Energy Assessment Report for

County of Kauai

Waimea Wastewater Treatment Plant

U.S. Environmental Protection Agency Region 9
Waimea WWTP is located at 9275 G
Kaumualii Highway, Waimea, Hawaii

April 7, 2010

SECTION 1
Executive Summary

Under contract to USEPA, Tetra Tech Inc., (Tetra Tech) performed a site energy assessment of the Waimea Wastewater Treatment Plant (WWTP) facility. The facility is located on the island of Kauai at 9275 G. Kaumualii Highway, Waimea, Hawaii. Representatives from the Waimea WWTP provided access to the facility and they also provided valuable information and data on the Wastewater Plant operations including site energy use, equipment, systems, and operations.

Based on observations during the assessment, energy conservation opportunities (ECO) were identified and are summarized in Table 1-1.

Table 1-1: Summary of Energy Conservation Opportunities at the Waimea WWTP

ECO No.	Recommendation	Potential Energy Reduction (kWh/yr)	Potential Demand[1] Reduction (kW)	Potential Water Reduction (Gal/yr)	Potential Cost Savings ($/yr)	Estimated Implem. Cost ($)	Simple Payback (Years)
Investment Grade Measures							
1	Lighting System Improvements	9,140	3	0	$2,650	$7,000	2.6
2	Effluent Pumping System Improvements	8,000	10	0	$2,320	$17,500	7.5
3	Replace Lower Efficiency Motors With Higher Efficiency Motors	9,600	5	0	$2,800	$23,000	8.2
4	Install New Direct Drive, Higher Efficiency Blowers With Automated Process Controls	34,000-84,000	>6	0	$9,900-$24,400	$99,000-$244,000	10.0
Total Potential Electrical Energy Savings		**60,740-110,740 kWh/yr**					
Total Potential Electrical Demand Savings			**24 kW**				
Total Potential Water Savings				**0 Gal/yr**			
Total Potential Cost Savings					**$17,670-$32,170 $/yr**		
Total Estimated Implementation Cost						**$146,000-$291,500**	
Total Simple Payback							**8.3-9.1**

Table 1-1 Notes:

1. Potential Demand Reduction (kW) = Estimated billing demand reduction.

ECO	Energy Conservation Opportunity
kWh/yr	Kilowatt-hours per year
kW	Kilowatts
Gal/yr	Gallons per year
$/yr	Dollars per year

ECO No. 1. Replace current lighting technologies with higher efficiency lighting technologies.

ECO No. 2. Replace lower efficiency motors with higher efficiency motors in addition to completing a more detailed assessment of all motors at the plant prior to final equipment selection and implementation.

ECO No. 3. Convert the constant speed effluent pumping system to a variable flow pumping system (Variable Frequency Drive "VFD" equipped pump) and modify the control strategy to allow the smaller horsepower effluent pumps to operate over a wider range of level.

ECO No. 4. Replace existing constant speed, belt driven, lower efficiency blowers and motors, and manual controls with new direct drive, higher efficiency blowers and motors, and automated controls.

TABLE OF CONTENTS

SECTION 2
Introduction

In 2009, Congress passed the American Recovery and Reinvestment Act (ARRA) which contains funding for Environmental Protection Agency (EPA) Region 9 States (AZ, CA, HI, NV), federally recognized Tribes, and Island Territories (America Samoa, Commonwealth of the Northern Marianas Islands, Guam) (States) to construct water infrastructure. ARRA promotes sustainable water infrastructure practices by requiring 20% of the funding to be directed to energy efficiency, water efficiency, green infrastructure, and/or other innovative environmental projects through the Green Project Reserve (GPR). GPR projects are identified on each State's Intended Use Plan, workplan, or Interagency Agreement developed specifically for the funding received under ARRA.

This report was prepared by Tetra Tech in support of EPA Region 9 Water Division in implementing the GPR requirements of ARRA. Mr. Donald King and Ms. Kim Williams conducted the field audits, analyzed site data and drafted the following report under project manager, Victor D'Amato. The EPA Region 9 provided for the Energy Assessments at four Wastewater Treatment Plants (WWTP) on the islands of Hawaii. Those sites selected for evaluation included:

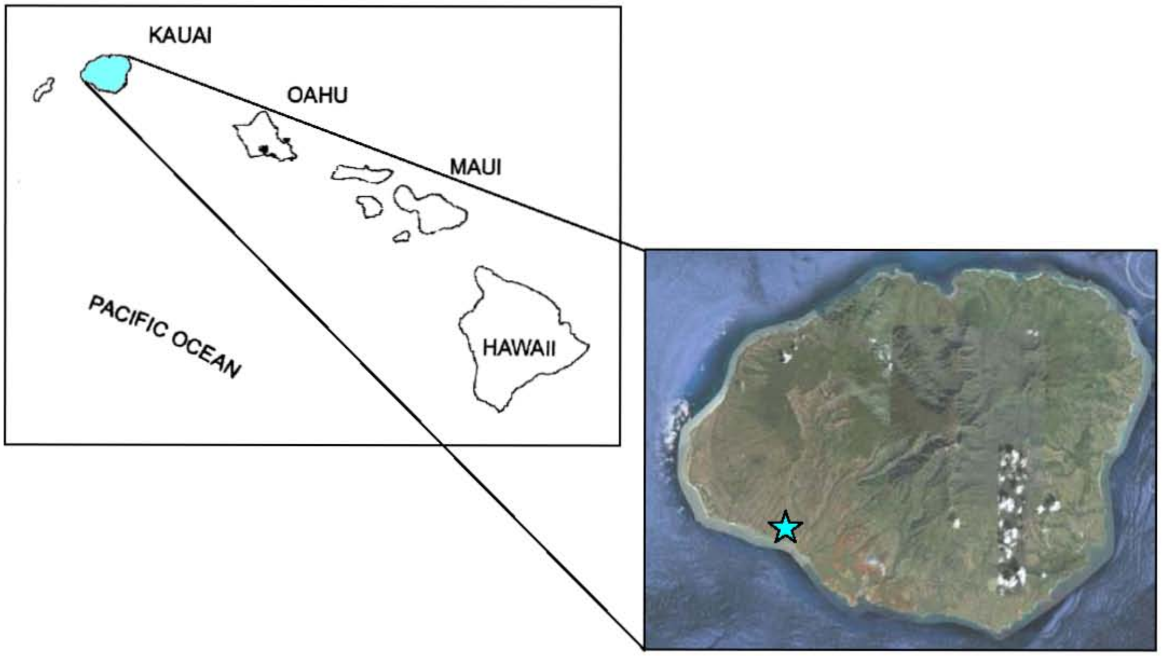
- Hilo WWTP – located on the island of Hawaii.
- Kailua WWTP – located on the island of Oahu.
- Kihei WWTP – located on the island of Maui.
- Waimea WWTP – located on the island of Kauai.

SECTION 3
Wastewater Treatment Plant Description

Location

The Waimea Wastewater Treatment Plant is located at, 9275 G. Kaumualii Highway, Waimea, Hawaii. As shown in Figure 3-1, the facility is located on the southwest shore of the Island of Kauai.

Figure 3-1: WWTP Island Vicinity Map



The facility is located just northwest of downtown Waimea on the north side of State Highway 50. Figure 3-2 provides a vicinity map of the area and the treatment plant location.

Figure 3-2: WWTP Island Vicinity Map

The WWTP is comprised of three process areas, including the primary, secondary treatment, and the solids handling areas. The effluent is disinfected and reused at the nearby agricultural operations. Back-up effluent disposal is provided at several injection wells located at the treatment plant. The facility has a waste discharge permit.

The service area sewage is collected and conveyed to the Waimea WWTP via a series of gravity systems and pump stations. The facility was constructed in 1972-1973.

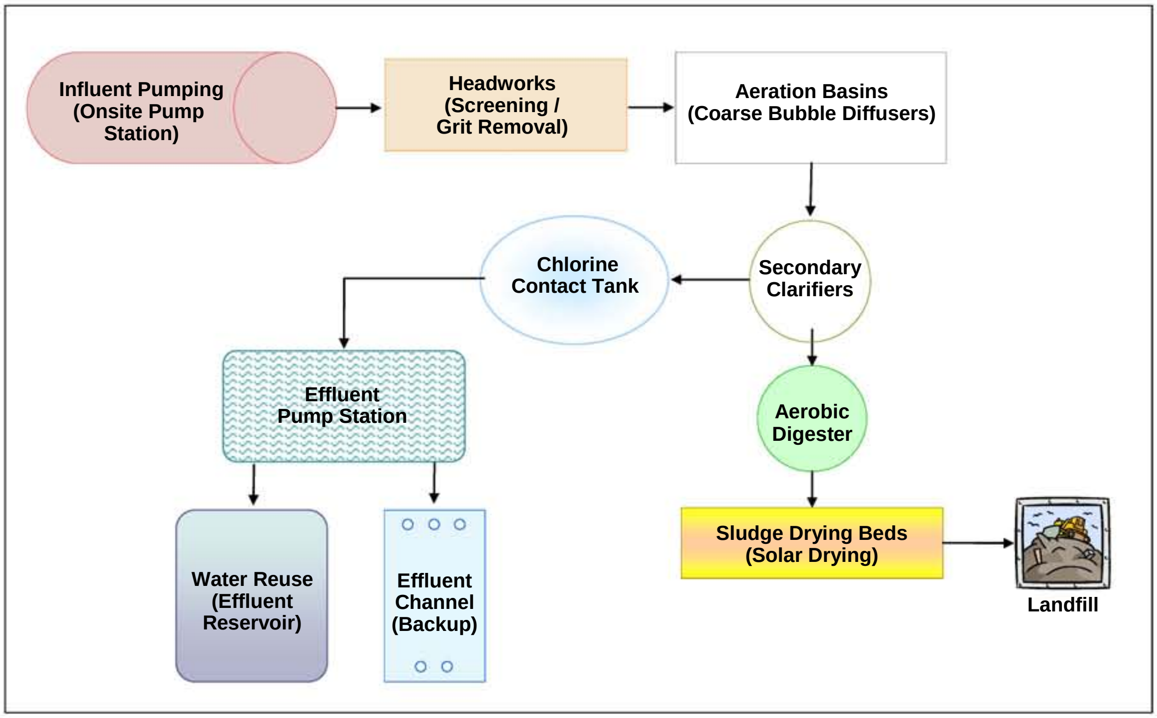
WWTP Operating Schedule

The plant maintains a staff of approximately 3 full-time operators during the week. Daily operations typically run between the hours of 7:00 a.m. and 3:30 p.m., Monday through Friday. The site is also staffed with approximately half the employees loading on one shift for Saturday and Sunday. Operators are on standby during the evening hours.

WWTP Process

The existing treatment plant has a design capacity of 0.30 million gallons per day (MGD) with a peak hourly maximum of 0.50 MGD. Currently, the facility is operating at 0.25 MGD. Figure 3-3 provides a schematic of the major treatment processes and plant flow. Waimea is designed for Conventional Activated Sludge secondary treatment.

Figure 3-3: Plant Flow Diagram



The wastewater is pumped to the headworks of the facility from Pump Station A. Pump Station A is powered from the plant main control panel and is included in the overall plant electrical load. Currently, the headworks screening and grit removal processes are out of operations pending construction of the new water reclamation plant.

The flow continues to the course aeration basins. The aeration air is provided by an air blower room with three constant speed blowers. The aeration air is set manually. Biomass laden wastewater is conveyed via channel to the final settling clarifiers. The secondary clarifiers allow a quiescent period of approximately 2-hours for biomass settlement. Approximately 90% of the biomass is pumped back to the aeration basins as return activated sludge (RAS) and a small portion, approximately 10% is pumped to the aerobic digesters as waste activated sludge (WAS).

Secondary effluent flows to the chlorine contact basins for chlorine addition. Disinfected effluent is pumped to an off-site reservoir and storage.

In the event the effluent pump station fails, or the reclaim water reservoir and distribution system is at maximum storage capacity, the fail-safe disposal method is via an on-site injection well.

Solids (WAS) from the secondary clarifiers are pumped to an aerobic digester where process air is continuously added via aeration blowers (part of the aeration blower manifold). The agitation/mixing air is provided and the volatile solids reduced prior to dewatering.

After the sludge has been digested, a stabilized sludge is pumped via engine driven pump to the solar drying beds. The sludge is dried and sent to the local landfill for disposal.

The facility is equipped with various support systems including: plant air, plant water, an administration and maintenance building, emergency power, and chemical handling.

The main energy users within the facility are the aeration blower, influent and effluent pumping.

Footnote:
A new water reclamation facility is in the construction phase and will include a comprehensive reconstruction and expansion of the treatment plant. In addition, a photovoltaic (PV) solar energy field is planned for the parcel of land immediately north of the new treatment plant. The PV system is described further in Section 7. Also, a second injection well is planned as part of the expansion project. The anticipated new treatment plant energy loads are anticipated to increase due to ultraviolet disinfection, mechanical dewatering, and enhanced treatment processes throughout the new configuration. All of the existing process tanks will be reused in some capacity.

Table 3-1 provides a summary of major equipment, estimated annual operational hours, and annual energy usage based on the twelve month period July 2008- June 2009.

As indicated in Table 3-1, the aeration blower, influent and effluent pumps account for approximately 83% of the energy use by the high energy use equipment.

Table 3-1: Major Equipment Inventory List
(Based on an average 26,050 kilowatts per month[(4)], 0.25 MGD wastewater,
(Major Equipment is defined as 1 hp or greater)

No.	Equipment Description	Equipment Size[1] (hp)	Equipment Load[2] (kW)	Est. Operational Hours[3] (hrs/yr)	Est. Energy Usage[4] (kWh/yr)
1	Influent Pump Station Pumps (PS #A, 2 units))	25	1@17.3	630 each	21,800
2	Sludge Pump #1 (Using Fuel Oil Geni)	7.5	0	0	0
3	Sludge Drying Bed Underdrain Pumps (2 units)	3	1@2.2	100 each	430
4	Aeration Primary Blower (1 unit, 100% Operation)	25	1@16.5	8,760	144,400
5	Aeration Primary Blowers (2 units) (1 unit, 40% Operation)	25	1@16.5	1,752 each	57,700
6	Froth Spray Pump	2	0	0	0
7	Effluent Pump	25	1@17.2	2,640	45,300
8	Effluent Pumps (2 units)	5	1@3.5	150 each	1,040
9	Administration / Maintenance Buildings - Estimated Load	---	3 kW average	4,380	13,100

No.	Equipment Description	Equipment Size[1] (hp)	Equipment Load[2] (kW)	Est. Operational Hours[3] (hrs/yr)	Est. Energy Usage[4] (kWh/yr)
10	Lighting Load	---	3.9 kW average	2,900	11,300
11	Balance of Plant Load	---	2 kW average	8,760	17,520
	TOTALS:				**312,600**[5]

Notes:

1. The equipment size includes nameplate horsepower (hp) rating of the equipment.
2. The equipment load includes measured average amperage readings taken at time of site on site survey to calculate power in kilo-watts (kW) considering the efficiency rating if available and operating characteristics.
3. Hrs/yr is hours per year.
4. Estimated energy usage (kWh/yr is Kilowatt-hours per year) is based on equipment and operating conditions. Energy use may not equal the product of the equipment size (kW) and the operating hours per year (hrs/yr) values shown due to truncating.
5. The total site estimated energy use captures upwards of 95% or more of annual site energy use.

SECTION 4
Utility Analysis

Current Utility Use

The Waimea WWTP currently consumes and is billed for four types of utilities, including Electricity, Propane, #2 Fuel Oil, and Water. Utility usage data and bills were reviewed between 2007–2009, or as available. According to this data, the site currently spends a total of over $103,000 annually for the site's energy and water usages. Over 87 percent of this cost is from electrical energy use. The use and cost summaries for each of these utilities are detailed in the sections below.

Table 4-1: WWTP Typical Annual Utilities

Utility	Site Utility Use (common units)	Site Utility Use (equivalent units)	Site Utility Costs	% of Costs
Electricity	312,720 kWh	1,067 MMBTU	$90,800	87.6%
Water	3,732,000 gal	3,732,000 gal	$12,500	12%
Propane	12 gal	0.03 MMBTU	$100	0.1%
#2 Fuel Oil	118 gal	17 MMBTU	$200	0.3%
Total		**1,084 MMBTU**	**$103,600**	**100%**

Propane

Liquefied petroleum gas or propane is used at the WWTP. The propane is delivered to the site in vertical vessels. The main user of this fuel is the site's water heater which is very seldom used. Typical annual use is approximately 12 gallons at a cost of approximately $100 per year.

#2 Fuel Oil / Diesel Fuel

Number 2 fuel oil or diesel fuel is used at the WWTP. The diesel energy is delivered to the site by truck and offloaded at the site's 1,000 gallon receiving tank. The users of this fuel at the site include the larger hauling trucks, a diesel generator that provide backup electrical energy to the site in the event of an electrical power outage and a local diesel powered pump currently used in replacement of the sites the sludge pump. The actual plant use is small, as the generator is typically run unloaded for about 0.5 hour weekly and the sludge volumes are low. Typical annual use is approximately 100 gallons, at a cost of approximately $200 per year.

Water

Purchased treated water is supplied to the WWTP. The city water is delivered to the site through a two inch water main supply line. Typical annual use is approximately 3,732,000 gallons, at a cost of approximately $12,500 per year.

Electricity

Kauai Island Utility Cooperative, (KIUC) provides electrical energy to the WWTP. The electrical energy is delivered through one transformer on site and one meter. Typical annual use is approximately 313,000 kilo-watt hours, at a cost of approximately $91,000 per year. Table 4-2 provides a summary of the electrical energy use purchased from KIUC for the Waimea WWTP for the period of October 2008 through September 2009.

Table 4-2: WWTP Monthly Electrical Energy Use

Billing Period	Electrical Energy Use (kWh)	Electrical Energy Cost ($)
Oct-08	27,280	$11,728
Nov-08	26,080	$10,299
Dec-08	24,000	$8,110
Jan-09	28,480	$7,650
Feb-09	24,000	$5,751
Mar-09	26,560	$5,951
Apr-09	25,200	$5,780
May-09	28,640	$6,663
Jun-09	25,200	$6,412
Jul-09	26,480	$7,027
Aug-09	23,760	$6,983
Sep-09	27,040	$8,437
Average (12 months)	**26,060**	**$7,566**
Total (12 months)	**312,720**	**$90,790**

As shown in Table 4-3 below, approximately 95% of the site's total electrical energy charges were for electrical energy use charges: 4.5% for electrical energy demand charges, and the remaining 0.5% for customer charges and other surcharges not impacted by electrical energy use or demands.

Table 4-3: WWTP Monthly Electrical Energy Cost Influence

Billing Period	Billing Days	Electrical Energy Use Costs ($)	Electrical Energy Demand Costs ($)	Other Costs ($)	Total Electric Costs ($)
Oct-08	32	$11,424	$268	$36	$11,728
Nov-08	30	$9,961	$302	$36	$10,299
Dec-08	27	$7,733	$340	$36	$8,110
Jan-09	33	$7,176	$438	$36	$7,650
Feb-09	28	$5,379	$336	$36	$5,751
Mar-09	30	$5,584	$331	$36	$5,951
Apr-09	29	$5,415	$328	$36	$5,780
May-09	33	$6,298	$328	$36	$6,663

Billing Period	Billing Days	Electrical Energy Use Costs ($)	Electrical Energy Demand Costs ($)	Other Costs ($)	Total Electric Costs ($)
Jun-09	31	$6,047	$328	$36	$6,412
Jul-09	32	$6,662	$328	$36	$7,026
Aug-09	29	$6,618	$328	$36	$6,983
Sep-09	33	$8,072	$328	$36	$8,437
Average (12 months)		$7,197	$332	$36	$7,566
Total (12 months)		$86,369	$3,984	$438	$90,790
Percent of Total		95%	4.5%	0.5%	100%

Table 4-4 provides a breakdown of the monthly measured peak power demands, monthly billed peak demands, and KIUC demand charges to the Waimea WWTP for the same 12-month period. As shown in Table 4-4, monthly billed peak demands were generally between 44 and 56 kW. The billed demand is charged at a fixed base rate of $6.08 per month per kW up to 100 kW. Billing demand for each month shall be the greater of one of the following two conditions (a) the highest kilowatt demand during the month or (b) 75% of the highest kilowatt demand during the preceding eleven months, as registered during an interval of fifteen consecutive minutes by an indicating demand meter. As Table 4-4 indicates, demand for the months of October 2008 through March 2009 were billed for the prior case (a) and demand for the months of April through September 2009 were billed for the latter case (b) due to the abnormal peak established in January 2009 of 72 kW. This means that a prior monthly demand resulted in an inflated current demand charge for all of the months in 2009 as they were all within an 11-month period after the January peak that caused this increase. As stated above, the highest maximum peak demand recorded in the last 12 months was in January 2009 at 72 kW. The lowest maximum peak demand was in October 2008 at 44 kW.

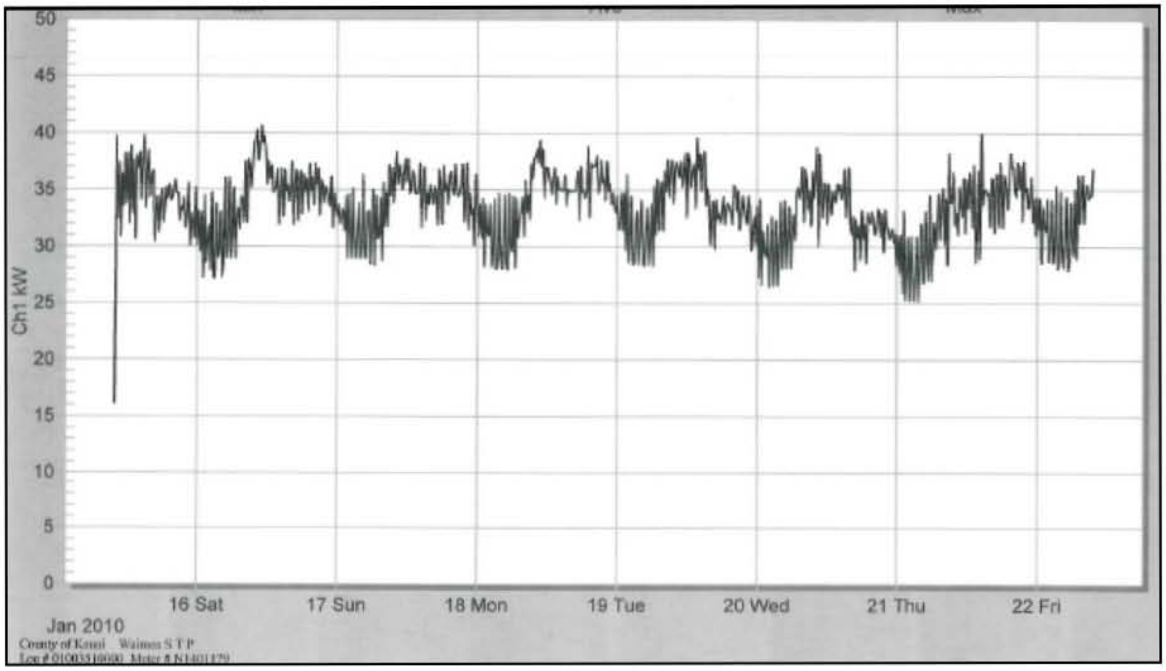
Table 4-4: WWTP Electrical Power Demand Summary

Bill Period	Measured Peak Demand (kW)	Billed Peak Demand (kW)	Total Demand Charge ($)
Oct-08	44.00	44.00	$268
Nov-08	49.60	49.60	$302
Dec-08	56.00	56.00	$340
Jan-09	72.00	72.00	$438
Feb-09	55.20	55.20	$336
Mar-09	54.40	54.40	$331
Apr-09	49.60	54.00	$328
May-09	48.80	54.00	$328
Jun-09	51.20	54.00	$328
Jul-09	47.12	54.00	$328
Aug-09	47.12	54.00	$328
Sep-09	46.64	54.00	$328
Average	**52**	**55**	**$332**
Total	**n/a**	**n/a**	**$3,984**

Note: Total demand charges above represents the base effective demand rate only as defined in the utility schedule.

Below Figure 4-1 provides a trend of the plant's electrical demand energy during a recent week in January 2010. This interval demand information was recorded by a temporary electric meter brought to the site by KIUC. The sites peak demands are stored within the local KIUC electric meter, however the interval data history is not, since the meter pulse data is not connected to KIUC's central database. Typically, if the meter is connected, this recorded information can be gathered from the utility provider, or remote access to an online interface may be available to view the information on a regular basis.

Figure 4-1: WWTP Electrical Energy – 15 Minute Interval Demand Trend



A plant's electrical demand typically follows the influent flow volumes; as influent flow increases, so does the amount of equipment online and hence, an increase in electrical energy use. Since the plant is typically staffed during the day only, the demand energy for the site is elevated slightly during the day versus at night. This can be seen on the demand trend above in which daily operations rise to a level of approximately 35-40 kW during the day and drop to approximately 28 kW during the evening periods. Also notice that the plant measured peak demands, which are typically over 50 kW, did not occur during this week of metering. In evaluating one minute demand trends that were taken in April 2009, demand levels at or above 45 kW typically only occur about once per month or very infrequently. Table 3-1 in Section 3 shows that it would only take one influent pump, one blower and one large effluent pump to be in operation at the same time to pull over 50 kW of demand at the site. This would occur in the case of higher than normal flows or when a more constant influent flow to the plant is observed. Unfortunately no instantaneous meter data is readily available to confirm this correlation of peak demand with peak and/or constant influent flow. If either of these situations can be controlled, then the site could better manage this portion of the bill. Fortunately, the new plant design has incorporated an equalization basin at the entrance to the plant, and this may assist in curbing such influxes in flow and equipment demand in the future.

As shown in Figure 4-1 above, this information can provide instantaneous awareness and feedback to the site about how much energy the plant equipment is using. The site can then determine how changes at the operations level impact the sites demand and make decisions accordingly. This can be valuable information if trying to control measured demands. Since approximately 4.5% of the site's electrical costs are determined from the monthly peak 15-minute interval demand, the site has direct influence over this portion of the bill, but at this time it would not influence the overall electric costs by much. However, as the new plant is built and the sites peak electric demands increase above 100kW, they are likely to move to a different rate schedule with KIUC. A new rate schedule will likely increase demand costs and move this 4.5% to a higher percentage of the bill. The new PV system will provide some additional support to assist in curbing the new anticipated electric demands and use at the plant. However it may not prevent a change in the rate schedule. Careful coordination between plant demands and time of day use for such demands will be key to keeping off the higher cost rate schedule and to keep such additional costs in line as much as possible. More details of the current billing rates are discussed in the following section of the report.

Electricity Rate Schedule

The Waimea WWTP purchases electricity from KIUC and is under the KIUC Electric Tariff Schedule "J" for General Light and Power Service. Schedule "J" is applicable for general light and/or power supplied through a single meter in which the customer's energy consumption exceeds 10,000 kWh or exceeds 30 kW and whose maximum demand is not greater than 100 kW during any consecutive 15-minute period.

The sites actual electric bills were not provided; therefore a full breakdown of the sites electrical energy charges was not calculated. As shown in Table 4-2, the sites electrical consumption for the more recent 12 month period captured from the site is 312,720 kilo-watt hours at a cost of $90,790 yielding an average "all inclusive" electric rate of $0.290/kWh. This average electric rate was utilized for estimating cost impacts of the Energy Conservation Opportunities in Section 5.

Table 4-5 describes the rates calculated from the WWTP's electric energy billed costs for the 12-month period starting October 2008 through September 2009.

Table 4-5: WWTP Monthly Electrical Energy Use and Demand Rates Utilized for ECO Cost Impact for the Site

Billing Period	Billing Days	Electrical Energy Use & Costs	Electrical Energy Demand Use & Costs	Other Costs ($)	Total Electric Use & Costs
Total (12 months)		$90,790 /yr	n/a	n/a	$90,790 /yr
Total (12 months)		312,720 kWh/yr	55 kW/mo average	n/a	n/a
Rate Used for ECO Calculations		$0.290 /kWh	n/a	n/a	n/a

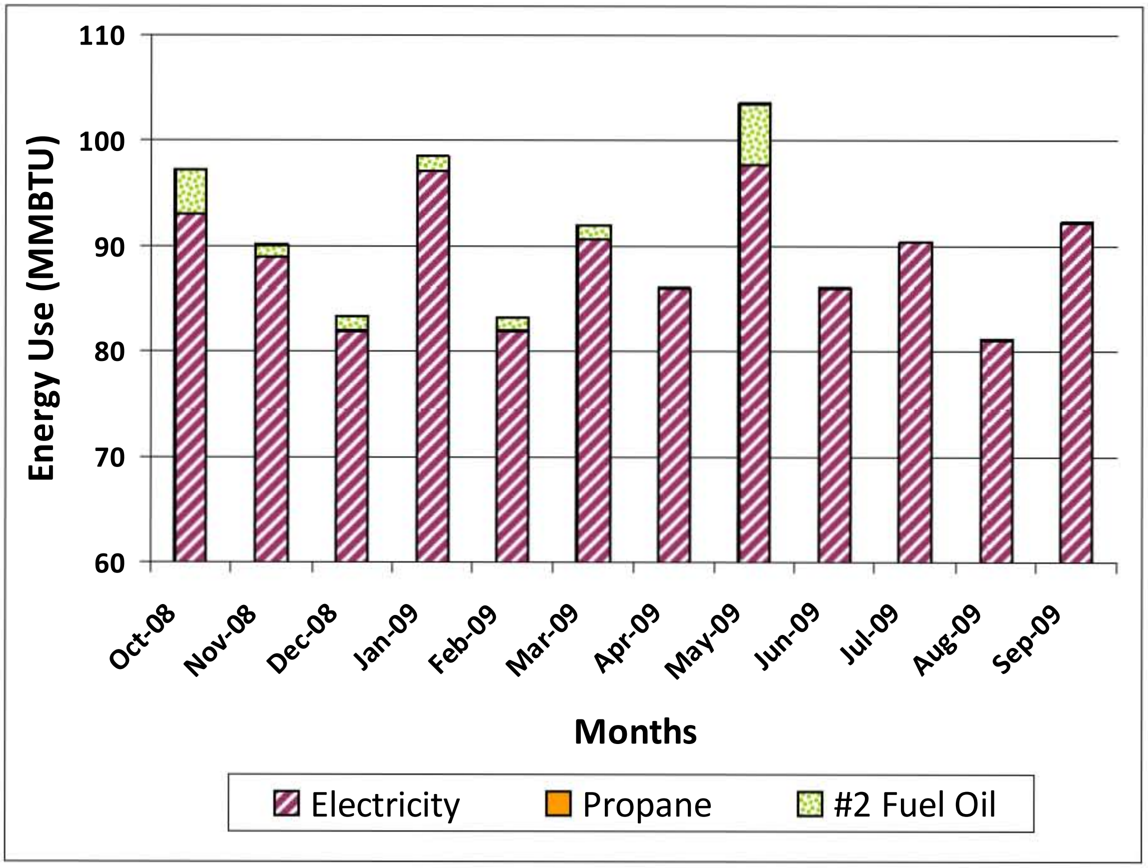
The site's electric service rate schedule is broken down into the following charges as of the date of this report:

- ***Customer Charge*** – this is a fixed fee of $36.48 per month and does not vary with use.
- ***Energy Charge*** – this is a fixed fee with a base rate of $0.16031 per kilowatt-hour.
- ***Demand Charge*** – the monthly billing demand shall be the greater of (a) the highest kilowatt demand during the month or (b) 75% of the highest kilowatt demand during the preceding eleven months, as registered during an interval of fifteen consecutive minutes by an indicating demand meter. Like the customer and energy charge, this is also a fixed fee at $6.08 per month per kW of billing demand.
- ***Resource Cost Adjustment (DSM & IRP) Surcharge*** – a surcharge that is to be added to the Customer and Energy, and energy cost adjustment. For October-December 2008 this rate was $0.003534. For 2009 this rate was $0.000888.
- ***Energy Rate Adjustment*** – this factor is evaluated each month and is charged to the energy used in kWhs. If the PUC approves KIUC's submitted rate change, then the new rate takes effect from that day forward until a new rate is approved. Since 2001, this rate has typically changed monthly. The days in the billing period are charged at the respective rates for such charges. In 2008, this rate increased to over $0.316 per kWh. In 2009, this rate averaged approximately $0.264 per kWh.

Energy Baseline

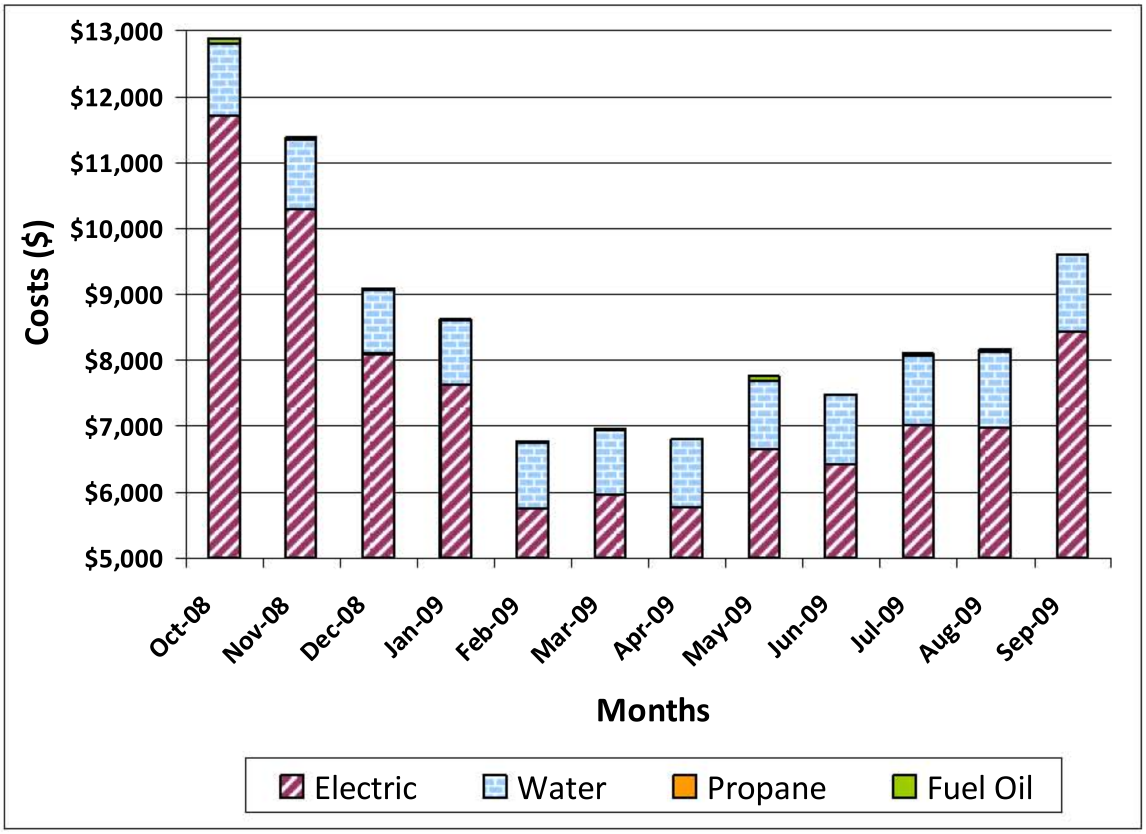
The following Figure 4-2 describes the site's energy use over the 12-month period from October 2008 through September 2009.

Figure 4-2: WWTP Total Energy Use Breakdown



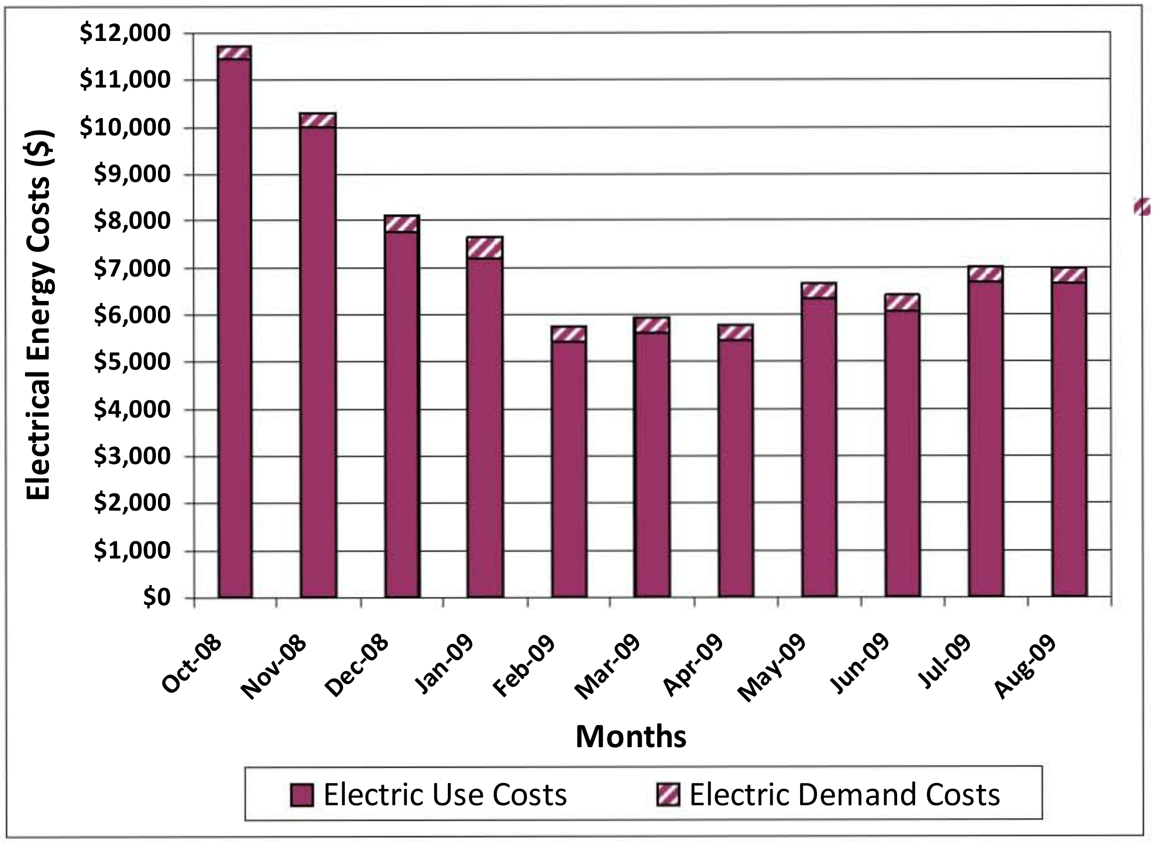
The following Figure 4-3 describes the site's energy costs over the same 12-month period, from October 2008 through September 2009. This illustration provides a view of the changes over time of the utility rates (specifically electrical rates) from 2008 to 2009, as oil prices in the world and region decreased significantly over the time period.

Figure 4-3: WWTP Total Energy (and Water) Cost Breakdown



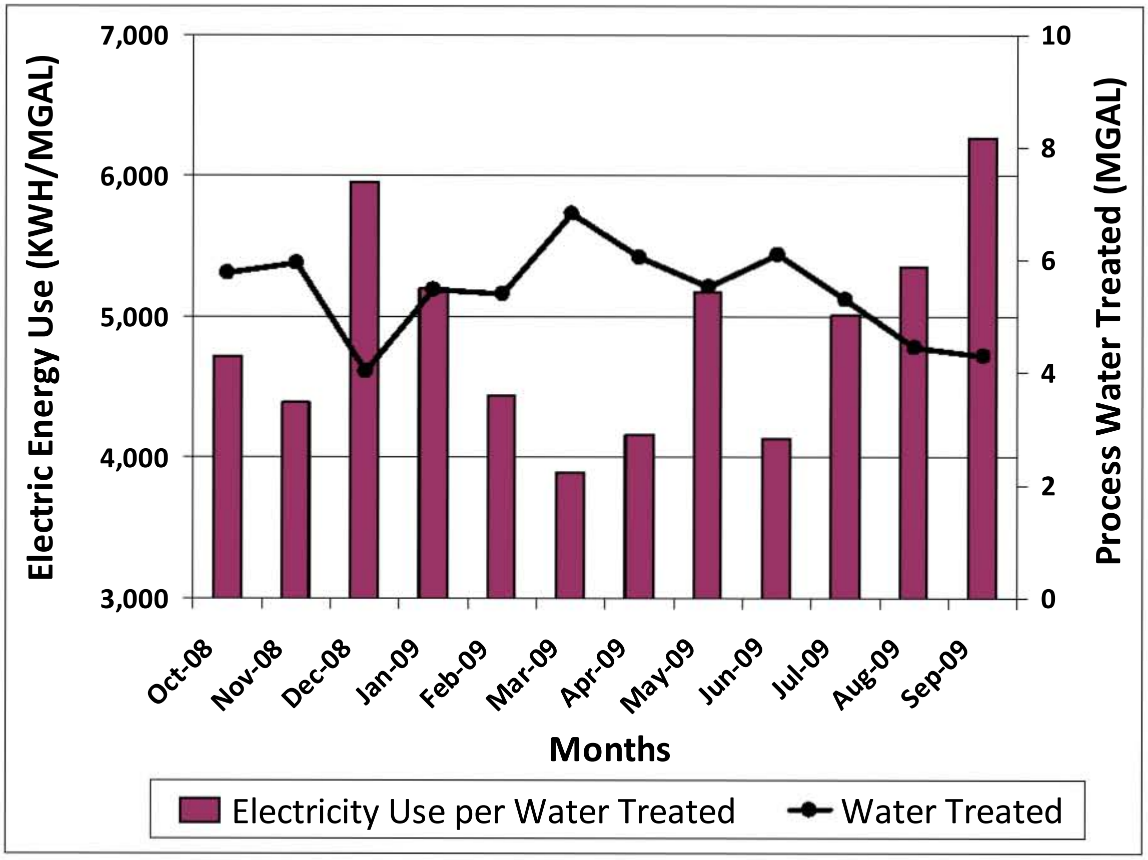
The following Figure 4-4 describes the site's electrical energy costs over the same 12-month period from October 2008 through September 2009. This illustration provides a breakdown of electric use costs versus electric demand costs. The site demand costs are on average approximately 4.5% of the electric bill each month.

Figure 4-4: WWTP Electric Energy Cost Breakdown



Since the site major utility use is electric energy, the following Figure 4-5 illustrates an overall energy baseline for electric energy use per million gallons of wastewater treated for the 12-month period from October 2008 through September 2009. This provides one productivity measurement of an energy utilization index to demonstrate deviations in electrical energy use over time. This offers both advantages and disadvantages in comparing year-to-year energy efficiency improvements and should not be used as a sole source of comparison.

Figure 4-5: WWTP Electric Energy Use Per Million Gallons of Wastewater Treated



SECTION 5
Energy Conservation Opportunities

ECO 1 – Lighting System Improvements

Recommendation

It is recommended that the Waimea WWTP considers further investment in new higher efficiency lighting technologies to reduce the site's electric demand and use. Replacing lower efficiency lighting systems with higher efficiency lighting systems will standardize lamp and ballast types and reduce the number of lamps, ballasts and other lighting equipment to be stocked and managed. Fixture upgrades would include replacing all T12 fluorescent lamps with T8 fluorescent lamps. Also, it is recommended to replace magnetic ballasts with electronic ballasts for further energy load improvement of the fixtures. Other fixture upgrades include considering replacement of HID fixtures with LEDs for improved control and to significantly reduce maintenance costs. Lighting controls are also recommended to optimize on lamp energy use and extend lamp life. Estimated energy, power demand, and cost savings and simple payback from such installations are summarized below.

Estimated Electrical Energy Savings	= 9,140 kWh/yr
Estimated Electrical Demand Savings	= 3 kW
Estimated Total Energy Cost Savings	**= $2,650/yr**
Estimated Implementation Cost	**= $7,000**
Simple Payback	**= 2.6 years**

Background

It was observed that a total of approximately 45 interior and exterior fixtures at the site use older generation lighting technologies. Most of theses fixtures were installed when the building or area was erected. This older lighting technology includes T12 fluorescent, incandescent, and High Pressure Sodium lamps and fixtures which also use magnetic ballasts.

The interior building lighting systems are typically on during daily operations. During the evening hours when the site is unoccupied the interior building lighting systems are shut down. The current controls for these fixtures are manual switches. The exterior lighting systems are also controlled manually and only turned on when necessary. It was estimated site exterior lighting is used approximately 200 hours per year.

Not including the cost of maintenance and replacement lamps and ballasts, it was estimated that the Waimea WWTP is spending over $3,000 per year for the energy to light areas of the plant. This estimate is based on light counts and information collected during the site walk.

5

Many of these lighting systems can be replaced with more efficient i.e. lower wattage lamps and ballasts. While replacing the lamps is a short term solution, Light Emitting Diodes (LED) is an example of a longer term solution. For instance LED lamps are rated for approximately 100,000 hours while high pressure sodium (HPS) lamps currently used by the site are rated for just a fraction of this lamp life at 24,000 hours approximately. The initial cost of LED maybe higher than HPS lamps, yet they consume minimal energy and require less equipment and maintenance which assists in justifying the use of LED. It is recommended that the site consider such alternative technologies when ultimately deciding on new fixture replacement.

Control improvements recommended include motion sensors or timer based switches for the building interior lighting systems. Implementing such controls to interior areas of the plant would need further assessment and may positively impact the energy reduction of this ECO.

Estimated Energy and Cost Savings

The estimated electrical demand energy savings, if all fixtures and lamps were replaced with higher efficiency ballasts and lamps, and operating at the same current conditions, is 3 kW. Based on the current operating hours for lighting, the energy savings would be 9,140 kWh per year.

The total estimated annual Cost Savings (CS) is the sum of the Electrical Energy Cost Savings (ECS) and Demand Cost Savings (DCS). The electrical energy and demand charges are based on the KIUC 2008-09 data as presented in Section 4.

CS = (ECS)(Usage Charge) + (DCS)(Demand Charge)

CS = (9,140kWh/yr) X 0.29 ($/kWh)] + [3 (kW) X 0 ($/kW–month) X 12 (months/yr)]

CS = $2,650/yr + $0/yr

CS = $2,650/yr

Estimated Implementation Cost and Payback

The total preliminary estimated cost to implement this ECO is $7,000. This estimate includes the cost for new lighting fixtures, ballasts, lamps and installation.

Based on this preliminary assessment, the simple payback period would be 2.6 years.

The following assumptions were made about this ECO:

1) Lamps and fixture prices remain the same.
2) Light counts are estimates.
3) Interior lighting operates on average 8 hours per day, 7 days per week.
4) Exterior lighting operates on average 200 hours per year.
5) Reduced lamp replacement costs (equipment and labor) due to extended lamp life expectancies for new lighting technologies were not included in the savings estimates.

6) Cost savings estimated were based on current electric demand rates and cost adjustment factors. Future rates for the site may go up or down and would impact the cost savings estimates in this ECO accordingly.

The following steps are required to implement this ECO:

1) Further evaluation with regard to the new plant design is necessary for full implementation of this ECO for future facility needs.
2) Confirm lighting fixture, efficiency, and operating hours.
3) Confirm lighting levels and acceptability of new fixture types and controls.
4) If the ECO has acceptable operational criteria and an acceptable payback period, implement the ECO.

Plant Staffing Impact

Implementation of this ECO is not anticipated to impact plant staffing or operating requirements.

Photo Gallery

Existing Two Lamp Incandescent Lighting

Existing T12 Fluorescent Lighting

Existing Outdoor Lighting

ECO 2 – Effluent Pumping System Improvements

Recommendation

It is recommended that the Waimea WWTP considers equipping the effluent pumps with variable frequency drives (VFD's) and adjusting the level control range at which the pumps operate. This retrofit will reduce the site's electric demand, improve operating efficiencies and be consistent with the new treatment plant's flow equalization basin strategy. The variable speed pumps and wider control range would allow the smaller pumps to operate and minimize the use of the larger horsepower effluent pump. Estimated energy, power demand, and cost savings and simple payback from installations identified during the initial audit only are summarized below.

Estimated Electrical Energy Savings	= 8,000 kWh/yr
Estimated Electrical Demand Savings	= 10 kW
Estimated Total Energy Cost Savings	**= $2,320/yr**
Estimated Implementation Cost	**= $17,500**
Simple Payback	**= 7.5 years**

Background

Currently the WWTP utilizes one 25 horsepower (hp) and two 5hp constant speed pumps for effluent pumping needs at the site. The pumps are controlled by a liquid level sensor in the effluent channel. Since the influent into the plant is provided by constant speed pumps, the effluent liquid level modulates (rises and falls) based upon the short term (pulse) type operations. The effluent pump(s) operate in concert with the influent pumping and results in a double demand spike (one spike for the influent pumps and a second spike for the 25 hp effluent pump.)

A new plant is currently under design and plans to reuse the effluent pump station. The VFD control modifications recommended here will be consistent with the new plant design requirements.

Estimated Energy and Cost Savings

The current electrical energy used by the effluent pump station is approximately 46,300 kwh per year with a demand load of approximately 20 kW. The effluent VFD and control strategies will reduce the peak demand and have a slight reduction in operating kilowatt-hours.

The total estimated annual Cost Savings (CS) is the sum of the Electrical Energy Cost Savings (ECS) and Demand Cost Savings (DCS). The electrical energy and demand charges are based on the KIUC 2008-09 data as presented in Section 4.

CS = (ECS)(Usage Charge) + (DCS)(Demand Charge)

CS = [8,000 (kWh/yr) X 0.29 ($/kWh)] + [0 (kW) X 0 ($/kW–month) X 12 (months/yr)]

CS = $2,320/yr + $0/yr

Estimated Implementation Cost and Payback

Prior to implementation of the effluent pump VDF and level control retrofit, the site will need to further evaluate the future plant designs that are currently under development. This ECO was developed for providing only a perspective here for the plant on what improvements such as these could potentially have on the plant operations based on what information is known today.

Based on this preliminary assessment, a retrofit cost of $17,500 was estimated for the addition of a new VFD drive to the 25 hp motor and liquid level control adjustments.

The following assumptions were made about this ECO:

1) Future variable speed load factor was estimated at 50%.
2) Cost savings estimated were based on current electric demand rates and cost adjustment factors. Future rates for the site may go up or down and would impact the cost savings estimates in this ECO accordingly.

The following steps are required to implement this ECO:

1) Further evaluation with regard to the new plant design is necessary for full implementation of this ECO for future process needs.

Plant Staffing Impact

Implementation of this ECO is not anticipated to impact plant staffing or operating requirements.

Photo Gallery

Existing 25 hp and 5 hp Effluent Pumps

ECO 3 – Replace Lower Efficiency Motors With Higher Efficiency Motors

Recommendation

It is recommended that the Waimea WWTP considers investment in new higher efficiency motors, to reduce the site's electric demand and improve operating efficiencies of motorized systems throughout the facility. Estimated energy, power demand, and cost savings and simple payback from installations identified during the initial audit only are summarized below.

Estimated Electrical Energy Savings	= 9,600 kWh/yr
Estimated Electrical Demand Savings	= 5 kW
Estimated Total Energy Cost Savings	**= $2,800/yr**
Estimated Implementation Cost	**= $23,000**
Simple Payback	**= 8.2 years**

Background

Many systems throughout the WWTP utilize electrical motors for operation of blowers, pumps, fans, compressors, and other operations such as skimmer mechanisms, etc. Motorized equipment uses the majority of the site's electrical use. There are over 15 motors at the site with the majority of these motors over 1 horsepower in size or greater. Higher-efficiency or premium efficiency motors are typically available in motors of 1 horsepower and larger.

Many of the motors on site were installed in 1974 when the plant was built and are low efficiency rated units. Many units are still operation at the site even though the plant is over 36 years old. Efficiency ratings of motors found at the site were typically in the low 80% level. With the site's current electrical energy costs, it has been determined that motors operating continuously or 8,760 hours per year with an existing efficiency of below 93% and operating load factor of at least 80% would most likely meet a 10-year simple payback if replaced with a higher efficiency motor. Motors in use at least half the year or approximately 4,380 hours per year with an existing efficiency below 92% and operating load factor of at least 80% would also likely meet a 10-year simple payback. The following list of motors in Table 5-1 below were identified for replacement to higher efficiency type units.

Table 5-1 Motor Upgrade List

Motor/System Description	Number of Motors	Motor Horsepower	Current Efficiency
Influent Pump Station Pumps	2	25	82.5%
Effluent Pump (Large Unit)	1	25	82.5%
Effluent Pumps (Small Units)	2	5	82.5%
Sludge Scrapper	1	0.5	82.5%
Scum Collectors	2	0.5	82.5%
Total	**8**	**87**	**---**

Note that current new plant design specifications are calling for all of the above motors to be replaced with the new plant installation except for the 3 effluent pumps. If this specification should change prior to or during construction of the new facilities, the plant should revisit what motors are not replaced at that point for replacement.

Estimated Energy and Cost Savings

The estimated electrical demand energy savings, if all motors in Table 5-1 were replaced with the higher efficiency motors and operating at the same current conditions, is 5 kW. Based on the current operating hours for each motor, the energy savings are estimated at 9,600 kWh per year.

The total estimated annual Cost Savings (CS) is the sum of the Electrical Energy Cost Savings (ECS) and Demand Cost Savings (DCS). The electrical energy and demand charges are based on the HELCO 2008-09 data as presented in Section 4.

CS = (ECS)(Usage Charge) + (DCS)(Demand Charge)
CS = [9,600 (kWh/yr) X 0.29 ($/kWh)] + [5 (kW) X 0 ($/kW–month) X 12 (months/yr)]
CS = $2,800/yr + $0/yr
CS = $2,800/yr

Estimated Implementation Cost and Payback

The total preliminary estimated cost to implement this ECO is $23,000. This estimate includes the cost for the new motor equipment and installation.

Based on this preliminary assessment, the simple payback period would be 8.2 years.

The following assumptions were made about this ECO:

1) The motors identified in Table 5-1 were electrically metered for load factor values and therefore unit load is based on site operating conditions measured.
2) Some motors identified in Table 5-1 had nameplate data that was not captured due to nameplate missing, unrecognizable text on nameplate and/or information not available from site equipment manuals or other means. In these instances unit information was estimated based on year equipment was purchased.
3) Influent pump station pumps were built in 1974 and are due to be replaced in the plans for a new plant. These units individually do not meet a 10 year simple payback threshold, but when paired with the other motor replacements the collective ECO does still meet such a threshold. We recommend the site further evaluates replacement of these units with greater than 94% efficiency motors that are available in the market today.
3) Improvements for blower motor replacement were captured in ECO #4.
4) Cost savings estimated were based on current electric demand rates and cost adjustment factors. Future rates for the site may go up or down and would impact the cost savings estimates in this ECO accordingly.

The following steps are required to implement this ECO:

1) Further evaluation with regard to the new plant design is necessary for full implementation of this ECO for future process needs.
2) Confirm equipment size, efficiency, and operating hours.
3) Confirm equipment rpms, loading, and horsepower requirements.
4) Add motor performance evaluation to site PM process for future selection of motors that meet criteria for replacement, as site conditions change.

Plant Staffing Impact

Implementation of this ECO is not anticipated to impact plant staffing or operating requirements.

Photo Gallery

Existing Influent Pump Station

Existing Effluent Pumps and Motors

Existing 25hp Effluent Pump Motor Nameplate


Existing Scum Collector Motor


Existing Sludge Scrapper Motor

ECO 4 – Install New Direct Drive, Higher Efficiency Blowers With Automated Process Controls

Recommendation

It is recommended that the Waimea WWTP considers replacement of the three constant speed blowers with new higher efficiency variable speed blowers. This retrofit will reduce the site's electric demand and improve operating efficiencies. The variable speed blowers would also provide improved aeration or air flow capability and allow for the site to more efficiently and effectively match dissolved oxygen (DO) supply with DO requirements of the aeration tanks. Estimated energy, power demand, and cost savings and simple payback from installations identified during the initial audit only are summarized below.

Estimated Electrical Energy Savings	= 34,000-84,000 kWh/yr
Estimated Electrical Demand Savings	= >6 kW
Estimated Total Energy Cost Savings	**= $9,900-$24,400/yr**
Estimated Implementation Cost	**= $99,000-$244,000/yr**
Simple Payback	**= 10.0 years**

Background

Currently the WWTP utilizes three 25 horsepower (hp) constant speed, belt driven blower units. All three units are rated for 550 cubic feet per minute (cfm) at 6 pounds-force per square inch gauge (psig) for a total site capacity of 1,650 psig. One unit is fairly new and was installed approximately 3 years ago while the other two are older units. Currently the plant is providing air to the secondary aeration basins with coarse bubble diffusers only. Air piping is installed to provide flow to the headworks and primary channel; however this air supply flow is not currently in use. For current air needs to the aeration basins only, the site typically requires one blower online continuously with partial use for a second blower. The aeration air is currently controlled manually.

A new plant to replace the existing units is currently under design. According to current design specifications, the site plans to replace all three blower units.

The blower units at 25hp each are three of six largest motors at the site. Also, these units are operated more than any other motor at the site and are estimated at using over 65% of the sites electrical energy needs. Due to the large impact these units have on the sites energy requirements; a thorough evaluation and investigation of the type of units that will replace the older blowers with the new plant is recommended to verify the most efficient blowers and aeration system is being specified. It is also recommended the site further assesses utilization of belt driven units which have lower drive efficiency than direct drive units in the market today. Direct drive units typically can have drive efficiencies of 97% or more while belt driven drives tend to have only 92-94% drive efficiencies at best which can deteriorate by 2-5% over time.

Estimated Energy and Cost Savings

The current electrical energy used by the blowers in place today is estimated at approximately 200,000 kWh annually. If all blowers are replaced with higher efficiency motors and drives and operating at the same current load and flow conditions, we would anticipate a demand reduction of at least 3 kW when one unit is in operation and an energy use reduction of up to 34,000 kWh per year. This is a net reduction of at least 17% without reducing air flow over time. From the site flow conditions it is anticipated to potentially further reduce the sites energy use for aeration air flow by an additional 15-25% annually with installation of variable speed units and automated control. Based on the current operating hours for each unit, the total energy savings the site potentially would benefit from with improvements to the aeration system is upwards of a 42% total reduction in aeration energy which equates to upwards of 84,000 kWh per year.

The total estimated annual Cost Savings (CS) is the sum of the Electrical Energy Cost Savings (ECS) and Demand Cost Savings (DCS). The electrical energy and demand charges are based on the KIUC 2008-09 data as presented in Section 4.

CS = (ECS)(Usage Charge) + (DCS)(Demand Charge)
CS = [34,000-84,000 (kWh/yr) X 0.29 ($/kWh)] + [0 (kW) X 0 ($/kW–month) X 12 (months/yr)]
CS = $9,900-$24,400/yr + $0/yr
CS = $9,900-$24,400/yr

Estimated Implementation Cost and Payback

Prior to implementation of new blower units, motors and controls, the site will need to further evaluate the future plant designs that are being developed. This ECO was developed for providing only a perspective for the plant on what improvements such as these could potentially have on plant operations based on what information is known today.

Based on this preliminary assessment, the amount of potential capital funding that would be supported by such improvements and that meet a 10 year simple payback period is between $99,000-$244,000.

The following assumptions were made about this ECO:

1) Motor efficiency improvements captured here were not duplicated in ECO #3.
2) Current motor efficiency was assumed to be 82.5%.
3) Current belt driven unit drive efficiency was estimated to be 92% and future direct drive efficiency was estimated to be 97%.
4) Current/future operating hours were estimated at 100% or 8,760 hrs/year for one unit and at 40% or 3,504 hrs/year for a second unit.
5) Current/future load factors were estimated at 67% per electrical motor amperage measurements taken at time of site visit.
6) Future variable speed load factor was estimated at 50%.

7) Cost savings estimated were based on current electric demand rates and cost adjustment factors. Future rates for the site may go up or down and would impact the cost savings estimates in this ECO accordingly.

The following steps are required to implement this ECO:

1) Further evaluation with regard to the new plant design is necessary for full implementation of this ECO for future process needs.

Plant Staffing Impact

Implementation of this ECO is not anticipated to impact plant staffing or operating requirements.

Photo Gallery

Existing 25 hp, constant speed, belt driven, 550 cfm blower units

SECTION 6
Sustainable Energy Opportunities

An evaluation, of sustainable design concepts, was performed to identify opportunities for incorporating innovative initiatives such as renewable energy alternatives at the Waimea Wastewater Treatment Plant. The following table lists the sustainable design options evaluated at this facility for energy use impact and/or the opportunity to improve the site's environmental impact. Recommendations are provided for those options the site should consider for further feasibility.

Table 6-1 Sustainable Energy Opportunities

SUSTAINABLE OPPORTUNITY	DESCRIPTION	RECOMMENDED NEXT STEPS	PAYBACK
Behavioral Modifications	Facility personnel practices have the potential to impact energy use significantly. Manual procedures or use of automated controls to lower conditioned air settings when an area is vacant and turning off lights and equipment when not needed or in use will result in increased energy savings at all levels of the facility.	Requires Further Study	Short Term
Green Procurement	Environmentally responsible or 'green' procurement is the selection of products and services that minimize environmental impacts. It requires an organization to carry out an assessment of the environmental consequences of a product at all the various stages of its lifecycle. This means considering the costs of securing raw materials, and manufacturing, transporting, storing, handling, using and disposing of the product. Opportunities at the WWTP may include the purchase of energy efficient IT systems such as energy star rated computers and appliances. The purchase of green products for cleaning and IT equipment typically do not cost more than alternative products.	Requires further study	Short Term
Plant Vehicle Fuel Options	The plant currently utilizes multiple vehicles for transportation and maintenance purposes. As vehicles are due to be replaced the site should consider use of hybrid or alternative fuel models. An alternative fuel vehicle could also be considered when deciding on new vehicle purchases.	Requires further study	Short to Mid Term
Solar Renewable Energy	Waimea is located on the sunny and dry side of the island. A solar to energy facility is expected to be constructed adjacent to the new plant and an electrical interface is planned.	Currently being constructed	Long Term
Wind Renewable Energy	Resource is unknown.	Unlikely a good fit for area adjacent to treatment plant	Long Term
Effluent Water Reuse	The facility currently reuses effluent for agriculture nearby. The new treatment plant will enhance the effluent treatment and continue to provide a reliable source of water.	Currently implemented	n/a
Cogeneration	The site operates an aerobic digester for sludge stabilization.	No available resource	n/a

Payback Range Estimate: Short Term = <5 years; Mid Term = 5 years to 10 years; Long Term = > 10 years

SECTION 7
Additional Energy Conservation Considerations

During the course of the site visit and in review of the planned wastewater treatment plant expansion, a review of the proposed upgrades was conducted which identified additional avoided energy and cost savings related to resource conservation. While Tetra Tech was unable to detail these opportunities within the limits of this initial study, these items warrant further attention, whether requiring additional study or simply operations and maintenance actions. Table 7-1 lists the opportunities noted and explains the nature of actions required to capitalize on the items listed.

Table 7-1 Additional Energy Conservation Considerations

ECO OPPORTUNITY	ECO DESCRIPTION	RECOMMENDED NEXT STEPS	PAYBACK
Energy Tracking	Tracking and trending the site's energy and water use and demands enhances the site's capabilities; not only to verify energy reduction strategies implemented, but, also to support sustaining these reductions year after year. This can be accomplished through manual spreadsheets and calculations or automatically through the site's SCADA system. This information is critical for supporting decisions from daily operations to future capital investments.	Incorporate energy management system within new treatment plant design.	Short Term
New Treatment Plant Process Review and Recommendations	In review of the proposed design/build treatment plant documents, the following observations are provided: • The influent pumps will be replaced with new larger constant speed pumps and maintain the draw/fill control strategy. • New process air blowers will be installed to provide aeration air for the aerobic digesters, flow equalization basins and conveyance channels. **[Add process controls and turndown capabilities.]** • A vortex grit system is being provided in lieu of aerated grit system. **[Less air required]** • MBBR process has the lowest energy footprint when compared to convention activated sludge or MBR. • UV disinfection was selected over chlorine addition. The specification for the UV indicates high efficiency, self cleaning and automatic turn-down controller. **[Fine tune controller to maintain proper UV electrical dose.]** • A flow equalization basin (FEB) strategy will be used to dampen the wide swings in flow. The FEB will be equipped with agitation air to maintain solids suspension and aerobic conditions. **[Recommend careful review of process control for recovery cycle to minimize double pumping of wastewater.]** • With the use of the FEB strategy, the two 5 hp effluent pumps will be the major effluent pumping units instead of the 25 hp pump. **[Replace motors to premium efficiency.]** • Mechanical dewatering using a centrifuge is planned for operation 6 hours per day, 3 to 4 days per week. The anticipated connected horsepower of 55hp is estimated. The full load electrical impact will be in the 40 kW demand range. Concurrent operations with high electrical loads will push the facility into the >100 kW demand schedule and the resulting additional costs associated with a large electrical user. **[Evaluate best time of day strategy for dewatering operations.]**	See highlights to left in **BOLD** for individual recommended next steps.	Short Term

ECO OPPORTUNITY	ECO DESCRIPTION	RECOMMENDED NEXT STEPS	PAYBACK
	• The new administration/ laboratory building is being equipped with energy efficient lighting and associated occupancy controls. • A 137.7kW DC photovoltaic facility is planned to be installed adjacent to the treatment plant to offset power purchases at the new plant. According to the manufacturer's brochure (www.recgroup.com/usa) and conceptual design documents the array is anticipated to consist of 612 REC AE-US 225 Watt DC polycrystalline modules on a REC solar racing rack system at a fixed tilt. Electrical power generation of the PV system at a 10^{o} tilt angle, 200^{o} azimuth and 82% DC to AC derate factor is estimated at 112.9kW AC and 203,077 kilowatt hours per year (65% of current plant electric use). The system is designed for up to a maximum of 112lbs/ft2 load and 122 mph wind speeds. The arrays are 17.76 square feet per module and with 612 modules will be approximately 11,000 square feet in area. Total cost for the system is estimated at $799,194 or about $7.08/kW. At the current average electric rate $0.29/kWh and if 100% of the PV electrical generation is utilized, then the system would reduce site electric costs by an estimated $58,892/year providing an overall project simple payback of 13.5 years. This does not include rate schedule impacts or escalation of such rates over time. **[The plant power trend and PV generation trend may be different and seasonal. KIUC will provide grid stability and any additional power to support the plant operations. Careful coordination should be made for grid interconnection such as utility bill schedule impact, standby charge implications and possible sequencing of plant operations to maximize the generated power during the peak daytime generation. For instance, dewater sludge during peak solar generation periods. It is anticipated that periods of excess PV production will occur and the mechanism for handling the excess is currently under review. If a net metering contract and/or battery capacity can not be installed, then the size of the system should be further evaluated so that either excess power generated would be utilized or all power generated would be fully utilized by the new facility. The new plant and PV design is still preliminary. Once the final designs are more complete then the power production and utilization of the 203,077 kilowatt hour electric production can be validated.]**		

Payback Range Estimate: Short Term = <5 years; Mid Term = 5 years to 10 years; Long Term = > 10 year

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

TETRA TECH

10306 Eaton Place Suite 340 | Fairfax, VA 22030
www.tetratech.com