Comprehensive Energy Audit
For
Twin Hills Water Treatment Plant

Prepared For

Twin Hills Village

December 15, 2014

Prepared By:

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PREFACE

The Energy Projects Group at the Alaska Native Tribal Health Consortium (ANTHC) prepared this document for the village of Twin Hills, Alaska. The authors of this report are Carl Remley, Certified Energy Auditor (CEA) and Certified Energy Manager (CEM) and Gavin Dixon. Cody Uhlig also participated in the onsite portion of this audit.

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 2014 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.

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 RMW Program and associated RMW for each community has been undertaken to provide maximum accuracy in identifying audits and coordinating potential follow up retrofit activities.

In the near future, a representative of ANTHC will be contacting both the City of Twin Hills and the water treatment plant operator to follow up on the recommendations made in this audit report. A Rural Alaska Village Grant has funded ANTHC to provide the City with assistance in understanding the report and in implementing the recommendations. Funding for implementation of the recommended retrofits is being partially provided for by the above listed funding agencies, as well as the State of Alaska legislature.

ACKNOWLEDGMENTS

The ANTHC Energy Projects Group gratefully acknowledges the assistance of Mr. William Page, Water Plant Operator, Mr. Julius Henry, Water Plant Operator, Ms. Laura Pleasant, Bookkeeper, and Mr. William Ilutsik, Tribal Administrator.

1. EXECUTIVE SUMMARY

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

Based on electricity and fuel oil prices in effect at the time of the audit, the annual predicted energy costs for the buildings analyzed are $13,778 for electricity and $3,805 for fuel Oil. The total energy costs are $17,582 per year.

It should be noted that the city is currently paying $.59 per kilowatt-hour, which is a total electrical cost to the village of Twin Hills for the year of $8,129. The state power cost equalization (PCE) program subsidizes the remainder of the electrical cost for an additional cost of $4,271.

Table 1.1 below summarizes the energy efficiency measures analyzed for the 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, SIR[1]	Simple Payback (Years)[2]
1	Heating and Ventilation	Shut off boilers in summer months.	$978	$250	61.98	0.3
2	Lighting – Replace interior lighting with LED replacements.	Replace interior lighting with LED replacement bulbs and Add a new Occupancy Sensor	$3,934 plus $150 Maintenance Savings	$2,500	13.60	0.6
3	Other Electrical – Change Boiler Circulation Pumps operating schedule	The boiler circulation pumps should be shut off in the summer, along with the boiler.	$155	$100	12.89	0.6

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]**
4	Air Tightening: Perform weatherization improvements to reduce heating demand	Perform air sealing to reduce air leakage by 200 CFM at 50 Pascals.	$144	$500	2.68	3.5
5	Exterior Door: Replace Water Treatment Plant exterior Door	Remove existing door and install standard pre-hung U-0.16 insulated door, including hardware.	$94	$1,817	1.22	19.3
6	Tank and Circulation Loop Heating: Replace controls and add insulation. To piping	Automate heat add controls and replace missing insulation on the water storage tank.	$375	$5,500	1.18	14.7
7	Other Electrical – Identify leaks to reduce water pumping and treatment needs.	Identify water leaks and fix, install controls on the well pump to reduce run time to on demand.	$2,464	$32,000	1.13	13.0
	TOTAL, all measures		**$8,145 plus $150 Maintenance Savings**	**$42,667**	**2.27**	**5.1**

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 $8,145 per year, or 46.3% of the buildings' total energy costs. These measures are estimated to cost $42,667, for an overall simple payback period of 5.1 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**	**Ventilation Fans**	**Lighting**	**Other Electrical**	**Tank Heat**	**Service Fees**	**Total Cost**
Existing Building	$3,431	$0	$0	$0	$4,979	$8,110	$1,063	$0	**$17,582**
With Proposed Retrofits	$2,918	$0	$0	$0	$573	$5,471	$476	$0	**$9,438**
Savings	$512	$0	$0	$0	$4,407	$2,639	$587	$0	**$8,145**

2. AUDIT AND ANALYSIS BACKGROUND

2.1 Program Description

This audit included services to identify, develop, and evaluate energy efficiency measures at the Water Treatment Plant. The scope of this project included evaluating building shell, lighting and other electrical systems, process loads, heating and ventilating equipment, and 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, & 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 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.

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

1) Water Treatment Plant: 600 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 ventilating; 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

3.1. Building Description

The 600 square foot Water Treatment Plant was constructed in 1977, with a normal occupancy of 0 people. The number of hours of operation for this building average 5.7 hours per day, considering all seven days of the week.

The water treatment plant in Twin Hills provides circulating water to the community.

Raw water is pumped to the plant from a well below the WTP and stored in an outdoor WST located high enough that no pressure pumps are required. Essentially the entire village has piped water which is circulated through an in-ground loop. The circulation pump is used during the heating season only.

Approximately 1,000 gallons of fuel are used at the water plant annually for building heat, heating the circulation loop and heating the WST.

Description of Building Shell

The exterior walls are panel construction with 3.5 inches of polyurethane insulation, and totals approximately 1,152 square feet.

The roof of the building is a warm roof with 3.5 inches of polyurethane insulation.

The floor of the building is a below grade floor, with no insulation.

Typical windows throughout the building are double pane glass windows with vinyl frames.

Doors are metal, with an EPS core and metal edge; there is no glass.

Description of Heating Plants

One of the boilers was set at 120 with a 15 degree differential and the other was set at 140 with a 15 degree differential. Both boilers were on. The outside temperature was approximately 55 degrees during our visit. The boilers are new and installed in 2013.

The Heating Plants used in the building are:

Ultimate Engineering Div of Dunkirk

Nameplate Information:	Model PFO-7
Fuel Type:	#1 Oil
Input Rating:	276,000 BTU/hr
Steady State Efficiency:	88 %
Idle Loss:	1.5 %
Heat Distribution Type:	Water
Boiler Operation:	All Year

Ultimate Engineering Div of Dunkirk

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Heat Distribution Type: Water
Boiler Operation: All Year

<u>Space Heating Distribution Systems</u>

Space heating in the water treatment plant is provided by a single 80,000 BTUH unit heater off the main plant boiler system.

<u>Lighting</u>

Lighting in the facility is made up of eight T8 fixtures with magnetic ballasts. Each fixture has two 32 watt bulbs.

<u>Major Equipment</u>

A well pump runs continuously at approximately 5 gallons per minute, and pulls about 560 watts. Based on the population of approximately 60 people, that works out to approximately 120 gallons used per person per day which is significantly more that the average rural Alaska village.

A ½ horsepower circulation pump circulates water from November to May, and is shut off the rest of the year.

Treatment Process

Water treatment is minimal and consists of pumping well water, adding chlorine, and pumping the chlorinated water to the water storage tank. Water is then circulated through the village with a circulation pump.

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.

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

Electricity: Twin Hills Village Council - Commercial - Sm

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	$ 1.00/kWh
#1 Oil	$ 3.81/gallon

3.2.1.1 Total Energy Use and Cost Breakdown

At current rates, Twin Hills Village pays approximately $17,582 annually for electricity and fuel costs for the 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

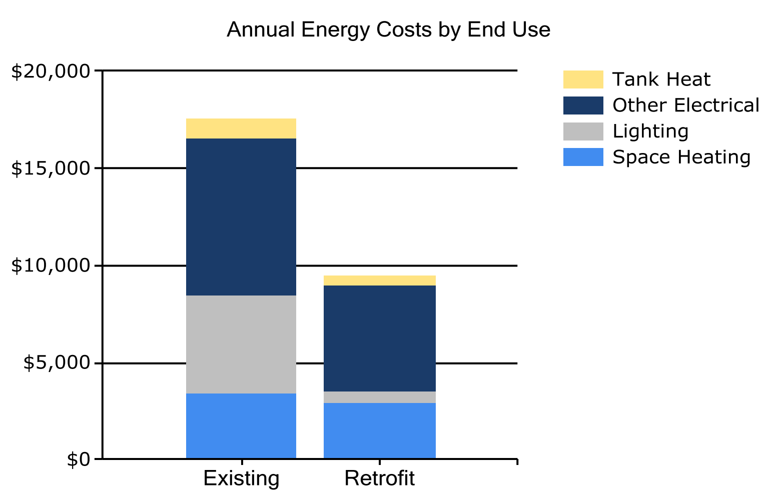


Figure 3.2 below shows how the annual energy cost of the building splits between the different fuels used by the building. The “Existing” bar shows the breakdown for the building as it is now; the “Retrofit” bar shows the predicted costs if all of the energy efficiency measures in this report are implemented.

Figure 3.2
Annual Energy Costs by Fuel Type

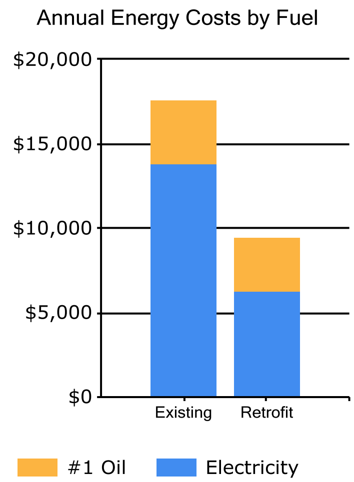
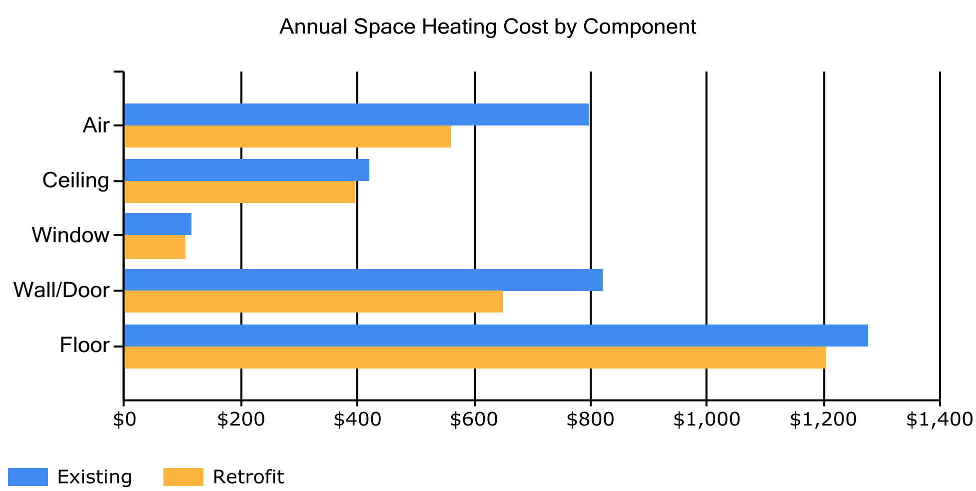


Figure 3.3 below addresses only Space Heating costs. The figure shows how each heat loss component contributes to those costs; for example, the figure shows how much annual space heating cost is caused by the heat loss through the Walls/Doors. For each component, the space heating cost for the Existing 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	60	54	57	56	55	51	52	53	52	57	54	60
DHW	0	0	0	0	0	0	0	0	0	0	0	0
Ventilation_Fans	0	0	0	0	0	0	0	0	0	0	0	0
Lighting	421	384	421	407	421	407	421	421	407	421	407	421
Other_Electrical	813	741	813	653	536	518	536	536	518	813	787	813
Tank_Heat	5	5	6	0	0	0	0	0	0	0	6	5

Fuel Oil #1 Consumption (Gallons)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Space_Heating	82	70	63	66	54	45	47	47	47	67	55	84
DHW	0	0	0	0	0	0	0	0	0	0	0	0
Tank_Heat	53	50	58	0	0	0	0	0	0	0	58	53

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):

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

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

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

Table 3.4
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	13,723 kWh	46,836	3.340	156,432
#1 Oil	999 gallons	131,819	1.010	133,137
Total		**178,655**		**289,569**
BUILDING AREA		600	Square Feet	
BUILDING SITE EUI		298	$kBTU/Ft^2/Yr$	
BUILDING SOURCE EUI		483	**$kBTU/Ft^2/Yr$**	
* 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 was modeled using AkWarm© energy use software to establish a baseline space heating and cooling energy usage. Climate data from Twin Hills 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 Twin Hills. 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. Calculations and cost estimates for analyzed measures are provided in Appendix C.

Table 4.1
Water Treatment Plant, Twin Hills, Alaska
PRIORITY LIST – ENERGY EFFICIENCY MEASURES

Rank	Feature	Improvement Description	Annual Energy Savings	Installed Cost	Savings to Investment Ratio, SIR	Simple Payback (Years)
1	Heating and Ventilation	Shut off boilers in summer months.	$978	$250	61.98	0.3
2	Lighting – Replace interior lighting with LED replacements.	Replace interior lighting with Led replacement bulbs and Add a new Occupancy Sensor	$3,934 plus $150 Maintenance Savings	$2,500	13.60	0.6
3	Other Electrical – Change Boiler Circulation Pumps operating schedule	The boiler circulation pumps should be shut off in the summer, along with the boiler.	$155	$100	12.89	0.6
4	Air Tightening: Perform weatherization improvements to reduce heating demand	Perform air sealing to reduce air leakage by 200 cfm at 50 Pascals.	$144	$500	2.68	3.5
5	Exterior Door: Replace Water Treatment Plant exterior Door	Remove existing door and install standard pre-hung U-0.16 insulated door, including hardware.	$94	$1,817	1.22	19.3
6	Tank and Circulation Loop Heaing: Replace controls and add insulation. To piping	Automate heat add controls and replace missing insulation on the water storage tank.	$375	$5,500	1.18	14.7
7	Other Electrical – Identify leaks to reduce water pumping and treatment needs.	Identify water leaks and fix, install controls on the well pump to reduce run time to on demand.	$2,464	$32,000	1.13	13.0
	TOTAL, all measures		**$8,145 plus $150 Maintenance Savings**	**$42,667**	**2.27**	**5.1**

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 Building Shell Measures

4.3.1 Door Measures

Rank	**Location**	**Size/Type, Condition**		**Recommendation**	
5	Exterior Door: WTP	Door Type: Entrance, Metal, EPS core, metal edge, no glass Modeled R-Value: 2.7		Remove existing door and install standard pre-hung U-0.16 insulated door, including hardware.	
Installation Cost	$1,817	**Estimated Life of Measure (yrs)**	30	**Energy Savings (/yr)**	$94
Breakeven Cost	$2,219	**Savings-to-Investment Ratio**	1.2	**Simple Payback yrs**	19
Auditors Notes: A new well fit door would reduce air leakage in the facility, and provide better more insulation to conserve heat.					

4.3.2 Air Sealing Measures

Rank	**Location**	**Existing Air Leakage Level (cfm@50/75 Pa)**		**Recommended Air Leakage Reduction (cfm@50/75 Pa)**	
4		Air Tightness estimated as: 800 cfm at 50 Pascals		Perform air sealing to reduce air leakage by 200 cfm at 50 Pascals.	
Installation Cost	$500	**Estimated Life of Measure (yrs)**	10	**Energy Savings (/yr)**	$144
Breakeven Cost	$1,338	**Savings-to-Investment Ratio**	2.7	**Simple Payback yrs**	3
Auditors Notes: Seal openings in building including around building penetrations and at roof beams.					

4.4 Mechanical Equipment Measures

4.4.1 Heating /Domestic Hot Water Measure

Rank	Recommendation				
1	Shut off boilers in summer months.				
Installation Cost	$250	**Estimated Life of Measure (yrs)**	20	**Energy Savings (/yr)**	$978
Breakeven Cost	$15,494	**Savings-to-Investment Ratio**	62.0	**Simple Payback yrs**	0
Auditors Notes: The boilers are not needed in the summer time. There is no heating demand for the water system, and the building can be kept at room temperature. Additionally, this is an excellent opportunity to clean and tune the boilers to maximize their effectiveness during operation in the winter.					

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 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.

4.5.1a Lighting Measures – Replace Existing Fixtures/Bulbs

Rank	Location	Existing Condition		Recommendation	
2	WTP Lighting	8 FLUOR (2) T8 4' F32T8 32W Standard Instant EfficMagnetic with Manual Switching		Replace with 8 LED (2) 17W Module StdElectronic and Remove Manual Switching and Add new Occupancy Sensor	
Installation Cost	$2,500	**Estimated Life of Measure (yrs)**	10	**Energy Savings (/yr)**	$3,934
				Maintenance Savings (/yr)	$150
Breakeven Cost	$34,007	**Savings-to-Investment Ratio**	13.6	**Simple Payback yrs**	1
Auditors Notes: Add occupancy sensor to limit on-time for lighting to building occupancy which averages approximately 1 hour per day. Per the water plant operator, the lights are now on approximately 24 hours per day. Replacing the current fluorescent bulbs with direct wired LED replacement bulbs would reduce electrical loads in the facility significantly.					

4.5.2 Other Electrical Measures

Rank	Location	Description of Existing		Efficiency Recommendation	
3	Boiler Circulation Pumps	2 Boiler Circulation Pumps with Manual Switching		Replace with 2 Boiler Circulation Pumps and Improve Manual Switching	
Installation Cost	$100	**Estimated Life of Measure (yrs)**	10	**Energy Savings (/yr)**	$155
Breakeven Cost	$1,289	**Savings-to-Investment Ratio**	12.9	**Simple Payback yrs**	1
Auditors Notes: Shut off boiler circulation pumps for four months during the summer.					

Rank	Location	Description of Existing		Efficiency Recommendation	
7	Well Pump	Well Pump with Manual Switching		Replace with Well Pump and Improve Manual Switching	
Installation Cost	$32,000	**Estimated Life of Measure (yrs)**	20	**Energy Savings (/yr)**	$2,464
Breakeven Cost	$36,004	**Savings-to-Investment Ratio**	1.1	**Simple Payback yrs**	13
Auditors Notes: At present, the water use/leaks are approximately 150 gallons per day per person. Historically, this should be more in the 30 to 70 range. The rest is being leaked into the ground within the distribution system. These leaks should be repaired to reduce run time on the well pump.					

4.5.3 Other Measures

Rank	Location	Description of Existing		Efficiency Recommendation	
6		Tank and Circulation Loop Heat Load		Automate heat add controls and replace missing insulation on tank.	
Installation Cost	$5,500	**Estimated Life of Measure (yrs)**	20	**Energy Savings (/yr)**	$375
Breakeven Cost	$6,515	**Savings-to-Investment Ratio**	1.2	**Simple Payback yrs**	15
Auditors Notes: Automating the heat add controls can be done by a combination of the water treatment plant operator and the Tribal utility Support (TUS) engineer that comes to the village to work with the operator on implementing these energy efficiency measures.					

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 City of Twin Hills and the water treatment plant operator to follow up on the recommendations made in this audit report. A Rural Alaska Village Grant has funded ANTHC to provide the City with assistance in understanding the report and in implementing the recommendations. Funding for implementation of the recommended retrofits is being partially provided for by the above listed funding agencies, as well as the State of Alaska legislature.

APPENDICES (Please Attach Documents for Appendixes A and B)

Appendix A – Energy Audit Report – Project Summary

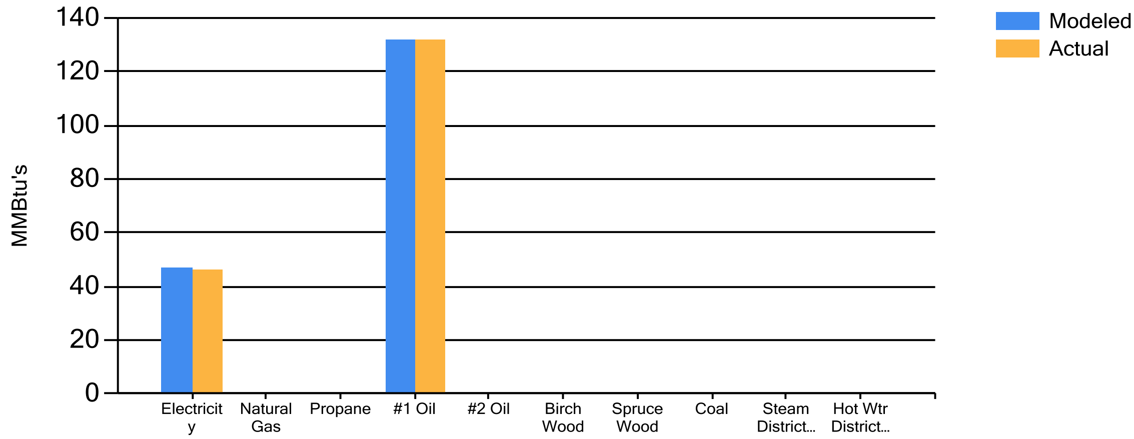
ENERGY AUDIT REPORT – PROJECT SUMMARY	
General Project Information	
PROJECT INFORMATION	**AUDITOR INFORMATION**
Building: Water Treatment Plant	**Auditor Company:** ANTHC-DEHE
Address: PO Box TWA	**Auditor Name:** Carl Remley
City: Twin Hills	**Auditor Address:** 3900 Ambassador Drive, Suite 301 Anchorage, AK 99508
Client Name: Julius Henry & William Page	
Client Address: PO Box TWA Twin Hills, AK 99576	**Auditor Phone:** (907) 729-3543 **Auditor FAX:**
Client Phone: (907) 525-4821	**Auditor Comment:** Cody Uhlig joined me from TUS
Client FAX:	
Design Data	
Building Area: 600 square feet	**Design Space Heating Load:** Design Loss at Space: 20,667 Btu/hour with Distribution Losses: 20,667 Btu/hour Plant Input Rating assuming 82.0% Plant Efficiency and 25% Safety Margin: 31,505 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: Twin Hills	**Design Outdoor Temperature:** -19.3 deg F
Weather/Fuel City: Twin Hills	**Heating Degree Days:** 11,306 deg F-days
Utility Information	
Electric Utility: Twin Hills Village Council - Commercial - Sm	**Natural Gas Provider:** None
Average Annual Cost/kWh: $1.004/kWh	**Average Annual Cost/ccf:** $0.000/ccf

Annual Energy Cost Estimate									
Description	**Space Heating**	**Space Cooling**	**Water Heating**	**Ventilation Fans**	**Lighting**	**Other Electrical**	**Tank Heat**	**Service Fees**	**Total Cost**
Existing Building	$3,431	$0	$0	$0	$4,979	$8,110	$1,063	$0	**$17,582**
With Proposed Retrofits	$2,918	$0	$0	$0	$573	$5,471	$476	$0	**$9,438**
Savings	$512	$0	$0	$0	$4,407	$2,639	$587	$0	**$8,145**

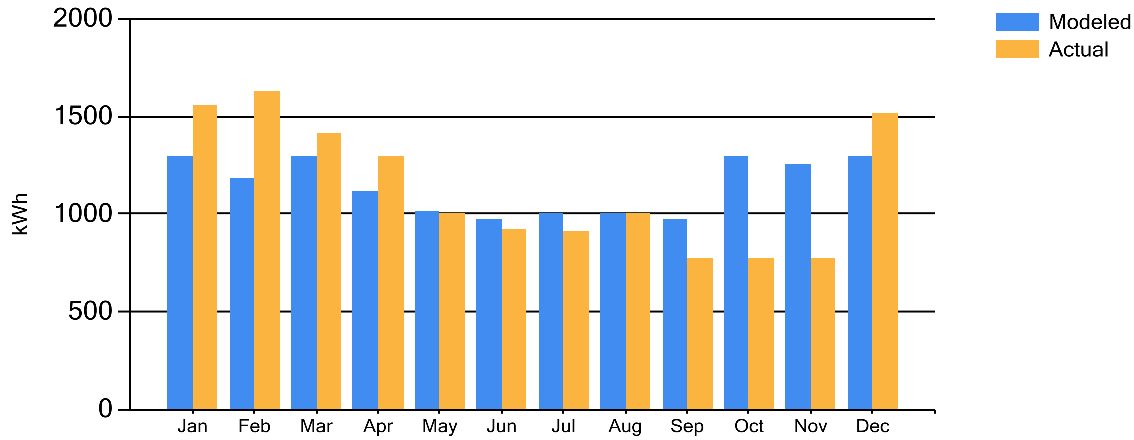
Appendix B – Actual Fuel Use versus Modeled Fuel Use

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