

Agency: Commerce, Community and Economic Development**Grants to Named Recipients (AS 37.05.316)****Grant Recipient: Alaska Native Tribal Health Consortium****Federal Tax ID: 920162721****Project Title:****Project Type: Other**

Alaska Native Tribal Health Consortium - Rural Sanitation Systems Sustainability and Energy Efficiencies - Shungnak and Deering

State Funding Requested: \$3,800,000**House District: Statewide (1-40)**

Future Funding May Be Requested

Brief Project Description:

Alaska Rural Utility Collaborative (ARUC) expansion \$3,000,000 and Rural Utility Energy Audits and Efficiency Upgrades \$800,000

Funding Plan:

Total Project Cost:	\$3,800,000
Funding Already Secured:	(\$0)
FY2013 State Funding Request:	<u>(\$3,800,000)</u>
Project Deficit:	\$0

Funding Details:

ANTHC manages 24 rural communities facilities through ARUC; these expansion funds would address the wait list of communities wanting to join. ANTHC conducted audits of 41 rural sanitation facilities in 2011 and 2012 with federal dollars which are no longer available.

Detailed Project Description and Justification:

ANTHC is seeking \$3 million to add communities to the Alaska Rural Utility Collaborative (ARUC) and \$800,000 for Rural Utility Energy Audits and Efficiency Upgrades. This two-part strategy used in a number of rural communities has resulted in energy savings and plant efficiencies,

ALASKA RURAL UTILITY COLLABORATIVE (ARUC)

ARUC successfully operates and manages 24 village water and sewer systems. Membership in ARUC improves user rate collections to 100% after a transition period of two to three years, and ensures that user rates cover the entire costs of operation and routine maintenance. This capital request provides funding to bring the 15 communities currently on the waiting list into ARUC. It will be used to pay for rate studies, efficiency upgrades needed to reduce operational costs, and parts and repairs necessary to ensure efficient and reliable operation of the water and wastewater system. Benefits to these communities include:

Lower fuel and parts costs due to ARUC purchasing power: ARUC-purchased fuel averaged \$4.36 versus \$6.04 per gallon in non-ARUC communities.

Improved water safety: Communities that join ARUC are 50% less likely to be on the State's Significant Non-Compliance (SNC) list. Communities with some of the highest SNC list violations in the country are in compliance shortly after joining ARUC.

Steady local employment: ARUC turnover of operators is approximately 8%, versus non-ARUC community turnover of up to 75%. ARUC operators also receive retirement benefits that encourages longer term employment.

Reliable water service: ARUC management results in improved reliability. Communities with one-third of their homes without service during winter prior to ARUC now have much more reliable service after joining ARUC.

Sustainable infrastructure: More sustainable, longer lasting infrastructure results from ARUC management and operations. Routine maintenance is ensured through ARUC operator oversight and supervision; this saves local, state and federal money.

RURAL UTILITY ENERGY AUDITS AND EFFICIENCY UPGRADES

The \$800,000 for rural utility energy audits and efficiency upgrades will pay for the cost of the water and wastewater system energy audit and minor upgrades, which will be implemented immediately. More substantial major upgrades, which include equipment replacement and water treatment plan modifications, will be identified in enough detail to define a design and construction phase. Benefits to the communities include:

Immediate savings -- By average, it takes three years or less for an energy upgrade project to pay for itself (this includes the cost of the audit and upgrades). Recent ANTHC audits have realized payback in one year or less.

Long-term savings -- Water and wastewater operation modifications will include instantaneous, minor equipment upgrades and community education. While upgrades are important, it is equally important to educate water system operators and utility managers on the changes implemented in order to maintain the long-term savings.

Arctic water and wastewater system process audits are conducted by engineers who specialize in arctic water system operations, efficiency and design. ANTHC has gathered available information about energy use and cost for water and sewer systems in rural Alaska by surveying various system operators and local governments. (Published in "Energy Use and Costs for Operating Sanitation Facilities in Rural Alaska, A Survey," dated October 2011). Communities that were identified in the survey with the high energy costs will be selected.

Project Timeline:

Project will begin as soon as funding is available. Expenditures will occur over the following 12 months.

Entity Responsible for the Ongoing Operation and Maintenance of this Project:

N/A

Grant Recipient Contact Information:

Name:	Roald Helgesen
Title:	Chief Executive Officer
Address:	4000 Ambassador Drive Anchorage, Alaska 99508
Phone Number:	(907)729-1905
Email:	rhelgesen@anthc.org

Has this project been through a public review process at the local level and is it a community priority? Yes No

High energy costs threaten the sustainability of rural Alaska communities and the health benefits provided by modern water and sewer facilities.



Rural Utility Energy Audits and Efficiency Upgrades

The Alaska Native Tribal Health Consortium (ANTHC) is seeking \$800,000 for energy audits and immediate energy saving upgrades in 15 rural Alaska communities. This project will pay for the cost of the water and wastewater system energy audits and minor upgrades, which will be implemented immediately. More substantial major upgrades include equipment replacement and water treatment plant modifications, and will be identified in enough detail to define a design and construction phase.

Immediate savings. By average, it takes three years or less for an energy upgrade project to pay for itself (this includes the cost of the audit and upgrades). However, recent ANTHC audits have realized payback in one year or less.

Long-term savings. Water and wastewater operation modifications will include instantaneous minor equipment upgrades and community education. While upgrades are important, it is equally important to educate water system operators and utility managers on the changes implemented and maintain the long-term savings.

Preliminary research nearly complete. ANTHC gathered available information about energy use and costs for water and sewer systems in rural Alaska by surveying various system operators and local governments (published in Energy Use and Costs for Operating Sanitation Facilities in Rural Alaska, a Survey, dated October 2011). Communities that were identified in the survey with high energy costs will be selected.

Technical expertise. Arctic water and wastewater system process audits are conducted by engineers specializing in arctic water system operations, efficiency and design.

Five-Year Energy Savings (*Actual savings identified by ANTHC)

Selawik*	\$1,126,850
Minto*	\$104,000
Allakaket*	\$219,000
Eek	\$58,285
Nulato	\$175,922

Total Project Cost

\$800,000 for the next 15 communities

Energy Savings

Average five-year energy savings per community (average of 13 per year):

- \$137,465 to the community
- \$49,080 to the State

Facts

- Arctic water systems comprise up to 30% of a community's energy.
- On average, 50% energy savings have been realized by ANTHC's sanitation audits.



For more information

Valerie Davidson, Senior Director
Legal & Intergovernmental Affairs
through Pat Jackson
(907) 523-0363
pajackson@anthc.org
anthctoday.org



State and federal agencies have made significant investment in sanitation infrastructure across rural Alaska. For this investment to last, Alaska needs proactive operation and maintenance.

Alaska Rural Utility Collaborative (ARUC)

Total Project Cost

\$3 million to add communities

Facts

- ARUC saved member communities \$176,000 in fuel last year.
- ARUC employs 61 local hires across Alaska.
- ARUC water treatment plant operators make an average of \$4 more per hour than non-ARUC operators.
- 89% of ARUC communities (compared to 40% non-ARUC) meet capacity indicators allowing them to be eligible for federal grants.



For more information

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ANTHC is seeking \$3 million to add communities to ARUC. This will pay for rate studies, energy audits and repairs needed to decrease energy costs, and provide parts and repairs necessary to operate the water system reliably. ARUC membership and management will ensure that state and federal investments made are sustainable into the future.

ARUC successfully operates and manages 24 village water and sewer systems. Benefits to these communities include:

Lower fuel and parts costs. Due to ARUC purchasing power, water system parts and fuel for operation cost less. ARUC-purchased fuel averaged \$4.36 versus \$6.04 per gallon in non-ARUC communities.

Improved water safety. Communities that join ARUC are 50% less likely to be on the State's Significant Non-Compliance (SNC) list. Communities with some of the highest SNC list violations in the country are now in compliance after joining ARUC.

Steady local employment. ARUC turnover of operators is around 8%, versus non-ARUC community turnover of up to 75%.

Reliable water service. ARUC management results in improved reliability. Communities with one-third of their homes without service during winter prior to ARUC now have much more reliable service after joining ARUC.

Sustainable infrastructure. More sustainable, longer lasting infrastructure results from ARUC management and operations. This saves local, state and federal money.

Communities in the Alaska Rural Utilities Collaborative – February 2012

Managed from Bethel by Frank Neitz

Chevak
Goodnews Bay
Kotlik
Lower Kalskag
Russian Mission
Sleetmute
Toksook Bay
Upper Kalskag
Holy Cross
Pitkas Point (joined November, 2011)

Managed from Anchorage

Golovin
Newhalen
Savoonga
Tyonek
Saint Michael

Managed from Kotzebue

Ambler
Kobuk
Kiana
Noorvik
Selawik

Managed from Dillingham

Chignik Lake
Chignik Lagoon
New Stuyahok
South Naknek

A 25th member, Quinhagak, is in the process of joining now and will be managed from Bethel.

Communities on the Waiting List:

1. Akiak
2. Buckland
3. Deering
4. Gulkana
5. Kake
6. Quinhagak
7. Scammon Bay
8. Shungnak
9. St. Marys
10. Tanana
11. Noatak
12. Chuathbaluk
13. Kasigluk
14. Ekwok
15. Aniak

John Nichols, P.E.
ARUC Manager, ANTHC

Alaska Native Tribal Health Consortium

Rural Energy Audits & Efficiency Upgrades for Sanitation Facilities and Community Infrastructure

41 Audits currently Funded with Federal Funds and in progress

15 Audits Completed and Published as of February 2012:

Village	Total Cost of Retro Fits	Annual Total Savings	Simple payback (years)	Comment
Akiak	\$ 39,670.00	\$ 14,939.00	2.7	
Eek	\$ 47,606.00	\$ 16,756.00	2.8	
Goodnews Bay	\$ 37,953.00	\$ 15,872.00	2.4	
Kongiganak	\$ 34,030.00	\$ 12,060.00	2.8	
Lower Kalskag	\$ 22,165.00	\$ 4,688.00	4.7	
Napaskiak	\$ 17,980.00	\$ 25,294.00	0.7	
Nenana	\$ 400.00	\$ 4,274.00	0.1	
Nulato	\$ 148,556.00	\$ 19,022.00	7.8	Includes Heat Recovery
Oscarville	\$ 23,785.00	\$ 3,752.00	6.3	
Russian Mission	\$ 6,193.00	\$ 4,174.00	1.5	
Savoonga	\$ 331,330.00	\$ 37,717.00	8.8	Includes Heat Recovery
Selawik	\$ 508,995.00	\$ 175,995.00	2.9	Funded
Shaktoolik	\$ 309,593.00	\$ 39,125.00	7.9	Includes Heat Recovery
Sleetmute	\$ 142,395.00	\$ 26,796.00	5.3	Includes Heat Recovery
Teller	\$ 31,760.00	\$ 53,438.00	0.6	
Toksook Bay	\$ 26,940.00	\$ 7,161.67	3.8	



REPORT

COMPREHENSIVE ENERGY AUDIT

For

SELAWIK WATER AND SEWER SYSTEMS

Selawik, Alaska

Prepared for

The City Selawik, Alaska

And

The Alaska Rural Utility Collaborative (ARUC)

June 21, 2011

Prepared by

Alaska Native Tribal Health Consortium
Energy Projects Group
1901 Bragaw Street, Suite 200
Anchorage, Alaska 99508
Phone: 907-729-3543
cremley@anthc.org

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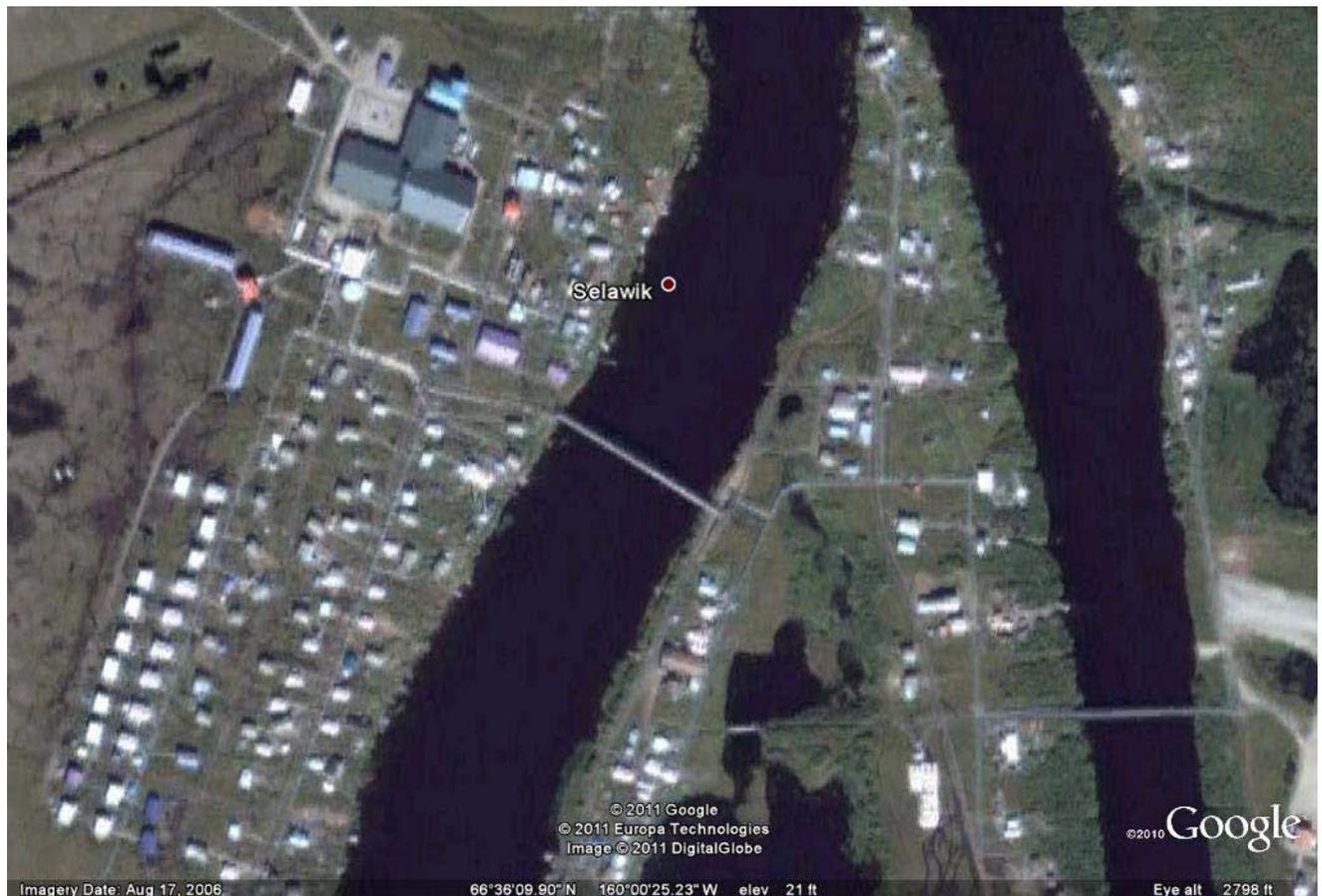
PREFACE

The Energy Projects Group at the Alaska Native Tribal health Consortium (ANTHC) prepared this document for The City of Selawik, Alaska and the Alaska Rural Utility Collaborative (ARUC). The authors of this report are Carl Remley, Certified Energy Auditor (CEA) and Certified Energy Manager (CEM), Chris Mercer PE, and Gavin Dixon.

The purpose of this report is to provide a comprehensive document of the findings and analysis that resulted from an energy audit conducted in February of 2011 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 Operators, Henry Coaltrain, Bruce Dexter, and Fred Cleveland, ARUC Statewide Manager John Nichols, and Selawik City Administrator Roger Clark.



1. EXECUTIVE SUMMARY

This report was prepared for the City of Selawik, Alaska and the Alaska Rural Utility Collaborative. The audit focused on the city wide water and sewer systems. These systems include a water treatment plant, island vacuum plant, pump house, an extensive water distribution system and an extensive vacuum sewer collection system. The scope of this report is a comprehensive energy study which included all energy consuming aspects of the systems.

Based on fiscal year 2010 electricity, fuel oil and recovered heat prices, the annual energy costs for the systems analyzed are approximately \$199,041 for electricity, \$57,701 for fuel oil, and \$7,688 for recovered heat, giving a total energy cost of \$264,430 per year.

Fourteen Energy Conservation Measures (ECMs) are recommended for implementation. By implementing these fourteen projects, the utility cost can be reduced by approximately \$175,995 per year or 66 percent of the \$264,430 annual energy cost. Implementation costs for these measures would be approximately \$508,955 for an overall simple payback of 2.9 years.

The energy and economic impact of these projects is summarized in Table 1.1. Detailed descriptions and economics of each measure are included in the report. The recommended projects were limited to those with paybacks periods of approximately 10 years or fewer.

Please note that this energy audit used calendar year 2010 costs and savings. With the recent escalation of oil prices of approximately 35 percent, both fuel costs and electricity costs will be significantly higher in the near future. This will result in both a higher cost for energy and higher savings.

Two areas were identified for further study. The first is to reduce the vacuum settings on the vacuum systems and develop a leak detection program. The second is to perform a detailed analysis of the power cost equalization (PCE) allocation to assure it is appropriate. Although these two areas are beyond the scope of this energy study, the potential for significant savings exists.

This report does not include recommendations for cost savings associated with a glycol system upgrade earlier submitted to the City of Selawik. That proposal suggested a \$660,000 upgrade and retrofit project can save the City a significant amount in annual water and sewer maintenance and operating costs. The recommendations in this report are energy savings in addition to those operation and maintenance savings.

Table 1.1 Recommended Energy Conservation Measures

Measure	Description	Cost	Savings	Payback
1	Eliminate Use of Heat Tape on Island Utiladors	\$0	\$75,001	Immediate
2	Isolate Standby Boiler in the Water Treatment Plant	\$0	\$300	Immediate
3	Eliminate Use of Heat Tape on Arctic Pipe Used for Water Loops	\$5,550	\$13,924	0.4 Years
4	Re-Commission Pump House Heating System	\$6,850	\$2,684	2.5 Years
5	Maximize Use of Recovered Heat in Water Treatment Plant	\$24,800	\$26,125	0.9 Years
6	Replace Water Tank Heat Add Controls	\$5,850	\$4,912	1.2 Years
7.	Reconfigure Heat Add System for Island Vacuum Plant	\$6,350	\$1,410	4.5 Years
8.	Replace Interior Lighting in Both Buildings	\$25,280	\$2,938	8.6 Years
9.	Re-Commission Vacuum Pump Systems	\$9,675	\$4,499	2.2 Years
10.	Separately Meter Cable TV Equipment	\$10,400	\$1,620	6.4 Years
11.	Eliminate Use of Electric Heaters in Washeteria and Rest Room	\$8,650	\$800	10.8 Years
12.	Reduce Building Shell Leaks in Island Vacuum Plant	\$5,550	\$564	9.8 Years
13.	Replace Water Treatment Plant Heat Add Controls	\$120,500	\$13,218	9.1 Years
14	Replace Boilers and Circulation Pumps	\$279,500	\$28,000	10.0 Years
Totals		\$508,955	\$175,995	2.9 Years

2. AUDIT AND ANALYSIS BACKGROUND

2.1 Program Description

This audit effort comprised energy engineering services to identify, develop, and evaluate energy efficiency and conservation measures for the Selawik water treatment and sewer systems located in Selawik, Alaska. The scope of this project includes auditing the entire system including the water treatment plant, the island vacuum plant, the pump house, and both the water distribution system and the vacuum sewer collection system. Measures were selected such that a simple payback period of approximately 10 years or less is achieved. Measures that were evaluated but had longer simple payback periods are not included in the report.

2.2 Audit Description and Methodology

On February 2nd and 3rd and again on February 16th, 2011, the Energy Projects Group at ANTHC conducted an on-site audit of the above referenced facilities and systems. Complete facility surveys were conducted including a systematic inspection of the entire system, interviews with plant operators, observation of actual operating procedures, and data collection of all major equipment and structures including nameplate data for major equipment, operating hours of equipment, actual equipment loads over time, maintenance needs, condition of equipment, blower door test of each facility, and thermal imaging of each facility.

Lighting audits were also completed for each facility including complete physical counts of all the fixtures and a determination of fixture configuration.

Some of the major tools used to facilitate the audit included:

- Energy Conservatory Blower Door Test System
- FLIR b50 Infrared Camera
- Extech Video Boroscope
- Bacharach Fyrite Insight Combustion Gas Analyzer
- Dranetz/BMI EP1 Power Monitor

In addition to the physical inspection, the following sources of information were used to obtain the level of detail necessary to accurately understand and analyze the buildings energy use.

- As-built architectural, mechanical and electrical drawings
- Operation and Maintenance manuals for both facilities
- Fiscal year 2010 fuel and electricity use data

2.3 Analysis Methodology

This section describes the main analysis methods used to identify baseline building energy usage and to evaluate energy conservation measures (ECMs).

2.3.1 Energy Engineering Analysis

Following the site visit, energy balances were calculated to determine the distribution of energy use as given in the historical bills. The significant number of separate meters combined with the equipment monitoring done made analyzing the electrical usage easier. The lack of historical data for recovered heat, made the calculation of total heat used more difficult. Electrical, oil and recovered heat consumption were prorated to the end use categories based on a combination of monitoring and calculations of consumption by the system components. This analysis confirms the understanding of how systems are operated. For example, it is a check on the assumed load, cycling factor, or length of operation of the various systems or individual pieces of equipment.

After the balances were completed, potential energy efficiency measures were analyzed and annual savings calculated. Savings calculations are based on reduction in run time of an existing system, improved control of an existing system, or conversion to more efficient equipment.

We recognize that there will be process changes implemented in the water treatment plant in the near future. The impact of these changes was not considered in this audit.

Cost estimates are provided for the proposed conversions or improvements. These are budget estimates based on a combination of quotations and the experience of the auditors on similar projects completed in rural Alaska.

2.3.2 Thermal Imaging

An infrared thermal imaging analysis of the buildings was conducted using a FLIR b50 infrared camera. Several areas of large losses were identified and each are included in the list of energy conservation measures.

2.4 Limitations of Study

The information presented herein is an energy efficiency and conservation study to identify potential energy conservation measures and estimate their costs and savings. In some cases, several methods may achieve the identified savings. This report does not include specific design instructions. It is not intended as a final design document and projects have not been developed to construction design level. The design professional or other persons following the recommendations shall accept responsibility and liability for the results. Budget for engineering and design of these projects is included in the cost estimate for each measure as needed.

3. WATER AND SEWER SYSTEMS

3.1 Systems Overview

3.1.1 Water System

The water and sewer systems in the City of Selawik serve 189 connections. The raw water is pumped from the river through a pump house to the water treatment plant as a batch process. The raw water is then filtered, treated, heated, and pumped into an insulated 300,000 storage tank.

A combination of utilidors and arctic pipe are used to form a circulated water system. This circulated system has several loops and is heated with a combination of glycol heat –add via heat exchangers, water tank heat, and heat tape. Pumps are used to both circulate the water and pressurize the system. The heat tape was meant to be used as a method of emergency thaw only, not as a heat add method.

3.1.2 Sewer System

The vacuum sewer system is separated into two collection systems. One system with dual pumps is co-located with the water treatment plant. This system is a combination of arctic pipe and utilidors. It is heated with a combination of glycol and heat tape. The second system is located at the island vacuum plant. This vacuum collection system is built with utilidors that contain both water and sewer. The utilidors are heated with a combination of heated water and heat tape. Each of the two systems have a collection tank with a pump that discharges via force main to the sewage lagoon.

3.2 Water Treatment Plant



3.2.1 Facility Construction

The water treatment plant is a 5,700 square foot steel frame building. It is mounted on steel piles and has three inches of foam insulation covered with metal siding and a corrugated metal roof. Floor insulation is minimal and may actually be resulting in snow melting under the building.

The building was originally built in 1973 and has been upgraded and added onto since then with the most recent being in 1995. Overall it is in good condition although the limited amount of insulation is far below standard for a building in the arctic.

The blower door test results on this building clearly indicate it can and should be sealed tighter. This was especially true of all of the doors.

3.2.2 Facility Heating

Heat, both for the building and for process is provided by a combination of two boilers and heat recovered from the nearby AVEC power plant. When operating properly, the recovered heat has the capacity to provide all necessary heat on most but not all days. This was illustrated on a zero degree day in February when the boilers never came on during a twelve hour observation period.

The two boilers are Weil McClain with model CF 1400 Becket burners. The output capacity of each is 1,250,000 btu/hr. The operating temperature range was 162 to 172. The burner was operating at 84% efficiency with a stack temperature of 415 degrees.

The following items were noted on the boilers. Both the boilers and burners are in good condition. The burners were fouling with soot with heavy accumulation on the air tube burner fins. The nozzles were too small for the boilers as they were below the minimum firing rate. Although the burner was designed for a low/high firing rate, it was not wired appropriately to take advantage of that capability. Finally, heated glycol was being circulated through the second boiler even though it was shut off. This results in excessive radiant and convection losses.

During the discussions with the operator, it was noted that during cold periods, they sometimes adjust the boiler operating temperature such that the heat recovery system is not utilized. This results in inefficient operation.

During the first visit of the audit team, the heat recovery system was operational and providing all the heat required. However, during the second trip, a leak in the circulation system forced a shutdown of the circulation pump and therefore the recovery system was not functioning. It is obviously critical to assure the system is operational to minimize heating costs.

During the second visit of the audit team, electric heaters were being used to heat the old washeteria area and the rest room. One of the heaters was 1,500 watts and the other was 15,000 watts.

3.2.3 Water System

Within the water treatment plant, the water is filtered, treated, heated and then stored. This is accomplished with a batch process. The pumps used to pressurize and circulate the water are located within this plant.

Heat is added to the water through a heat exchanger located near the water tank. The controls on this heat exchanger are not operational.

Another heat exchanger is used to heat a glycol circulation loop to the pump house. The controls for this heat exchanger are not functioning properly either.

3.2.4 Vacuum Sewer System

Within the water treatment plant, is the vacuum pumps, sewer holding tank and discharge pumps for approximately half the village. A combination of monitoring the run time of the vacuum pumps and discussions with the manufacturer have illustrated the excessive leaks are present in the vacuum system.

Tests conducted on the vacuum pumps indicated that they were all operating properly and near full capacity.

3.2.5 Other Electrical Loads

The cable TV system for the village is located within the water treatment plant. Measurements of the loads associated with this equipment concluded that it is adding approximately 500 kilowatt-hours of usage to the water treatment plant each month that is not associated with the function of the plant.

3.3. Island Vacuum Plant



3.3.1 Facility Construction

The island vacuum plant is a 1,120 square foot steel frame building. It is mounted on steel piles and has three inches of foam insulation covered with metal siding and a corrugated metal roof. Floor insulation is minimal.

The building was built in approximately 2000 and overall is in good condition. However, the limited amount of insulation is far below standard for a building in the arctic.

The blower door test on this facility helped us identify several leaks that need to be eliminated. They are the exhaust dampers for the emergency generator are not closing properly, the dampers on the fresh air inlet for the emergency generator are not closing properly, the double doors on the front of the building do not latch between doors which results in a significant air leak, the draft damper on # 2 boiler is missing.

3.3.2 Facility Heating

Heat for both the building and the process is provided by a combination of two boilers. There is no recovered heat from the AVEC power plant in this building. The two boilers are Weil McClain with model CF800 Becket burners. The boilers were new when the plant was put into operation in approximately 2002 and are in good condition except for the missing draft damper on # 2 boiler and the stuck damper on #1 boiler. Both boilers need to be cleaned and tuned.

3.3.3 Water System

Water is pumped from the water treatment plant to the island vacuum building. There are no water storage tanks at the island vacuum plant. A separate set of circulation pumps circulates the water loops on the island and heat from the boilers is added as necessary.

This heat-add loop is configured such that the heat is added before the temperature controller. A more efficient control approach would be to add heat based on the loop return temperature. This improvement could be implemented fairly easily. At a minimum, there must be a way to monitor the return temperature.

3.3.4 Vacuum Sewer System

The main purpose of this building is to house the vacuum system for the island connections to the system. Within this building are the vacuum pumps, sewer holding tank and discharge pumps for all the connections on the island. A combination of monitoring the run time of the vacuum pumps and discussions with the manufacturer resulted in the conclusion that there are excessive leaks in the vacuum system. It was also noted that the high vacuum level setting on the controls for the pumps are resulting in excessive run times

3.4 Water Distribution Loops



The vast majority of the water loops circulated from the water treatment plant are separate from the sewer lines and run in arctic pipe. The design intent was that the heat-add on the recirculation heat exchanger would keep the water in these lines from freezing. The heat tape was meant to be used in an emergency only.

The water lines in the island are run in a utilidor that also includes the vacuum sewer piping.

3.5 Vacuum Sewer Lines



All of the vacuum sewer lines to the water treatment plant are also run in arctic pipe. As noted above, the vacuum lines on the island are run in a utilidor that includes both the water and sewer lines.

4. ENERGY USE SUMMARY

Energy data for fiscal year 2010 was used for this energy audit. During this period, the electrical usage for the combined water and sewer systems was 734,410 kilowatt-hours at a cost of \$199,041. This results in an average cost per kilowatt-hour of \$0.27.

Combined fuel use during fiscal year 2010 totaled approximately 15,595 gallons at a cost of approximately \$57,701. The price per gallon of the fuel was approximately \$3.70. In addition, it is estimated that the recovered heat used during this period was the equivalent of 5,125 gallons of fuel. Per the heat sales agreement with AVEC, the approximate value of the fuel is \$7,688.

The resulting overall cost of energy used for the combined water and sewer systems was approximately \$264,430.

Understanding just how and where this energy was used is a critical step in identifying both how to reduce consumption and how much could be saved by implementing each energy conservation measure.

Identifying where the electricity was used was accomplished by a combination of two methods. First, the large number of electric meters allowed us to breakdown usage into functional areas. For example, many of the meters only provide electricity to heat tape. Second, we used a Dranetz/BMI EP1 power monitor to record the run times and power draw of pumps, heaters, and many other loads.

Identifying where the fuel and recovered heat was used was accomplished by a combination of two methods as well. First, we analyzed the available historical records and second, we performed calculations utilizing temperature differences and flow rates.

The remainder of this energy use summary section documents just how the consumed energy was used during fiscal year 2010.

4.1 Electrical Use Summary

As mentioned above, electrical usage for fiscal year 2010 totaled 734,410 kilowatt-hours and that cost a total of \$199,041. The following table illustrates the consumption and cost variations throughout the year.

It is obvious from the data in the table, that consumption increased dramatically in the winter months. This increase in consumption is due primarily to the use of electric heaters and electric heat tape. The other factor that becomes obvious from this table is that the cost per kilowatt-hour increases significantly when the consumption increases. This increase in the rate per kilowatt-hour is due to exceeding the allotted kilowatt-hour limit for power cost equalization (PCE).

Table 4.1.1 – Total Electrical Consumption

Month	Kilowatt-hours	Dollars	\$/Kilowatt-hour
October	28,895	\$4,322	\$0.150
November	71,873	\$18,520	\$0.258
December 2009	103,989	\$33,683	\$0.324
January 2010	115,877	\$38,535	\$0.333
February	88,917	\$25,672	\$0.289
March	99,244	\$30,102	\$0.303
April	91,731	\$26,687	\$0.291
May	50,824	\$8,151	\$0.166
June	21,689	\$3,535	\$0.163
July	20,043	\$3,245	\$0.162
August	22,103	\$3,517	\$0.159
September	19,225	\$3,072	\$0.160
Totals	734,410	\$199,041	\$0.271

Power cost equalization or PCE is a state subsidy of the high cost of electricity in rural Alaska. However, there are limits to the consumption that is subsidized. It is obvious from this data that those limits were exceeded in the winter months. The cost per kilowatt-hour with the PCE included is in the \$0.15 to \$0.16 range as illustrated in October of 2009 and May through September of 2010. The average rate doubles during the winter months illustrating the need to stay within the PCE subsidized rate. This will be factored into the savings used later in this report.

Figure 4.1.1 below is an overview of the breakdown of annual electrical consumption for the entire water and sewer system. The breakdown of that consumption on a percentage basis is as follows:

- Island Heat Tape 38%
- Heat Tape with Glycol 13%
- WTP Side Heat Tape No Glycol 1%
- Water Treatment Plant 27%
- Island Vacuum Plant 16%
- Pump House 3%
- Heat Recovery and Tank Farm 2%

Combined, heat tape comprised 52% of the total electrical charges in fiscal year 2010. This \$102,848 cost is obviously both a major expense and the use of heat tape should be minimized.

Figure 4.1.1 – System Wide Electrical Cost

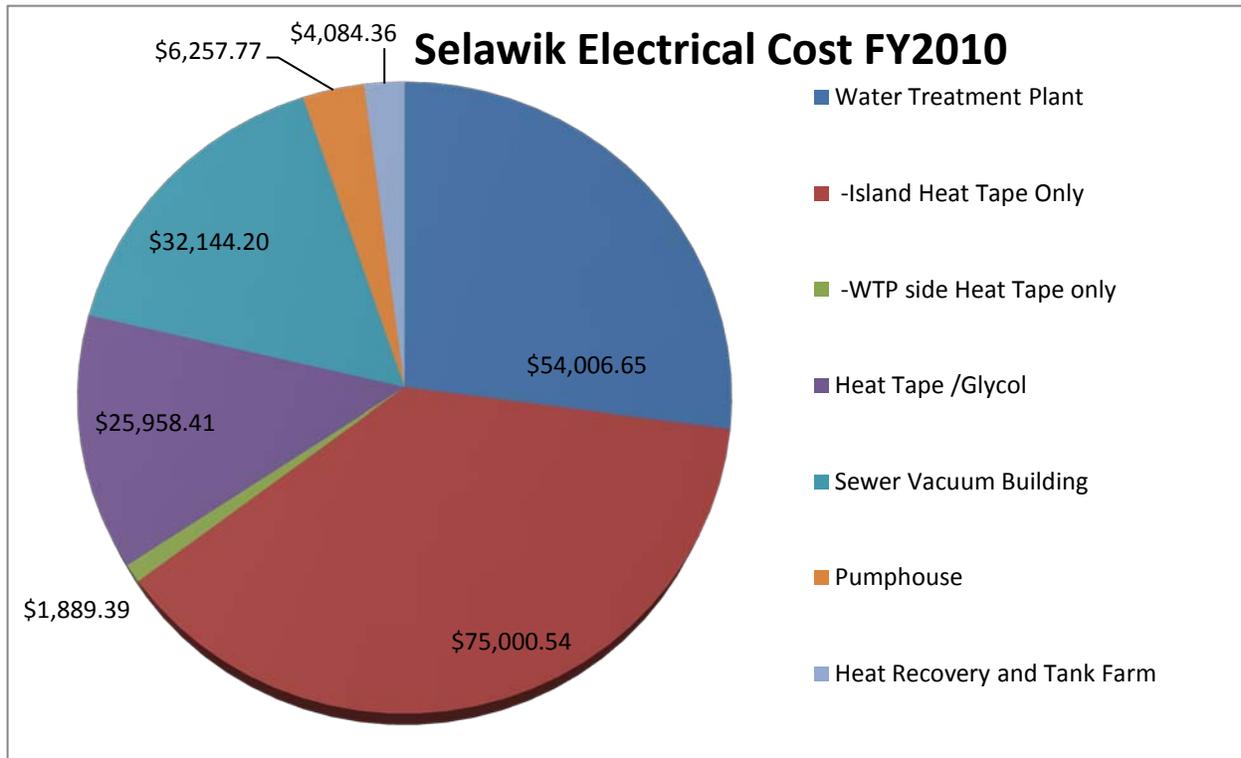


Figure 4.1.2 below is a breakdown of the electricity use at the water treatment plant. This breakdown was derived by measuring the individual loads over time.

The \$1,620 spent on operation of the city TV cable electrical equipment is a cost born by the WTP that should not be.

It is obvious from this chart that the \$25,383 annual operating cost of the vacuum pumps is a major portion (47%) of the water treatment plant electricity cost each month. Recommendations for reducing those costs are listed later in this report.

Recommendations will also be made on how to reduce the annual lighting cost of approximately \$2,700.

Figure 4.1.2

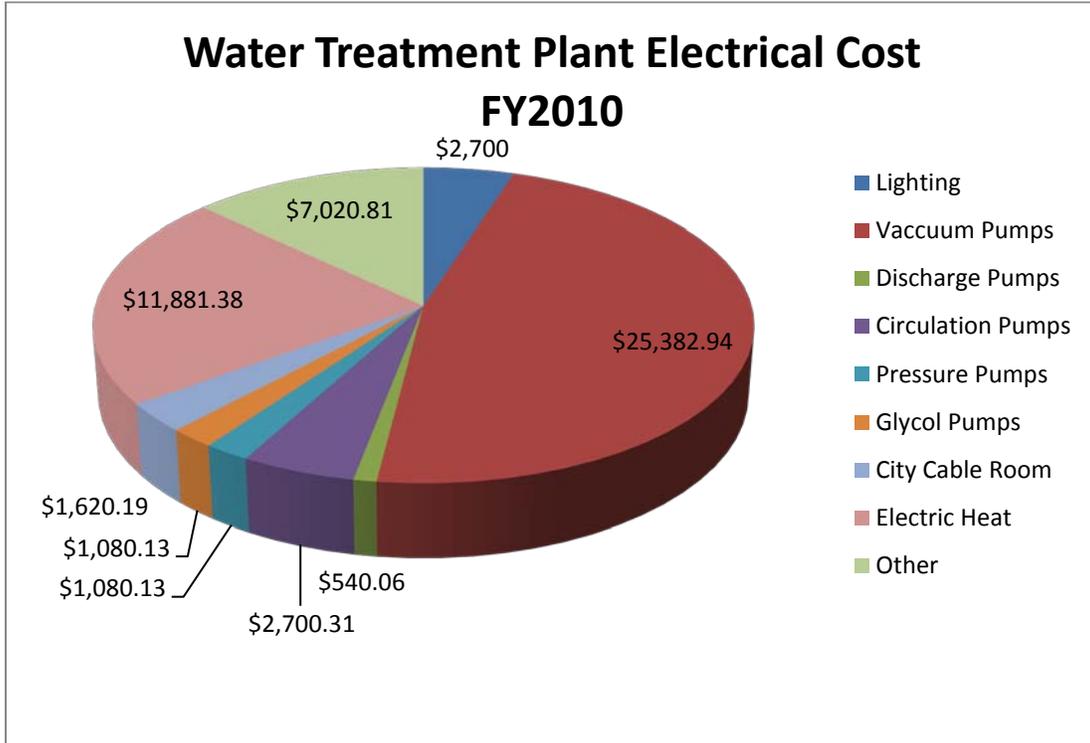


Figure 4.1.3 below is a breakdown of the operating costs of the Island vacuum building. The same lighting and vacuum pump comments made above apply to this plant as well.

Figure 4.1.3

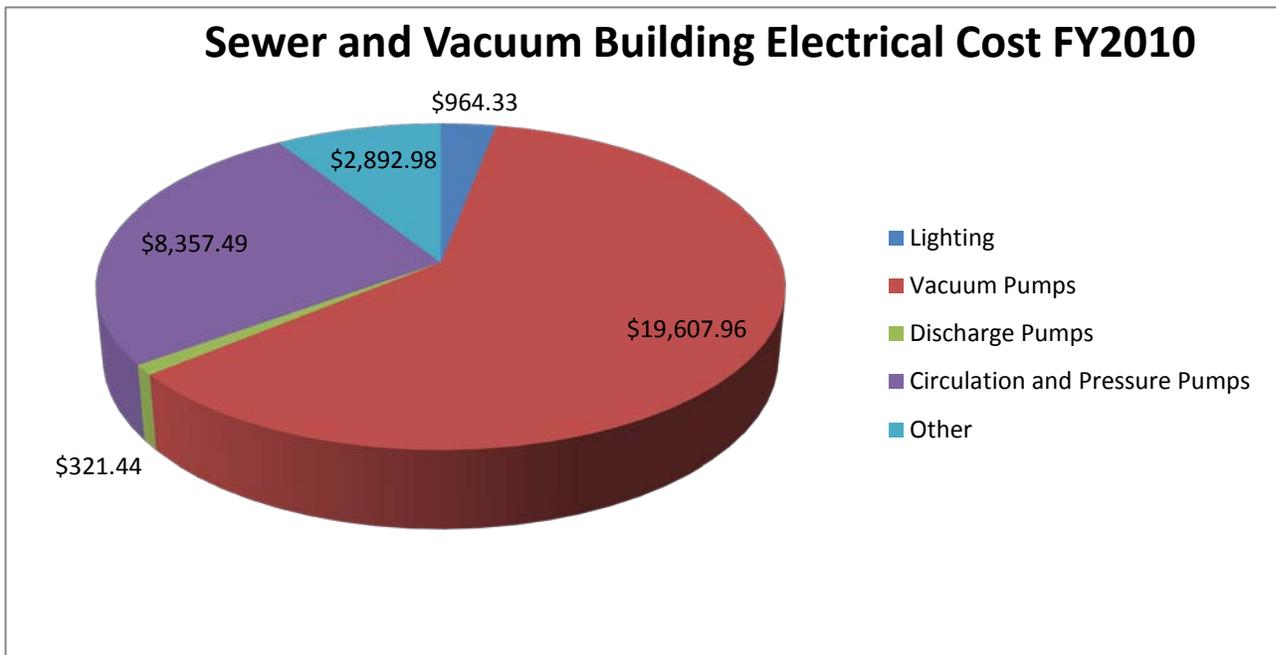


Figure 4.1.4 below is a breakdown of the heat tape used in the entire water and sewer system. As mentioned earlier, the cost of operating the heat tape was approximately \$102,849 in fiscal year 2010. This represents approximately 52% of the annual electricity costs and 39% of the total annual utility costs.

Later in this report, several recommendations are made to drastically reduce these costs.

Figure 4.1.4

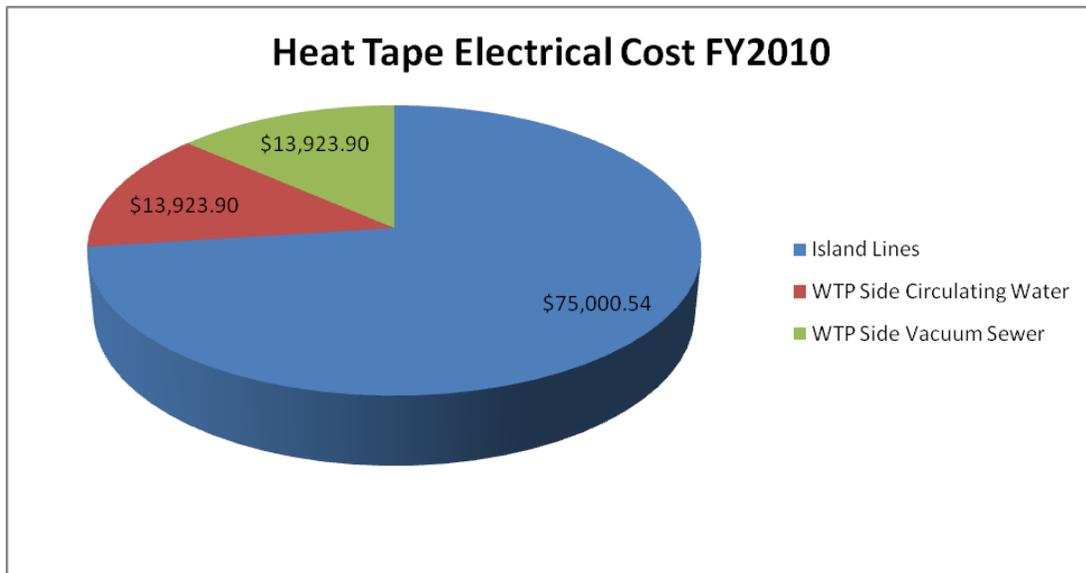
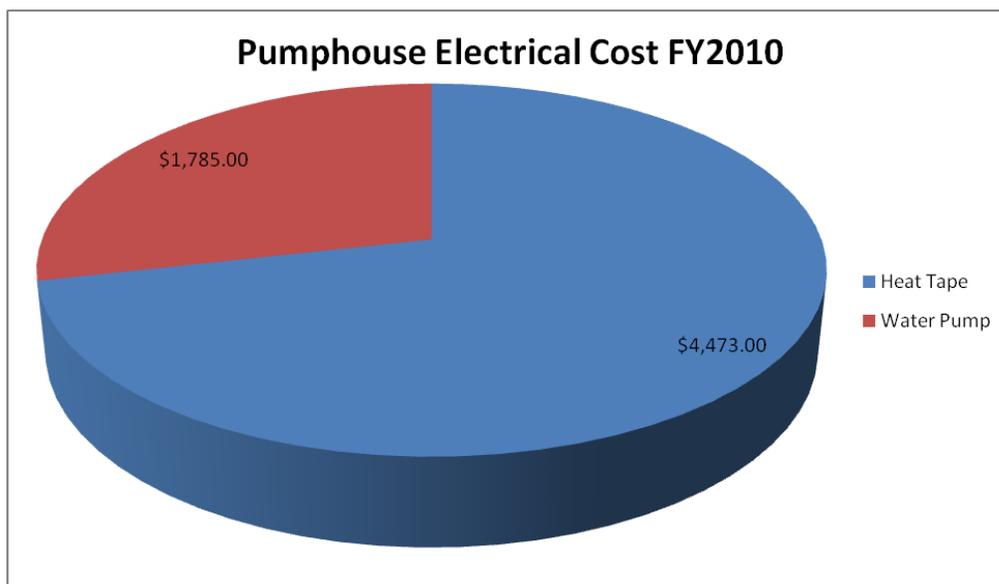


Figure 4.1.5 below is a breakdown of the electricity usage in the pump house. It is obvious that the heat tape loosely coiled in the bottom of the pump house is the major consumer of electricity.

This heat tape cost is not included in the above numbers because the recommendation for how to reduce the cost is different.

The \$4,473 used to heat the pump house represents 71% of the annual operating costs of the pump house. The remainder is used to operate the two horsepower pump that pumps the water from the river to the water treatment plant.

Figure 4.1.5



4.2 Fuel Use Summary

As mentioned earlier, the combined fuel use during fiscal year 2010 totaled approximately 15,595 gallons at a cost of approximately \$57,701. The average price per gallon of the fuel was approximately \$3.70. In addition it is estimated that the recovered heat used during this period was the equivalent of 5,125 gallons of fuel. Per the heat sales agreement with AVEC, the approximate value of the fuel is \$7,688. This results in a total consumption equivalent of approximately 20,720 gallons of fuel with a value of approximately \$65,390.

It should be noted that AVEC has not invoiced for the value of the recovered heat. It is included in this report because it is contractually owed and because it was actually used.

The following, Table 4.2 is a summary of the approximate fuel usage over time. It should be noted that parts of the table are estimated, especially the recovered heat. No accurate records exist for the actual amount of recovered heat used.

Table 4.2.1 – Fuel Use Summary

Month	WTP Gallons	WTP Recovered	WTP Total	Island Gallons	System Total
October	913		913	392	1,305
November	935	300	1,235	401	1,636
December	1,400	400	1,800	600	2,400
January	1,190	1,800	2,990	794	3,784
February	2,528	400	2,928	1,083	4,011
March	272	2,225	2,497	407	2,904
April	2,576	0	2,576	1,104	3,680
May	0	0	0	0	0
June	0	0	0	0	0
July	0	0	0	0	0
August	0	0	0	0	0
September	700	0	0	300	1,000
Total	10,514	5,125	15,639	5,081	20,720

The recovered heat from the AVEC power plant is only available at the water treatment plant. AVEC has estimated that the heat recovery system has the capacity to deliver the equivalent heat of approximately 17,000 gallons of fuel. During fiscal year 2010, the water treatment plant only used the equivalent of approximately 5,125 gallons of fuel. This is due to a combination of control issues, operator actions, and problems with the delivery system. The heat equivalent to one gallon of recovered heat costs (when invoiced) approximately \$1.50 versus the approximate \$3.70 per gallon of fuel purchased. If the use of the recovered fuel was maximized, the annual fuel cost would have been reduced by approximately \$26,125. This is derived by multiplying the difference in fuel cost of \$2.20 per gallon by the additional 11,875 equivalent gallons available.

In the water treatment plant, the heat is being used for the following purposes with the approximate percentage used and associated costs noted. Table 4.2.2 below is an approximation of where the heat was utilized in the water treatment plant. Please note that due to the lack of controls and historical data, this is an estimate based on typical usage and observations made during the audit.

Table 4.2.2 – Water Treatment Plant Fuel Usage

Where Used	Gallons	Percent of Total	Cost
Building Heat	2,344	15	\$6,988
Well Line Heat	1,565	10	\$4,660
Water Tank Heat	9,386	60	\$27,954
Vacuum Lines	2,344	15	\$6,988
Total	15,639	100	\$46,590

Energy conservation measures have been identified to reduce the consumption and cost of fuel in the water treatment plant and are discussed in detail in that section of the report.

In the island vacuum plant, the heat is being used for the following purposes with the approximate percentage used and associated costs noted. Table 4.2.3 below is an approximation of where the heat was utilized in the island vacuum plant. Please note that due to the lack of controls and historical data, this is an estimate based on typical usage and observations made during the audit.

Table 4.2.3 – Island Vacuum Plant Fuel Usage

Where Used	Gallons	Percent of Total	Cost
Building Heat	1,016	20	\$3,760
Add Heat Circ Lines	2,540	50	\$9,400
Water Supply Line	762	15	\$2,820
San. Discharge Line	762	15	\$2,820
Total	5,081	100	\$18,800

Energy conservation measures have been identified to reduce the consumption and cost of fuel in the island vacuum plant and are discussed in detail in that section of the report.

5. ENERGY CONSERVATION MEASURES

A large number of energy conservation measures (ECMs) have been identified that if implemented will have a major impact on the operating costs of the water and sewer systems in the City of Selawik. These measures are described on the following pages.

The recommendations, savings calculations and estimated implementation costs are derived from design information obtained from the original drawings and specifications, observations made during the on-site audit, discussions with plant operators, detailed measurements and monitoring done during the audit, review of historical consumption data, review of the heat recovery system, quotations and historical knowledge of both energy engineering and water treatment plants.

The ECMs are divided into the following three implementation categories.

Category 1. Those operational improvement ECMs that can be implemented by a combination of existing water plant operators, a remote maintenance worker, or a member of the ARUC staff during a normal visit. This category of ECM has little or no implementation cost.

Category 2. Those ECMs that do not require a design effort such as repairs, control improvements, and minor retro-commissioning that can be implemented by a small team consisting of an engineer or technician and an electrician and/or plumber in a time frame of 1 to 5 days. The implementation costs in this category assume that ECMs may be implemented during the same trip to Selawik where common trades are used and the total implementation time does not exceed one week for each trade person needed.

Category 3. Those ECMs that do require a design effort and/or require either an extended amount of time to implement and the talents of several technical disciplines.

It should be noted that this report does not include specific design instructions. It is not intended as a final design document and projects have not been developed to construction design level. The design professional or other persons following the recommendations shall accept responsibility and liability for the results. Budget for engineering and design of these projects is included in the cost estimate for each measure as needed.

Energy Conservation Measure #1

Eliminate Use of Heat Tape on Island Utilidors

Category 1

Description:

The water and vacuum sewer lines that serve all the connections on the island are within a common utilidor. By design, the utilidor is heated with the heat in the circulating water. The heat tape was installed and intended to only be used if for some reason the water and/or sewer lines froze and needed to be thawed. These heat tapes were left on the entire winter.

It is critical that the heat-add be properly controlled and set before this is implemented.

Savings Potential:

The heat tape for these lines is separately metered. Therefore, the exact consumption is known. This information was gathered from actual AVEC electric bills and is shown in Figure 4.1.1. A total of \$75,001 was spent to heat these utilidors with electric heat tape. The entire amount can be saved by making sure they are not used.

Implementation Cost:

There is no cost to implement this recommendation, the existing water plant operators can make sure the circuit breakers that feed this heat tape are shut off on each pole. We do recommend that the appropriate AVEC accounts be closely watched by ARUC to assure they are not turned back on. A clearly marked permanent label on each panel that feeds this heat trace may be appropriate. These labels can be implemented by either the water plant operators or the remote maintenance worker (RMW).

Simple Payback:

Since there is no implementation cost, the simple payback would be immediate.



Energy Conservation Measure #2

Isolate the Standby Boiler in the Water Treatment Plant

Category 1

Description:

Only one boiler is kept on-line at a time in the water treatment plant but both are kept hot. That is, the circulated glycol is split between the two boilers. This is inefficient because it overheats the boiler room, results in excessive convection and radiant losses to them boiler room, and it reduces the flow through the boiler that is in use reducing the overall efficiency of the hydronic system. This second boiler should be isolated by closing the supply and return valves on the boiler.

Savings Potential:

Although it would be very difficult to quantify the exact savings, the combination of radiant and convection losses would be a minimum of \$300 per year.

Implementation Cost:

Since all that is required to isolate the boiler would be to close the two valves, this ECM can be implemented by the water plant operators eliminating any implementation cost.

Simple Payback:

Since there is no implementation cost, the payback would be immediate.



Energy Conservation Measure #3

Eliminate Use of Heat Tape on Arctic Pipe Used for Water Loops

Category 2

Description:

The water lines that run from the water treatment plant, are within an insulated arctic pipe. By design, the arctic pipe is heated with the heat in the circulating water. The heat tape was installed and intended to only be used if for some reason the water line froze and needed to be thawed. These heat tapes were left on the entire winter. It was apparent during the audit that they are still on since the water leaving the water treatment plant was colder than the water returning from the loop.

Savings Potential:

The heat tape for these lines is fed from the same meters that are used to feed the heat tape for the sewer lines that in nearby arctic pipe. The combined consumption for both sources is known because it is metered. This information was gathered from actual AVEC electric bills. Figure 4.1.4 shows the annual consumption as \$13,924 for the water line heat tape. This amount assumes that the breakdown between the water line heat tape and the sewer line heat tape is approximately equal. That should be the case since all breakers are on.

Implementation Cost:

It is recommended that either an electrician or other qualified individual such as an engineer determine which breakers feed the water lines and which breakers feed the sewer lines and clearly mark them. The breakers that feed the water lines should then be shut off. It is estimated that this effort could be accomplished in four days, one of those in the office researching the meters and preparing the labels, one day traveling to Selawik, one day on site identifying and marking the loads and training the operators, and a day traveling back to Anchorage. The implementation cost would then be as follows.

Office Work	\$1,000
Materials	\$ 200
Travel, Travel Time, Per Diem and Lodging	\$3,350
On-Site Work	\$1,000
Total	\$5,550

Simple Payback:

The simple payback would be the cost divided by the saving or $\$5,550/\$13,924 = 0.4$ Years.



Energy Conservation Measure #4

Re-Commission the Pump House Heating System

Category 2

Description:

The heat tape that is used to keep the pump house above freezing so the raw water can be pumped from the river to the water treatment plant is just a large coil of heat tape in the bottom of the pump house with no controls on it. During the audit the pump house was approximately 80 degrees when the outside temperature was zero. The existing glycol heater and back-up electrical heater should be repaired, put back into operation, and the heat tape removed.

Savings Potential:

The pump house is separately metered. As illustrated by Figure 4.1.5, the total consumption of the water pump and the heat tape is \$6,258 annually. The pump is 2 horsepower and based on both records and operator discussions, it operates approximately half of the available hours. This results in an annual operating cost of \$1,785. The difference between the \$6,258 annual usage for the total meter and the pump operating cost of \$1,785 is the \$4,473 operating cost of the uncontrolled heat tape. A conservative estimate is that 60 percent of the operating cost could be eliminated by installing a heater designed for the application that is properly controlled. The result would be an operating cost in the range of \$1,789 and therefore an annual savings of approximately \$2,684.

Implementation Cost:

The controls on both the glycol heater and the electric back-up need to be re-commissioned and the excess heat tape removed. These tasks will require the skills of an electrician and would require a total of five days to implement. One of those days preparing in the shop, one day traveling to Selawik, two days implementing the ECM on site, and one day traveling back to Anchorage. It is assumed that this ECM would be implemented at the same time as ECM #1 and guidance would be provided by that engineer. The implementation cost would then be as follows:

Preparation work in shop	\$1,000
Materials	\$ 500
Travel, Travel Time, Per Diem and Lodging	\$3,350
On-Site Work	\$2,000
Total	\$6,850

Simple Payback:

The simple payback would be the cost divided by the savings or $\$6,850/\$2,684 = 2.5$ Years.



Energy Conservation Measure #5

Maximize Use of Recovered Heat in the Water treatment Plant

Category 2

Description:

The heat available for recovery from the AVEC power plant was determined by AVEC to be the equivalent of approximately 17,000 gallons of fuel. At present, the equivalent of approximately 5,125 gallons are being recovered. The necessary operational and control improvements should be made to maximize the use of recovered heat.

Savings Potential:

As discussed in Section 4.2 of this report, the cost of purchased fuel is \$3.70 per gallon while the cost of recovered heat is the equivalent of approximately \$1.50 per gallon (if invoiced). The additional heat available for recovery is equivalent to approximately 11,875 gallons. At the price difference of \$2.20 per gallon, that would result in a savings of approximately \$26,125.

Implementation Cost:

Two issues need to be corrected to maximize the use of recovered heat. The first is the temperature sensor that controls the variable speed drive (VSD) on the pump for the recovered heat system needs to be replaced to allow the VSD to properly control the pump. The second is that the controls between the boiler need to be set up such that the operator can't easily set the boiler operating temperature higher than the recovered heat temperature. The temperature sensor required is inexpensive and a relatively inexpensive boiler controller can be installed to properly sequence the heat recovery system and the boilers. A mechanical engineer will be required to determine what improvements are appropriate, and an electrician to implement them under the direction of the engineer. The implementation cost would then be as follows:

Engineering Office Work – 5 Days	\$5,000
Material	\$2,000
Electrician Shop Work – 2 Days	\$2,000
Travel, Travel Time, Per Diem, and Lodging for 2 People	\$7,800
On-Site Work – 4 days for 2 people	\$8,000
Total	\$24,800

Simple Payback:

The simple payback would be the cost divided by the savings or $\$24,800/\$26,125 = 0.9$ Years.



Energy Conservation Measure #6

Replace Water Tank Heat Add Controls

Category 2

Description:

The controls used to add hydronic heat to the water tank are inoperable or need to be replaced. The heat exchanger that heats the water tank has no operable control and presently controlled manually. During the audit, the tank temperature was 54 degrees Fahrenheit, a minimum of 10 degrees higher than it needed to be.

Savings Potential:

The improvements necessary to maximize the use of recovered heat should be implemented prior to this recommendation. Therefore, the new cost of providing hydronic heat to the water treatment plant would be approximately \$20,465. As illustrated in Table 4.2.2, approximately 60 percent of the heat used in the water treatment plant is used to heat the water in the tank and approximately 40% of that can be saved by reducing over-heating of the tank water. Ignoring the savings potential in the well raw water line and the vacuum sewer lines, the savings would conservatively be 40 percent of the new cost to heat the tank water (\$12,279) or \$4,912.

Implementation Cost:

The tank heat add can be made operational by replacing the existing temperature controller and solenoid. This effort would require some planning in Anchorage, purchase of the materials, traveling to Selawik, and installing and testing the new controls. The estimated cost would be as shown below:

Materials	\$1,500
Travel, Travel Time, Per Diem and Lodging	\$3,350
On-Site Work	\$1,000
Total	\$5,850

Simple Payback:

The simple payback would be the cost divided by the savings or $\$5,850/\$4,912 = 1.2$ years.



Energy Conservation Measure #7

Reconfigure the Heat Add System in the Island Vacuum Plant

Category 2

Description:

The heat add system for the circulating water loop on the island presently measures the water temperature after the heat is added instead of before. As a result, there are times when the leaving temperature is higher than it needs to be. The heat-add system should be reconfigured to measure the temperature of the water returning from the loop and adding heat as required.

Savings Potential:

As shown in Table 4.2.3, the heat-add load is approximately half the total load on the island vacuum plant boilers. This results in a current operating cost of the added heat of approximately \$9,400. Lowering the temperature to 45 degrees would save a minimum of 15 percent of the estimated \$9,400 present operating cost. This would be a savings of at least \$1,410.

Implementation Cost:

Implementing this improvement would require the addition of a new well in the return line and the purchase and installation of a new controller. This effort would best be accomplished by a plumber. The controller would need to be purchased, a trip made to Selawik, the required piping changes made and the controller installed and tested. The implementation cost would then be as follows:

Shop Work	\$1,000
Materials	\$1,000
Travel, Travel Time, Per Diem, and Lodging	\$3,350
On-Site Work	\$1,000
Total	\$6,350

Simple Payback:

The simple payback would be the cost divided by the savings or $\$6,350/\$1,410 = 4.5$ years.



Energy Conservation Measure #8
Replace Interior Lighting in Both Buildings

Category 2

Description:

The lighting in both the water treatment plant and the island vacuum plant is almost entirely four lamp, four foot, fluorescent fixtures with energy efficient T12 lamps and energy efficient magnetic ballasts. These fixtures should be retrofitted by eliminating the ballasts and installing new LED lamps.

Savings Potential:

The water treatment plant has a total of 74 fixtures and the island vacuum plant has 24 fixtures for a total of 98 fixtures. The annual operating cost of these fixtures based on operating hours supplied by the operators, is \$4,881. If all of these fixtures are retrofitted by eliminating the ballasts and installing LED lamps, the annual operating cost will be reduced to approximately \$1,943. This would result in an annual savings of \$2,938.

Implementation Cost:

The retrofit would best be implemented by an electrician. RS Means estimates that the retrofit time would be 0.61 hours per fixture. This would result in the following implementation cost:

Shop Work	\$1,000
Materials	\$10,780
Shipping to Selawik	\$1,200
Travel, Travel Time, Per Diem, and Lodging	\$4,800
On-Site Installation	\$7,500
Total	\$25,280

Simple Payback:

The simple payback would be the cost divided by the savings or $\$25,280/\$2,938 = 8.6$ years.



Energy Conservation Measure #9

Re-Commission the Vacuum Pumps

Category 2

Description:

During the on-site visits, it became obvious that the vacuum pumps in both facilities are not operating per the original recommendations of the manufacturer. Both the pump staging (lead/lag) settings between the primary and secondary pumps as well as the absolute on and off set points should be adjusted to reduce run times. This should be done with the input of the manufacturer. The manufacturer also recommends an alarm be added on each set of pumps to alert operators of excessive run times.

Savings Potential:

Discussions with the manufacturer have indicated that the run times are excessive and that some of that is due to attempting to reach higher than necessary vacuum levels and improper on/off settings between the lead and lag pumps. The pump load is linear in the vacuum level range we are operating so any decrease in the set point will result in savings. The addition of an alarm on each set of pumps will alert the operators to excessive run times due to leaks. In discussions with the manufacturer, he stated that a 10% savings in power consumption would be a very conservative estimate of what we should expect from a combination of the addition of the alarm and re-commissioning the pump controls.

Figures 4.1.2 and 4.1.3 show the vacuum pump operating cost of the water treatment plant and the island vacuum plant as \$25,383 and \$19,607 respectively for a total vacuum plant operating cost of \$44,990. Ten percent of this would be \$4,499.

Implementation Cost:

The manufacturer has stated that most of what we need to implement an excessive run time alarm in each of the plants is already built into the controls. An estimate of \$500 each for materials to implement the alarms should be adequate. The actual re-commissioning would require an on-site visit by an engineer for a few days and additional coordination with the manufacturer. The approximate implementation cost of this ECM would be:

Office Work and Coordination with Manufacturer	\$2,000
Materials	\$1,000
Travel, Travel Time, Per Diem, and Lodging	\$3,675
On-Site Work	\$3,000
Total	\$9,675

Simple Payback:

The simple payback would be the cost divided by the savings or $\$9,675/\$4,499 = 2.2$ years



Energy Conservation Measure #10

Separately Meter the Cable TV Equipment

Category 2

Description:

At present, the power for the City of Selawik operated cable TV operation is being paid for through the water treatment plant meter. This equipment should either be relocated to a separate building or separately metered.

Savings Potential:

As part of the on-site portion of the energy audit, we metered the consumption of the four circuits that feed the cable TV equipment and have calculated that they consume approximately 500 kilowatt-hours per month or 6,000 kilowatt-hours per year. At the average rate of \$0.27 per kilowatt-hour, the annual savings would be \$1,620.

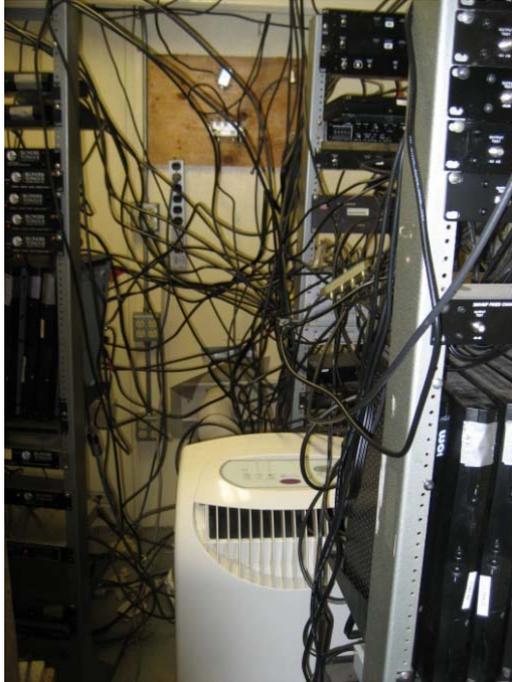
Implementation Cost:

Separating the cable TV load would require bringing a new service to the building, installing a meter socket and meter, installing a new panel, and relocating the four circuits to the new panel. This ECM would be best implemented by an electrician. It is estimated that approximately \$1,500 in materials would be required. The implementation cost would be as follows.

Shop Work	\$1,000
Materials	\$1,500
Travel, Travel Time, Per Diem, and Lodging	\$3,900
On-Site Work (4 Days)	\$4,000
Total	\$10,400

Simple Payback:

The simple payback would be the cost divided by the savings or $\$10,400/\$1,620 = 6.4$ years.



Energy Conservation Measure #11

Eliminate Use of Electric Heaters in Washeteria and Rest Room

Category 2

Description:

The old washeteria and the nearby restroom are being heated with portable electric heaters. The restroom heater has a capacity of 1,500 watts and the washeteria heater has a capacity of 15,000 watts. These heaters should be removed and the plant hydronic heating system modified to heat both areas with hydronic heat.

Savings Potential:

The water plant operators say the electric heat is only used on cold days. A review of the electrical consumption of the water treatment plant over throughout the year indicates that the usage increases significantly during the winter. Approximately 66,930 total additional kilowatt-hours are used in the winter months. Certainly not all of these kilowatt-hours are used by the heaters since there is a small amount of heat tape fed from the water treatment plant and the boilers run more. Also, we would be replacing the expensive electric heat with less expensive fuel or recovered heat but this heat is not free. A conservative savings estimate of \$800 per year appears appropriate.

Implementation Cost:

Installing a new unit heater fed from the existing hydronic heating loop would allow the electric heaters to be eliminated. This ECM would be best implemented by a plumber and would require specification by an engineer in the office. The implementation cost would be:

Engineering Office Work	\$1,000
Plumber Shop Work	\$1,000
Materials	\$1,200
Travel, Travel Time, Per Diem, and Lodging	\$3,450
On-Site Work and Testing	\$2,000
Total	\$8,650

Simple Payback:

The simple payback would be the cost divided by the savings or $\$8,650/\$800 = 10.8$ years.



Energy Conservation Measure #12

Reduce the Building Shell Leaks in the Island Vacuum Plant

Category 2

Description:

During the blower door test and thermal imaging of the Island Vacuum Plant, several large building leaks were identified that should be repaired. The worst were the intake and exhaust dampers for the emergency generator, the fresh air damper for the building, and the draft damper for the #2 boiler. All of these should be repaired.

Savings Potential:

From Table 4.2.3, the approximate total cost to heat the island vacuum plant is \$3,760. This is a heating cost per square foot of approximately \$3.36 which indicates that the losses through these leaks are significant. A 15% reduction in the overall heating cost would be a conservative estimate. This would be an annual savings of approximately \$564.

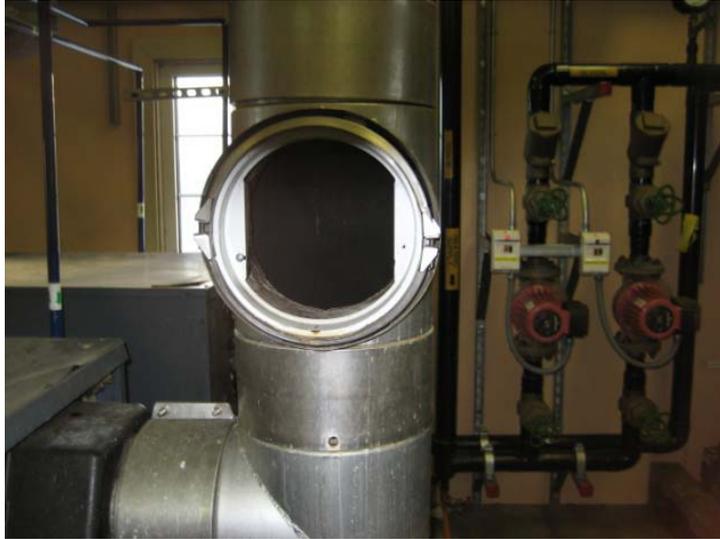
Implementation Cost:

None of the dampers need to be replaced except the draft damper on boiler #2. The rest can be repaired. This ECM would best be implemented by a technician. The approximate cost for implementation would be as follows.

Shop Work	\$1,000
Materials	\$200
Travel, Travel Time, Per Diem, and Lodging	\$3,350
On-Site Work	\$1,000
Total	\$5,550

Simple Payback:

The simple payback would be the cost divided by the savings or $\$5,550/\$564 = 9.8$ years.



Energy Conservation Measure #13

Replace Water Treatment Plant Heat Add Controls

Category 3

Description:

The controls used to add hydronic heat to the well raw water line and the vacuum glycol lines are all either inoperable or need to be remounted to accurately sense the temperature of the liquid they should be measuring. The controller for the heat exchanger that heats the glycol line for the well water is inappropriate for the sensor well and was measuring water plant ambient temperature. The same was true of some of the vacuum glycol controllers. All of these controllers need to be replaced or at a minimum re-commissioned.

Savings Potential:

The improvements necessary to maximize the use of recovered heat and the replacement of the water tank add-heat controller should both be implemented prior to this recommendation. Therefore, the new cost of providing hydronic heat to the water treatment plant would be approximately \$15,553 (\$20,465 - \$4,912). Approximately 25% or \$3,888 of this could be eliminated by re-commissioning the controls. In addition, the approximately \$13,924 in heat tape usage for the sewer lines could be replaced with hydronic heat at a cost of approximately \$4,594 for an additional savings of approximately \$9,330 (\$13,924 - \$4,594). This would be a total savings of approximately \$13,218.

Implementation Cost:

The most cost effective method of replacing the controllers would be to purchase and install new controllers that could use the existing sensor wells. Four new controllers would be required at a total cost of approximately \$2,000. In addition, additional expansion tank capacity would be required on the sewer lines and the well heat add loop. This ECM would require both an engineering design effort and a fairly sophisticated installation crew that included a superintendent, plumber, and electrician. The approximate implementation cost would be as follows:

Design Engineering	\$20,000
Controls and Expansion Tanks	\$15,000
Travel and Travel Time	\$9,000
On-Site Work (3 Men for 3 Weeks)	\$76,500
Total	\$120,500

Simple Payback:

The simple payback would be the cost divided by the savings or $\$120,500/\$13,218 = 9.1$ years.



Energy Conservation Measure #14

Replace Boilers and Hydronic Circulation Pumps

Category 3

Description:

The boilers and associated hydronic circulation pumps were sized and installed when the washeteria was functional. The washeteria is no longer used and will not be used in the future. As a result, the boilers are significantly oversized as are the circulation pumps, associated piping, and hot water heater. The controls on this equipment are such that it is kept hot at all times. All of this equipment should be replaced with appropriately sized equipment that is only operated on an as needed basis.

Savings Potential:

The combination of appropriately sized boilers, reducing the size of the hot water heater significantly, replacing the oversized heat piping and only running the system on a call for heat will reduce fuel oil consumption by approximately 5,000 gallons per year. At the expected price of fuel of \$5.00 per gallon, this would result in a savings of approximately \$25,000 per year.

Replacing the 1.5 horsepower hydronic heat circulation pumps with new high efficiency pumps with variable speed drives will reduce electrical consumption by approximately \$3,000 per year. This results in a total annual savings of approximately \$28,000 per year.

Implementation Cost:

This ECM would require both an engineering design effort and a fairly sophisticated installation crew that included a superintendent, plumber, and electrician. The approximate implementation cost would be as follows:

Design Engineering	\$50,000
Boilers and associated materials (Includes Shipping)	\$68,500
Travel and Travel Time	\$12,000
On-Site Work	\$149,000
Total	\$279,500

Simple Payback:

The simple payback would be the cost divided by the savings or $\$279,500/\$28,000 = 10.0$ years.



Existing Boiler

Areas for Further Study

Reduce the Vacuum Settings on the Vacuum Pumps and Develop a Leak Program

Discussions with the manufacturer of the vacuum pumps indicated that there is potentially significant savings potential on the two vacuum sewer systems. However, the time to perform the on-site testing and analysis is beyond the scope of this energy audit. It is recommended that additional discussions with the manufacturer of the pumps and additional testing take place to quantify savings achievable by a combination of reducing the vacuum levels to those minimally acceptable to reduce operating costs. It is also recommended that a leak detection and repair program be developed and put in place to minimize vacuum pump operating costs.

Confirm that the Power Cost Equalization Allocation is Correct

Analysis of the historical electric bills clearly illustrate that the power cost equalization limits were exceeded on a regular basis during the winter months on several accounts. A more detailed analysis and discussion with the electric company on the exact method used to allocate the kilowatt-hours available under power cost equalization is warranted but beyond the scope of this energy audit. It is recommended that due to the major impact this allocation has on the monthly electric bills, it be clearly understood and maximized to the extent possible.

ANTHC Heat Recovery Update February, 2012

Rural Western and Northern Alaska are among the most economically depressed regions of the State and experience some of the highest energy costs in the nation. The energy to operate water systems in the villages in these regions is derived primarily from fuel oil. Water and wastewater systems consume up to 30% of these villages' total energy consumption. In 2010 ANTHC developed an energy audit and waste heat recovery program to address the issue of high energy use and cost for rural water and wastewater systems. Energy audits of water and wastewater systems examine ways of reducing the energy used by these systems. The waste heat recovery program seeks to identify and implement waste heat recovery as a readily available renewable energy solution to high cost energy.

To date DEHE has conducted 16 audits of water systems. On average, the audits have discovered ways of achieving 50% energy savings with an investment promising a simple pay back of 10 years or less. Many of the energy conservation measures (ECMs) recommended in our audits are fairly simple operational changes or completion of deferred maintenance.

The largest single energy saving ECM, where feasible, is the implementation of waste heat recovery from the village's diesel power generation plants. Heat recovery works similarly to an automobile heating system, namely, it uses heat from the diesel engine's cooling system to heat water in the water plant, or building space. When the water infrastructure is near the power plant, waste heat can be used to offset much or all of the fuel oil required to heat the water system.

DEHE has been actively working with the Alaska Energy Authority, EPA, and Power Producers to fund and implement heat recovery projects in 2011 and 2012. To date, four heat recovery projects have been recently completed and 7 more are in development.

Below is a summary table of recent and on-going work and estimated savings:

Village	Approximate Cost of Improvement	Energy Savings (Annual Gallons of Fuel)	Annual Cost Savings (DCCED fuel price report January, 2012)	Present Value of Lifetime Savings (20 years, 3.5% real cost increase of fuel)	Status
Minto *	\$ 200,000	11,000	\$ 55,550	\$ 1,698,000	Complete
Allakaket	\$ 463,000	7,300	\$ 45,041	\$ 1,370,000	Complete
Kwigillingok	\$ 50,000	4,500	\$ 29,025	\$ 858,200	Complete
Goodnews Bay	\$ 500,000	5,000	\$ 26,500	\$ 1,732,900	Complete
McGrath	\$ 200,000	6,000	\$ 44,820	\$ 1,319,200	Construction
Savoonga	\$ 350,000	9,000	\$ 50,490	\$ 1,477,200	Design
Selawik	\$ 50,000	11,875	\$ 73,268	\$ 2,157,000	Design
Shungnak	\$ 576,000	10,400	\$ 64,168	\$ 1,889,400	Design
Ambler	\$ 435,000	10,300	\$ 63,551	\$ 1,871,200	Construction
Sleetmute	\$ 150,000	2,068	\$ 15,199	\$ 450,000	Planning
Russian Mission	\$ 300,000	2,200	\$ 12,650	\$ 375,500	Planning
Totals	\$ 3,274,000	81,843 gal	\$ 491,058	\$ 15,198,700	

*As of the second week of February, 2012, Minto reports that the fuel oil boilers have not yet had to be fired.