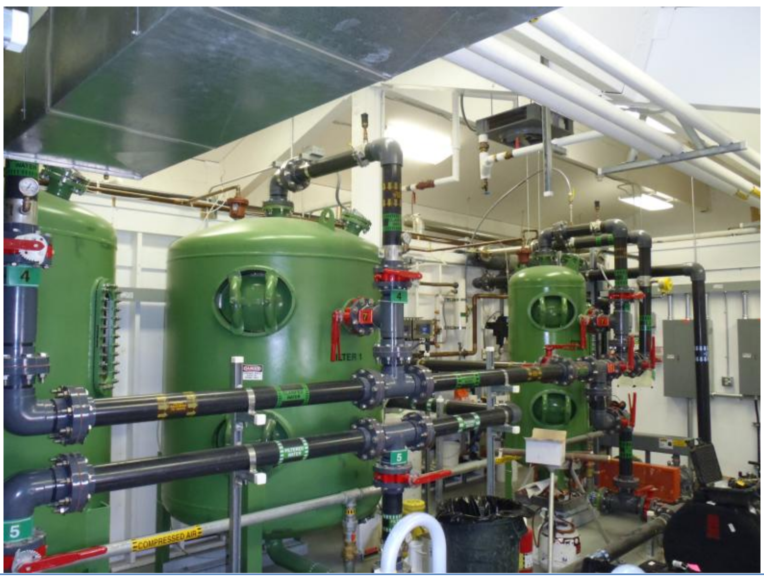
Comprehensive Energy Audit
For
Eek Water Treatment Plant/Washeteria



Prepared For:

City of Eek

August 1, 2011

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PREFACE

The Energy Projects Group at the Alaska Native Tribal Health Consortium (ANTHC) prepared this document for the City of Eek. The authors of this report are Carl H. Remley, Certified Energy Auditor (CEA) and Certified Energy Manager (CEM), Chris Mercer, PE and CEA, Gavin Dixon and Kyle Monti.

The purpose of this report is to provide a comprehensive document that summarizes the findings and analysis that resulted from an energy audit conducted over the past couple months by the Energy Projects Group of ANTHC. This report analyzes historical energy use and identifies costs and savings of recommended energy efficiency measures. Discussions of site specific concerns and an Energy Efficiency Action Plan are also included in this report.

ACKNOWLEDGMENTS

The Energy Projects Group gratefully acknowledges the assistance of Mr. Adolph Carter, Eek Water Plant Operator, Mr. Fritz Petluska, Clerk, City of Eek, Mr. Nick Carter, Tribal Administrator, Eek Traditional Council and Marcie Sherer, Vice President of Business Enterprises, AVCP.

1. EXECUTIVE SUMMARY

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

Based on electricity and fuel oil prices in effect at the time of the audit, the annual energy cost for the building analyzed was $6,648 for electricity and $37,330 for #1 fuel oil. This results in an annual cost of $43,978. Please note that this was for calendar year 2010. Energy costs in rural Alaska fluctuate significantly with the price of oil.

It should be noted that this facility received the power cost equalization (PCE) subsidy last year. If it did not receive the PCE subsidy, the annual electricity cost would have been $24,448 and the total annual energy cost would have been $61,778.

Table 1.1 below summarizes the energy efficiency measures recommended for the Eek Water Treatment Plant/Washeteria. 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, SIR[1]	Simple Payback (Years)[2]
1	Backwash of Filters	At present, backwash is being done twice each time and only needs to be done once. This practice results in a significant use of water and therefore a significant use of oil to heat that water. This is an operational change, therefore there is no implementation cost	$204	$0	>100	0.0
2	Setback Thermostat: Water Treatment Plant	Implement a Heating Temperature Unoccupied Setback to 50.0 deg F for the Water Treatment Plant space.	$761	$100	114.26	0.1
3	Setback Thermostat: Washeteria	Implement a Heating Temperature Unoccupied Setback to 50.0 deg F for the Washeteria space.	$332	$100	49.88	0.3
4	Heating and Domestic Hot Water	Convert boilers to cold start and set up existing Tekmar controller to shut off boilers and associated pumps when the washeteria is closed unless the thermal loads drop below acceptable temperatures.	$5,091	$25,000	3.86	4.9

Table 1.1 PRIORITY LIST – ENERGY EFFICIENCY MEASURES						
Rank	**Feature**	**Improvement Description**	**Annual Energy Savings**	**Installed Cost**	**Savings to Investment Ratio, SIR[1]**	**Simple Payback (Years)[2]**
5	Washeteria Clothes Dryers	Re-commission the dryer air plenum make up heat and lower setpoint from 70 degrees to 50 degrees. Install unoccupied setback when washeteria is closed to 40.	$1,829	$15,000	1.66	8.2
6	Air Tightening	Perform air sealing to reduce air leakage by 250 cfm at 50 Pascals.	$189	$1,800	1.08	9.5
	TOTAL, cost-effective measures		**$8,408**	**$42,000**	**3.39**	**5.0**

Table Notes:

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

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

With all of these energy efficiency measures in place, the annual utility cost can be reduced by $8,408 per year, or 19.1% of the buildings' total energy costs. These measures are estimated to cost $42,000 to implement, for an overall simple payback period of 5.0 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**	**Space Cooling**	**Water Heating**	**Lighting**	**Other Electrical**	**Water Treatment, Storage & Circulation**	**Clothes Drying**	**Ventilation Fans**	**Service Fees**	**Total Cost**
Existing Building	$6,034	$0	$6,092	$851	$527	$17,569	$12,904	$0	$0	**$43,978**
With All Proposed Retrofits	$2,796	$0	$2,956	$851	$527	$17,365	$11,074	$0	$0	**$35,570**
SAVINGS	$3,238	$0	$3,136	$0	$0	$204	$1,829	$0	$0	**$8,408**

2. AUDIT AND ANALYSIS BACKGROUND

2.1 Program Description

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

2.2 Audit Description

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

- Building envelope (roof, windows, etc.)
- Heating, ventilation, and air conditioning equipment (HVAC)
- Lighting systems and controls
- Building-specific equipment

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 Eek Water Treatment Plant/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.

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

1) Water Treatment Plant: 1,435 square feet
2) Washeteria: 597 square feet

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

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

2.3. Method of Analysis

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

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

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

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

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

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

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

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

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

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

2.4 Limitations of Study

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

3. Water Treatment Plant/Washeteria

3.1. Building Description

The 2,032 square foot Eek Water Treatment Plant/Washeteria was constructed in 2003. The water treatment plant is occupied five hours per day, seven days per week. The co-located washeteria is occupied nine hours per day, six days per week. Normally, the water treatment plant has a single occupant. The occupancy of the washeteria varies.

The building is mounted on pads and has thermal siphons to help protect the foundation. It has 2 X 12 floor joists with R28 insulation, six inch stud walls with R19 insulation, and an eight inch sloped hot roof with a cathedral ceiling and 8-10 inches of insulation.

The building has five 12 square foot double pane windows and two insulated steel doors. One of those doors is in the water treatment plant end of the building and the other is in the washeteria end.

A heated water storage tank is located next to the water treatment plant. Within the water treatment plant is all the process equipment necessary to treat the raw well water, and the pumps necessary to both circulate the potable water to the clinic and school and maintain system pressure.

Description of Heating Plants

The Heating Plants used in the building are:

Cast Iron boiler

Nameplate Information:	Weil McLain with Becket Burners (two boilers)
Fuel Type:	#1 Oil
Input Rating:	476,000 BTU/hr
Steady State Efficiency:	83 %
Idle Loss:	4 %
Heat Distribution Type:	Water
Boiler Operation:	All Year
Notes:	The heating system circulation pumps distribute heat to the unit heaters year round.

Space and Process Heating Distribution Systems

Circulation pumps are used to distribute the heat generated by the boilers to both the process loads and the space heating loads. The process loads include the incoming well water, the school and clinic potable water circulation loops, and the potable water storage tank. The space heating loads include both the water treatment plant and the washeteria.

Domestic Hot Water System

The domestic hot water system is heated by the boilers and consists of a circulation pump and a 190 domestic hot water storage tank. The vast majority of this hot water is used for either washing clothes or taking showers, both in the washeteria.

Lighting

The interior lighting consists of 11 three lamp four foot fluorescent fixtures with 34 watt T12 lamps and magnetic ballasts in the washeteria and 17 four lamp four foot fluorescent fixtures with 34 watt T12 lamps and magnetic ballasts in the water treatment plant. The exterior lighting consists of two 100 watt metal halide fixtures.

Although the limited “on-time” hours and the subsidized electricity rates do not justify replacing these lights at this time, we recommend that as they burn out, you replace them with LED lighting.

Plug Loads

The existing plug loads are minimal and normal for a water treatment plant.

Major Equipment

The major equipment is that used for the treatment, storage, and circulation of potable water in the water treatment plant and the washers, dryers, and showers in the washeteria.

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.

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.

Electricity at the Eek Water Treatment Plant is provided by AVEC under its Small Commercial User Rate.

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	$ 0.16/kWh
#1 Oil	$ 5.36/gallons

3.2.1.1 Total Energy Use and Cost Breakdown

At current rates, City of Eek pays approximately $43,978 annually for electricity and #1 fuel costs for the Water Treatment Plant/Washeteria.

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

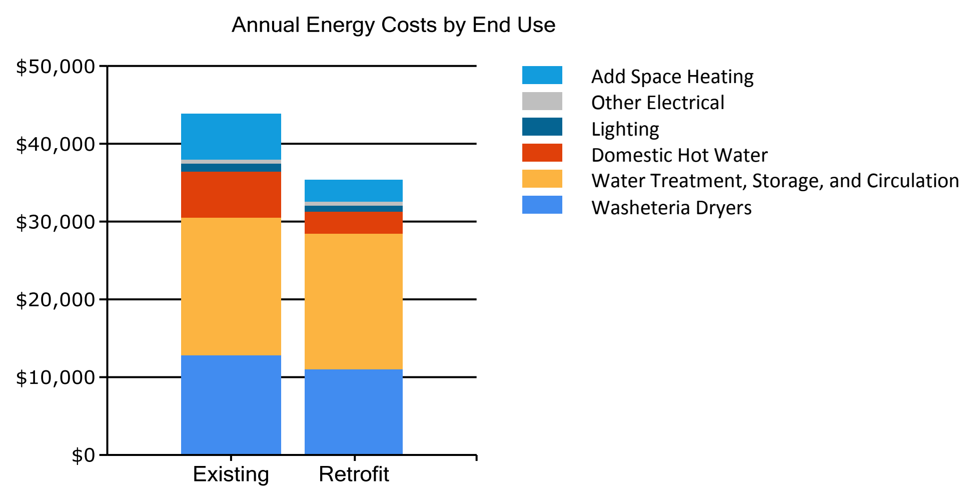


Figure 3.2 below shows how the annual energy cost of the building splits between the different fuels used by the building. The "Existing" bar shows the breakdown for the building as it is now; the "Retrofit" bar shows the predicted costs if all of the energy efficiency measures in this report are implemented.

Figure 3.2
Annual Energy Costs by Fuel Type

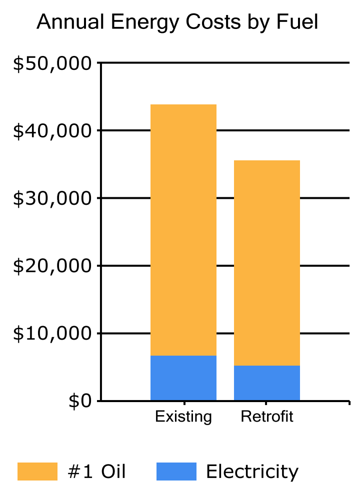
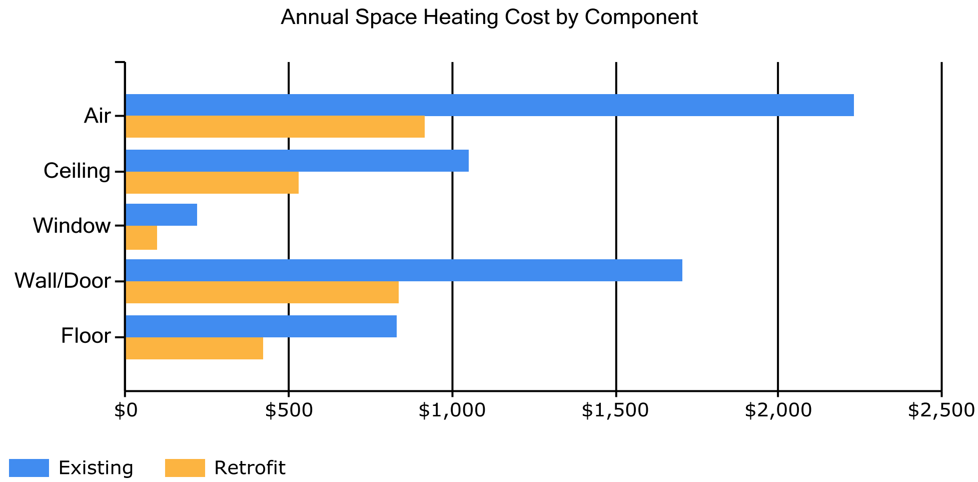


Figure 3.3 below addresses only Space Heating costs. The figure shows how each heat loss component contributes to those costs; for example, the figure shows how much annual space heating cost is caused by the heat loss through the Walls/Doors. For each component, the

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.

Electrical Consumption (kWh)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Other Electrical	289	263	289	279	289	279	289	289	279	289	279	289
Lighting	466	425	466	451	466	451	466	466	451	466	451	466
Water Processing, Storage & Circulation	1003	914	1003	970	1003	826	854	854	970	149	144	149
Clothes Drying	1761	1605	1761	1705	1761	1705	1761	1761	1705	1761	1705	1761
Ventilation Fans	0	0	0	0	0	0	0	0	0	0	0	0
Domestic Hot Water	12	11	13	13	14	14	14	14	14	13	12	12
Space Heating	514	468	513	495	510	493	510	510	230	2	3	4
Space Cooling	0	0	0	0	0	0	0	0	0	0	0	0

Fuel Oil #1 Consumption (Gallons)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Water Treatment, Storage, & Circulation	343	312	343	332	343	89	92	92	332	251	243	251
Clothes Drying	153	140	153	148	153	148	153	153	148	153	148	153
Domestic Hot Water	56	52	62	83	138	134	138	138	134	84	61	53
Space Heating	182	163	150	80	0	0	0	0	0	86	143	200

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):

Building Site EUI = (Electric Usage in kBtu + Oil Usage in kBtu + similar for other fuels)
Building Square Footage

Building Source EUI = (Electric Usage in kBtu X SS Ratio + Oil Usage in kBtu X SS Ratio + similar for other fuels)
Building Square Footage
where "SS Ratio" is the Source Energy to Site Energy ratio for the particular fuel.

Table 3.4
Water Treatment Plant/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	42,891 kWh	146,386	3.340	488,928
#1 Oil	6,965 gallons	919,322	1.010	928,515
Total		**1,065,707**		**1,417,443**
BUILDING AREA		2,032	Square Feet	
BUILDING SITE EUI		524	kBTU/Ft²/Yr	
BUILDING SOURCE EUI		698	**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.				

3.3 AkWarm© Building Simulation

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

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

For the purposes of this study, the Water Treatment Plant/Washeteria was modeled using AkWarm© energy use software to establish a baseline space heating and cooling energy usage. Climate data from Eek 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 Eek. 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 and cooling 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 cooling/heating loads across different parts of the building.
• The model does not model HVAC 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 Water Treatment Plant/Washeteria, Eek, Alaska PRIORITY LIST – ENERGY EFFICIENCY MEASURES						
Rank	**Feature**	**Improvement Description**	**Annual Energy Savings**	**Installed Cost**	**Savings to Investment Ratio, SIR**	**Simple Payback (Years)**
1	Backwash of Filters	At present, backwash is being done twice each time and only needs to be done once. This practice results in a significant use of water and therefore a significant use of oil to heat that water. This is an operational change, therefore there is no implementation cost	$204	$0	>100	0.0
2	Setback Thermostat: Water Treatment Plant	Implement a Heating Temperature Unoccupied Setback to 50.0 deg F for the Water Treatment Plant space.	$761	$100	114.26	0.1
3	Setback Thermostat: Washeteria	Implement a Heating Temperature Unoccupied Setback to 50.0 deg F for the Washeteria space.	$332	$100	49.88	0.3
4	Heating and Domestic Hot Water	Convert boilers to cold start and set up existing Tekmar controller to shut off boilers and associated pumps when the washeteria is closed unless the thermal loads drop below acceptable temperatures.	$5,091	$25,000	3.86	4.9
5	Washeteria Clothes Dryers	Re-Commission the dryer air plenum make up heat and lower setpoint from 70 degrees to 50 degrees. Install unoccupied setback when washeteria is closed to 40.	$1,829	$15,000	1.66	8.2
6	Air Tightening	Perform air sealing to reduce air leakage by 250 cfm at 50 Pascals.	$189	$1,800	1.08	9.5
	TOTAL, cost-effective measures		**$8,408**	**$42,000**	**3.39**	**5.0**

4.2 Interactive Effects of Projects

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

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

Interior lighting, plug loads, facility equipment, and occupants generate heat within the building. 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 Building Shell Measures

4.3.1. Energy Efficiency Measure: Seal Air Leaks

Rank	Estimated Air Leakage	Recommended Air Leakage Target	Energy Auditor Comments	Cost	Savings
6	Air Tightness from Blower Door Test: 1800 cfm at 50 Pascals	Perform air sealing to reduce air leakage by 250 cfm at 50 Pascals.		$1,800	$189

Many buildings, especially older ones, have air leaks allowing heated and cooled air to escape when the air pressure differs between the inside and outside of the building. Because these leaks allow unconditioned air to enter as conditioned air is lost, air leaks can be a significant waste of energy and money. They also make the building drafty. Many buildings have hidden air leaks requiring a weatherization technician to find and seal. It is recommended that you seal around the window frames and door frames and add weather stripping to the doors in both the washeteria and in the water treatment plant. A reduction of 250 CFM at 50 Pascals will result in a savings of approximately $189 per year in fuel oil. Buildings with indoor air pollution caused by combustion heating, tobacco smoking, or moisture problems, may require more ventilation than average buildings.

4.4 Heating Measures

4.4.1. EEM Heating Plants and Distribution Systems

A heating system is expected to last approximately 20-25 years, depending on the system. Since your boilers are relatively new, it is worth upgrading the controls on your current boilers.

Recommendation: Convert boilers to cold start and up-grade your Tekmar controller to a model that can shut off boilers and associated pumps when the washeteria is closed unless the thermal loads drop below acceptable temperatures. This will require some re-piping to separate the heat circulation loops from the process circulation heat add loops. Included in this EEM is shutting off the domestic hot water pump when the washeteria is unoccupied.

Estimated Cost: $25,000

Estimate Savings per Year: $5,091

Energy Auditor Comments: This conversion from a always hot boiler control system to a hot on demand only system will both result in significant fuel oil and electricity savings and keep the mechanical room from overheating. This upgraded control system will also shut off the heat to the hot water heater when the washeteria is closed.

4.4.1.1. Existing Systems

4.4.1.1.1 Cast Iron boiler (two identical)
Description: Weil McLain with Becket Burners heating plant fueled by #1 Fuel Oil, with a Natural draft.
Size: 476,000 BTU/h
Efficiency (Steady State & Idle): 83%
Portion of heat supplied by this unit: 100%
Notes: The heating system circulation pumps distribute heat to the unit heaters year round.

4.4.1.1.2 Unit Heaters and Space Heating Circulation Loops are used for space heating.

4.4.2 Programmable Thermostats

Location	Existing Situation	Recommended Improvement	Install Cost	Annual Savings	Notes
Water Treatment Plant	Existing Unoccupied Heating Setpoint: 65 deg F	Implement a Heating Temperature Unoccupied Setback to 50.0 deg F for the Water Treatment Plant space.	$100	$761	
Washeteria	Existing Unoccupied Heating Setpoint: 70 deg F	Implement a Heating Temperature Unoccupied Setback to 50.0 deg F for the Washeteria space.	$100	$332	

There is no reason to keep the water treatment plant temperature set at 65 degrees during unoccupied hours and the washeteria set at 70 degrees during unoccupied hours. The set back thermostats will allow these temperatures to be lowered to 50 degrees during unoccupied hours. This can be easily implemented with the new Tekmar controller discussed above.

4.5 Lighting Upgrades

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 lamps with more energy-efficient equivalents will have a small effect on the building heating and cooling 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.

Based on your run hours, your existing lighting, and the present cost of electricity, it is not cost effective to replace either your fluorescent interior lighting or your metal halide exterior lighting. However, as these fixtures do need to be replaced, it is recommended that you replace them both with LED fixtures. The LED eliminates the need for ballasts and produces a higher lumen output per watt consumed. The price of fixtures utilizing this new technology is dropping as the produced quantities increase.

4.6 Process Energy Efficiency Measures

4.6.1 Backwash

Location	Life in Years	Description	Recommendation	Cost	Savings	Notes
WTP	15		At present, backwash is being done twice each time and only needs to be done once. This practice results in a significant use of water and therefore a significant use of oil to heat that water. This is an operation change, therefore there is no implementation cost	$0	$204	

4.6.2 Clothes Dryer

Location	Life in Years	Energy Source	Description	Recommendation	Cost	Savings	Notes
Washeteria	15	#1 Fuel Oil		Re-commission the dryer air plenum make up heat and lower setpoint from 70 degrees to 50 degrees. Install unoccupied setback when washeteria is closed to 40.	$15,000	$1,829	

This energy efficiency measure involves a small amount of design and therefore should be implemented with the boiler control modifications discussed above. It involves two changes. The first is to add the controls necessary to setback the dryer air plenum temperature during both occupied and unoccupied hours. The second is to shut off the circulation pump when there is not call for heat in the plenum.

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.

APPENDIX

Attached to this report is Appendix A. The objective of Appendix A is to provide the Eek City Council and the Water Plant Operator with a wide range of energy conservation and renewable energy websites to further your knowledge.

Appendix A – Listing of Energy Conservation and Renewable Energy Websites

Lighting

Illumination Engineering Society - http://www.iesna.org/

Energy Star Compact Fluorescent Lighting Program - www.energystar.gov/index.cfm?c=cfls.pr_cfls

DOE Solid State Lighting Program - http://www1.eere.energy.gov/buildings/ssl/

DOE office of Energy Efficiency and Renewable Energy - http://apps1.eere.energy.gov/consumer/your_workplace/

Energy Star – http://www.energystar.gov/index.cfm?c=lighting.pr_lighting

Hot Water Heaters

Heat Pump Water Heaters -
http://apps1.eere.energy.gov/consumer/your_home/water_heating/index.cfm/mytopic=12840

Solar Water Heating

FEMP Federal Technology Alerts – http://www.eere.energy.gov/femp/pdfs/FTA_solwat_heat.pdf

Solar Radiation Data Manual – http://rredc.nrel.gov/solar/pubs/redbook

Plug Loads

DOE office of Energy Efficiency and Renewable Energy – http:apps1.eere.energy.gov/consumer/your workplace/

Energy Star – http://www.energystar.gov/index.cfm?fuseaction=find_a_product

The Greenest Desktop Computers of 2008 - http://www.metaefficient.com/computers/the-greenest-pcs-of-2008.html

Wind

AWEA Web Site – http://www.awea.org

National Wind Coordinating Collaborative – http:www.nationalwind.org

Utility Wind Interest Group site: http://www.uwig.org

WPA Web Site – http://www.windpoweringamerica.gov

Homepower Web Site: http://homepower.com

Windustry Project: http://www.windustry.com

Solar

NREL – http://www.nrel.gov/rredc/

Firstlook – http://firstlook.3tiergroup.com

TMY or Weather Data – http://rredc.nrel.gov/solar/old_data/nsrdb/1991-2005/tmy3/

State and Utility Incentives and Utility Policies - http://www.dsireusa.org