Energy Assessment Report for

County of Hawaii
Hilo Wastewater Treatment Plant

U.S. Environmental Protection Agency Region 9
Hilo WWTP is located at 150 Kekawnoa Place,
Hilo, Hawaii

April 14, 2010

1

SECTION 1
Executive Summary

Under contract to USEPA, Tetra Tech Inc., (Tetra Tech) performed a site energy assessment of the Hilo Wastewater Treatment Plant (WWTP) facility. The facility is located at 150 Kekawnoa Place, Hilo, Hawaii. Representatives from the Hilo 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 Hilo 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)
No-Cost Measures							
1	Operate Dewatering Odor Control Fan Only During Dewatering Periods	69,850	0	0	$19,100	$0	0.0
Low-Cost Measures							
2	Eliminate 1 Of 3 Primary Tanks In Use And Optimize Primary Sludge Pump Operations	39,900	14	0	$11,200	$5,000	0.4
Investment Grade Measures							
3	Electrical Demand Management	0	26	0	$6,600	$50,000	7.6
4	No. 2 Water Pumping System Improvements	35,000	0	6,500,000	$35,700	$100,000	2.8
5	Replace Lower Efficiency Motors With Higher Efficiency Motors	136,400	27	0	$44,300	$175,000	4.0
6	No. 3 Water Pumping System Improvements	94,800	10	0	$28,600	$220,000	7.7
Total Potential Electrical Energy Savings		**375,950 kWh/yr**					
Total Potential Electrical Demand Savings			**77 kW**				
Total Potential Water Savings				**6,500,000 Gal/yr**			
Total Potential Cost Savings					**$145,400 $/yr**		
Total Estimated Implementation Cost						**$550,000**	
Total Simple Payback							**3.8**

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. Operate the solids dewatering system odor control fan only during periods of sludge dewatering.

ECO No. 2. Eliminate 1 of 3 primary tanks in use when plant flows allow and optimize the primary sludge pump operations.

ECO No. 3. Install on site electrical metering to continuously monitor the site's electrical demand loads and energy use which will provide operators with the information necessary to proactively manage the site's energy use and reduce 15-minute interval demand peaks.

ECO No. 4. Reduce the site's potable city water used by the No. 2 water pumping system by converting the froth spray system at the clarifiers to utilize the No. 3 Water effluent.

ECO No. 5. 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. 6. Convert the constant speed Number 3 water pumping system to a pressure based variable flow pumping system (Variable Frequency Drive "VFD" equipped pumps) and install a jockey pump for use during low flow periods. Also, conduct a more thorough water utilization study of the Number 3 water pumping system as well as the Number 2 water pumping system to account for the various plant water requirements.

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:

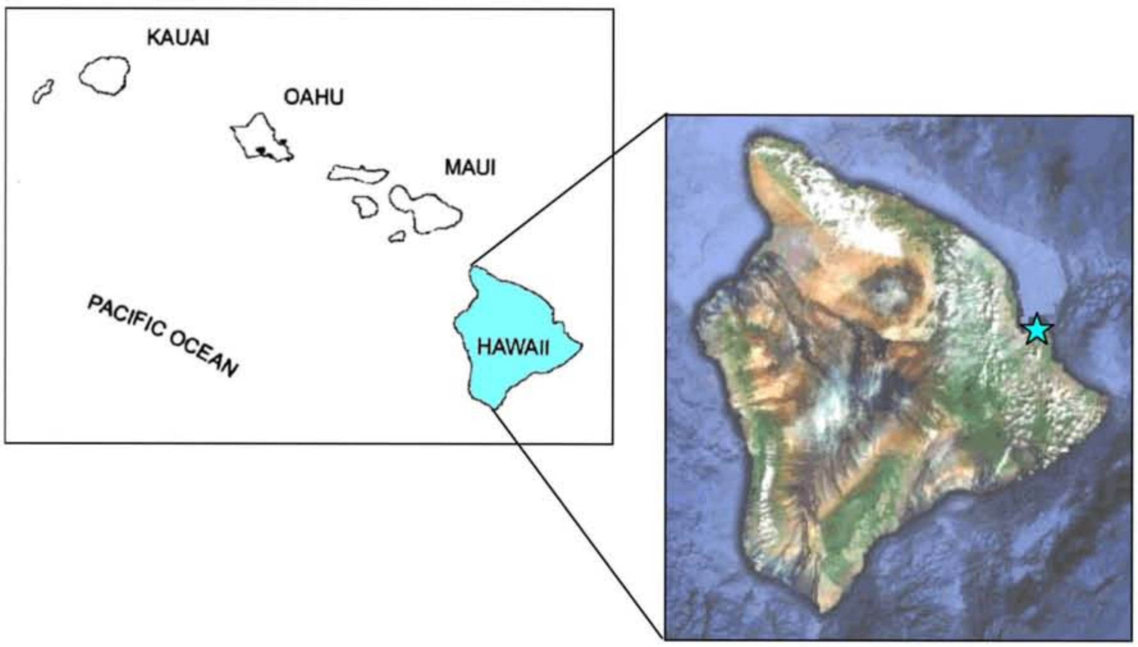
- Hilo WWTP – located on the island of Hawaii.
- Kailua WWTP – located on the island of Oahu.
- Kihei WWTP – located on the island of Maui.
- Waimea WWTP – located on the island of Kauai.

SECTION 3
Wastewater Treatment Plant Description

Location

The Hilo Wastewater Treatment Plant is located at, 150 Kekawnoa Place, Hilo, Hawaii. As shown in Figure 3-1, the facility is located on the northeast shore of the Island of Hawaii (Big Island).

Figure 3-1: WWTP Island Vicinity Map



The facility is located just east of downtown Hilo and immediately east of the Hilo International Airport. 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 and secondary treatment facility and the solids handling areas. The effluent is discharged to the ocean via an ocean outfall and has a waste discharge permit (NPDES HI 0021377).

The service area sewage is collected and conveyed to the Hilo WWTP via a series of gravity systems and pump stations. Part of the service area is adjacent to Hilo Bay and the collection system below the ground water elevation. The service area has inflow and infiltration (I&I) impacts. The facility was constructed in 1993-1994, with subsequent rehabilitation and upgrade projects in recent years.

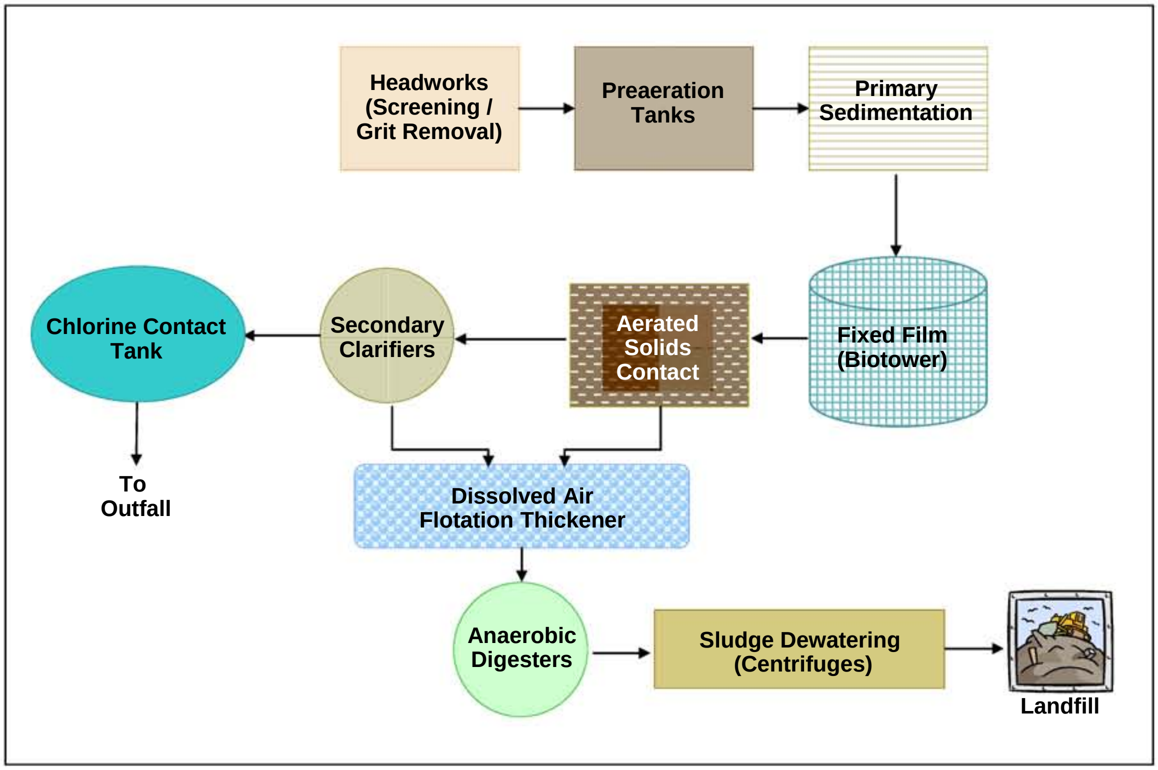
WWTP Operating Schedule

The plant maintains a staff of approximately 18 full-time employees. 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 primary and secondary processes have a design capacity of 5 million gallons per day (MGD). Currently, the facility is operating at 3 MGD. Figure 3-3 provides a schematic of the major treatment processes and plant flow. Hilo is designed for Fixed Film secondary treatment.

Figure 3-3: Plant Flow Diagram



The flow enters the facility via offsite pump stations. Influent wastewater is measured via an inline flow meter and is mechanically screened, and the grit removed, via an aerated grit system. The wastewater gravity flows through two pre-aeration holding tanks and enters into the primary sedimentation basins for the settling of solids. The primary treated wastewater is conveyed via gravity to the biotower pump station. The biotower pump station circulates wastewater over the fixed-film biotowers for biological (secondary) treatment. The two biotowers are equipped with hydraulic rotating arms for continuous and even distribution of wastewater over the media. Supplemental air fans are provided at the base of each biotower, to pass air countercurrent to the wastewater flow to maintain an aerobic healthy environment for the biological culture.

The effluent of the biotower gravity flows to the secondary solids contactor, prior to entering the secondary clarifiers. The solids contactor provides a mixed liquor suspended solids (MLSS) environment with aeration to further reduce the wastewater constituents.

The secondary clarifiers provide a quiescent environment to allow the solids to settle out. The settled solids are returned to the solids contactor or wastes to the solids processing.

The effluent from the secondary clarifiers flows via gravity to a chlorine contact tank; where a chlorine solution is added for disinfection prior to gravity discharge to the ocean outfall.

Solids from both the primary sedimentation basins and the secondary clarifiers are pumped to the solids processing area.

The solids processing consists of a dissolve air flotation (DAF), which is currently being used as a temporary holding tank; two anaerobic digesters, auxiliary digester support equipment including boilers, heat exchangers, gas mixing, and waste gas flare station. After the sludge has been digested, a centrifuge station is provided to dewater the sludge prior to landfill disposal.

The facility is equipped with various support systems including: odor control for the primary and solids areas, plant air, plant water, an administration and maintenance building, emergency power, and chemical handling.

The main energy users within the facility are the two aeration systems, biotower pumping, and sludge mixing and dewatering.

Table 3-1 provides a summary of major equipment, estimated annual operational hours, and annual energy usage. As indicated in Table 3-1, the aeration blowers and biotower pumps account for approximately 55% of the energy use by the high energy use equipment.

Table 3-1: Major Equipment Inventory List

(Based on an average 165,000 kilowatts per month[(4)], 2.5 MGD wastewater)

(Major equipment is defined as 7.5 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	No. 2 Water Pump	15	12	2,190	51,000
2	Grit Pumps (2 units)	10	2@7.5=15	4,380 each	65,500
3	Primary System Odor Control Fan	7.5	5	8,760	41,500
4	Primary Sludge Pumps (3 units)	10	3@7.4=22.1	2,190 each	48,500
5	Primary Blower (1 large unit)	50	33	8,760	290,000
6	Primary Blower (1 small unit)	25	16	8,760	141,000
7	Secondary Blower w/ VFD	20	8.5	8,760	74,500
8	Centrifuge	35	30	624	18,500
9	Solids Processing Odor Ctrl Fan	15	8.7	8,760	76,000
10	Biotower Pumps (2 units)	40	2@30=60.6	8,760	530,500
11	Biotower Pumps (50% 1unit)	40	30	4,380	132,500
12	DAF Thickened Sludge Pumps (2units)	7.5	2@3.9=7.8	604	4,700
13	Digester Sludge Mix Pump	25	21	8,760	184,500

No.	Equipment Description	Equipment Size[1] (hp)	Equipment Load[2] (kW)	Est. Operational Hours[3] (hrs/yr)	Est. Energy Usage[4] (kWh/yr)
14	Digester Sludge Transfer Pumps (2 units)	7.5	6	624	3,800
15	No. 3 Water Pump	40	26	8,760	226,000
16	Administration / Maintenance Buildings - Estimated Load	---	17 kW average	2,190	37,000
17	Lighting Load	---	6 kW average	2,920	17,500
18	Balance of Plant	6.3	4 kW average	8,760	37,000
	TOTALS:				**1,980,000**[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.

3

SECTION 4
Utility Analysis

Current Utility Use

The Hilo 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 $635,000 annually for the site's energy and water usages. Over 92 percent of this cost is from electrical energy use. Typical site annual utility use and costs are summarized in Table 4-1 and described in more detail 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	1,848,000 kWh	6,305 MMBTU	$582,400	92%
Water	9,399,000 gal	9,399,000 gal	$37,300	5%
Propane	3,228 gal	8 MMBTU	$12,000	2%
#2 Fuel Oil	906 gal	125 MMBTU	$3,500	1%
Total		**6,440 MMBTU**	**$635,200**	**100%**

Propane

The Gas Company LLC provides liquefied petroleum gas or propane to the WWTP. The main user of this fuel is the site's boilers that generate heat to maintain the plant's anaerobic digesters. Typical annual use is just over 3,200 gallons at a cost of approximately $12,000 per year.

#2 Fuel Oil / Diesel Fuel

Aloha Petroleum, Ltd. provides #2 fuel oil or diesel fuel to the WWTP. The diesel energy is delivered to the site by truck and offloaded at the site's 10,000 gallon receiving tank. The only user of this fuel at the site is the diesel generator that provides backup electrical energy to the site in the event of an electrical power outage. This use is small, as the generator is typically run unloaded for about 1 hour weekly and loaded for about 1 hour monthly. Typical annual use at the site is only approximately 900 gallons, at a cost of approximately $3,500 per year. The diesel fuel stored at the plant is also used for offsite purposes, such as filling the other offsite WWTP and pump station backup generator tanks. However, since this usage is not used for on site purposes, the volumes for such were not included in this assessment.

Water

Purchased treated water is supplied by the County of Hawaii to the WWTP. The city water is delivered to the site through an 8 inch water main supply line. Typical annual use is approximately 9,399,000 gallons, at a cost of over $37,000 per year.

Electricity

Hawaii Electric Light Company, Inc., (HELCO) provides electrical energy to the WWTP. The electrical energy is delivered through one transformer on site and one meter. Typical annual use is approximately 1,848,000 kilo-watt hours, at a cost of over $582,000 per year. Table 4-2 provides a summary of the electrical energy use purchased from HELCO for the Hilo WWTP for the period of July 2008 through June 2009.

Table 4-2: WWTP Monthly Electrical Energy Use

Billing Period	Electrical Energy Use (kWh)	Electrical Energy Cost ($)
Jul-08	162,600	$58,278
Aug-08	167,400	$62,394
Sep-08	153,600	$60,865
Oct-08	152,400	$58,289
Nov-08	156,600	$57,316
Dec-08	150,600	$52,045
Jan-09	166,800	$49,553
Feb-09	139,800	$36,897
Mar-09	147,600	$38,444
Apr-09	142,800	$35,297
May-09	144,000	$34,634
Jun-09	163,800	$38,395
Average (12 months)	**154,000**	**$48,534**
Total (12 months)	**1,848,000**	**$582,408**

As shown in Table 4-3 below, approximately 87% of the site's total electrical energy charges were for electrical energy use charges, 12% for electrical energy demand charges, and the remaining 1% 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 ($)	Total Electric Costs ($)
Jul-08	30	$51,713	$5,961	$604	**$58,278**
Aug-08	32	$55,846	$5,938	$610	**$62,394**
Sep-08	30	$54,436	$5,835	$594	**$60,865**
Oct-08	30	$51,925	$5,772	$592	**$58,289**
Nov-08	31	$50,820	$5,898	$597	**$57,316**
Dec-08	30	$45,580	$5,876	$590	**$52,045**
Jan-09	33	$42,882	$5,959	$711	**$49,553**
Feb-09	28	$30,462	$5,749	$687	**$36,897**

Billing Period	Billing Days	Electrical Energy Use Costs ($)	Electrical Energy Demand Costs ($)	Other Costs ($)	Total Electric Costs ($)
Mar-09	30	$32,097	$5,645	$702	**$38,444**
Apr-09	29	$28,958	$5,647	$692	**$35,297**
May-09	29	$28,479	$5,748	$408	**$34,634**
Jun-09	33	$32,516	$5,576	$302	**$38,395**
Average (12 months)		**$42,226**	**$5,800**	**$591**	**$48,534**
Total (12 months)		**$505,713**	**$69,605**	**$7,090**	**$582,408**
Percent of Total		**87%**	**12%**	**1%**	**100%**

Table 4-4 provides a breakdown of the monthly measured peak power demands, monthly billed peak demands, and total HELCO demand-influenced charges to the Hilo WWTP for the same 12-month period.

Table 4-4: WWTP Electrical Power Demand Summary

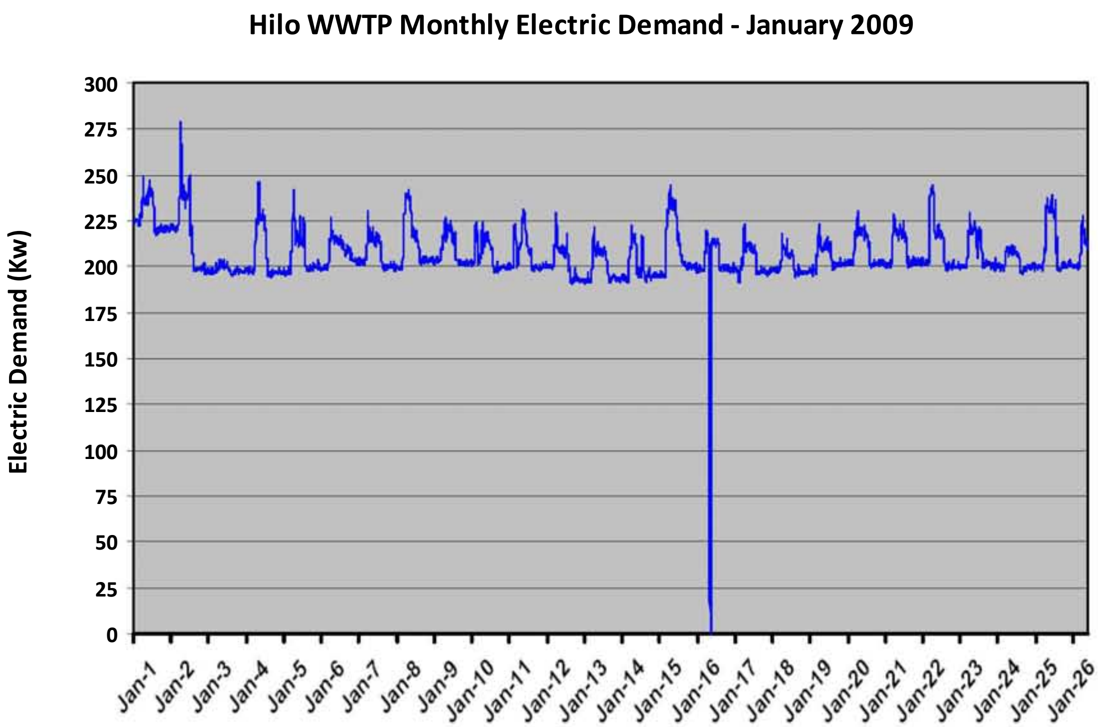
Bill Period	Measured Peak Demand (kW)	Billed Peak Demand (kW)	Total Demand Charge ($)
Jul-08	276	282	$5,961
Aug-08	270	279	$5,938
Sep-08	264	276	$5,835
Oct-08	258	273	$5,772
Nov-08	270	279	$5,898
Dec-08	264	276	$5,876
Jan-09	276	282	$5,959
Feb-09	252	270	$5,749
Mar-09	258	267	$5,645
Apr-09	256	267	$5,647
May-09	264	270	$5,748
Jun-09	252	264	$5,576
Average	**263**	**274**	**$5,800**
Total	**n/a**	**n/a**	**$69,605**

Note: Total demand charges above represents the "demand charge" as defined in the utility schedule in addition to all charges that are influenced by the monthly billed peak demand.

Monthly billed peak demands were generally between 264 and 282 kW. The billed demand charges for use up to 500 kWs is $11.25 per kW. Billing demand for each month shall be the maximum average load in kW during any fifteen-minute period for such month or the mean of current monthly maximum demand and the greatest maximum demand for the preceding eleven months, whichever is higher, but not less than the minimum billing demand of 200 kW. As Table 4-4 indicates, all demand was billed for the later case. This means that a prior monthly demand resulted in an inflated current demand charge. There were three months of measured demand within the prior 11-month period that caused this increase; these measured demands were March 08 (288 kW), July 08 (276 kW), and January 08 (276 kW). The highest maximum peak demand recorded in the last 12 months was in both July 08 and January 09 at 276 kW. The lowest maximum peak demand was recorded in February 09 and June 09 at 252 kW.

Below Figure 4-1 provides a trend of the plant's electrical demand energy during a typical month. This information is recorded by the site's electric meter and is stored at HELCO. Typically, you can gather this recorded information from your utility provider or even have remote access to an online interface to view the information yourself on a regular basis. The site's electrical load profile is the variation of the plant's electrical energy demand over time. A plant's electrical demand typically follows the influent flow volumes; as influent flows increase 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 below in which daily operations rise to a level of approximately 215-225 kW during the day and drop to approximately 200 kW during the evening periods. You'll also notice that the plant measured peak demands which are typically over 252 kW and occur at this level of demand only about once per month or very infrequently. If this demand peak can be controlled then the site could better manage this portion of their bill.

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



As can be seen in the trend above, this information can provide instantaneous feedback to the site about how much energy the site is using. The site can then determine how changes at the operations level will impact the site's demand and make decisions accordingly. This can be valuable information if you are trying to control your measured demands. Since approximately 12% 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. More details of this billing rate are discussed in the following section of the report. Evaluation of the site's load profile will help the plant determine intermittent versus base electric loads and possibly help plan for opportunities to reduce the site's peak demands. The influence of electric demand and opportunities already identified for the site to improve this demand are provided in the Energy Conservation Opportunities Section 5.

Electricity Rate Schedule

The Hilo WWTP purchases electricity from HELCO and is under the HELCO Electric Tariff Schedule "P" for Large Power Service. Schedule "P" is applicable to large light and/or power service supplied and metered at a single voltage and delivery point.

As the site's actual electric bills were provided, a full breakdown of the site's electrical energy charges were calculated using the detailed rate schedule information as summarize below. Since electric use and electric load or demand contribute differently to the site's utility bill accounting factors, we separated these rates for improved accuracy when evaluating the individual Energy Conservation Opportunities and their expected impact on the site's future utility bills. As provided in Table 4-5 the electrical energy use rate was determined to be $0.273 calculated using the site's electrical energy use and costs for the most recent 12 month period. The electrical energy demand rate we determined to be $21.19/kW/month using the site's electrical energy demand use and costs for the same 12 month period. These electric rates were utilized for estimating cost impacts of the Energy Conservation Opportunities provided in Section 5.

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

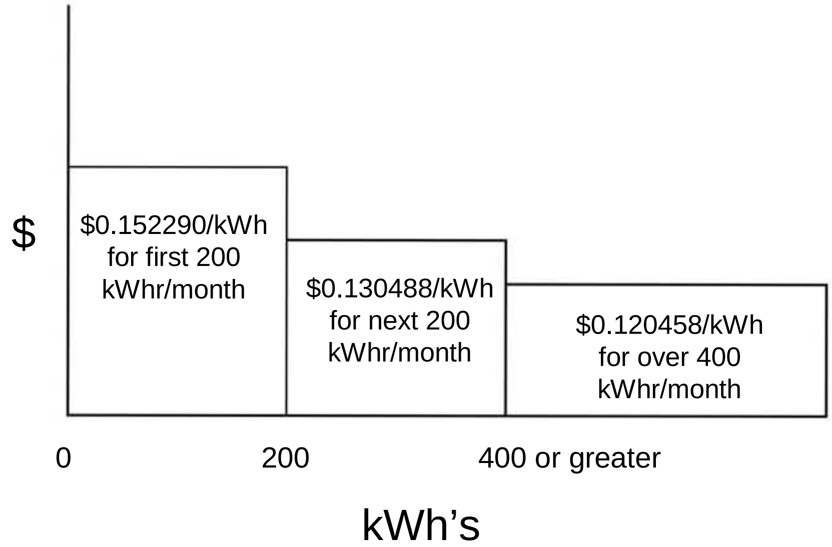
Table 4-5: WWTP Monthly Electrical Energy Use and Demand Rates Utilized for ECO Cost Impact for the Site

	Electrical Energy Use & Costs	Electrical Energy Demand Use & Costs	Other Costs ($)	Total Electric Use & Costs
Total (12 months)	$505,713 /yr	$69,605 /yr	$7,090 /yr	$582,408 /yr
Total (12 months)	1,848,000 kWh/yr	275 kW/mo average	n/a	n/a
Rate Used for ECO Calculations	$0.274 /kWh	$21.19 /kW/mo	n/a	n/a

The rate schedule the site is under for their electric service is broken down into the following charges as of the date of this report:

- Customer Charge – this is a fixed fee of $375 per month and does not vary with use.
- Energy Charge – this is a declining block charge in which there is a set price for the first block of energy (kWh) used and less for the next increment(s) of energy as more energy is used. The following blocks are currently set under Schedule P. Note that the energy charge is per kWh/month/kW of billing demand per kWh. For

example, a site using 150,000 kWhs in a month with a billed demand of 250 kW would have a total energy charge of 200kWh x 250kw x $0.152290/first 200kWh + 200kWh x 250kw x $0.130488/next 200kWh + (150,000kWh – (400 x 250)) x $0.120458/over 400kWh = $7,614.5000 + $6,524.4000 + $7,685.2204 = $21,824.12 for that billing month.



- ***Demand Charge*** – the demand charge is the maximum average load in kW during any fifteen-minute period. The billing demand for each month is the maximum average load in kW during any fifteen-minute period for such month, or the mean of current monthly maximum demand and the greatest maximum demand for the preceding eleven months, whichever is higher, but not less than the minimum billing demand of 200 kW. Like the energy charge, this is also a declining block charge. However, there are only two blocks which are 0-500kW at $11.25 per kW of billing demand and over 500 kW at $10.75 per kW of billing demand. Since the site typically has a demand between 250-275 kW, they are typically in the first block at $11.25 per kW.

- ***Power Factor*** – the above energy and demand charges are based upon an average monthly power factor of 85%. For each 1% the average power factor is above or below 85%, the demand and energy charges, as computed under the above rates, shall be decreased or increased, respectively, by 0.15%. Typically, the site is at a 97%-98% power factor. This means they are given a credit each month for having high power factor. This credit is normally in the range of $400-$500 per month.

- ***Interim Rate Adjustment*** – effective April 5, 2007, an interim rate increase in the amount of 10.80% has been added to the site's monthly bill. This rate increase in essence increases the Customer Charge, Energy Charge, Demand Charge, and Power Factor Credit. This charge typically increases the monthly bill by approximately $2,600 per month.

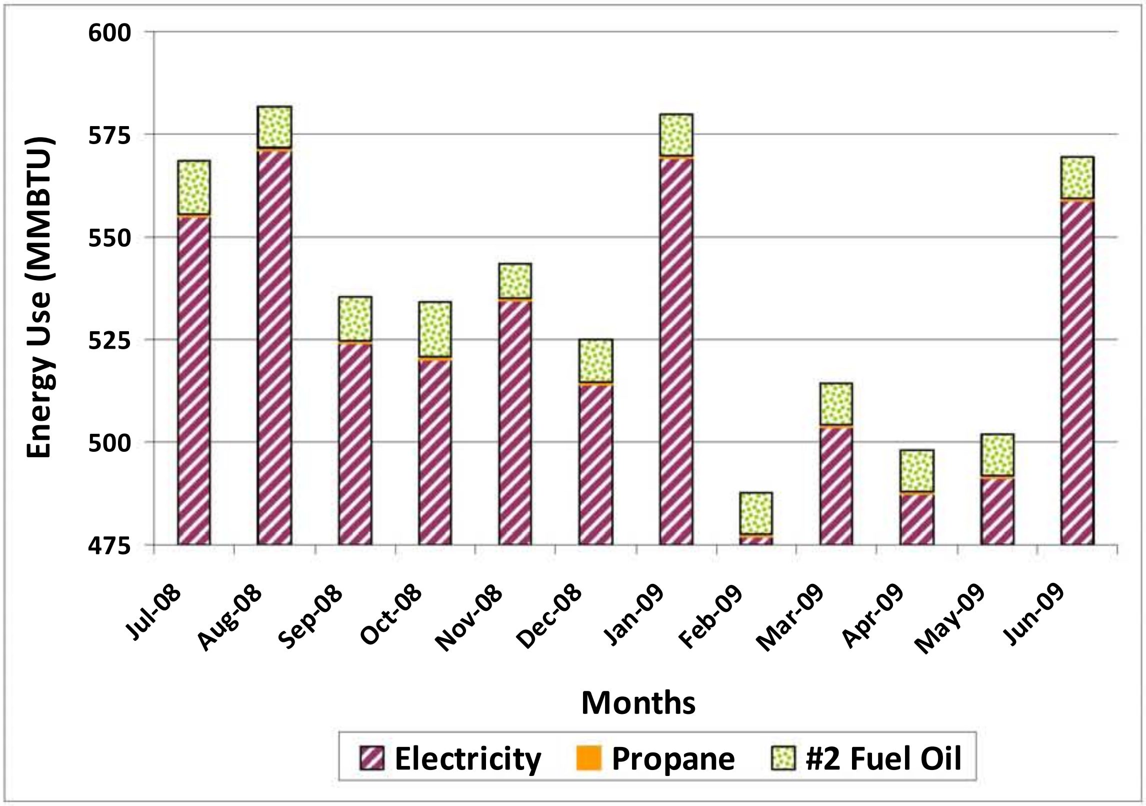
- ***Public Benefits Fund (PBF) Surcharge*** – effective January 1, 2009, this charge is a set percentage of the total energy used in kWh. Currently this rate is at $0.1015% per kWh. According to PUC documents, the PBF rate is set to increase over the next few years and then level off. This funding is to support investment in more sustainable alternatives to fossil fuel derived power needs. This charge typically increases the monthly bill by approximately $150 per month.

- ***Energy Cost Adjustment*** – this factor is evaluated each month and is charged to the energy used in kWhs. If the PUC approves HELCO's submitted rate change then the new rate takes into 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 $0.22 per kWh. In 2009, this rate averaged approximately $0.08 per kWh.
- ***Integrated Resource Planning (IRP) Cost Recovery*** – this charge supports the planning and other costs for HECO's Integrated Resource Planning programs. This charge typically increases the monthly bill by approximately $175 per month.

Energy Baseline

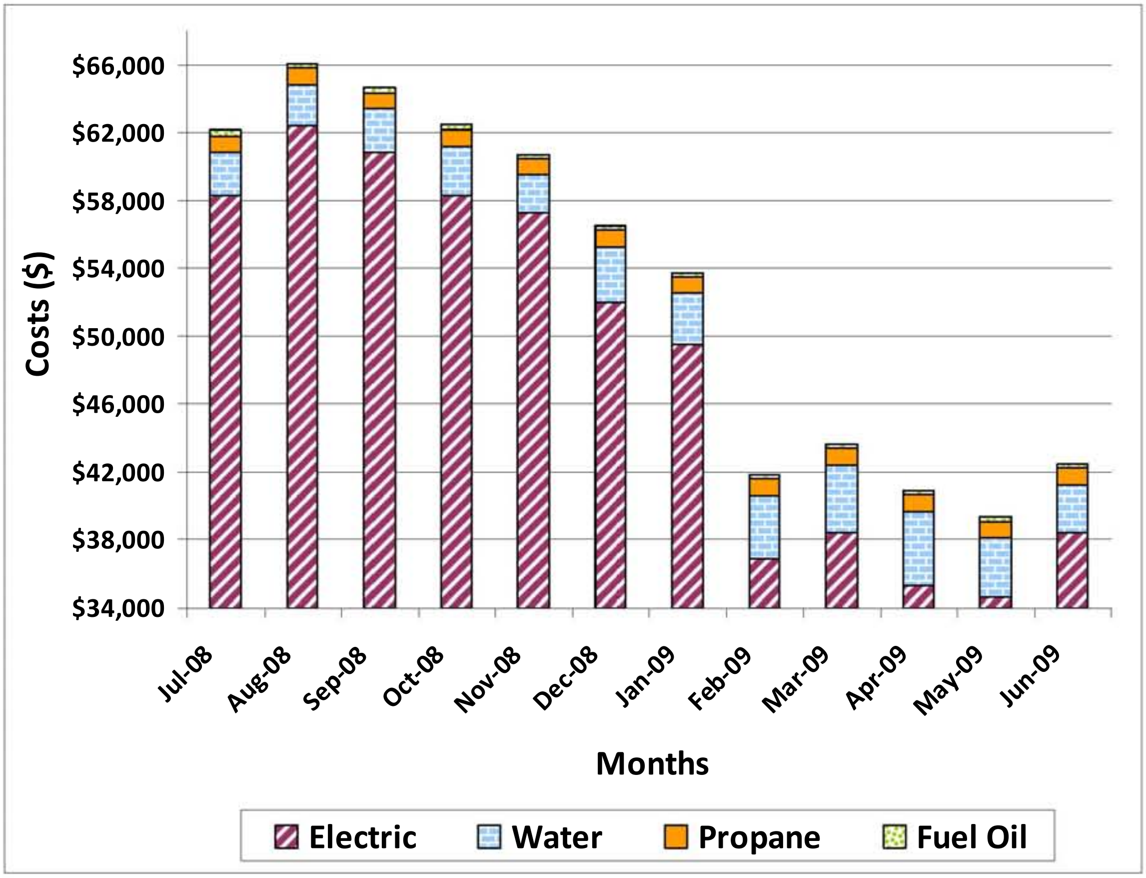
The following Figure 4-2 describes the site's energy use over the 12-month period from July 2008 through June 2009.

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 July 2008 through June 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.

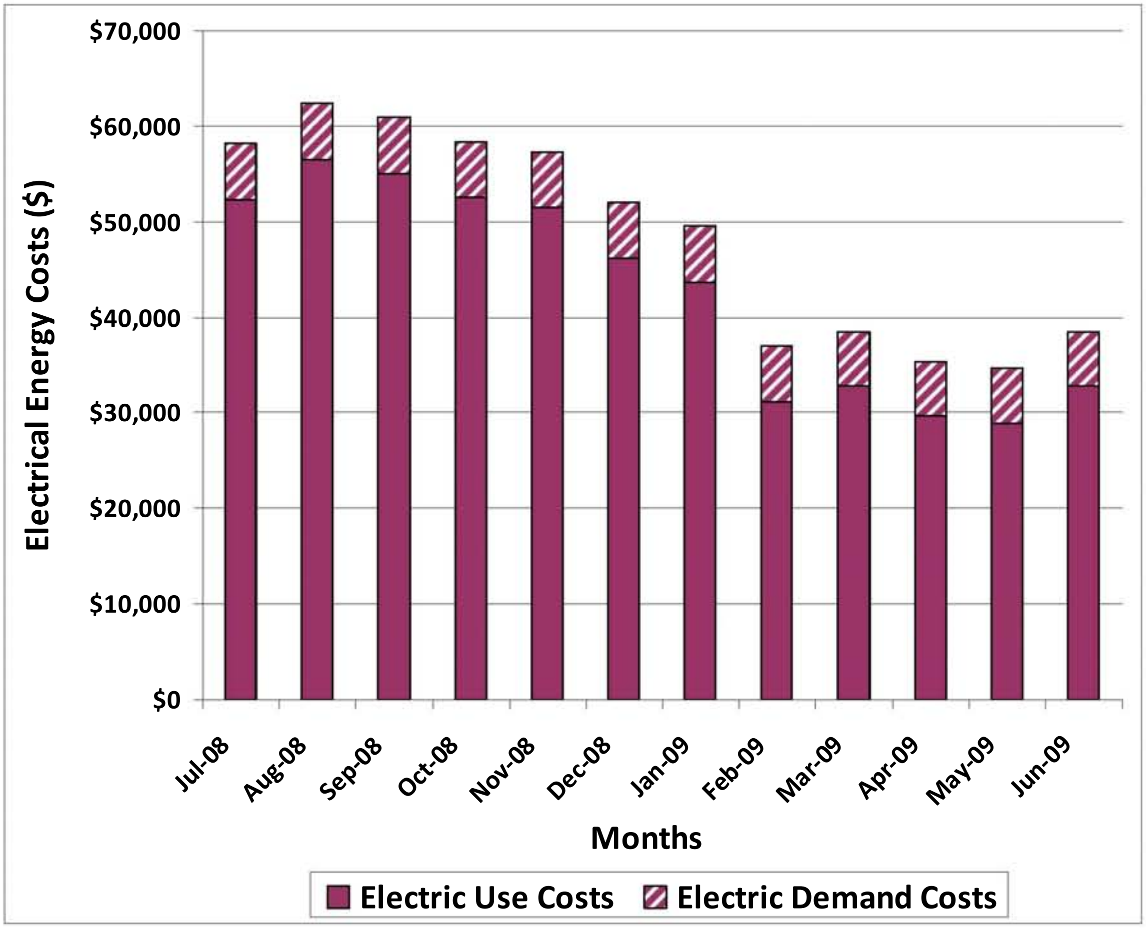
Figure 4-3: WWTP Total Energy (and Water) Cost Breakdown



4

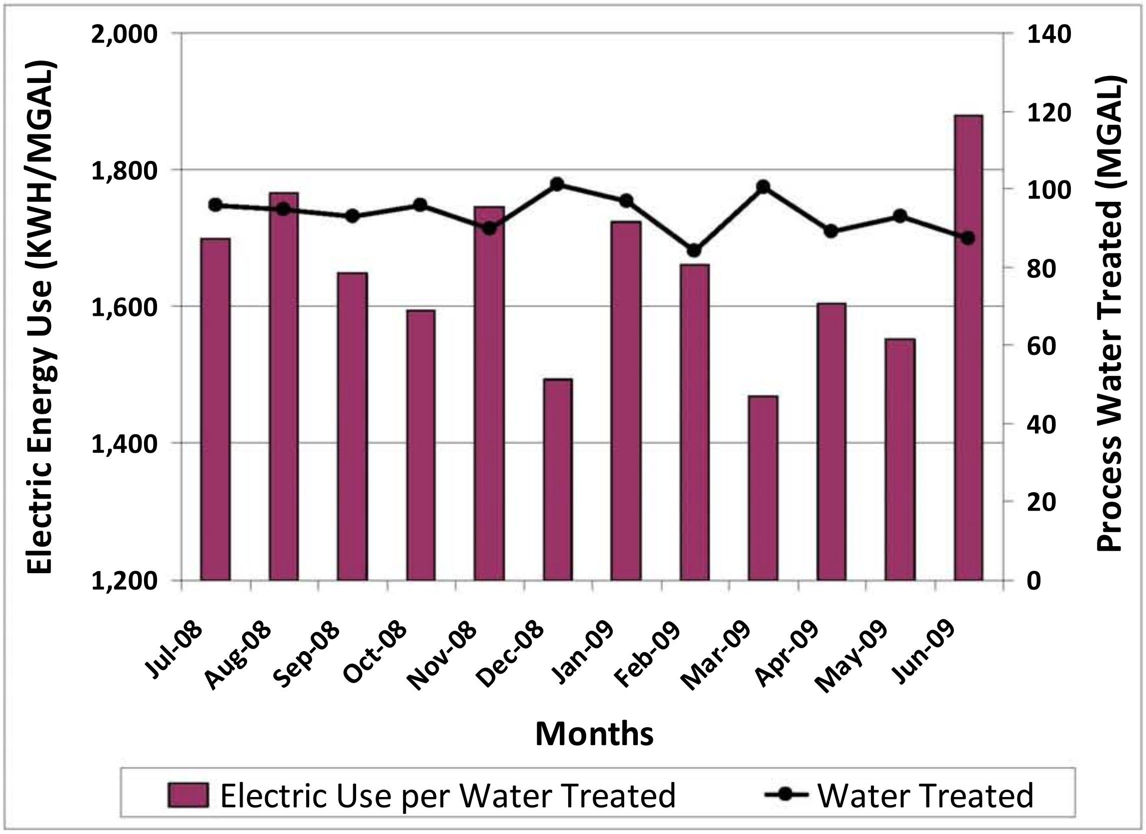
The following Figure 4-4 describes the site's electrical energy costs over the same 12-month period, from July 2008 through June 2009. This illustration provides a breakdown of electric use costs versus electric demand costs. The site average demand costs are on average approximately 12% of the electric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

Figure 4-4: WWTP Electric Energy Cost Breakdown



The site's 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 July 2008 through June 2009. This provides one productivity measurement of an energy utilization index to demonstrate deviations in electrical energy use over time. Both advantages and disadvantages exist 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



4

SECTION 5
Energy Conservation Opportunities

ECO 1 – Operate Dewatering Odor Control Fan Only During Dewatering Periods

Recommendation

To improve control of the ventilation fan associated with the solids processing odor control system, it is recommended to reduce the energy required for solids dewatering. Reduction in operation of the odor control fan can be obtained by modifying procedures to operate the fan immediately prior to dewatering operations and up to 1-hour beyond the termination of the dewatering operation. The equipment control modification will significantly reduce the operation of the odor control fan's energy use at the facility. Estimated energy, power demand, and cost savings, and simple payback from such an installation, are summarized below.

Estimated Electrical Energy Savings	=	69,850 kWh/yr
Estimated Electrical Demand Savings	=	0 kW
Estimated Total Energy Cost Savings	**=**	**$19,100/yr**
Estimated Implementation Cost	**=**	**$0**
Simple Payback	**=**	**0.0 years**

Background

The solids processing area was designed in 1995 with a ventilation/mist tower odor control system. The odor treatment segment of the odor control system was abandoned in-place in late 1995. The odor control fan is a 15 hp, constant speed fan that is currently in operation 8,760 hours per year with an estimated electric load of 8.7 kW for a total of approximately 76,200 kWh per year. The odor collection system (ductwork) connects the centrifuge building and dissolved air flotation (DAF) units to the fan. The DAF has been converted to an intermediate holding tank, and the cover and ductwork associated with the DAF are in disrepair.

Solids processing operations occur weekly, two days per week typically on Monday and Thursday for 6 hours which equates to 12 hours of dewatering per week. The twice a week daily load of dewatered sludge is trucked the day of dewatering to the landfill, approximately four miles from the treatment plant. No dewatered sludge is stored on site.

Estimated Energy and Cost Savings

Presently, one odor control fan operates continuously, using over 76,200 kWh of energy per year. Improving control of this operation to allow the fan to operate only during each dewatering event, plus one hour beyond to fully ventilate the building, would reduce weekly run time from 168 hours per week to 14 hours per week. This would reduce the fan's annual energy use from approximately 76,200 kWh to 6,350 kWh, which equates to a net energy savings of 69,850 kWh per year. Since the fan would still operate at least once during the

5

month, idling of this equipment is not anticipated to reduce measured demand influenced loading at the site.

The total estimated annual Cost Savings (CS) is the sum of the Electrical Energy Cost Savings (ECS) and Demand Cost Savings (DCS). The 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 = [69,850 (kWh/yr) X 0.274 ($/kWh)] + [0 (kW) X 21.19 ($/kW–month) X 12 (months/yr)]
CS = $19,100/yr + $0/yr
CS = $19,100/yr

Estimated Implementation Cost and Payback
The total preliminary estimated cost to implement this ECO is $0 as shutdown of this equipment could be performed manually by site operators when they startup and shutdown the solids dewatering process.

Based on this preliminary assessment, the simple payback period would be 0.0 years.

The following assumptions were made about this ECO:

1) DAF will continue to operate as interim holding tank.
2) No odor control air permit or requirement currently exists.
3) DAF odor duct will be isolated from dewatering odor control system.
4) No dewatering sludge is stored on site.
5) Incorporation of an electrical interconnect to automatically start fan when centrifuge is energized and installing an adjustable timer controller to the centrifuge circuit to allow fan operation up to 1-hour beyond centrifuge operation is not included at this time.
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) Isolate DAF ductwork from odor system.
2) Modify operating procedure for solids processing operation to included confirmation that ventilation fan is on prior to solids processing and to confirm shutdown of the ventilation system once solids processing subsides.

Note: If this manual shutdown can not be accomplished consistently, then installing an electrical interconnection circuit between the fan and the centrifuge to enable automatic control for startup and shutdown may be necessary. Implementation of such control modifications is estimated between $5,000-$7,500.

Plant Staffing Impact

Implementation of this ECO is not anticipated to impact plant staffing requirements. Implementation will introduce an added step in the centrifuge operations procedure to turn the odor control fan on and off with solids processing once or twice a week, but does not require any special functions or training beyond current requirements for centrifuge operations.

Photo Gallery

	
Solids Dewatering Building Odor Control Fan and Abandoned Mist Tower	Odor Control Duct at DAF Tank

ECO 2 – Eliminate 1 Of 3 Primary Tanks In Use And Optimize Primary Sludge Pump Operations

Recommendation

It is recommended that one of three Primary Tanks currently in use be removed from service and the timer settings of the sludge pumps modified to optimize sludge transfer operations. Over the last 2 years, the plant's influent flows have averaged 3.14 million gallons a day (mgd). This average flow rate is below 63% of the plant's average dry weather flow of 5 mgd. Shutdown of one Primary Tank and its respective auxiliary systems will eliminate the operation of a sludge pump, helical skimmer, sludge collector, and cross collector motor loads and reduce the annual energy use at the facility. Increasing the primary sludge pump's cycle time would allow for more solids settling time, reduce the likelihood of pumping water to the digesters, and also improve the site's energy use. Total estimated energy, power demand, and cost savings, and simple payback from such an installation are summarized below.

Estimated Electrical Energy Savings	=	39,900 kWh/yr
Estimated Electrical Demand Savings	=	14 kW
Estimated Total Energy Cost Savings	**=**	**$11,200/yr**
Estimated Implementation Cost	**=**	**$5,000**
Simple Payback	**=**	**0.4 years**

Background

Currently, the site utilizes all three primary sedimentation tanks at the site for process operations. Each of the three primary tanks has an individual loading rate of 1.67 mgd for a total plant capacity loading rate of 5.00 mgd. Removing one tank from service would reduce this plant capacity to 3.33 mgd, which is still above the site's average daily flow of 3.14 mgd. This reduction would still allow for a 6% average excess capacity.

The auxiliary equipment, typically in operation, that would be eliminated by removing one of the primary sedimentation tanks from service includes: one sludge pump, one helical skimmer, one sludge collector, and one cross collector. This equipment, although out of service, would require regular cycling. This infrequent energy use is deducted from the anticipated savings. Equipment for the tank that would remain in operation includes: the odor control fan and scum pump.

The site currently operates the sludge pumps at a rate of 5 minutes on and 15 minutes off cycle. Based on typical site operations, and to provide more settling time for the solids, it is recommended the off time operation of these pumps be increased by 10 minutes; which results in a new sludge pumping period of 5 minutes on time and 25 minutes off time. This cycling change would be recommended for the two sludge pumps which would remain in service.

Estimated Energy and Cost Savings

Presently, one (0.75 hp) sludge collector and one (0.75 hp) cross collector operate continuously 8,760 hours per year. The estimated electrical load, based on an average load factor of 80% and average motor efficiency of 85%, is 0.527 kW and 0.527 kW respectively. The total electrical consumption reduction associated with shutdown of this equipment, on at least one tank throughout the year, is 1.053 kW and 9,226 kwH per year. Even though this equipment would be out of regular service, it would require intermittent cycling to make sure the units stay in proper working condition. A recommended cycling frequency is 15 minutes every week. This would reduce the equipment's total energy use savings from 9,226 to 9,212 kwH per year.

Equipment at the primary tank which runs less than 100% of the time includes: one (10 hp) primary sludge pump and one (7.5 hp) helical skimmer, per tank. The sludge pumps are currently operated on a 5 minutes on and 15 minutes off cycle for an estimated operational time of 2,190 hours per pump per year. The estimated electrical load based on the current motor efficiency is 7.39 kW per pump which equates to 16,184 kwH per pump per year. The helical skimmer is estimated to run about 5 minutes every hour or approximately 730 hours per year. The estimated electrical load based on an average load factor of 80% and average motor efficiency of 85% is 5.27kW, which equates to 3,844 kwH per year. Energy use would be eliminated for one of the sludge pumps and one of the helical skimmers currently in operation. Due to recommended future cycling frequency of 15 minutes every week, the equipment's total energy use savings would be reduced from 20,028 to 19,863 kwH per year.

If the timer cycles are modified to the recommended 5 minutes on and 25 minutes off cycle, the pumps' new operation time would be 1,460 versus 2,190 hours per pump per year. This is a reduction of 730 hours per pump per year. The additional electrical energy savings, from reducing pump operation for the two sludge pumps which would remain in operation, is 10,789 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 = [39,864 (kWh/yr) X 0.274 ($/kWh)] + [14 (kW) X 21.19 ($/kW–month) X 12 (months/yr)]
CS = $10,900/yr + $300/yr
CS = $11,200/yr

Estimated Implementation Cost and Payback

The total preliminary estimated cost to implement this ECO is $5,000. A control function would be installed to cycle the off tank during non-peak operating periods to ensure equipment reliability.

Based on this preliminary assessment, the simple payback period would be 0.4 years.

The following assumptions were made about this ECO:

1) The primary tank and equipment associated with that tank would be shut down and out of service with periodic weekly cycling of the equipment.
2) The implementation cost estimated is for control wiring, programming, and installation. This estimate does not include any equipment replacement.
3) The two sludge pumps to remain in operation would have their timer settings adjusted to 25 minute off cycling versus 15 minutes to allow for improved sludge settling capability.
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) Isolate one of three primary tanks from process water flow.
2) Drain tank, clean it, and fill it with effluent via Number 3 water pumping system.
3) Cycle the respective primary tanks sludge pump, helical skimmer, and collector motors on a frequency of 15 minutes per week (New control timer on equipment).
4) Create primary tank shutdown procedures for rotation of primary tanks on a regular basis. A routine procedure, to verify tank and auxiliary equipment remains out of service, may be necessary.
5) Shutdown/lockout tags may be necessary, to inform other site representatives of a tank currently offline and to prevent unnecessary startup of systems to stay offline.

Plant Staffing Impact

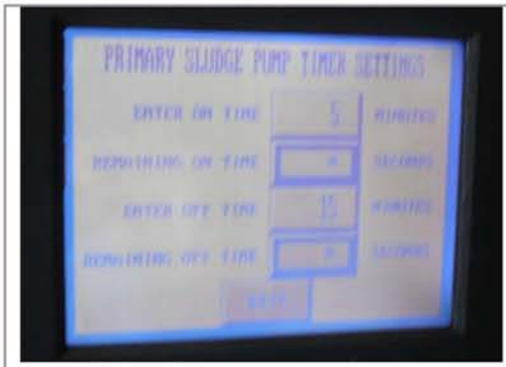
Implementation of this ECO is not anticipated to impact plant staffing requirements. This ECO has a need for operators to make specific changes in the operation of certain plant equipment which is currently part of their daily operating procedures and duties.

Photo Gallery

Existing Primary Sedimentation Tanks 1, 2 and 3

Existing Primary System Blowers

Existing Smaller 25 hp / 1,500 cfm Primary Blower



Primary Sludge Pump Timer Settings and Human Machine Interface (HMI)

ECO 3 – Electrical Demand Management

Recommendation

It is recommended that the Hilo WWTP considers investment in on site electrical metering to continuously monitor the site's electrical loads and energy use information. This data could be used to provide the site operators' detailed information to make operational changes to minimize or prevent additional demand charges from the power company. Estimated energy, power demand, and cost savings, and simple payback from such installations are summarized below.

Estimated Electrical Energy Savings	=	0 kWh/yr
Estimated Electrical Demand Savings	=	26 kW
Estimated Total Energy Cost Savings	**=**	**$6,600/yr**
Estimated Implementation Cost	**=**	**$50,000**
Simple Payback	**=**	**7.6 years**

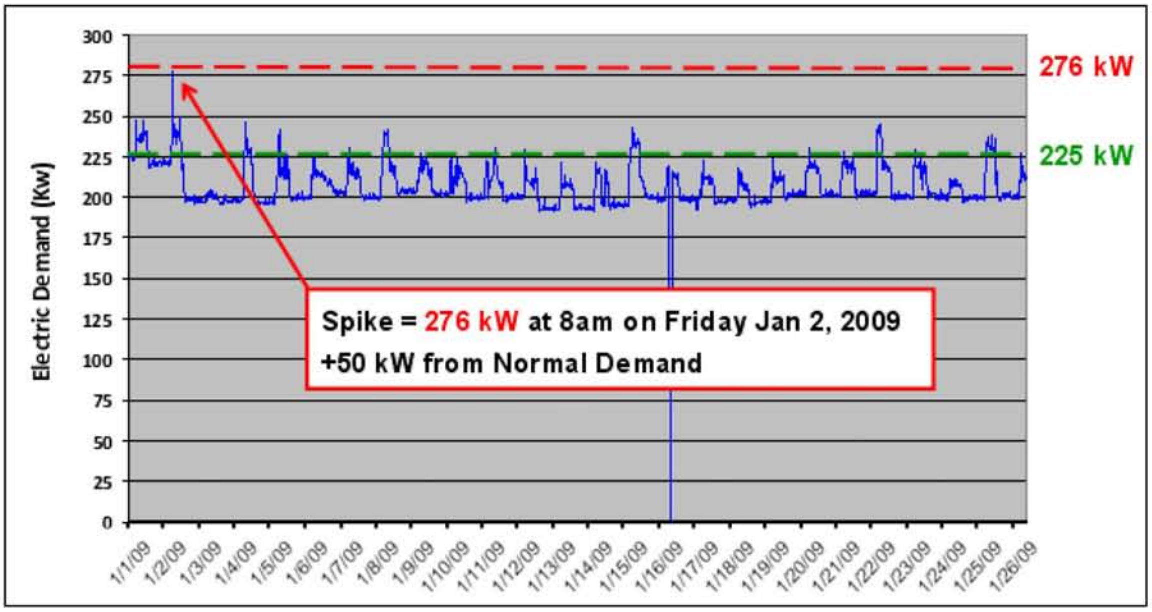
Background

Currently, the site has one main electric meter on site that is owned by the local utility provider, Hawaii Electric and Lighting Company (HELCO). This meter logs the site's electrical energy use over time and electrical demand information. As stated in the Utility Analysis section, the site is on HELCO's schedule rate "P" for large power service. The monthly billing demand affects the bill in two ways. First, the billing demand is used as a multiplier within the Energy Charge and makes up almost 75% of this charge. Secondly, the Demand Charge is a direct block rate of $11.25/kW. This determination of demand is defined by HELCO as

> "*The maximum demand for each month shall be the maximum average load in kW during any fifteen-minute period. The billing demand for each month is the maximum demand for such month or the mean of the current monthly maximum demand and the greatest maximum demand for the preceding eleven months, whichever is higher, but not less than the minimum billing demand of 200kW.*"

Billed demand over the last 12 months has averaged over 12% of the site's total electric bill. Annually, that amounts to almost $70,000 per year. Therefore, monitoring the electrical energy, and specifically the electrical demand at the site, can provide means to decrease the monthly utility billing demand and resultant charges. Below, Figure 5-1 provides a view of the plant's typical monthly electric demand graph in 15 minute intervals. As illustrated, a demand spike on Friday January 2, 2009 resulted in a new measured peak demand that was used for billing over the following 11 months. This spike is not a frequent event and well over 50kW from normal daily demands, and also over other demand spikes that range below 250 kW throughout the month.

Figure 5-1: WWTP Monthly Electric Demand – 15 Minute Interval Data January 2009



During the 12 month period examined for this study, the site's measured demand fluctuated between 252 - 276 kW's, with an average measure demand of 263 kW. However, due to a prior 11-month peak of 288 kW in March 2008, eight of the last 12 months were averaged with this value inflating the billed demand by 2-7%. Average billed demand for the same period was 274 kW. This had a resultant cost impact of over $7,000 per year. Measured versus billed electrical demand for the site over the last 12 months of billing obtained is presented in Table 5-1 below.

Table 5-1: Measured vs. Billed Site Demand

Bill Period	Measured Peak Demand (kW)	Billed Peak Demand (kW)
Jul-08	276	282
Aug-08	270	279
Sep-08	264	276
Oct-08	258	273
Nov-08	270	279
Dec-08	264	276
Jan-09	276	282
Feb-09	252	270
Mar-09	258	267
Apr-09	256	267
May-09	264	270
Jun-09	252	264

Bill Period	Measured Peak Demand (kW)	Billed Peak Demand (kW)
Average	263	274
Low	252	264

Estimated Energy and Cost Savings

The estimated electrical demand energy savings if this ECO is implemented is a net reduction of 26 kW.

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 = [0 (kWh/yr) X 0.274 ($/kWh)] + [26 (kW) X 21.19 ($/kW–month) X 12 (months/yr)]
CS = $0/yr + $6,600/yr
CS = $6,600/yr

Estimated Implementation Cost and Payback

The total preliminary estimated cost to implement this ECO is $50,000. This estimate includes the cost for new metering interface hardware to connect to new current transformers to incorporate the electrical power usage into the site's supervisory, control, and data acquisition (SCADA) system. A basic power monitoring system would convert the current and voltage readings at the switchgear to 4-20mA signals, which would be inputted to the SCADA system. Programming of the Programmable Logic Controllers (PLC) and operator interface would provide the necessary calculations and display the electrical power signals through the SCADA interface as well as indicate any alarms and warnings. This would provide the site the minimum tools necessary for electrical demand management.

Based on this preliminary assessment, the simple payback period would be 7.5 years.

The following assumptions were made about this ECO:

1) The site will monitor and regulate equipment operation to maintain site electric demand loads under the 250 kW demand threshold.
2) The site may not see the expected demand savings for upwards of 11 months due to the influence of a higher kW demand measured from the prior 11 month period that will still contribute to a higher than measured billing demand. This is due to the site's electric schedule contract with the utility.
3) 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) Contact the local utility to request utilization of the pulse signals from the utility provided meter to reduce the costs of having to install a new meter.
2) Confirm that the site's SCADA system will have the capability and space to store and database the pulse signal data.
3) Train the site staff on the demand reduction strategy and update such staff on a regular basis as to the demand limiting set point.
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 requirements. This ECO has a small impact on the need for operators and site management to review the site's monthly electric demand, but should not require more than a few minutes for such reviews. This information is a tool to enhance the operator's knowledge of the system and the ability to make better decisions for daily operations.

Photo Gallery

	
Site's HELCO Electrical Power Meter	Site SCADA System Interface in Control Room

5

ECO 4 – Number 2 Water Pumping System Improvements

Recommendation

It is recommended to convert the froth spray system to move floatables on the surface of the clarifiers to the No. 3 Water Pumping system. Currently, approximately 8.3 million gallons of potable water per year is used as process related water. In addition the potable water for the City service must be provided with an "air gap" to prevent backflow. In essence, the potable water is re-pressurized by a two pump hydro-pneumatic tank system with an operating pressure of approximately 100 psig. Estimated energy, power demand, water and cost savings, and simple payback from such an installation are summarized below.

Estimated Electrical Energy Savings	=	35,000 kWh/yr
Estimated Electrical Demand Savings	=	0 kW
Estimated Total Energy Cost Savings	=	$ 9,600/yr
Estimated Water Savings (75% reduction)	=	6,525,000 gals/yr
Estimated Total Water Cost Savings	=	$26,100/yr
Estimated Total Resource Cost Savings	**=**	**$35,700/yr**
Estimated Implementation Cost	**=**	**$ 100,000**
Simple Payback	**=**	**2.8 years**

Background

The existing No. 2 Water Pumping system was primarily provided for the mist type odor scrubbers (headworks and solids processing). In addition, the process tank froth spray and pump seal water systems were integrated into the No.2 Water Pumping system. The No. 2 Water is potable water from the City of Hilo with an air gap and booster pump system. Currently, approximately 9.4 million gallons of potable water are used at the site each year. This consumption is for both personnel use and process water systems. Engineering estimates for personnel use up to 700,000 gallons per year resulting in approximately 8.7 million gallons per year used for froth spray and other process related uses. The froth spray and make-up water flow rates are estimated at 10- 20 gpm or approximately 8.7 million gallons per year. It is proposed to convert the froth spray system back to the No. 3 Water source and add a duplex basket strainer to the discharge of the No. 3 Water Pumping system to prevent froth spray clogging.

Presently, one (15 hp) booster pump at 35 gallon per minute (gpm) operates on a 2 minutes on and 2 minutes off cycle for an estimated operational profile of 50% online during the year. The current estimated electric load, based on the current motor efficiency, is 11.71 kWh. With an annual operating time of 4,380 hours per year, the total electrical consumption associated with the booster pump(s) is estimated at 51,290 kWh per year.

Estimated Energy and Cost Savings

With the addition of utilizing the No. 3 Water Pumping system for providing water for the froth spray, it is estimated to result in reducing a major portion of potable water use at the site. The estimated new cycle times for the No. 2 Water Pumps would be 2 minutes on, 6 minutes off. This is estimated to reduce the energy use of this system by approximately 35,000 kWh per year. It is also estimated to reduce current site process potable water use (currently at 8.7million gallons per year) by 75% or a net water reduction of approximately 6,525,000 gallons per year.

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

CS = (ECS)(Usage Charge) + (DCS)(Demand Charge) + (WCS)(Water Charge)
CS = [35,000 (kWh/yr) X 0.274 ($/kWh)] + [0 (kW) X 21.19 ($/kW–month) X 12 (months/yr)] + [6,525,000 gal/yr X 0.004 ($/gal)]
CS = $9,600/yr + 0/yr + $26,100/yr
CS = $35,700/yr

Implementation Cost and Payback

The total preliminary estimated cost to implement this ECO is $100,000. This estimate includes a cost of $60,000 for the basket strainer and nozzle replacement, $20,000 interconnection to No. 3 Water Pumping system, and $20,000 for design and management.

Based on this preliminary assessment, the simple payback period would be 2.8 years.

The following assumptions were made about this ECO:
1) No. 3 Water Pumping system has capacity to handle froth spray of approximately 15 gpm continuous flow rate.
2) No decrease in system considered for No. 2 Water Pumping system.
3) No. 2 Water Pumping system required for existing pump seals. (Need to confirm requirement is still valid.)
4) Energy savings for No. 3 Water Pumping system is considered under separate ECO #6.
5) High efficiency motor replacement is considered under separate ECO #5.
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) Integrate froth spray into No. 3 Water Pumping system.
2) Design and install new duplex basket strainer on No. 3 Water Pumping system.
3) Retrofit froth spray nozzles for No. 3 Water Pumping and pressure conditions.
4) Confirm water pressure requirements for systems remaining on No. 2 Water Pumping system.
5) Reduce operating pressures on No. 2 Water Pumping system if possible.

Plant Staffing Impact

Implementation of this ECO is not anticipated to impact plant staffing requirements. This ECO may eliminate portions of City Water systems and associated equipment at the site.

Photo Gallery

	
Existing No. 2 Water Pumping System - Booster Pumps	Existing No. 2 Water Pumping System - Air Gap Tank
	
Existing 3WHP Pumps	

ECO 5 – Replace Lower Efficiency Motors With Higher Efficiency Motors

Recommendation

It is recommended that the Hilo 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. It is also recommended that the plant survey all motors at the site to qualify units that were not captured during this energy audit for additional units to be replaced. 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	=	136,400 kWh/yr
Estimated Electrical Demand Savings	=	27 kW
Estimated Total Energy Cost Savings	**=**	**$44,300/yr**
Estimated Implementation Cost	**=**	**$175,000**
Simple Payback	**=**	**4.0 years**

Background

Many systems throughout the WWTP utilize electrical motors for operation of blowers, pumps, fans, centrifuges, compressors, and other operations such as skimmer mechanisms, etc. Motorized equipment uses the majority of the site's electrical use. There are over 160 motors at the site with approximately 100 motors of 1 horsepower or greater in size. Higher-efficiency or premium efficiency motors are typically available in motors of 1 horsepower and larger.

Many of the motors on site were installed over 20 years ago, and are low efficiency rated units. Efficiency ratings of motors found at the site spanned between 84% - 94.1%. 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 5-2 below, meet these requirements and were identified for replacement to higher efficiency type units.

Table 5-2 Motor Upgrade List

Motor/System Description	Number of Motors	Motor Horsepower	Current Efficiency
No. 2 Water Pump	2	15	91.7%
Grit Pumps	2	10	85%
Primary System Odor Control Fans	2	7.5	91%
Primary Tank Odor Control Fans	3	2	85%
Primary Sludge Pumps	3	15	91.7%
Primary Scum Pumps	2	5	85%

Motor/System Description	Number of Motors	Motor Horsepower	Current Efficiency
Primary Blower (small units)	2	25	92.4%
Secondary Blowers	3	20	90.2%
Centrifuges	2	35	88%
Solids Processing Odor Ctrl Fan	1	15	85%
Return Secondary Sludge Pumps	3	5	88%
Secondary Scum Pumps	3	5	91.7%
Biotower Pumps	3	40	88.7%
DAF Thickened Sludge Pumps	2	7.5	91.7%
Digester Sludge Mix Pumps	2	25	75.3%
Digester Sludge Recirc Pumps	2	5	88%
Digester Boiler Hot Water Pumps	2	1	91.7%
Digester Sludge Heat Exchanger Pumps	2	1	91.7%
Digester Sludge Grinders	2	3	88%
Digester Transfer Pumps	2	7.5	91.7%
No. 3 Water Pumps	2	40	92.4%
Total	**47**	**330**	**---**

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 27 kW. Based on the current operating hours for each motor, the energy savings are estimated at 136,400 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 = [136,400 (kWh/yr) X 0.274 ($/kWh)] + [27 (kW) X 21.19 ($/kW–month) X 12 (months/yr)]
CS = $37,400/yr + $6,900/yr
CS = $44,300/yr

Estimated Implementation Cost and Payback

The total preliminary estimated cost to implement this ECO is $175,000. This estimate includes the cost for the new motor equipment and installation.

Based on this preliminary assessment, the simple payback period would be 4.0 years.

The following assumptions were made about this ECO:

1) Some motors identified in Table 5-1 were not electrically metered for load factor values, and therefore unit load was estimated based on site operating conditions observed.
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) This ECO was calculated using already reduced operating hour impacts from implementation of ECO's #1, 2, 4, and 6. Therefore, savings are not double counted in the ECO summary. If ECO's #1, 2, 4, or 6 are not implemented, then energy savings for this ECO would likely increase from current estimates.
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) Confirm equipment size, efficiency, and operating hours.
2) Confirm equipment rpms, loading, and horsepower requirements.
3) Add motor performance evaluation to site PM process for future selection of motors that meet criteria for replacement, as site conditions change.
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

Primary Tank Odor Control Fan

Lower Efficiency Motor Nameplate Information

ECO 6 – Number 3 Water Pumping System Improvements

Recommendation

It is recommended to convert the No. 3 Water Pumping system to a pressure based system rather than a constant speed, constant flow with pressure relief return to the wet well. It is proposed to conduct a water utilization study on the No. 3 Water Pumping system as well as the No.2 Water Pumping system to account for the plants various water requirements. Also, in lieu of a constant flow system, it is recommended to install a variable flow pumping system (Variable Frequency Drive "VFD" equipped pumps) and install a jockey pump for low flow periods. The estimated No. 3 Water Pumping system energy, power demand, water and cost savings, and simple payback from such an installation are summarized below.

Estimated Electrical Energy Savings	=	94,800 kWh/yr
Estimated Electrical Demand Savings	=	10 kW (56 Max- 46 Max)
Estimated Total Energy Cost Savings	**=**	**$ 28,500/yr**
Estimated Implementation Cost	**=**	**$ 220,000**
Simple Payback	**=**	**7.7 years**

Background

Currently, the No. 3 Water Pumping system consists of two (2) 40 hp vertical turbine pumps rated at 540 gpm @ 175 feet of head. The pumps are controlled in a lead-lag configuration. Normally, one pump operates continuously, discharging 540 gpm @ a system pressure of 175 feet (75 psig). If the actual water demand is below 540 gpm, an altitude valve (pressure reducing valve) allows the excess water to return to the chlorine contact tank wet well. During specialty operations, e.g. centrifuge wash down cycle, the plant demand may exceed the 540 gpm. If the plant demand exceeds the 540 gpm resulting in a reduction in system pressure, the second pump will start and provide additional wash down water for the treatment plant.

Estimated Energy and Cost Savings

It is proposed to conduct a water utilization study on the No. 3 Water Pumping system as well as the No.2 Water Pumping system to account for the various water requirements. Also, in lieu of a constant flow/pressure system, it is recommended to install a variable flow pumping system (VFD equipped pumps) and install a jockey pump for low flow periods. The following flow and energy projections are provided based on plant discussions:

Table 5-3: Current Operations: Constant Flow/Pressure System

Number of No. 3 Water Pumps in Operation	Process Flow Requirements	Number of Hours per Year	Excess Flow Returned to Wetwell	Current Estimated kWh
1 / 400 gpm	Normal Daytime Operations	4,230	140 gpm (25%)	118,440
1 / 200 gpm	Normal Nighttime Operations	4,230	340 gpm (75%)	118,440
2 / 700 gpm	Dewatering Washdown (3 hrs / dewatering day)	300	380 gpm (35%)	16,800
Total				**253,680**

Table 5-4: Proposed Operations:
Variable Flow/Constant Pressure System + Jockey Pump

Number of No. 3 Water Pumps in Operation	Process Flow Requirements	Number of Hours per Year	Excess Flow Returned to Wet Well	Current Estimated kWh (21 kWh)
1-40hp / 400 gpm	Normal Daytime Operations	4,230	0 gpm	88,830
1-20hp / 200 gpm (Jockey Pump 250 gpm @ 75 psig)	Normal Nighttime Operations	4,230	0 gpm	59,220
2-40hp / 700 gpm	Dewatering Washdown (3 hrs / dewatering day)	300	0 gpm	10,800
Total				**158,850**

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, demand, and water charges are based on the HELCO 2008-09 data as presented in Section 2.

CS = (ECS)(Usage Charge) + (DCS)(Demand Charge)
CS = [94,830 (kWh/yr) X 0.274 ($/kWh)] + [10 (kW) X 21.19 ($/kW–month) X 12 (months/yr)]
CS = $26,000/yr + 2,500/yr
CS = $28,500/yr

Implementation Cost and Payback

The total preliminary estimated cost to implement this ECO is $175,000. This estimate includes a cost of $70,000 for the jockey pump, $40,000 VFD retrofit for existing pumps, $15,000 controls upgrade, $ 15,000 water study (No. 2 and No. 3 Water use) and $35,000 for design and management.

Based on this preliminary assessment, the simple payback period would be 6.1 years.

5

The following assumptions were made about this ECO:

1) Process flow requirements as summarized in the Tables 5-3 and 5-4 above.
2) Inclusion of froth spray of approximately 20 gpm from ECO #5 is total flow summarized in Tables 5-3 and 5-4 above.
3) Cost for new basket strainer was included as part of ECO #4.
4) High efficiency motor replacement was included as part of ECO #5.
5) 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) Install VFD's on (2) No. 3 Water Pumping system pumps.
2) Install new low flow jockey pump with VFD to No. 3 Water Pumping system manifold.
3) Complete process control modifications to operate the system via pressure controller and add jockey pump into (lead, lag, lag scheme).
4) Conduct Water Use Study for No. 2 and No. 3 Water Pumping system utilization.

Plant Staffing Impact

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

Photo Gallery

	
Existing 3WHP Pumps	Example 3WHP Pump Station with Jockey Pumps

5

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 Hilo 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
Effluent Water Reuse	Recommendations for effluent water reuse are described within ECO's 4 and 6 in Section 5 of this report.	Review ECO 4 and 6 for implementation.	Short to Mid Term
Cogeneration	The site currently produces methane gas from the digestion process, however due to the site's low sludge volumes methane generation is not efficient and major capital investment for equipment replacement would be necessary for continued generation and potential future cogeneration.	Further investigation of anaerobic digestion should be done before investigation of cogeneration opportunities.	Long Term
Fats, Oils & Grease (FOG)	The facility has monitored the viability of implementing a FOG collection program. Currently, a local contractor hauls the FOG to the Kona side of the island (approximately 150 miles roundtrip) for disposal of FOG. The Hilo WWTP is equipped with anaerobic digesters. The internal use of the site derived methane gas to heat the digesters is poor and will need substantial plant upgrades to efficiently utilize additional methane.	Further investigation of anaerobic digestion should be done before investigation of cogeneration opportunities.	Long Term
Solar Renewable Energy	Hilo is located on the rainy side of the Big Island and may have limited solar resource available.	Investigate solar resource at Hilo and Kona. Implement solar assets to Kona side of island.	Long Term
Wind Renewable Energy	Resource is unknown and close proximity to international airport may preclude installation of wind turbines	Investigate wind resource and height and associated flight restrictions.	Long Term

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, multiple opportunities for additional avoided energy and cost savings related to resource conservation were identified and should be considered. 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.	Work with accounting department to gather monthly utility cost information consistently.	Short Term
V-Belt Drives	A number of fan and motor combinations at the site using V-belt transmission systems that typically operate 365 days per year. The efficiency of these systems can deteriorate by as much as 5% over time if slippage occurs. Replacing V-belts with cogged type belts is recommended, as these belts run cooler, last longer, and have an efficiency that is approximately 2% higher than that of standard V-belts. Also, the site should consider synchronous belts and sprockets or direct drives for new installations, as the price premium at that time can be small due to the avoidance of conventional pulley costs.	Survey site for belt driven equipment and create strategy for individual retrofits.	Short Term
Snail Mitigation Program	Consistent with other fixed film coastal treatment plants, the snail population and resulting plugging, reduction in treatment capacity and operational and maintenance issues present an ongoing headache. Further investigation is necessary to determine a means to combat the snails from biological processes and thus reducing the recirculation pumping rate into the biotower and the reduced treatment capacity in the solids contact tanks.	Requires further study	Short term
Lighting Systems Optimization	The outdoor and building lighting currently utilizes older, inefficient technologies. Some of these components in the near future will be obsolete and even unavailable for purchase. Complete fixture replacements are recommended.	Requires further study	Short to Mid Term
Primary Blower Modulation	Primary blower modulation would have an immediate impact on the energy use at the facility. The primary blower(s) provide aeration air for the aerated grit and conveyance channels. Adequacy of mixing is determined through operational review. It is recommended that the site conduct a mixing study at the aerated girt chambers, pre-mix and connective channels.	Requires further study	Short to Mid-term
Digestion & Sludge System Optimization	The anaerobic digester system is currently 15 years of age and in need of rehabilitation and repair. The efficiency of the digester gas utilization is poor and a portion of the gas is flared. The existing flare station is ignited manually and may pose a safety hazard in certain weather conditions. Due to the small daily wastewater flow rate (~3 million gallons), conversion to an aerated digestion system may be more appropriate for the plant. The Kihei WWRP is currently testing a non aerated aerobic digestion project which uses biological cultures to reduce solids and may be an option for this plant.	Evaluate current condition of digestion process and determine long term strategy for solids management.	Mid-term

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