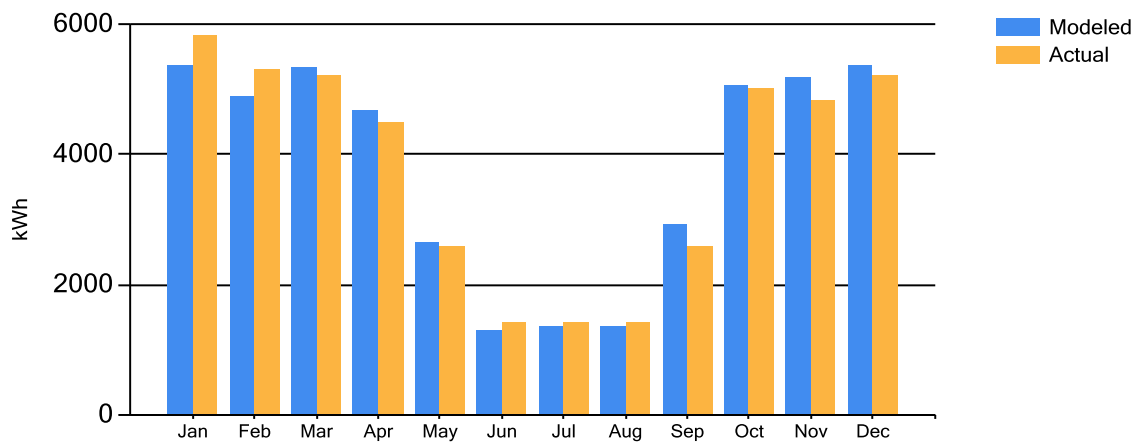
Appendix B – Actual Fuel Use versus Modeled Fuel Use

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

