MUNICIPAL WASTEWATER TREATMENT PLANT ENERGY EVALUATION FOR WALLKILL WASTEWATER TREATMENT FACILITY

AGREEMENT NO. 7185

Prepared for

THE NEW YORK STATE
ENERGY RESEARCH AND DEVELOPMENT AUTHORITY
ALBANY, NY

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INTRODUCTION

1.1 OVERALL PROJECT DESCRIPTION

The New York State Energy Research and Development Authority (NYSERDA) is currently sponsoring a research program to evaluate submetering at wastewater treatment plants (WWTPs) throughout New York State. The purpose of the monitoring is to obtain detailed electric power usage information through submetering various unit processes and equipment and to determine if that information is a cost-effective tool for identifying electric energy conservation measures. In addition to evaluating the usefulness of submetering, a secondary goal of the program is to identify and evaluate other energy cost savings measures at WWTPs and make the findings available to facilities across New York State.

The Wallkill Wastewater Treatment Facility (WWTF) is a relatively newer facility (in service since 1989) and has not evaluated energy-saving measures in the past. Because energy-saving opportunities do exist, the WWTF agreed to participate in this submetering study as conducted by the Research Team consisting of Malcolm Pirnie and Siemens Building Technology.

1.2 FACILITY BACKGROUND

The Wallkill WWTF is a 4 million gallon per day (MGD) secondary treatment plant, treating wastewater from the residential and commercial users within the Town of Wallkill limits as well as a portion of the City of Middletown. The WWTF also accepts and treats wastewater from industrial users, which contribute approximately 10 percent (%) of the total influent flow. The plant currently treats an average daily flow of 3 MGD.

The treatment processes at the Wallkill WWTF include the following:

- Influent pumping.
- Preliminary treatment, including mechanical bar screens and vortex-type grit removal.
- Secondary biological treatment through two mechanically-aerated oxidation ditches, followed by secondary clarification.
- Disinfection of effluent from May through October using a low pressure ultraviolet (UV) disinfection system.
- Solids handling consisting of gravity belt thickener, belt filter press dewatering, and sludge cake disposal to landfill.

The WWTF takes electric distribution service from Orange and Rockland Utilities, and purchased the electric commodity from Select Energy until February 2004, when it switched to Constellation New Energy. The WWTF is classified as a large commercial customer [over 200 kilowatt (kW) demand]. The facility has one electric service point and Wallkill owns the transformer gear.

One 500-kW emergency generator provides emergency back-up power for the facility and can handle the entire existing electric energy load. Heating and cooling for the office area is provided through a heat pump system supplemented by a small boiler and an air-cooled coil. This system is thermostatically controlled. The process areas use electric heat only and are controlled thermostatically. No control strategies are in place in the process areas.

There is no fuel usage at this facility, as heating is provided through electric energy.

The WWTF is staffed only during the day shift, 7 days per week. Solids processing takes place during the day shift every day of the year except for Christmas.

1.3 SCOPE AND OBJECTIVES

This study involved the following activities as part of the overall electric and fuel energy usage assessment and electric submetering program:

1.3.1 Review of Historical Plant Performance and Energy Usage Data

Data were obtained from the WWTF to establish a baseline for plant performance and energy usage. The baseline seeks to separate improvements related to power savings from those that result from exogenous effects, such as changes in influent water quality, seasonal and weekly cycles, and/or energy market changes.

Data obtained from the WWTF included:

- Influent and final effluent total suspended solids (TSS) and biochemical oxygen demand (BOD_5).
- Daily influent flow.
- Sludge handling operating records (percent solids thickened sludge, percent solids dewatered sludge, and sludge volume).

- Historical electric energy usage, including available time-of-use monitoring data, two years of utility bills, and any process changes recently undertaken or contemplated.
- Preventive and corrective maintenance records.

1.3.2 Electric Submetering

Continuous submetering and instantaneous power draw measurements were completed to assess the typical electric energy usage of some of the larger motors [greater than 5 horsepower (hp)] at the WWTF. Continuous submetering locations were selected based on the information gathered during a site energy audit such that the larger and most energy-intensive motors could be metered. Instantaneous power draw measurements were also obtained on additional motors, particularly those that operated on a set schedule at a constant speed.

The continuous submetering data were used to capture diurnal variations in electric energy demand for major pieces of equipment, as well as to provide a representative sample of electric energy usage and demand as equipment cycles on and off. The following data were recorded at each location:

- Load factor.
- Power factor.
- Demand (kW).
- Usage (kWh).

Instantaneous submetering was conducted during a one-day site visit and the data were used to verify expected electric energy demand at the facility, as well as monitor changes in electric energy demand as equipment is cycled on and off.

In addition, process data were collected for the duration of the submetering period including the following:

- Average, minimum, and maximum influent flow rate.
- Influent and final effluent BOD_5.
- Influent and final effluent TSS.
- Mixed liquor suspended solids (MLSS) for each basin.
- Gravity belt thickener feed rate and percent solids.
- Belt filter press feed rate and percent solids.

The process data collected were used to correlate energy usage to process parameters to ultimately develop alternatives for energy savings as well as to compare this WWTF's energy performance to other facilities in New York State.

1.3.3 Identification of Energy Saving Opportunities through Equipment Replacement or Modification

Energy savings opportunities resulting from equipment replacement and/or process modification were identified based on review of the submetering data.

1.3.4 Identification of Energy Savings Opportunities through Operational Changes

The submetering data were further reviewed to assess the impact of equipment operations on total plant energy demand throughout the course of the day and examined for energy savings opportunities through load shifting, peak shaving, and greater use of real-time data in energy-related decision-making.

Load shifting would involve changing the time of use of certain loads to reduce the total facility electric energy demand during peak periods in an attempt to reduce electric energy demand charges. Peak shaving is the practice of dispatching on-site generating assets to reduce dependence on the grid during peak electric energy demand periods.

This report summarizes the evaluation and offers recommendations for opportunities to reduce energy usage, and thereby costs, at the Wallkill WWTF.

Section 2

CURRENT AND HISTORICAL OPERATIONS

This section presents a brief description of the existing treatment processes at the Wallkill Wastewater Treatment Facility (WWTF), historical process improvement measures, and the resulting effect on the effluent quality.

2.1 EXISTING TREATMENT PROCESSES

FIGURE 2-1 presents the process flow diagram for wastewater treatment and solids handling at the Wallkill WWTF. A brief description of the unit treatment processes that are currently used at the plant is presented in this section.

2.1.1 Preliminary Treatment

Preliminary treatment at the Wallkill WWTF is accomplished through the use of a comminutor and mechanical bar screens, which remove large material and debris from the wastewater flow. The Wallkill WWTF has two vortex-type grit removal systems. Two 10-horsepower (hp) constant speed grit pumps pump collected grit from the vortex system to a cyclone classifier. The pumps are run on timers, and run three or four times a day.

2.1.2 Influent Pumping

The Wallkill WWTF has three 60-hp variable speed influent pumps, which convey flow from the preliminary treatment processes to the Pista Grit chamber for grit removal. One variable speed pump is typically operated at all times.

2.1.3 Secondary Treatment

The effluent from the grit removal system is conveyed to two extended oxidation basins, each equipped with two 75-hp aerators where approximately 92 percent (%) to 98% biochemical oxygen demand (BOD_5) and 90% to 95% total suspended solids (TSS) are removed. The power draw of the aerators is controlled by the effluent weir elevation of the oxidation basins, which is used to control the dissolved oxygen (DO) in the oxidation basins. DO concentration is kept between 0.7 milligrams per liter (mg/L) and 1.2 mg/L, and it is adjusted 2 to 4 times a year. After aeration, the wastewater is settled in secondary clarifiers. The sludge produced in the secondary clarifiers is either recycled to the head of the secondary treatment process (i.e., influent of the oxidation basins) or wasted.

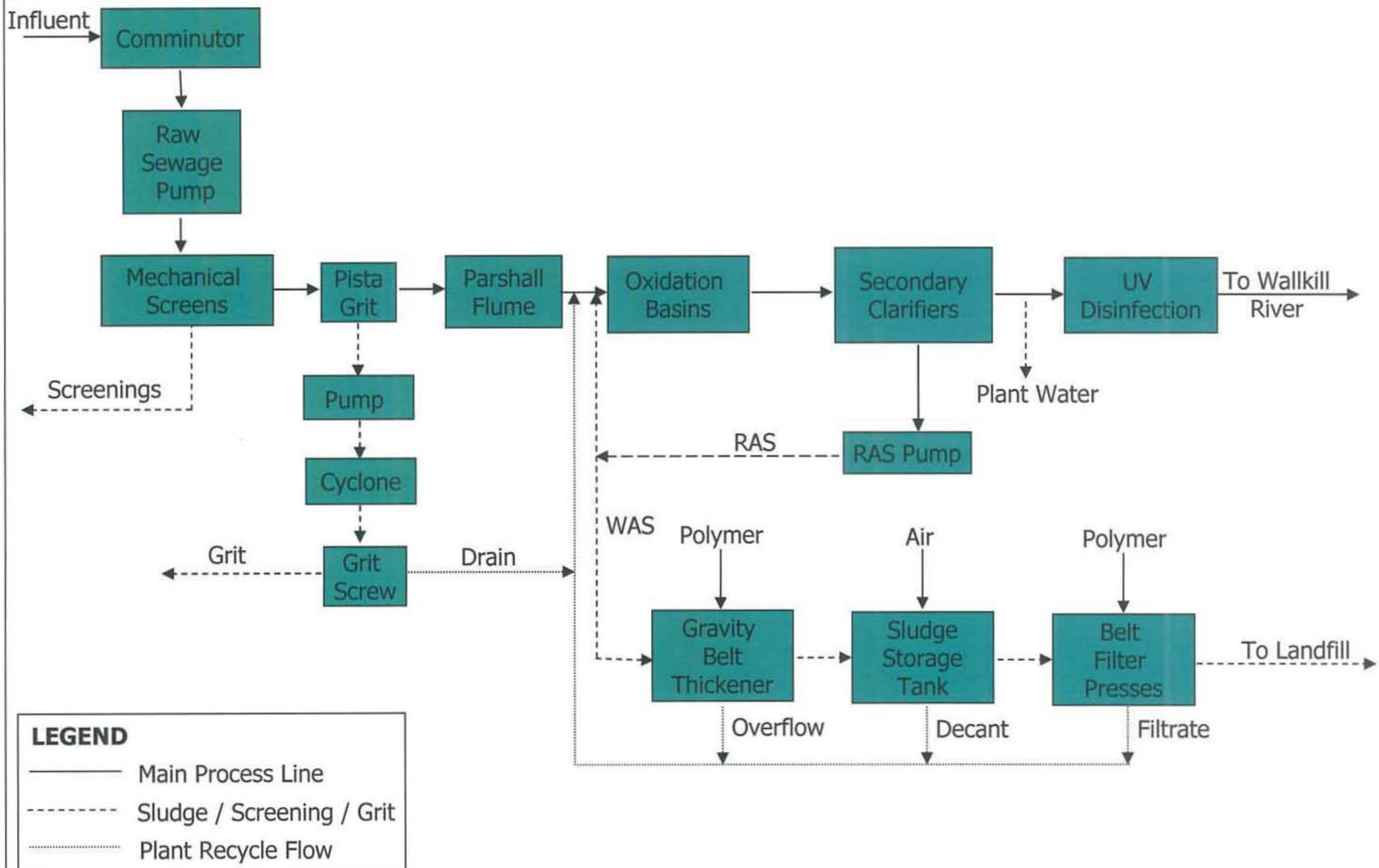

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FIGURE 2-1
PROCESS FLOW SCHEME

2.1.4 UV Disinfection

The Wallkill WWTF is equipped with a low pressure ultraviolet (UV) system to disinfect the wastewater after secondary settling. Disinfection is required from May 15 through October 15.

2.1.5 Solids Handling

Waste activated sludge (WAS) from the secondary treatment process is thickened using the gravity belt thickener. The thickened sludge is stored in an aerated sludge storage tank. The sludge is then dewatered using a belt filter press (BFP). The influent percent solids into the belt filter press is in the range of 2.2% to 2.8%. A polymer is used to enhance the thickening and dewatering processes. Although belt presses are typically able to dewater the sludge to approximately 20% solids, the historical data show the cake percent solids to be in the range of 14% to 17%, which is likely due to the fact that the Wallkill WWTF does not have primary clarifiers and primary sludge. Separate WAS typically has poor dewatering characteristics.

Once dewatered, the sludge is stored prior to ultimate disposal at a landfill site by an independent contractor. The supernatant from the gravity belt thickener, decant from the sludge storage tank and the filtrate from the belt filter presses are all recycled to the head of the secondary treatment process (i.e., influent of the oxidation basins).

2.2 HISTORICAL ENERGY USAGE

In the past decade, the Wallkill WWTF has performed a few projects that were focused on process improvement, with energy saving advantages. Some of the notable efforts toward the implementation of process improvement measures include:

- Wastewater Treatment Plant Process Assistance Summary Report (2002).
- Town of Wallkill Local Limits Evaluation (2003).
- Improvements to return activated sludge (RAS) system (2004).

2.2.1 Wastewater Treatment Plant Process Assistance Summary Report (2002)

Around October 2001, the plant started experiencing problems with poor settling sludge, high clarifier blankets, and solids washout at daily peak flows and during wet-weather events. These upset conditions resulted in permit violations. Subsequently, the Town was notified that a local environmental group was suing the Town for violations of the Federal Clean Water Act. In addition, the Town entered into an Order on Consent with the New York State Department of Environmental Conservation (NYSDEC) to address the non-compliance issues. The Town of Wallkill retained Malcolm Pirnie for assistance in determination of the potential causes and the preparation of a report to outline the steps that the Town should undertake to bring the WWTF back into compliance. Near-term recommendations included: optimize the WWTF process, optimize the solids handling operation, improve data collection and management, and monitor WWTF influent characteristics more closely. Longer-term recommendations included: upgrade polymer addition, provide RAS flow control capabilities, and develop an industrial pretreatment program (IPP).

2.2.2 Town of Wallkill Local Limits Evaluation (2003)

An IPP was developed to address the significant effect of the industrial users on the WWTF performance. The Town of Wallkill is in the process of monitoring the identified industrial users.

2.2.3 Improvements to RAS System (2004)

This project provided a control system to the RAS pumps to improve blanket control, mixed liquor suspended solids (MLSS) control, and attain more consistent sludge wasting rates.

2.3 HISTORIC UTILITY BILLING

Monthly data on electric energy usage and billing were obtained from the Wallkill WWTF for January 2001 through August 2004. FIGURE 2-2 shows the monthly electric energy demand and usage for 2001 through 2004. Billing for the Wallkill WWTF is based on the electric energy demand (kW) and electric energy usage (kWh). Billing is estimated on meter readings; during the months when the meter is not read, electric energy usage and demand are estimated based on the previous months increase or decrease. The electric energy demand and usage are then adjusted when based on an actual meter reading. This can cause an overestimate of electric energy usage and demand, followed by an apparent dip, as those reported for March 2001 and March 2002 usage.

The 2002 data set shows a decline in both the electric energy demand and usage from the 2001 data set, with an average decrease of 5.0% in electric energy demand and a 5.4% decrease in overall electric energy usage. Although the 2003 data set shows a 1.3% decline in electric energy demand from the 2002 data set, there is approximately 0.9% rise in the electric energy usage in 2003 when compared to the 2002 data set. The 2004 data set (up to August) shows a rise in both the electric energy demand and usage from the 2003 data set, with an average increase of 0.2% in electric energy demand and a 3.5% increase in average electric energy usage. FIGURES 2-3 and 2-4 illustrate the change in electric energy demand and usage, respectively for 2001, 2002, and 2003. As a result of the reduction in demand, usage, and electric power charges in 2002, electric power charges decreased by 24.1% (down from $248,670 in 2001 to $188,843 in

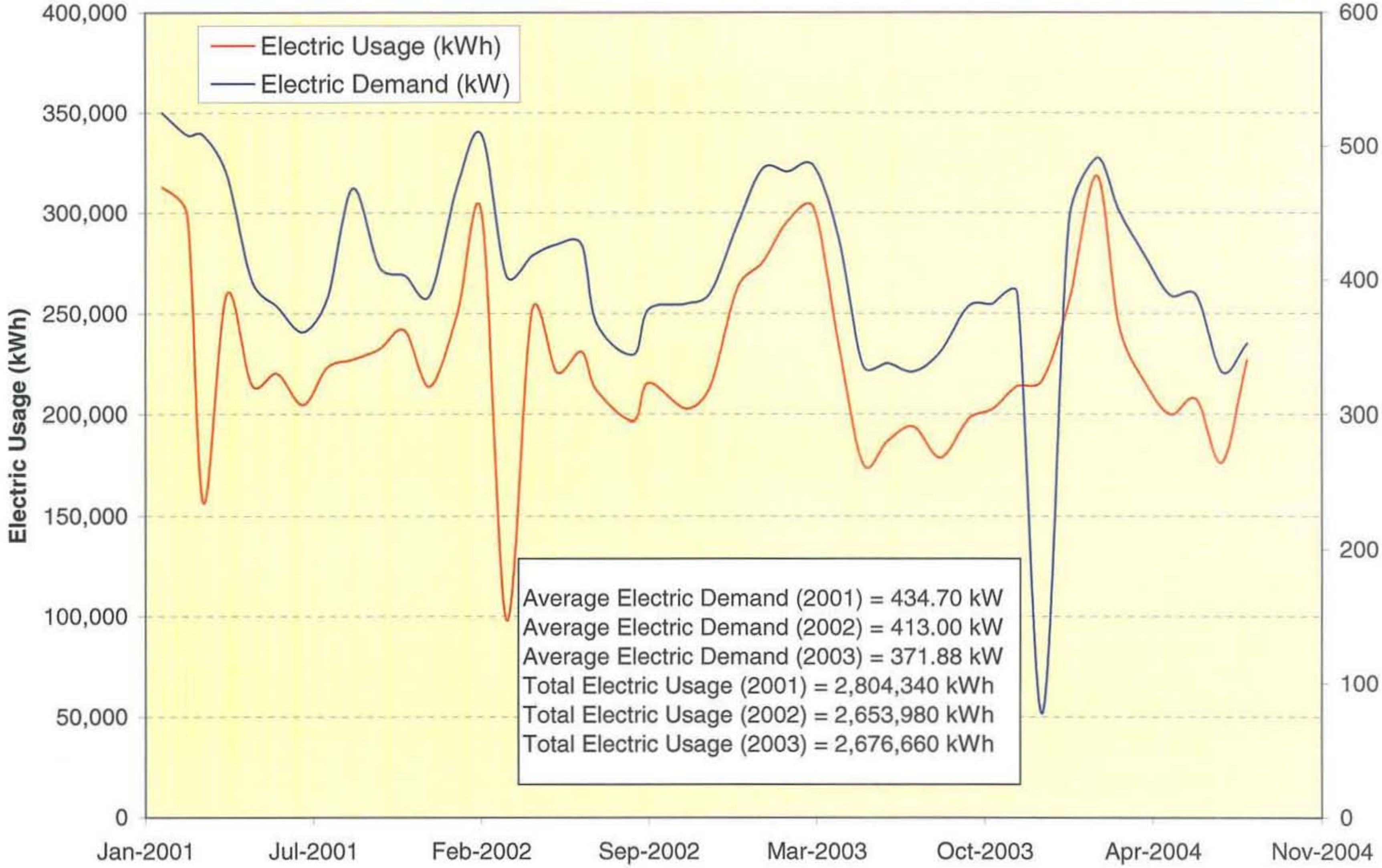

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FIGURE 2-2
ELECTRIC DEMAND AND USAGE

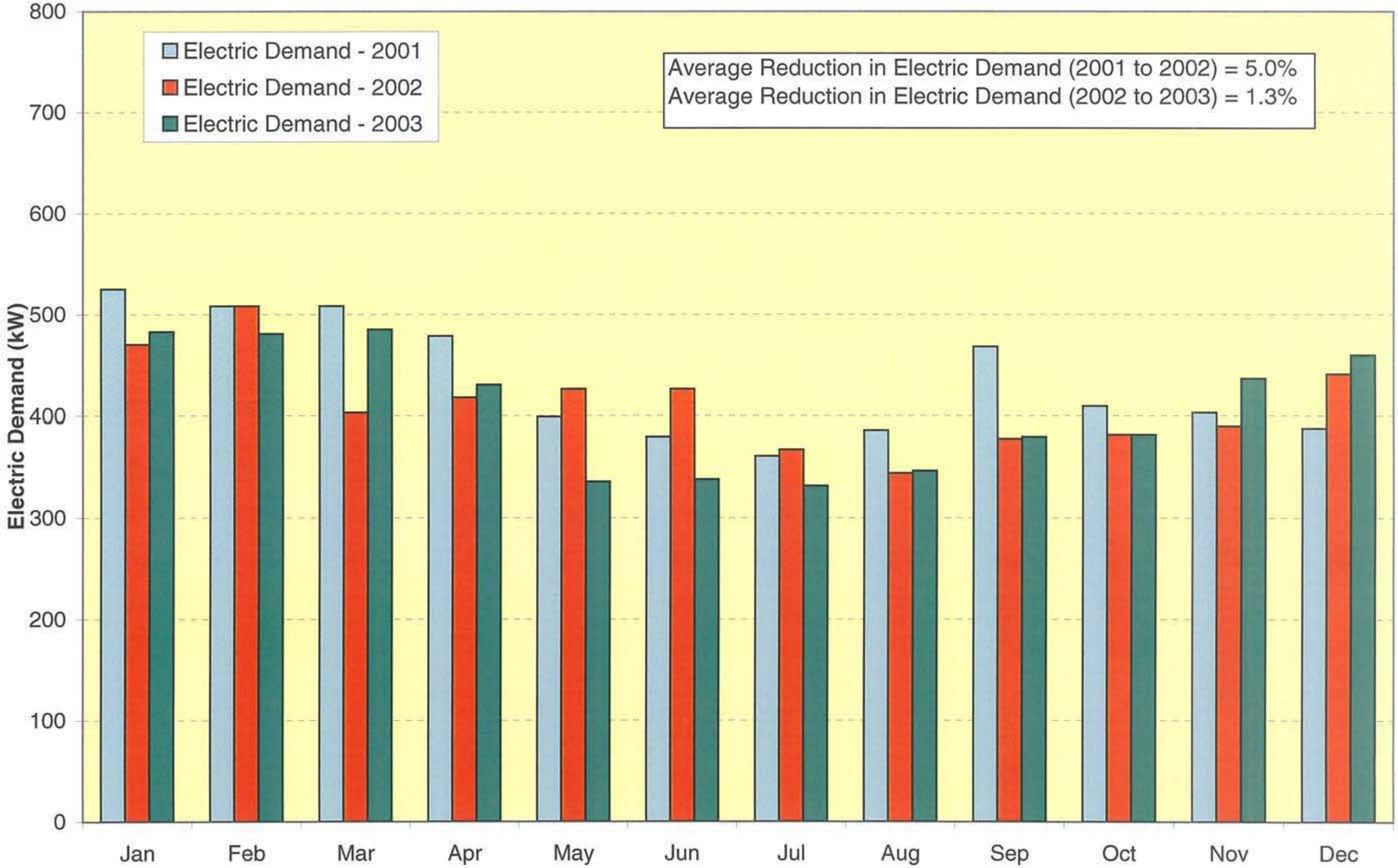

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FIGURE 2-3
CHANGE IN ELECTRIC DEMAND
(2001 THROUGH 2003)

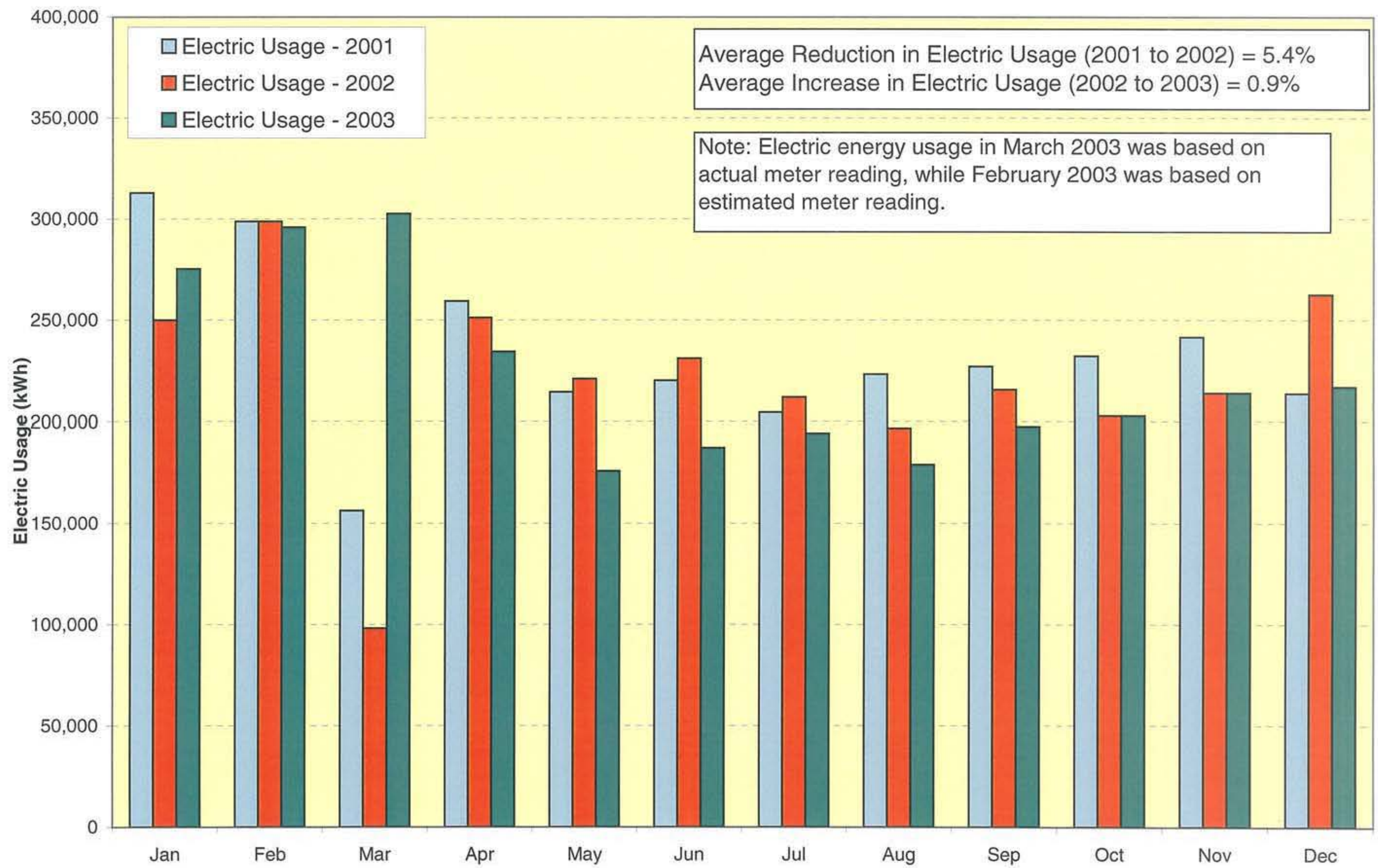

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FIGURE 2-4
CHANGE IN ELECTRIC USAGE
(2001 THROUGH 2003)

2002 at an average cost of $0.0894 per kWh in 2001 and of $0.0729 in 2002). There was a 7% increase in electric power charges in 2003 (up to $202,132 in 2003 at an average cost of $0.0759 per kWh).

2.4 SUMMARY OF ENERGY COSTS

TABLE 2-1 summarizes the energy costs for 2001 through 2004 based on data from the plant and the annual reports.

Table 2-1: Summary of Energy Costs

Year		2001	2002	2003	2004(1)
Average Flow (MGD)		2.66	2.68	3.08	2.80
Electricity	Annual Usage (kWh)	2,804,340	2,653,980	2,676,660	1,846,950
	Rate ($/kWh)	0.0894	0.0729	0.0759	0.0927
	Annual Costs	$248,671	$188,843	$202,133	$171,052
	Average Usage (kWh per MGD)	2,891	2,713	2,381(2)	2,748
	Average Costs ($/MGD)	$256.34	$193.21	$179.71	$254.54

Notes:
(1) January 2004 through August 2004
(2) The average usage per MGD in 2003 is lower than the other three years because the flow for 2003 was higher (i.e. it was a wetter year), but the energy usage remained relatively similar to the other three years. The energy usage did not drastically increase along with flow in 2003 because although the flow was higher in 2003, the loadings were not greatly affected, and as it is the aerators and not the influent pumps that are the highest energy user at the plant, it follows that the energy usage would not drastically increase as a result of higher flows. Furthermore, under current operations, the aerator output is only adjusted on a seasonal basis and is somewhat independent of the BOD loadings and flows.

2.5 SUMMARY OF HISTORICAL LOADINGS AND EFFLUENT QUALITY

Monthly plant flows and process data provided by the Wallkill WWTF for 2001 through 2004 are summarized in TABLE 2-2.

Table 2-2: Summary of Wallkill WWTF Performance – Wet Stream Process

Wastewater Parameter	Average (2001 to 2004(1) Data)
Influent Plant Flow	2.81 MGD
Influent BOD_5 Concentration	140 mg/L
Influent BOD_5 Loading	3,246 lb/d
Average BOD_5 Removal	95.1%
Influent TSS Concentration	342 mg/L
Influent TSS Loading	7,909 lb/d
Average TSS Removal	93.5%

Note:
(1) January 2004 through August 2004.

FIGURE 2-5 shows the relationship of influent BOD_5 and TSS loadings versus plant flow. As flow increases, loadings typically increase. BOD_5 and TSS loadings appear to follow a seasonal pattern. The spike of TSS concentration in January 2004 was most probably due to batch discharges from the industrial contributors to the WWTF. The Town of Wallkill is currently taking measures to limit the industries discharges.

The Wallkill WWTF has consistently achieved BOD_5 and TSS removal efficiencies in excess of 90% after addressing the violations of October 2001. Effluent concentrations of BOD_5 and TSS are well below the discharge permit limits of 25.0 mg/L and 30.0 mg/L, respectively.

In order to evaluate the energy usage at the Wallkill WWTF, the electric usage and demand data were compared to WWTF flows to ascertain the effects on varying flows on energy usage. FIGURES 2-6 and 2-7 show the average monthly plant influent flows along with electric energy demand and usage, respectively. Both electric energy demand and usage appear to be significantly influenced by influent flows, as both figures show that when plant influent flows increase, electric energy demand and usage also increase. Dips in electric energy usage and demand were due to actual readings of the meter, following estimated electric energy consumption.

Based on the historical data, approximately 3,367 lb/d BOD_5 are removed. Therefore, the estimated electric energy usage per pound of BOD_5 removed is 2.2 kWh / lb BOD_5 removed. Based on the historical data, approximately 7,395 lb/d TSS is removed, resulting in an estimated electric energy usage of 0.92 kWh/lb of TSS removed.

TABLE 2-3 summarizes the performance of the solids handling process at the plant, based on historical data.

Table 2-3: Summary of Solids Handling Processes

Parameter	Average (2001 to 2004[1] Data)
BFP Influent Percent Solids	2.45%
BFP Average Cake Percent Solids	15.13%
Dry Tons to Landfill	604 ton/year
Average Dry Tons to Landfill per Day	1.65 ton/d
BFP Polymer Addition	6.83 gallons/dry ton sludge

Note:
(1) January 2004 – August 2004.

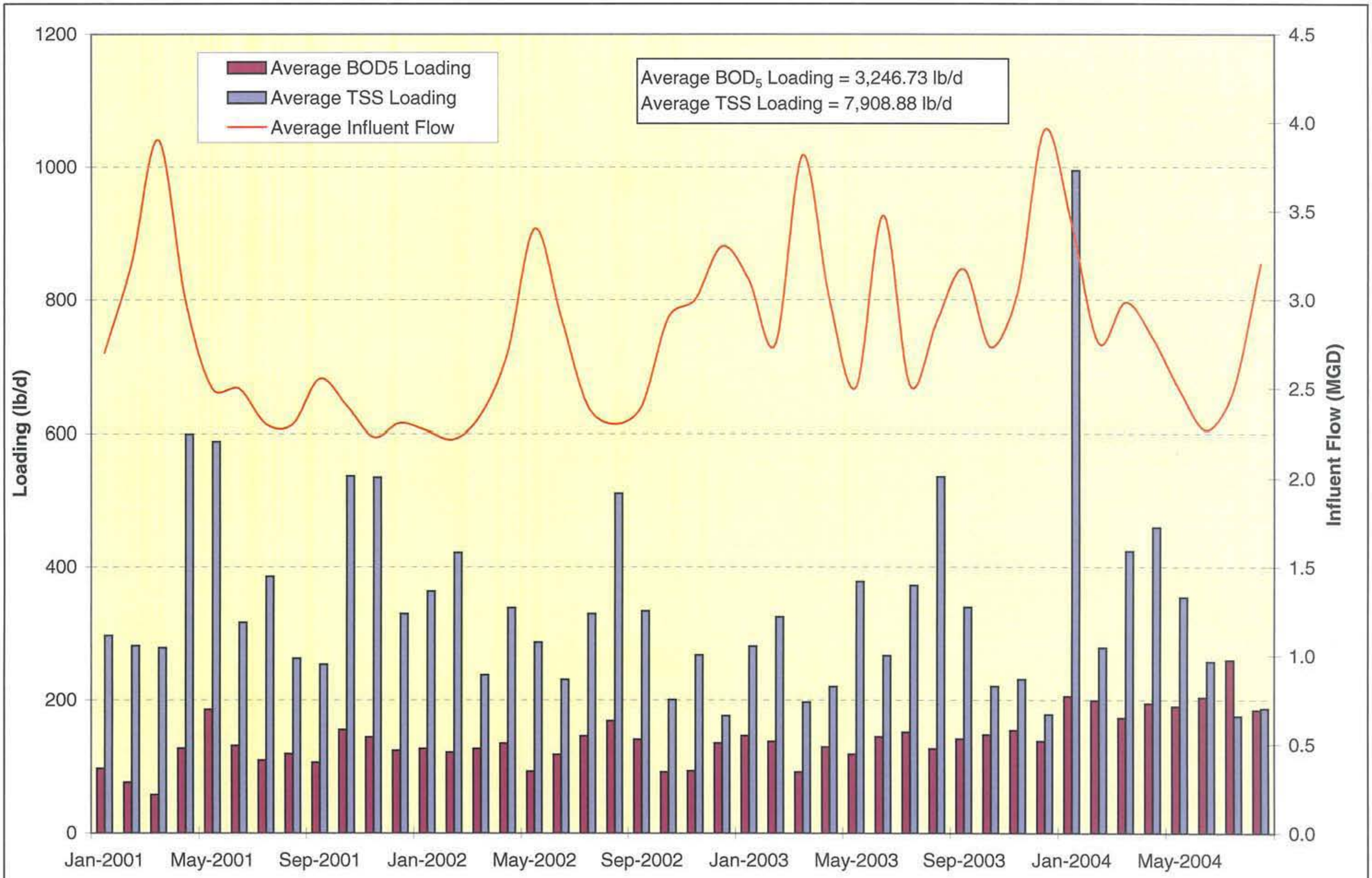

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FIGURE 2-5
INFLUENT TSS AND BOD_5 LOADING

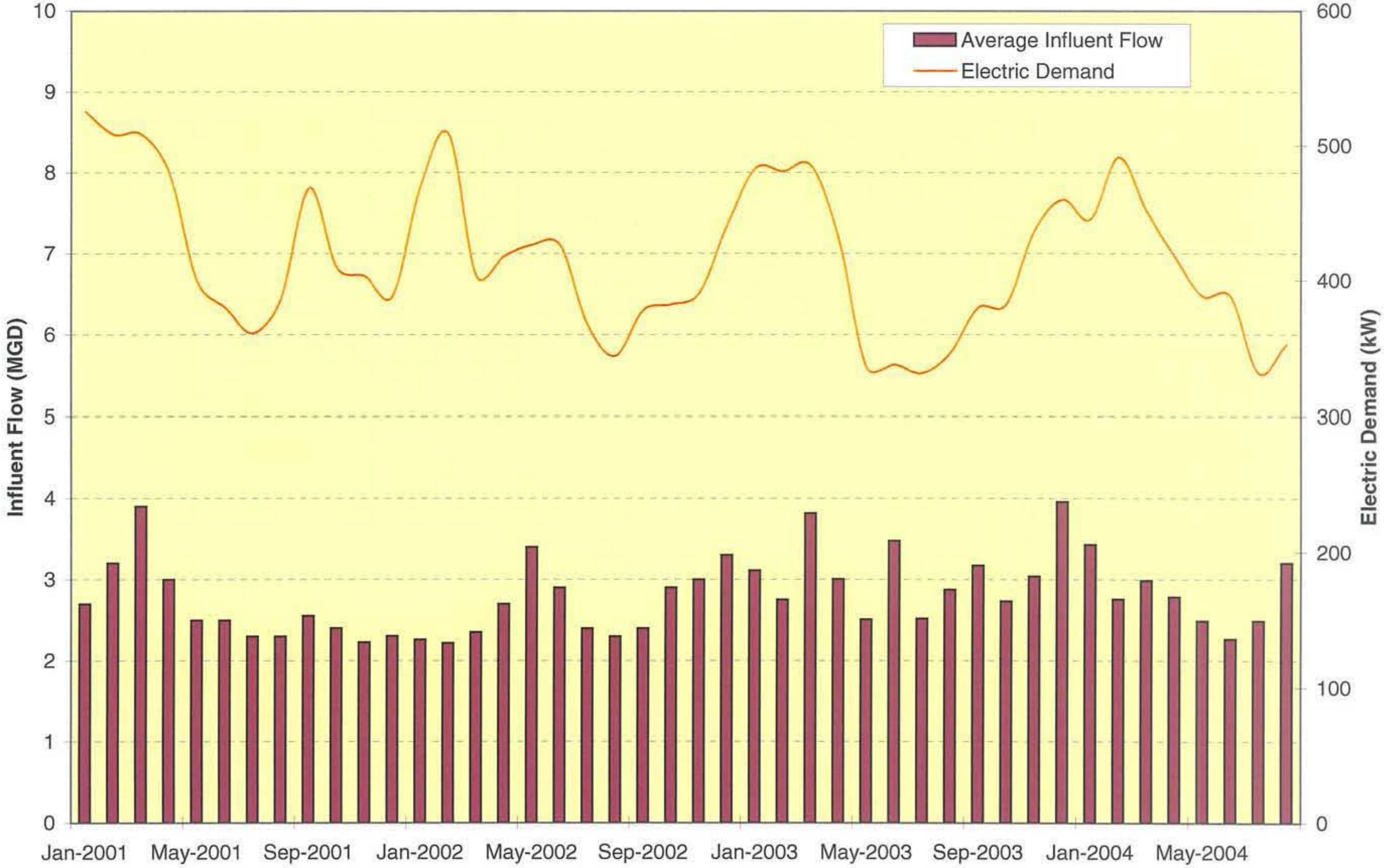

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FIGURE 2-6
ELECTRIC DEMAND vs. INFLUENT FLOW

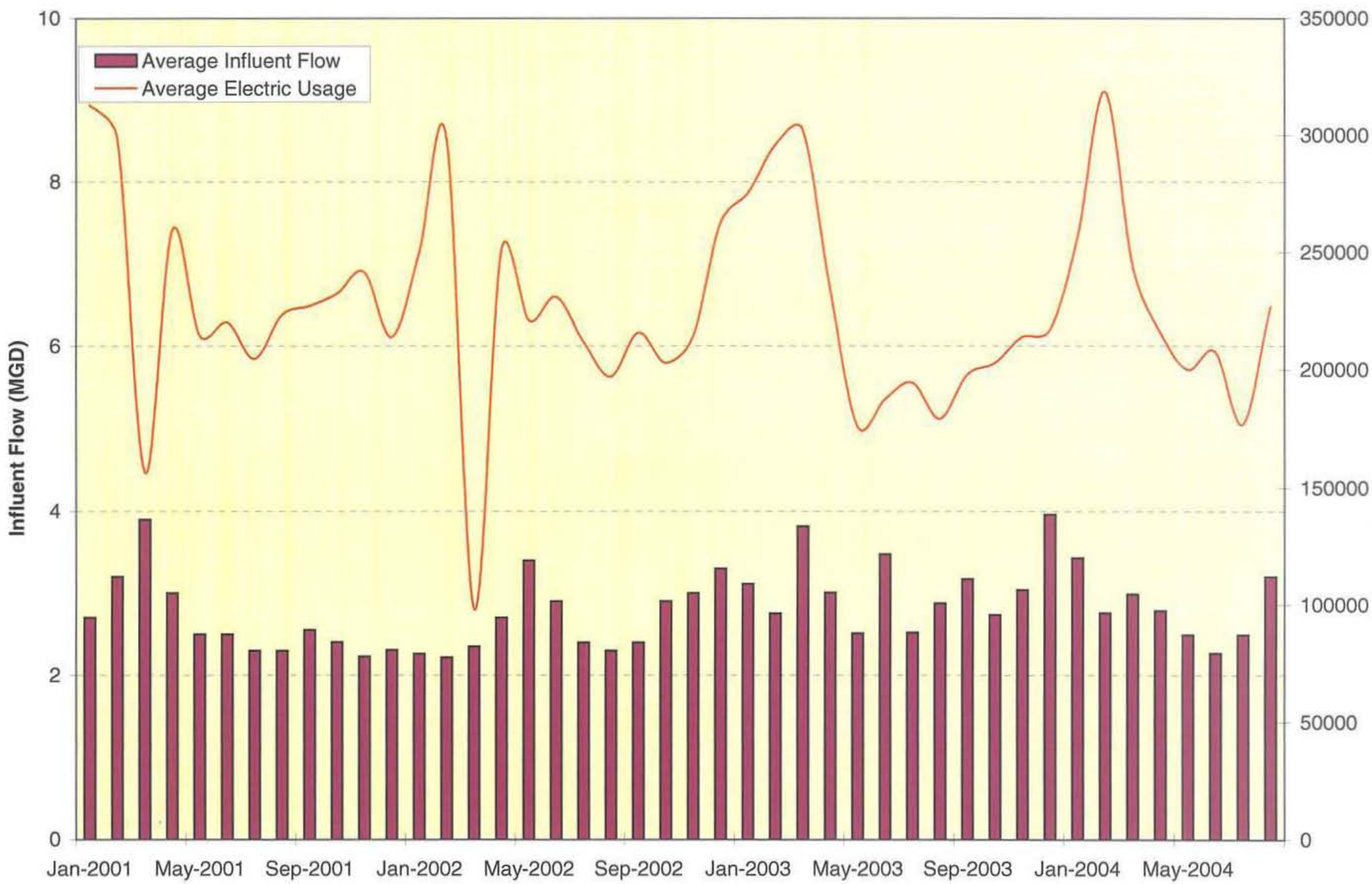

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FIGURE 2-7
ELECTRIC USAGE vs. INFLUENT FLOW

The polymer usage for 2003 was 75 drums of 55 gallons each, totaling 4,125 gallons of polymer per year. Wallkill WWTF personnel have indicated that they have used a reduced quantity of polymer thus far in 2004, relative to the polymer usage in 2003. Malcolm Pirnie has worked with the facility to solve facility operational problems thus improving the operational efficiency.

Section 3

ELECTRIC SUBMETERING PROGRAM

3.1 DESCRIPTION OF SUBMETERING PROGRAM AND SUBMETER LOCATIONS

3.1.1 Description of Program

Continuous submetering was conducted through installation of submeters with continuous recording electronic data loggers (Credos). Continuous submetering was used to capture diurnal variations in electric energy demand for major pieces of equipment, as well as to provide a representative sample of electric energy usage, including measuring electric energy demand as equipment cycles on and off.

In conjunction with the continuous submetering program, daily process data were collected for both the wet stream and the solids handling processes. The summary of process data is further detailed in Section 4 of this report.

Instantaneous submetering was also conducted on representative pieces of equipment, usually those that operated at a constant speed according to a set schedule and driven by motors rated at 5 horsepower (hp) or greater. TABLE 3-1 summarizes the motors greater than 5 hp. The instantaneous readings and estimated operating hours were then used to calculate estimated total electric energy usage for the particular piece of equipment.

3.1.2 Submeter Locations

Based on a plant walk-through and existing plant information, continuously recording submeters were installed in the following locations:

- Two meters on the raw wastewater pumping system, one for each of the two pumps typically in operation (Pumps No. 1 and No. 2).
- One meter at one mechanical aerator, representative of all four in operation.
- Two meters at the return activated sludge (RAS) pumps, one for each of the two pumps typically in operation.
- Two meters at the ultraviolet (UV) disinfection system.

Wallkill Wastewater Treatment Facility

Table 3-1 List of Motors over 5 hp[1]

Process	Use	Quantity	Size (hp)	Constant/ Variable Speed	Voltage
Wastewater Pumping	Raw Sewage (Influent) Pumps	3	60	V	460
Preliminary Treatment	Grit Pumps	2	10	C	460
Activated Sludge Aeration	Aerators	4	75	V	460
Solids Handling, Sludge Pumping	Return Activated Sludge Pumps	3	15	V	460
Solids Handling, Sludge Pumping	Waste Activated Sludge Pumps	2	7.5	C	460
Solids Handling, Sludge Pumping	Gravity Belt Thickener Return Pump	1	7.5	C	460
Solids Handling, Thickening	Gravity Belt Thickener	1	5	V	460
Solids Handling, Sludge Pumping	Belt Filter Press Pumps	2	7.5	V	460
Plant Water Pumping	Plant Water Pumps	2	20	C	460
Plant Water Pumping	Booster (Belt Press Pressure) Pumps	2	10	C	460
Disinfection	UV System	3	18.8	C	460

[1] All equipment listed in 3-phase

The submeters were installed from June 17, 2004 to August 6, 2004. The submeter on Raw Sewage Pump No. 1 was malfunctioning and data could not be used; a new functional submeter was installed from June 29, 2004 to August 6, 2004.

3.2 SUMMARY OF SITE AUDIT

A one-day on-site survey was conducted to:

- Document existing equipment, operations, and lighting.
- Finalize the list of opportunities for energy improvements.
- Finalize the submetering approach.

The submetering locations listed in Section 3.1.2 were finalized based on the site audit.

In addition, the site survey assessed the existing equipment at the plant with 5 hp or greater motors. As shown by the data in TABLE 3-1, the motors using the most energy are those on the influent raw sewage pumps and the mechanical aerators.

3.3 SUMMARY OF CONTINUOUS SUBMETERING

The following sections summarize the results from continuous submetering activities. The overall electric energy demand for submetered motors at the Wallkill WWTF is shown on FIGURE 3-1. Electric energy demand was calculated as the algebraic sum of the submetered equipment and it is reported for qualitative comparison only. The overall submetered electric energy demand averaged at approximately 250 kilowatts (kW). Significant electric energy demand peaks were not observed in the data with the exception of July 19, 2004, during which the 15-minute electric energy demand exceeded 285 kW. This corresponded to a high peak hourly influent flow rate, due to heavy rains. The average overall electric energy demand for the entire Wallkill WWTF during the submetered months was 357 kW.

<u>3.3.1 Raw Sewage Pumps</u>

There are three 60-hp raw sewage pumps with variable frequency drives (VFDs). Continuous submeters were installed on two of the three influent pumps to the plant. Typically, pumps are operated with one lead, one lag, and one standby. The average daily flow is 3 million gallons per day (MGD). Instantaneous maximum flow ranges from 8 MGD to 10 MGD, usually occurring during rain events. Instantaneous low flow is approximately 1 MGD. The lead pump operates to a maximum capacity of 4 MGD to 5 MGD. At

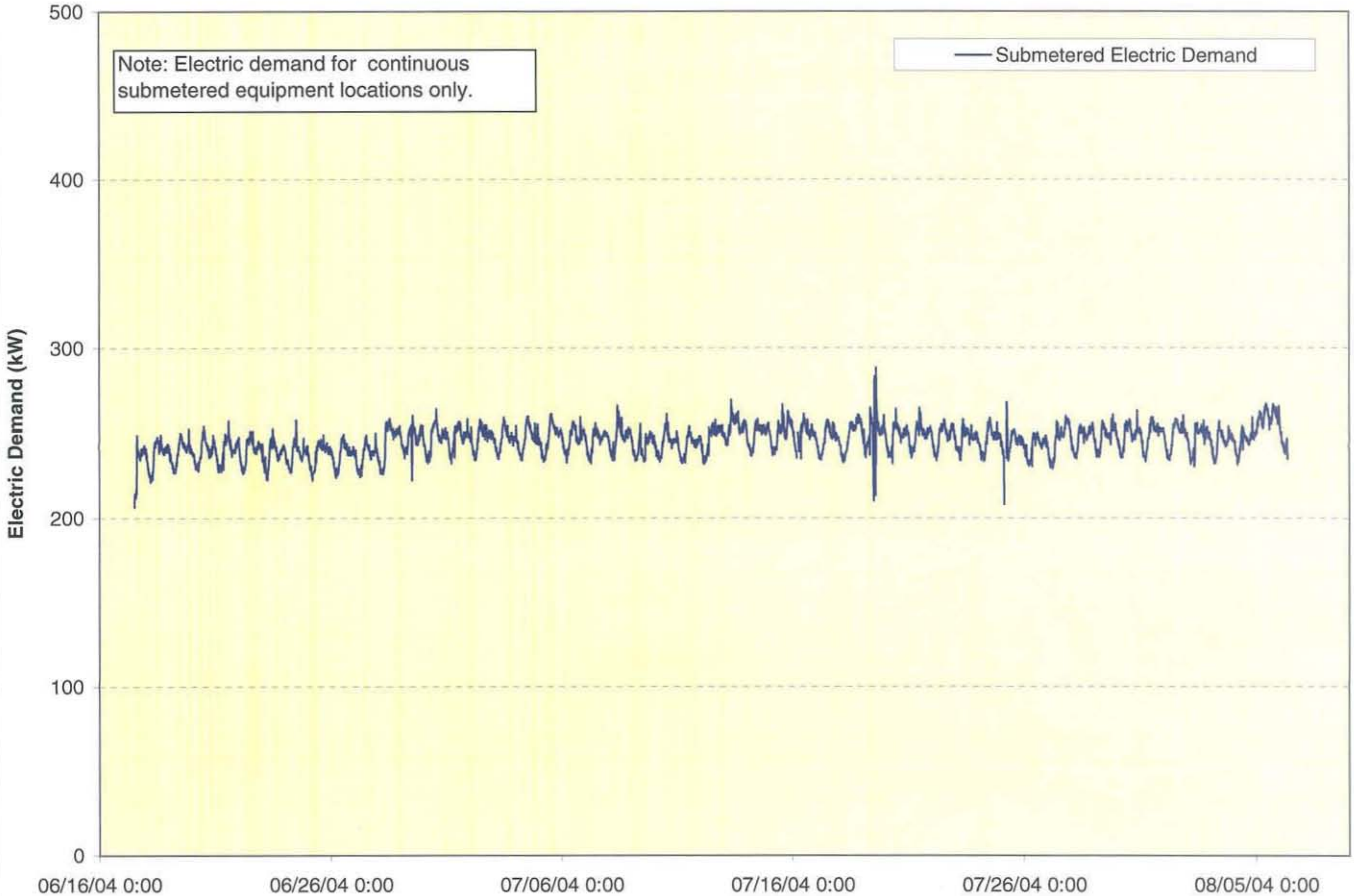

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FIGURE 3-1
SUBMETERED PLANT ELECTRIC DEMAND

F:\Projects\2255063\Technical\Wallkill\Continuous Submetering Data.xls\Fig 3.1 3/22/2005

5 MGD, the lag pump kicks on. These pumps convey flow from the collection system to the grit removal process at the plant.

During the submetering period, the daily influent plant flow did not exceed 4 MGD and one pump was operating at all times.

The patterns of use for both Raw Sewage Pumps No. 1 and No. 2 during the submetering period are shown on FIGURE 3-2. Data illustrates that Pump No. 1 was not operating for most of the submetering period, and so Pump No. 2 was on during this time. A new inverter was installed for Pump No. 1 before the submetering program. Operating pumps were intentionally switched (Pump No. 2 was switched off as soon as Pump No. 1 was switched on) to see if there was any significant change due to the new inverter.

The average power draw values for Pumps No. 1 and No. 2 (when in operation) are 21.89 kW and 24.83 kW, respectively.

TABLE 3-2 summarizes the electric energy usage and estimated cost for the raw sewage pump operation during the submetering period. If the numbers obtained are extrapolated to the full year, it is estimated that the total annual electric energy usage of the raw sewage pumps is 224,989 kWh and the total estimated cost is $16,942 or approximately 9.9% of the total wastewater treatment facility (WWTF) average annual electric energy cost. Data from 2003 were used to estimate the average annual electric energy usage and cost.

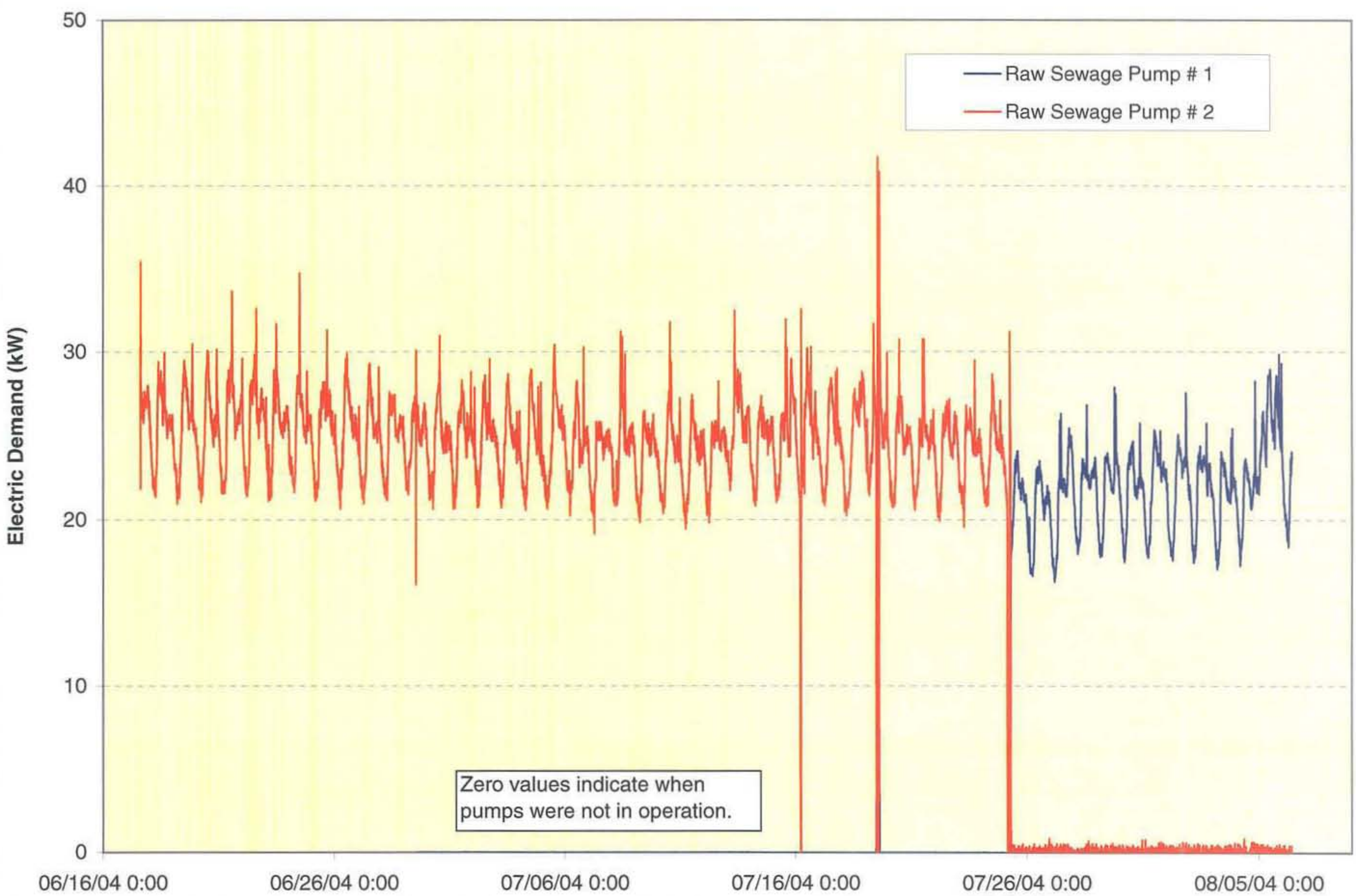
Table 3-2: Summary of Raw Sewage Pumps Electric Energy Usage and Associated Costs During the Submetering Period

Raw Sewage Pump No.	Electric Usage (kWh)	Estimated Cost(1)
1	6,385	$481
2	22,305	$1,680
3	Not metered(2)	
TOTAL	28,690	$2,161

Note:
(1) Estimated using $0.0753 per kWh, which was average cost per kWh from 2003 data.
(2) Raw Sewage Pump No. 3 was not operated during the submetering period.

3.3.2 Aeration Basin

Secondary treatment is accomplished through oxidation basins with mechanical aerators. There are four mechanical aerators, two per basin. Each aerator has a 75-hp motor. Each basin has an adjustable weir to change the water surface elevation and mixer submergence in the basin. The horsepower output of the



MALCOLM PIRNIE	NYSERDA MUNICIPAL WASTEWATER TREATMENT PLANT ENERGY EVALUATION WALLKILL WASTEWATER TREATMENT FACILITY	FIGURE 3-2 SUBMETERING - RAW SEWAGE PUMPS NO. 1 AND 2

aerators varies with the elevation of the weir. The greater the weir elevation, the greater is the horsepower output. FIGURE 3-3 summarizes the operation of Mechanical Aerator No. 1 in the oxidation basin. The mechanical aerator had an average electric demand of 49.84 kW (66.80 hp). Total usage and estimated associated costs during the submetering period were 59,503 kWh and $4,481, respectively. Cost was estimated using $0.0753 per kWh, which was average cost per kWh from 2003 data.

Extrapolating the number of kilowatt-hours and the estimated costs to the four aerators and to the entire year, it is estimated that approximately 1,576,800 kWh would be used by the mechanical aerators per year, which would account for 69.6% ($118,733) of the total annual electric energy cost. Data from 2003 were used to estimate the average annual electric usage and cost.

3.3.3 RAS Pumps

There are three 15-hp RAS pumps, out of which two are typically used, one for each clarifier. RAS pumps were recently upgraded to provide flow pacing based on influent flow. The RAS pumps have VFDs and pump 50% of influent flow in typical situations (approximately 300 gallons per minute (gpm) to 400 gpm).

Submeters were installed on two of the three RAS pumps which were in operation. During the continuous submetering period, both the RAS pumps ran continuously at estimated average powers draw of 4.1kW and 4.0 kW, respectively. A spike in the electric energy demand for RAS Pump No. 3 was noticed on July 19, 2004, in correspondence to a rain event. FIGURE 3-4 shows the operation of RAS pumps No. 1 and No. 3 during the course of the submetering period. Total usage and estimated associated costs during the submetering period are summarized in TABLE 3-3. It is estimated that at this average demand, the annual power usage is 69,707 kWh at a total annual cost of $5,249 (or 3.1% of the total electric usage at the plant). The annual total electric energy usage for the plant was estimated based on the 2003 data.

Table 3-3: Summary of RAS Pumps Electric Energy Usage and Associated Costs During the Submetering Period

RAS Pump No.	Electric Usage (kWh)	Estimated Cost*
1	4,777	$360
3	4,747	$357

Note:
* Estimated using $0.0753 per kWh, which was average cost per kWh from 2003 data.

3.3.4 UV Disinfection System

A low pressure UV system is used for disinfection, which is required only between May 15 and October 15. The facility is equipped with three modules (panels); one module is normally operated, a

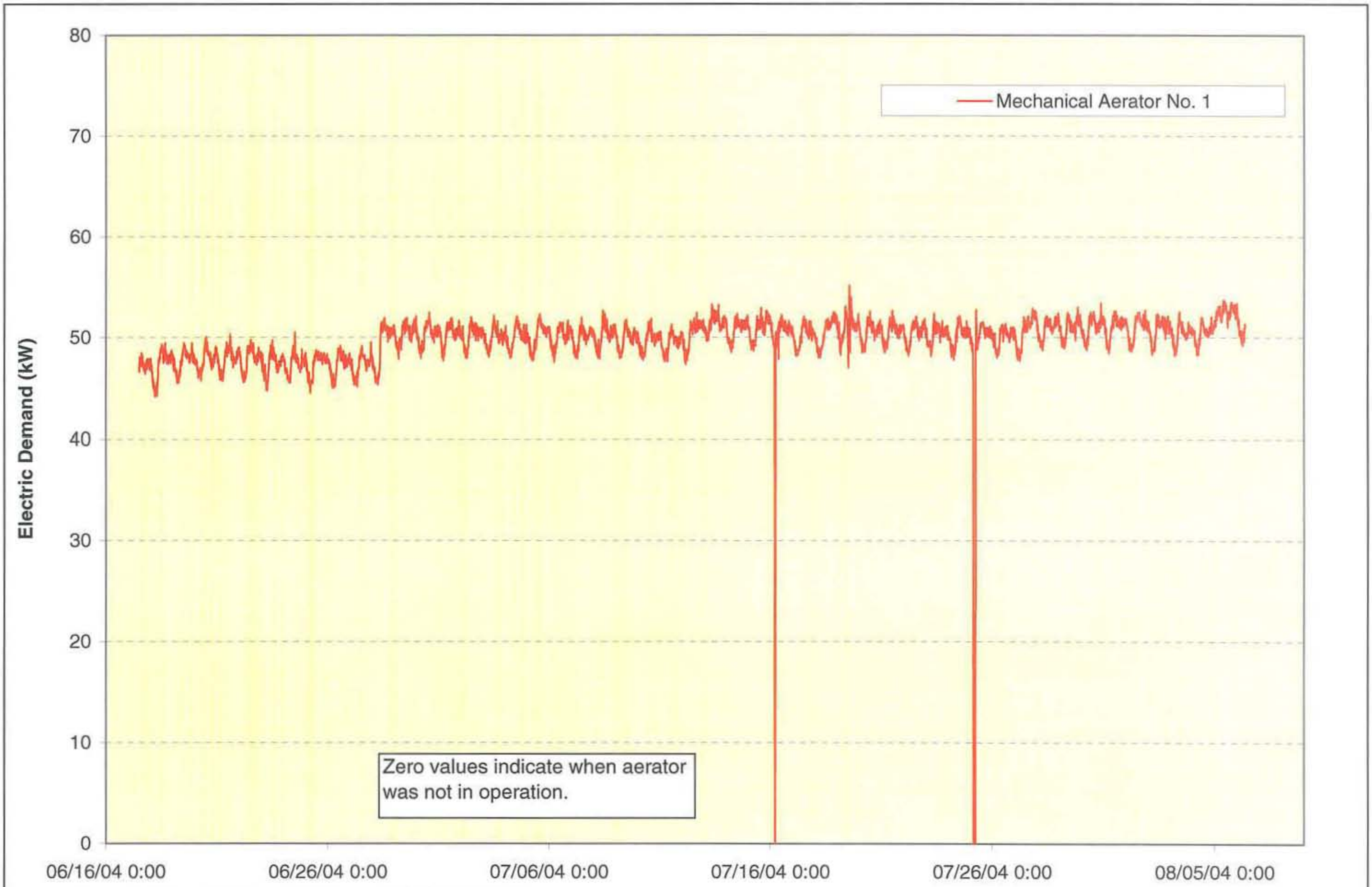


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FIGURE 3-3
SUBMETERING - MECHANICAL AERATOR NO. 1 - OXIDATION BASIN

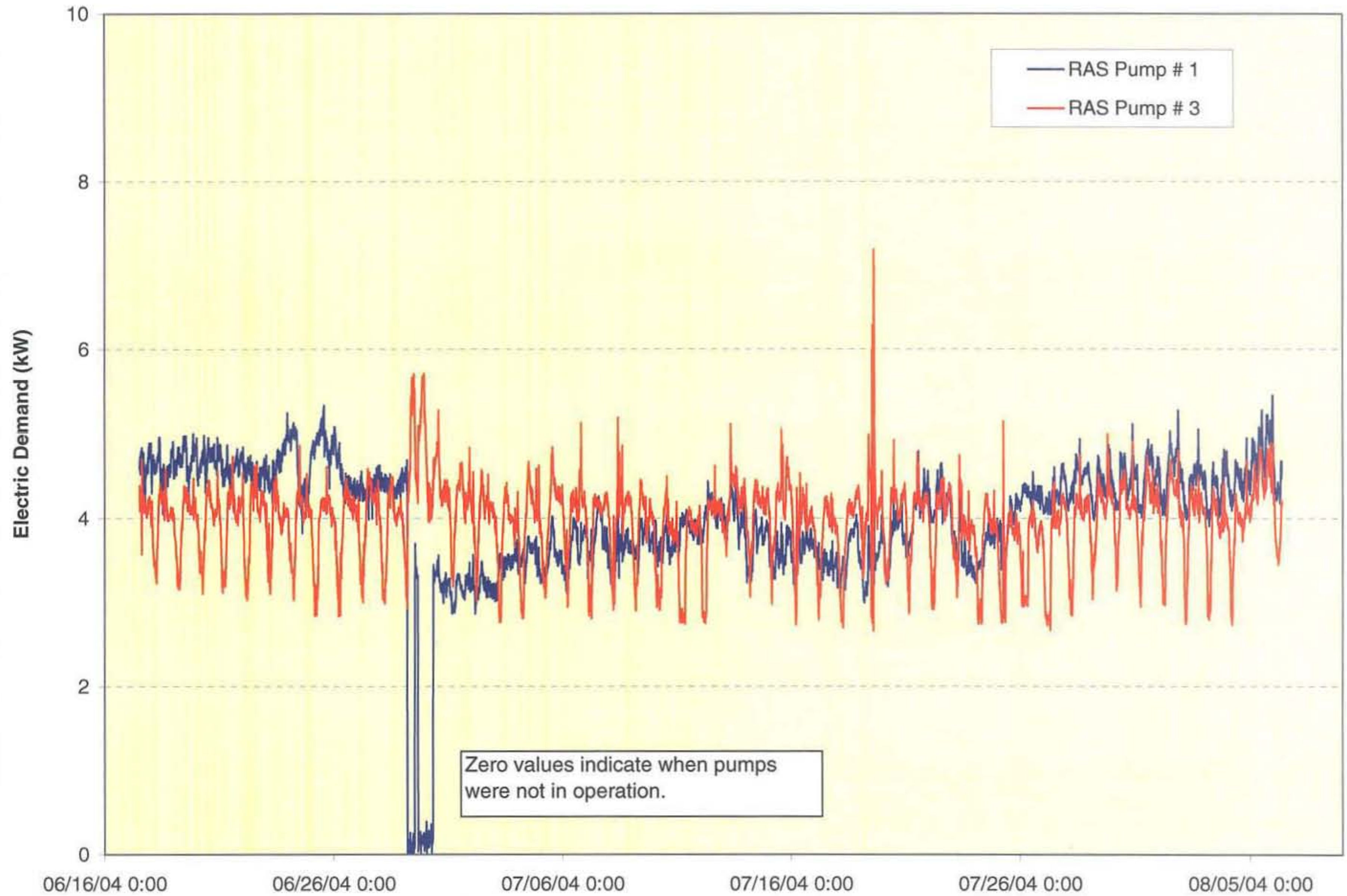

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FIGURE 3-4
SUBMETERING - RAS PUMPS

second one is started when needed, and the third one is stand-by. FIGURE 3-5 shows the operation of UV Panels No. 1 and No. 2 during the submetering period. UV Panel No. 1 did not turn on during the entire submetering period.

Total electric energy usage and estimated costs during the submetering period for UV Panel No. 2 was 16,985 kWh and $1,279, respectively. It is estimated that at this average demand, the electric energy usage of the UV system over the operating months is 63,454 kWh at a total annual cost of $4,778 (or 2.8% of the total electric energy usage at the plant). The annual total electric energy usage for the plant was estimated based on the 2003 data set.

3.3.5 Emergency Generator

There is one 500-kW stand-by generator (625kVA, 755 amps) at the Wallkill WWTF. The generator is exercised for one hour per month, and used during power interruptions. FIGURE 3-6 shows the operation of the emergency generator on August 6, 2004, during the course of the submetering period. The emergency generator had an average electric output of 262 kW. Total generation was 271 kWh.

3.4 SUMMARY OF INSTANTANEOUS SUBMETERING

Instantaneous power draw measurements were obtained from motors greater than 5 hp at the plant for equipment that is either in continuous use or operated on a set schedule. The resulting information was collected to verify electric energy demand at the facility, as well as to monitor changes in electric energy demand as the equipment is cycled on and off.

The instantaneous measurements were obtained using hand-held meters. TABLE 3-4 summarizes the instantaneous power draw and estimated operating hours for each piece of equipment over 5 hp.

Based on the instantaneous power draw measurements and the estimated operating hours, TABLE 3-5 shows the estimated annual electric energy usage and associated costs. The table presents both the usage and costs based on instantaneous power draw measurements along with estimates provided by plant staff as to equipment operating hours. In estimating electric energy usage for the raw sewage influent pumps, mechanical aerators, RAS pumps, and UV panels, the continuous submetering data were used.

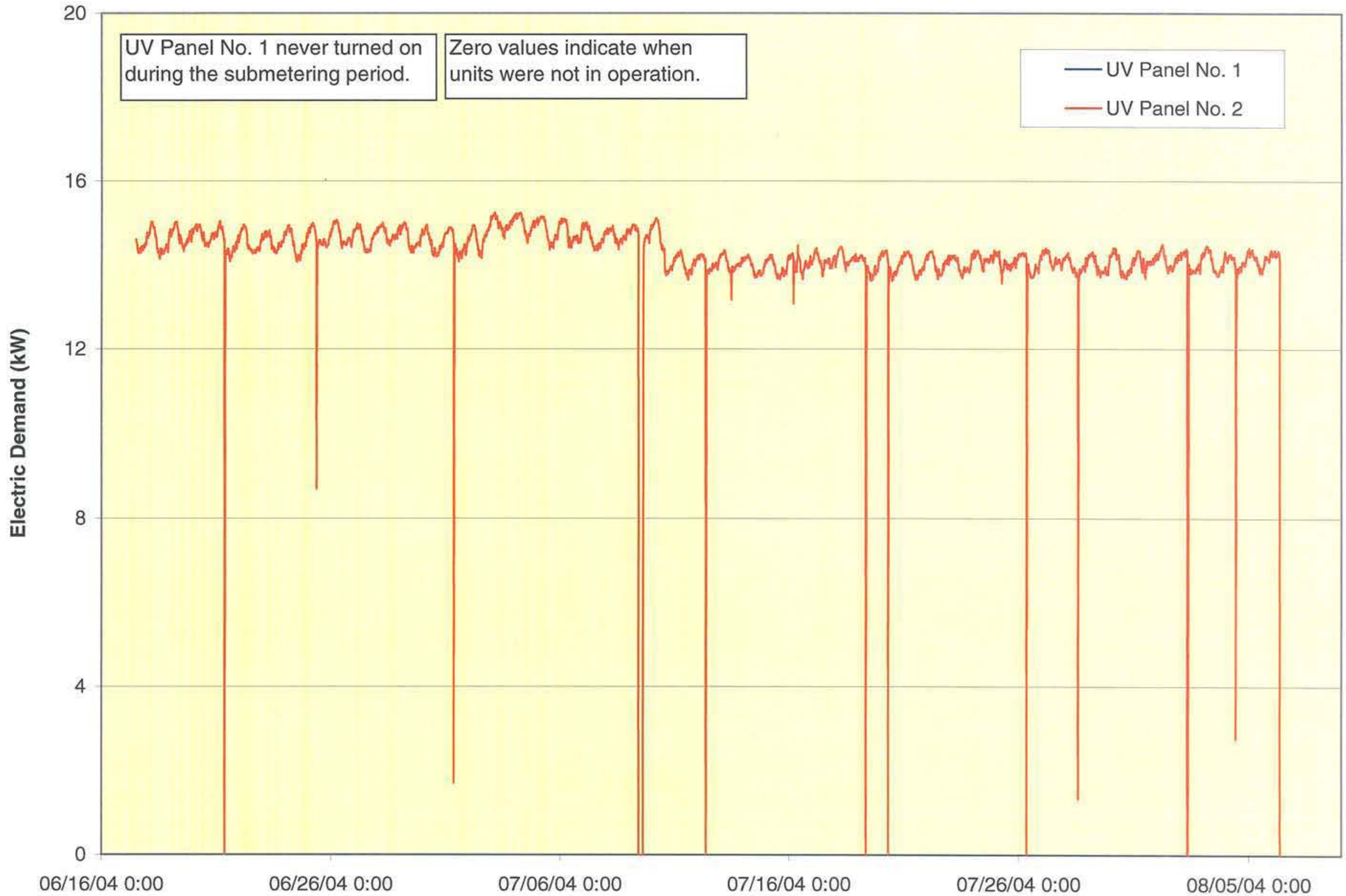

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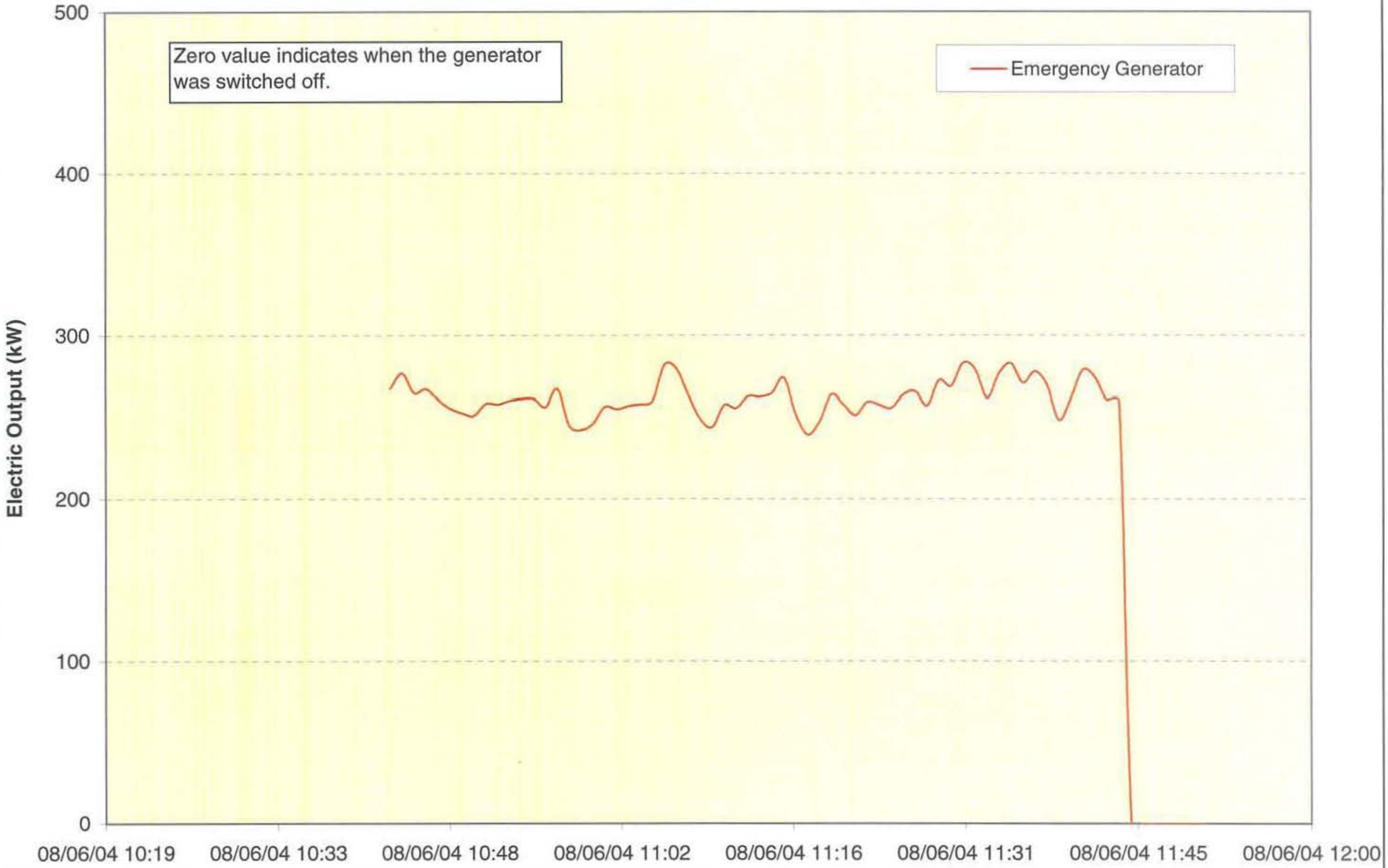
FIGURE 3-5
SUBMETERING - UV PANELS



MALCOLM PIRNIE	NYSERDA MUNICIPAL WASTEWATER TREATMENT PLANT ENERGY EVALUATION WALLKILL WASTEWATER TREATMENT FACILITY	FIGURE 3-6 SUBMETERING - EMERGENCY GENERATOR

Wallkill Wastewater Treatment Facility

Table 3-4 Instantaneous Power Draw Measurements and Estimates of Hours in Operation

Process	Use	Quantity	Size (hp)	Constant/ Variable Speed	Voltage	Efficiency Rating	Estimated Hours per Year	Continuous / Instantaneous Power Ratings	Power Draw (kW) per Motor	Notes
Wastewater Pumping	Raw Sewage (Influent) Pumps	3	60	V	460	93-91.7%	8,760	*C*	*23.36*	1 pump runs constantly
Preliminary Treatment	Grit Pumps	2	10	C	460	89.5	304	I	11.2	run 2 or 3 times/d
Activated Sludge Aeration	Aerators[2]	4	75	V	460	93%	35,040	I/C	45/49.84	All run constantly
Solids Handling, Sludge Pumping	Return Activated Sludge Pumps	3	15	V	460	87.5%	17,520	*C*	*4.02*	2 pumps run constantly
Solids Handling, Sludge Pumping	Waste Activated Sludge Pumps	2	7.5	C	460	86.5%	5,840	I	3.8	run 20 min every hr
Solids Handling, Sludge Pumping	Gravity Belt Thickener Return Pump	1	7.5	C	460	86.5%	677	I	2.79	runs depending on GBT
Solids Handling, Thickening	Gravity Belt Thickener	1	5	V	460	91.7%	1,015	I	0.99	runs 2-3 hr/d
Solids Handling, Sludge Pumping	Belt Filter Press Pumps	2	7.5	V	460	86.5%	2,234	I	3.47	1 pump runs w/ BFP
Plant Water Pumping	Plant Water Pumps	2	20	C	460	88.5%	1,787	I	12.7	run w/ BFP
Plant Water Pumping	Booster (Belt Press Pressure) Pumps	2	10	C	460	84%	2,548	I	11.9	run w/ BFP
Disinfection	UV System	3	18.8	C	460		8,760	*C*	*14.34*	1 runs constantly, May to Oct

[1] Usage and Cost are displayed in italics, if determined through continuous submetering.

[2] Aerators were part of both continuous and instantaneous submetering programs

Wallkill Wastewater Treatment Facility

Table 3-5 Estimates of Electric Usage and Costs

Process	Use	Quantity	Size (hp)	Efficiency Rating	Estimated Hours per Year	Power Draw (kW) per Motor	Estimated Annual Usage (kWh)[1]	Estimated Cost[1]	Notes
Wastewater Pumping	Raw Sewage (Influent) Pumps	3	60	93%	8,760	*23.36*	*224,989*	$16,942	1 pump runs constantly
Preliminary Treatment	Grit Pumps	2	10	89.5	304	11.2	3,405	$256	run 2 or 3 times/d
Activated Sludge Aeration	Aerators[2]	4	75	93%	35,040	45	1,576,800	$118,733	All run constantly
Solids Handling, Sludge Pumping	Return Activated Sludge Pumps	3	15	87.5%	17,520	*4.02*	*69,707*	$5,249	2 pumps run constantly
Solids Handling, Sludge Pumping	Waste Activated Sludge Pumps	2	7.5	86.5%	5,840	3.8	22,192	$1,671	run 20 min every hr
Solids Handling, Sludge Pumping	Gravity Belt Thickener Return Pump	1	7.5	86.5%	677	2.79	1,889	$142	runs depending on GBT
Solids Handling, Thickening	Gravity Belt Thickener	1	5	91.7%	1,015	0.99	1,000	$75	runs 2-3 hr/d
Solids Handling, Sludge Pumping	Belt Filter Press Pumps	2	7.5	86.5%	2,234	3.47	7,752	$584	1 pump runs w/ BFP
Plant Water Pumping	Plant Water Pumps	2	20	88.5%	1,787	12.7	22,695	$1,709	run w/ BFP
Plant Water Pumping	Booster (Belt Press Pressure) Pumps	2	10	84%	2,548	11.9	30,321	$2,283	run w/ BFP
Disinfection	UV System	3	18.8		8,760	*14.34*	63,454	$4,778	1 runs constantly, May to Oct
							2,024,204	**$152,423**	

Estimated Cost $0.0753

[1] Usage and Cost are displayed in italics, if determined through continuous submetering.

[2] Aerators were part of both continuous and instantaneous submetering programs

3.5 SUMMARY OF ENTIRE SUBMETERING PROGRAM

FIGURE 3-7 summarizes the apparent electric energy usage distribution among the larger motors at the Wallkill WWTF. TABLE 3-6 also shows the corresponding percentages of total electric energy usage.

Table 3-6: Summary of Major Equipment Estimated Electric Energy Usage and Costs at the WWTF

Equipment	Usage* (kWh)	Cost	Percentage of Total Cost
Mechanical Aerators	1,576,800	$ 118,733	69.6%
Raw Sewage (Influent) Pumps	224,989	$ 16,942	10.0%
UV System	63,454	$ 4,778	2.8%
RAS Pumps	69,707	$ 5,249	3.1%
Booster Pumps	30,321	$ 2,283	1.3%
Plant Water Pumps	22,695	$ 1,709	1.0%
WAS Pumps	22,192	$ 1,671	1.0%
Belt Filter Press (BFP) Pumps	7,752	$ 584	0.3%
Grit Pumps	3,405	$ 256	0.1%
GBT Return Pump	1,889	$ 142	0.1%
Gravity Belt Thickener (GBT)	1,000	$ 75	0.1 %
Other Unmetered	241,066	$ 18,152	10.6%
TOTALS	2,265,270	$ 170,574	100.00%

Note:
* Power usage based on both instantaneous and continuous (for those pieces of equipment continuously submetered) measurements.

From FIGURE 3-7 and TABLE 3-6, it is apparent that the largest "identified" usage of electric energy at the plant are the mechanical aerators and raw sewage pumps. Approximately 11% of the total electric energy usage is accounted for as "Other Unmetered" which would involve equipment such as heating and ventilating fans, lights, lab equipment, and other plant equipment with electric motors less than 5 hp that were not included as part of this submetering program.

FIGURE 3-8 shows the distribution of estimated energy usage among the major processes at the plant. Equipments were grouped into processes as follows:

- Wastewater Pumping – Raw sewage pumps.
- Plant Water Pumping - Plant water pumps, booster pumps.
- Preliminary Treatment – Grit pumps.
- Secondary Treatment – Mechanical aerators and RAS pumps.
- Solids Handling – BFP pumps, GBT, GBT return pumps, and WAS pumps.
- Disinfection – UV system.

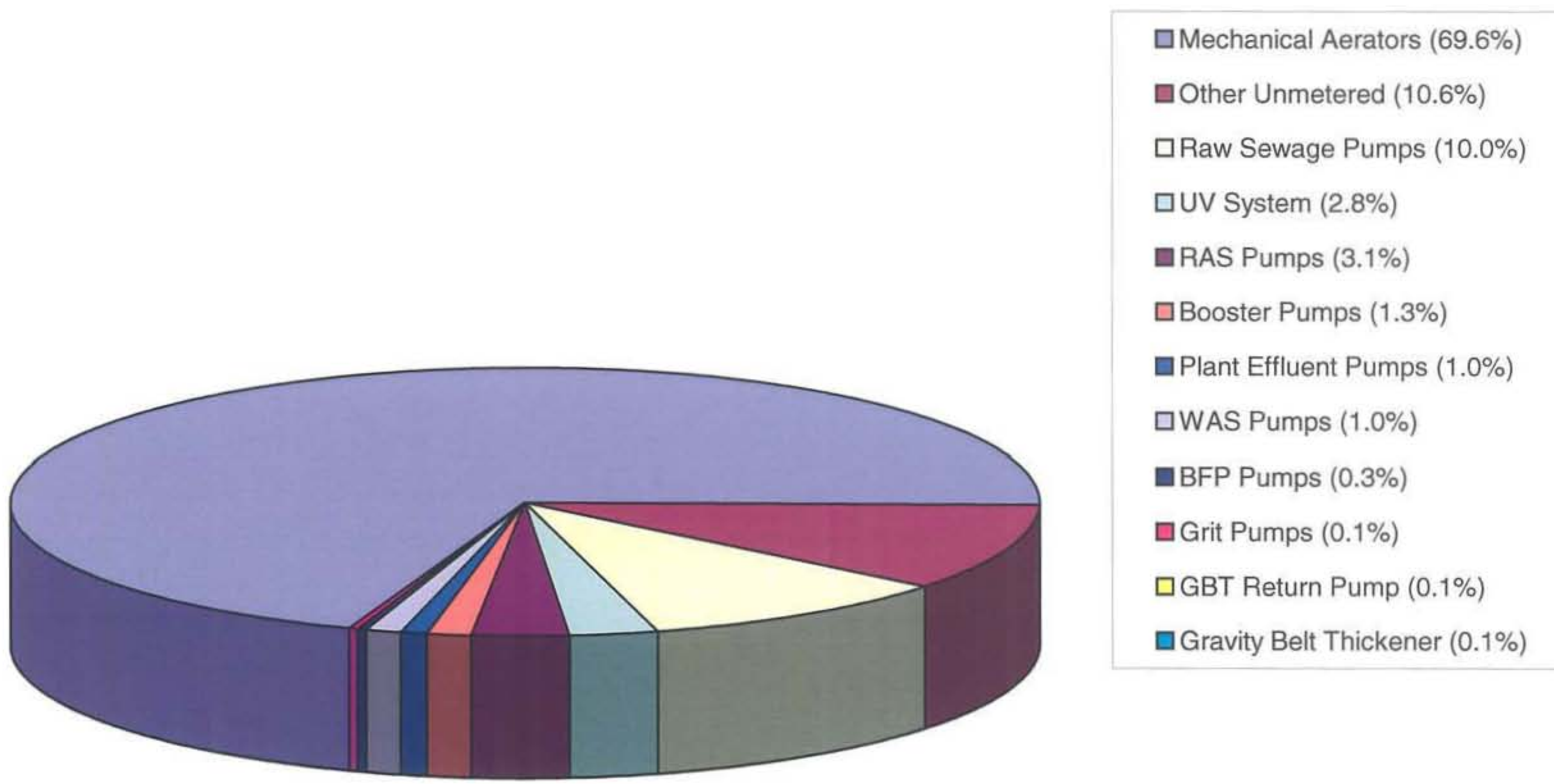


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FIGURE 3-7
ESTIMATED DISTRIBUTION OF ELECTRIC USAGE AND COST

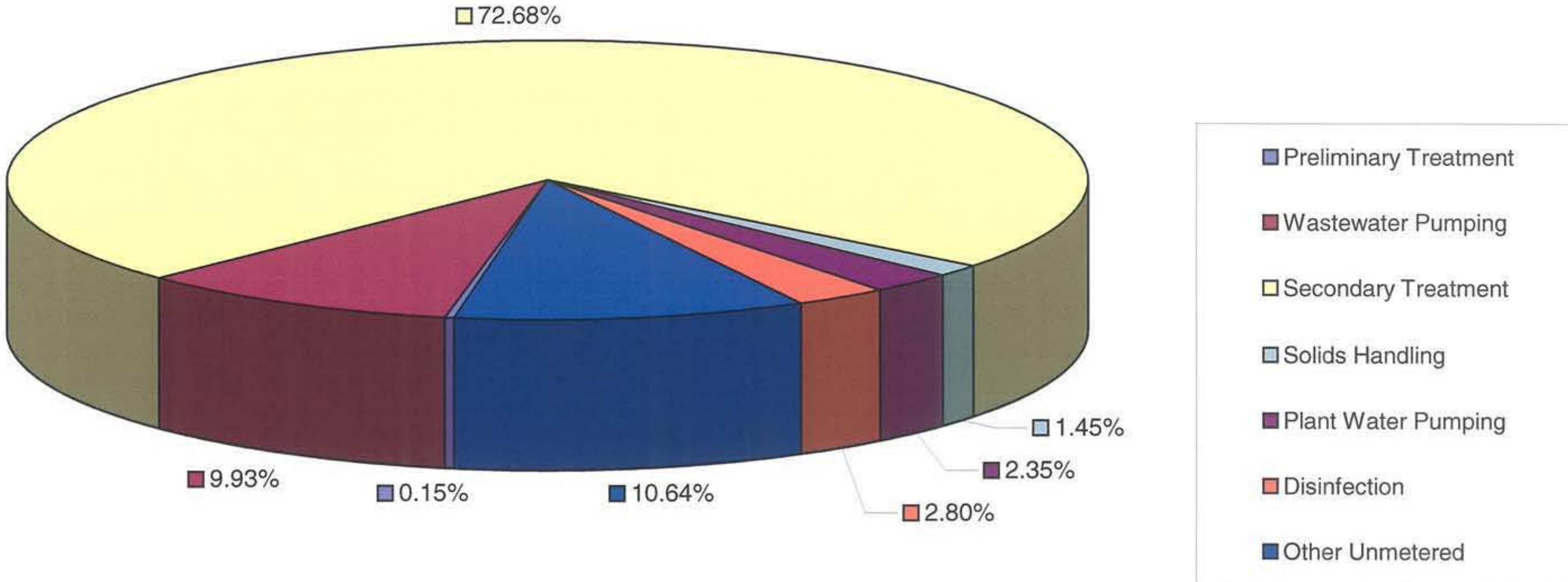

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FIGURE 3-8
DISTRIBUTION OF ELECTRIC USAGE AMONG PROCESSES

The secondary treatment process consumes the most electric energy at the Wallkill WWTF. It is estimated that approximately 2.19 kWh of electric energy is consumed per lb of BOD_5 removed in the secondary process.

The distribution of estimated electric energy usage in the solids handling processes is shown in FIGURE 3-9. The solids handling equipment was categorized as follows:

- Pumping and Mixing – WAS pumps.
- Thickening - GBT feed pump, GBT.
- Dewatering - BFP pumps.

Sludge pumping and mixing consume the majority of the electric energy in the solids handling processes.

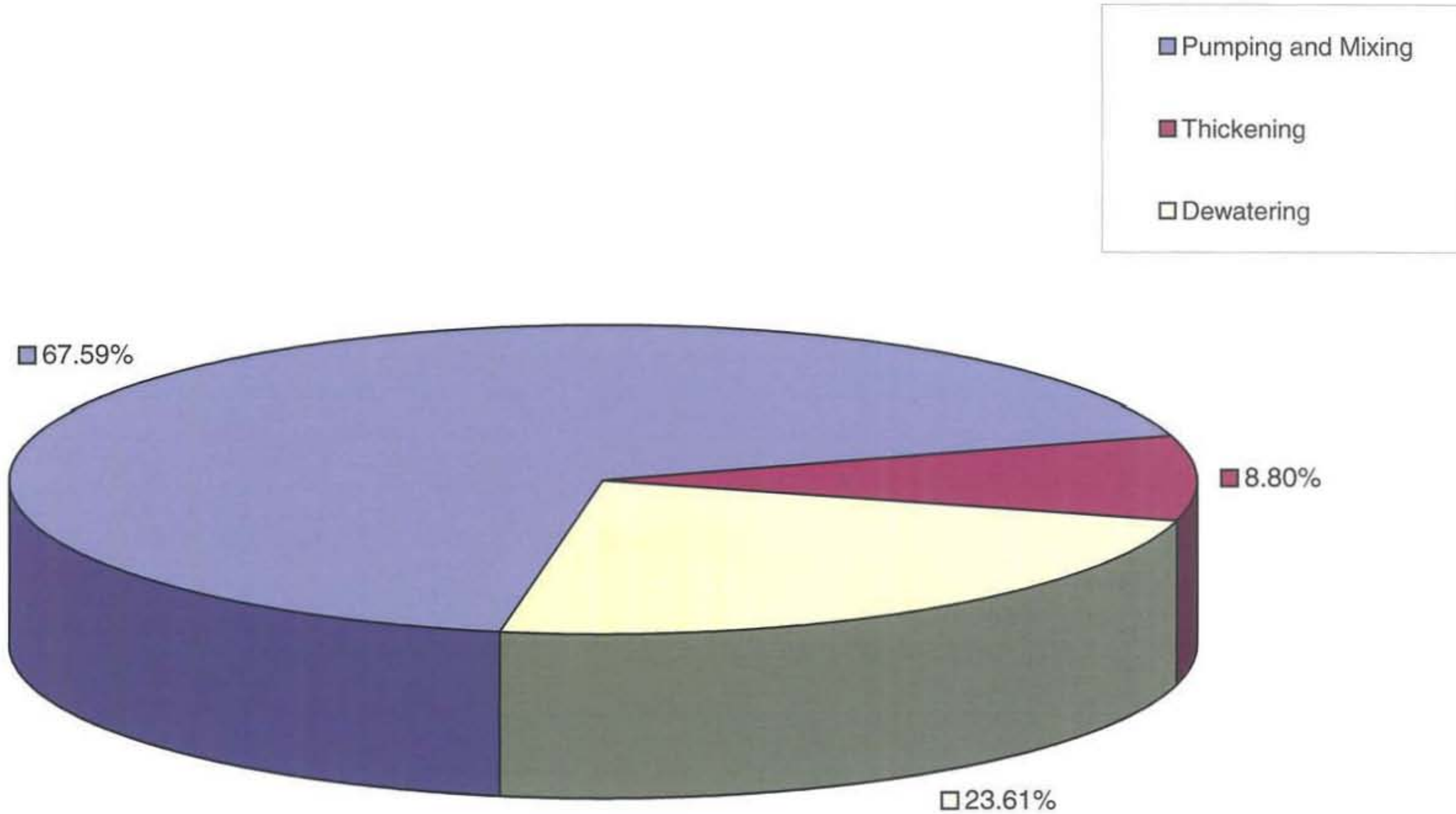

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FIGURE 3-9
DISTRIBUTION OF ELECTRIC USAGE IN SOLIDS HANDLING

Section 4

PROCESS PERFORMANCE DURING SUBMETERING

Process data were collected during the continuous submetering period, as well. These data were compared with historical plant data to determine if the operation during submetering and corresponding electric energy usage could be considered typical for the Wallkill Wastewater Treatment Facility (WWTF).

4.1 SUMMARY OF PROCESS PERFORMANCE PARAMETER MONITORING

The following daily process performance data were collected for the duration of the submetering program:

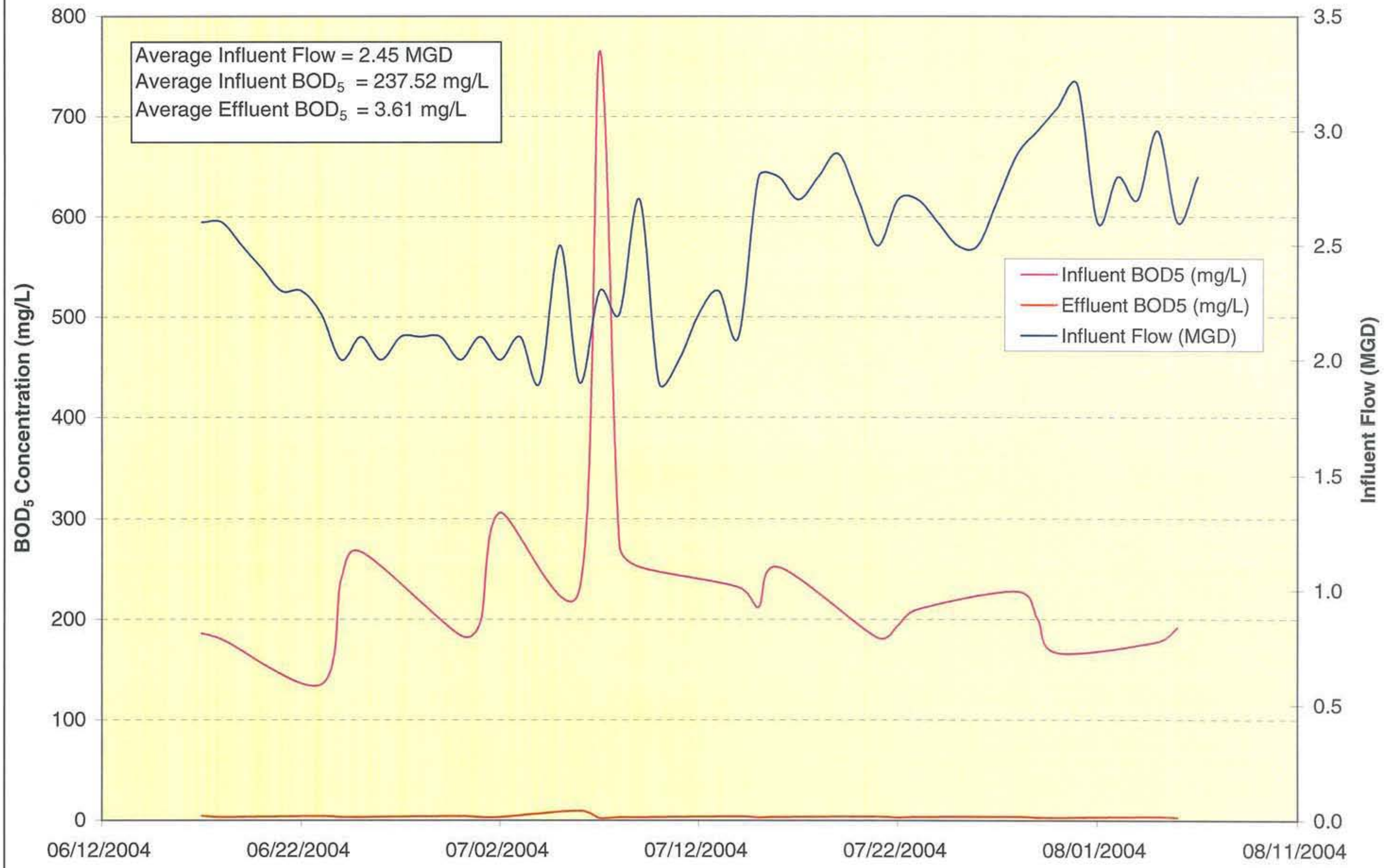
- Influent and plant effluent 5-day biochemical oxygen demand (BOD_5).
- Influent and effluent total suspended solids (TSS).
- Return Activated Sludge (RAS) flow rate.
- Waste Activated Sludge (WAS) flow rate.
- Mixed Liquor Suspended Solids (MLSS).

FIGURE 4-1 shows the influent and plant effluent BOD_5 concentrations during the course of the submetering program. BOD_5 concentrations do not appear to be affected by influent plant flow. FIGURE 4-2 shows the relationship between BOD_5 loading (in pounds per day) and influent plant flow. BOD_5 loadings appear to be marginally affected by the plant influent flow.

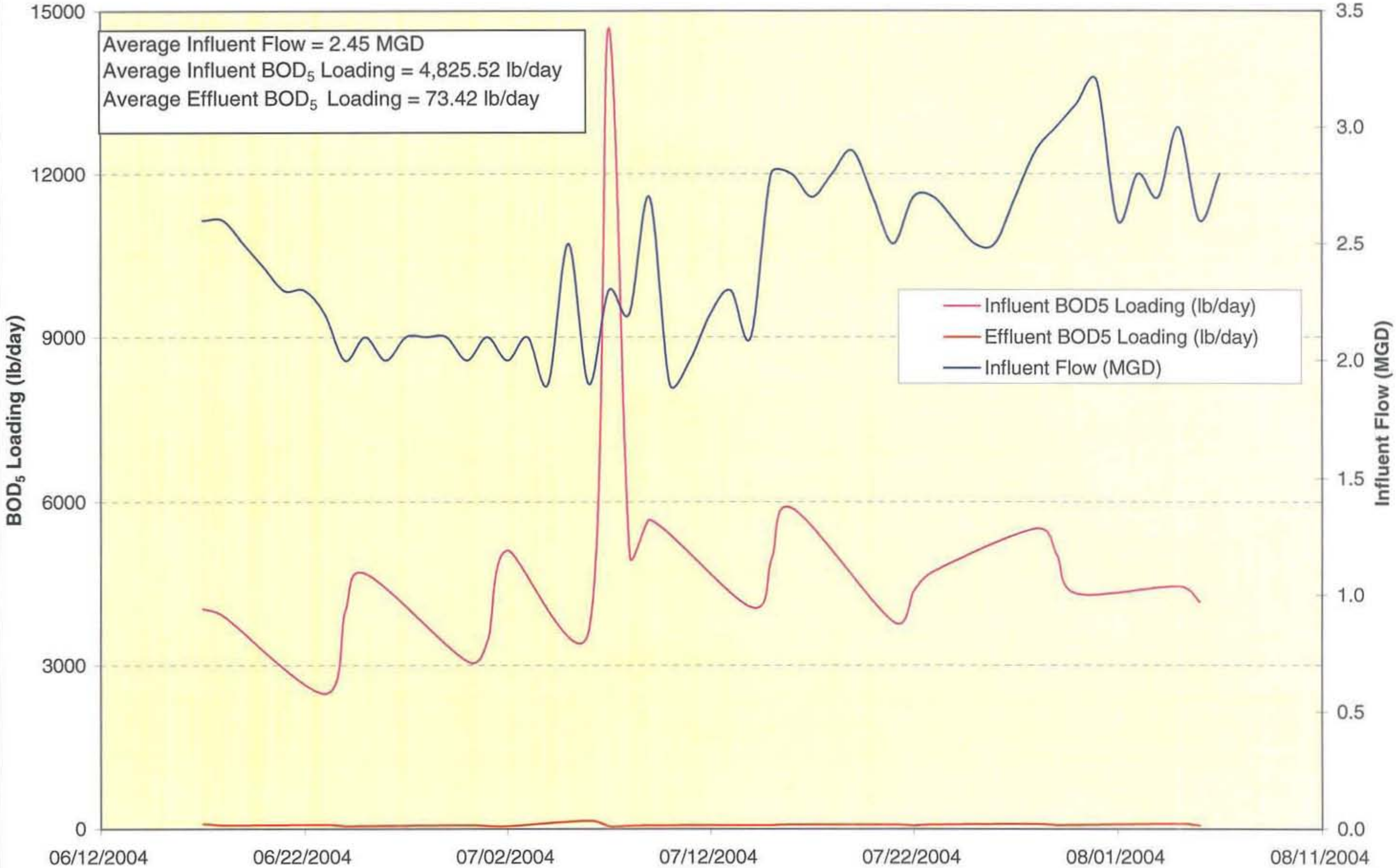
FIGURES 4-3 and 4-4 show the TSS influent and effluent concentrations and loadings, respectively, and the influent plant flow.

The RAS flow rate was maintained at an average of 1.29 MGD. 1.64 percent (%) of the total activated sludge was wasted as WAS during the submetering period, at an average flow rate of 0.021 MGD.

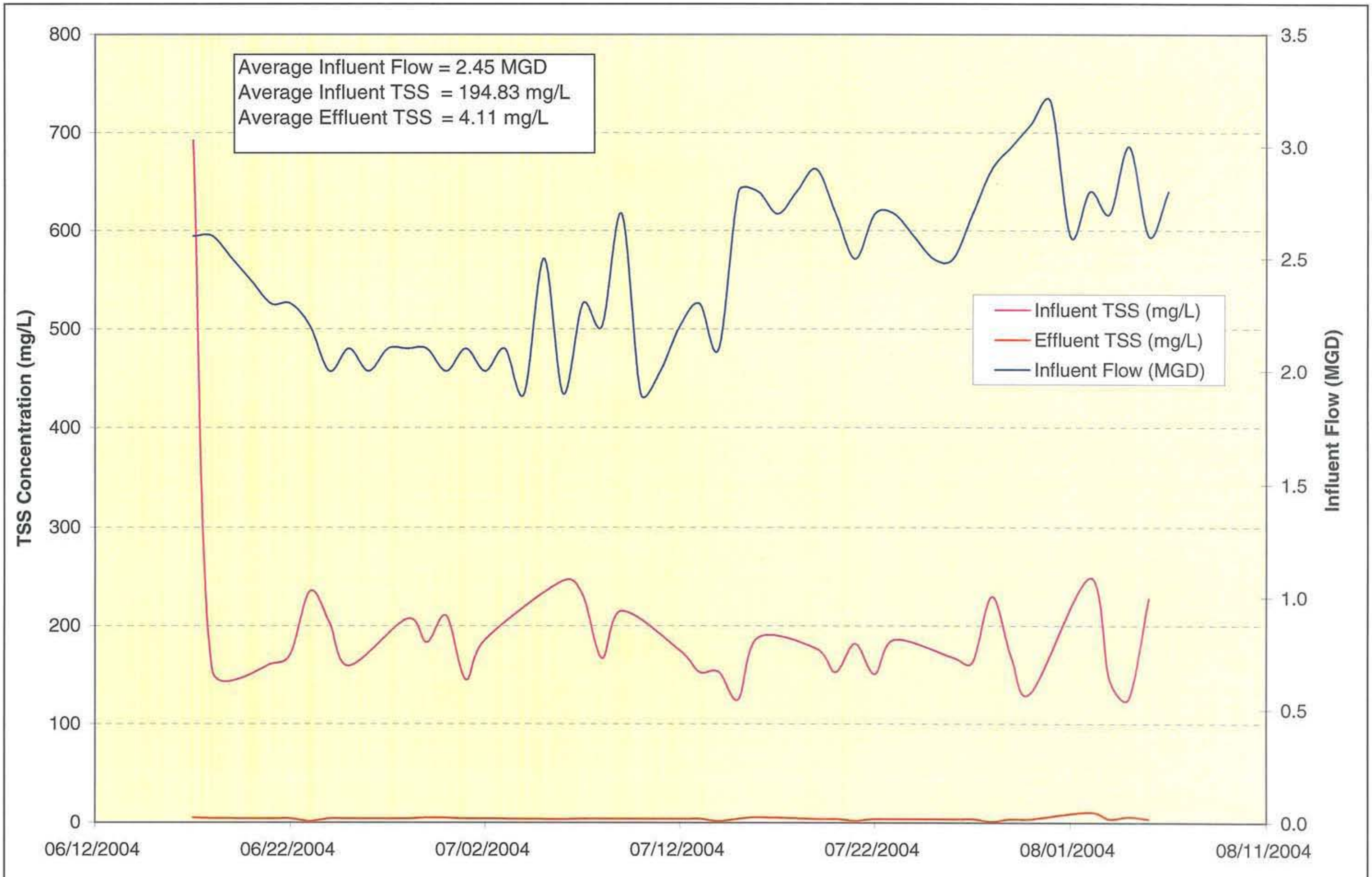
The most relevant data are summarized in TABLE 4-1. Parameters were compared to historical values.



MALCOLM PIRNIE	NYSERDA MUNICIPAL WASTEWATER TREATMENT PLANT ENERGY EVALUATION WALLKILL WASTEWATER TREATMENT FACILITY	FIGURE 4-1 SUBMETERING - BOD_5 CONCENTRATION VS. INFLUENT FLOW



MALCOLM PIRNIE	NYSERDA MUNICIPAL WASTEWATER TREATMENT PLANT ENERGY EVALUATION WALLKILL WASTEWATER TREATMENT FACILITY	FIGURE 4-2 SUBMETERING - BOD_5 LOADING VS. INFLUENT FLOW



MALCOLM PIRNIE	NYSERDA MUNICIPAL WASTEWATER TREATMENT PLANT ENERGY EVALUATION WALLKILL WASTEWATER TREATMENT FACILITY	FIGURE 4-3 SUBMETERING - TSS VS. INFLUENT FLOW

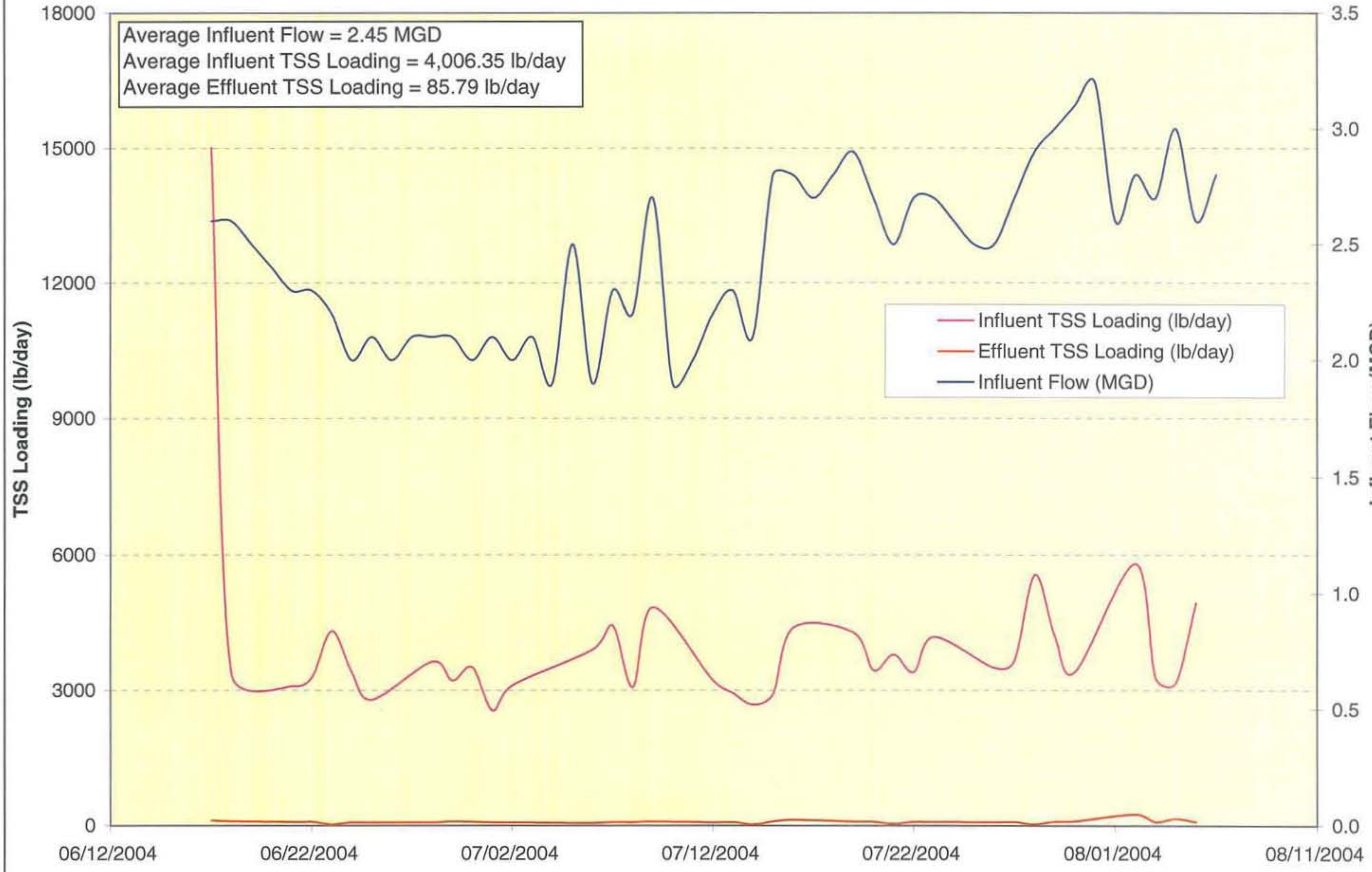


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FIGURE 4-4
SUBMETERING - TSS LOADING VS. INFLUENT FLOW

Table 4-1: Summary of Wallkill WWTF Performance During the Submetering Period Compared to Historical Data

Parameter	Unit	Monitoring		Historical	
		Average	Maximum	Average	Maximum
Influent Plant Flow	MGD	2.45	3.20	2.81	3.96
Influent BOD_5 Concentration	mg/L	237.52	765.00	140.39	260.07
Influent BOD_5 Loading	lb/d	4,825.52	14,674.23	3,246.73	5,884.07
Effluent BOD_5 Concentration	mg/L	3.61	9.30	6.31	69.60
BOD_5 Removal	%	98.28	99.71	95.12	98.60
Influent TSS Concentration	mg/L	194.83	692.00	342.01	994.75
Influent TSS Loading	lb/d	4,006.35	15,005.33	7,908.88	28,447.99
Effluent TSS Concentration	mg/L	4.11	11.00	22.06	291.67
TSS Removal	%	97.70	99.49	93.53	97.57
MLSS	mg/L	2,550	3,380	3,133	5,567
RAS Flow	MGD	1.29	1.80	1.55	2.85
WAS Flow	MGD	0.021	0.034	0.031	0.066

The hydraulic loading to the facility was similar to the historical values. The BOD_5 loading was approximately 50% higher, and the TSS loading was approximately 40% lower than historical values. It is noted that historical peak in TABLE 4-1 were estimated based on historical monthly averages. The peak values during the monitoring period were estimated based on daily averages.

4.2 RELATIONSHIP BETWEEN PLANT PROCESS DATA AND SUBMETERING DATA

Process data for the monitoring period were compared to the electric energy demand measured with the submeters. Demand was recorded in 15-minute intervals; data were averaged for each day to compare them to daily plant process data.

4.2.1 Raw Sewage Pumps

Electric energy usage in kilowatt-hours for each raw sewage pump (No.1 and No.2) was recorded in 15-minute intervals during the submetering period (June 17, 2004 to August 06, 2004).

Total electric energy demand for raw sewage pumps is the algebraic sum of the energy demand for wastewater pumps No. 1 and 2. Of the three raw sewage pumps, one pump acts as a lead pump, the second as a lag pump, while the third is a standby pump. FIGURE 4-5 shows a comparison of the average daily flow and the total energy demand from the two raw sewage pumps during the submetering period. During this period, flow ranged from approximately 1.9 MGD on July 4, 2004 to a peak of 3.2 MGD on July 31, 2004 with an average flow of 2.45 MGD. This figure shows a good correlation between total flow and electric energy usage indicating that the electric energy usage by the raw sewage pumps is dependent upon flow rate, i.e., the greater the influent flow, the greater the pumps energy usage. As expected, the total amount of energy used by the raw sewage pumps is proportional to the influent wastewater flow.

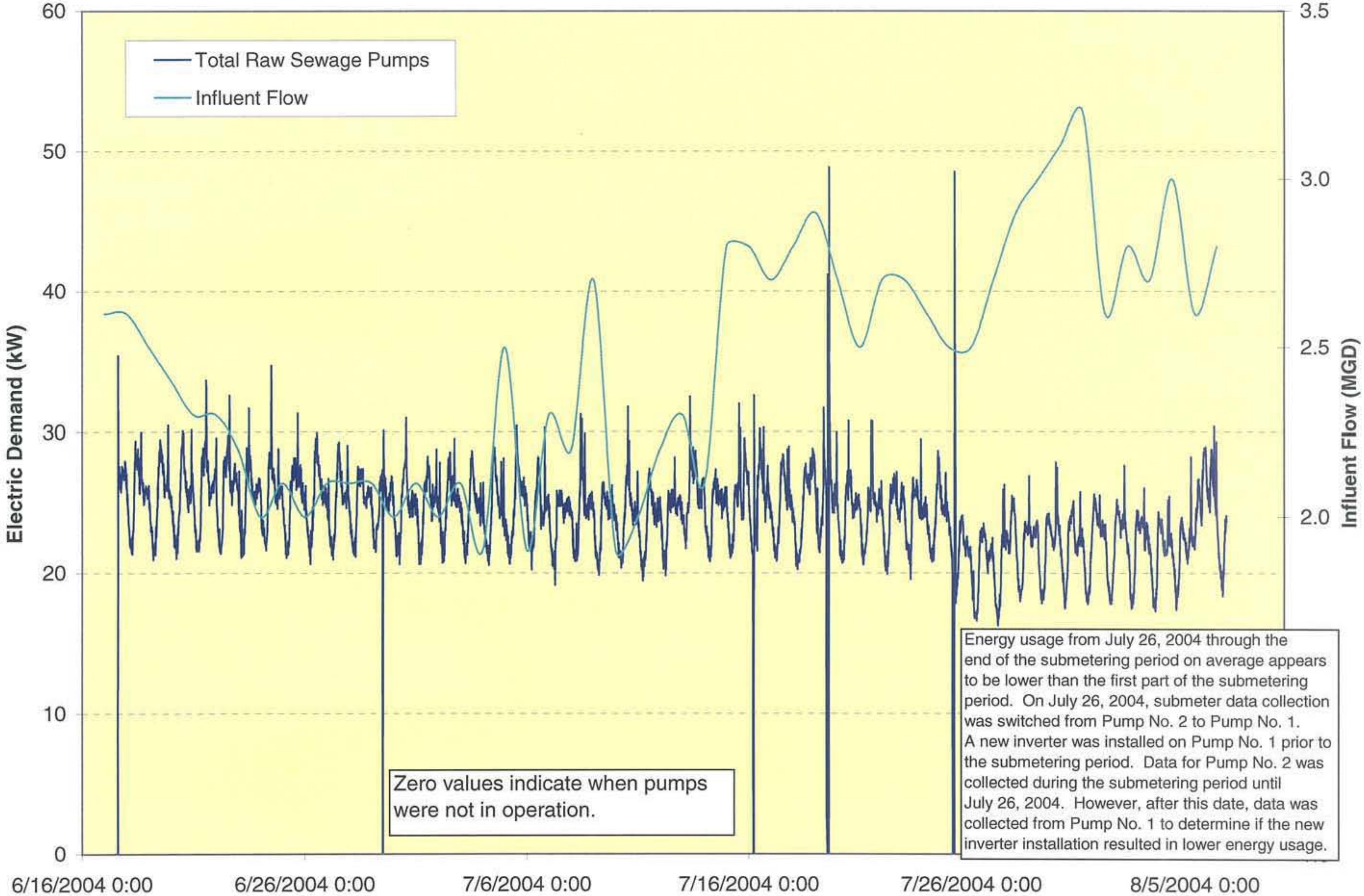

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FIGURE 4-5
ELECTRIC DEMAND VS. INFLUENT FLOW: RAW SEWAGE PUMPS

It was noted by the facility personnel that approximately 500,000 gallons per day might be attributed due to infiltration and inflow.

4.2.2 Aerators

Secondary treatment is accomplished through oxidation basins with mechanical aerators. The aerators represent the single largest user of electric energy at the Wallkill facility. There are four mechanical aerators, two per basin. Each aerator has a 75- horsepower (hp) motor. Process performance data for influent flow, influent and effluent BOD_5, and influent and effluent TSS were recorded to correlate the process performance data with the electric usage.

As observed in FIGURES 4-6 and 4-7, there is no apparent correlation between the total electric energy demand from the aerators and the secondary process BOD_5 loadings or plant flows. This is due to the fact that the aerators are run at a relatively constant output (close to full load) and the extra air / oxygen delivered under the low BOD_5 loading conditions is being "wasted". Therefore, the aerator energy usage is relatively constant, and is not affected by plant flows or BOD_5 loadings. From plant data, the average electric energy usage per pound of BOD_5 in the secondary system has typically averaged 2.19 kWh/lb BOD_5. The Wallkill Facility has indicated that each basin has an adjustable weir. The horsepower output of the aerators varies with the elevation of the weir. The greater the weir elevation, the greater is the horsepower output. The weir is adjusted manually for dissolved oxygen (DO) control, with a target range of 0.7 mg/L to 1.2 mg/L. The weir is adjusted infrequently, usually on a seasonal basis (raised in late fall and lowered in spring).

4.2.3 RAS Pumps

Flow continues to two final clarifier tanks after secondary treatment. There are three 15-hp RAS pumps out of which two are typically used, one for each clarifier. RAS pumps were recently upgraded to provide flow pacing based on influent flow. The RAS pumps have variable frequency drives (VFDs) and combine to pump 50% of influent flow in typical situations (approximately 300 to 400 gpm). Average RAS flow rate was 1.29 MGD during the submetering period. It can be seen from FIGURE 4-8 that there is an increase in the energy demand with an increase in flow.

4.2.4 WAS Pumps

During the submetering period, the WAS flow rate was kept nearly constant at an average rate of 0.021 MGD, so the pumps are generally operating at a constant speed. There are two 7.5-hp WAS pumps that are always set on a timer. No data was available to estimate the average power draw for these pumps.

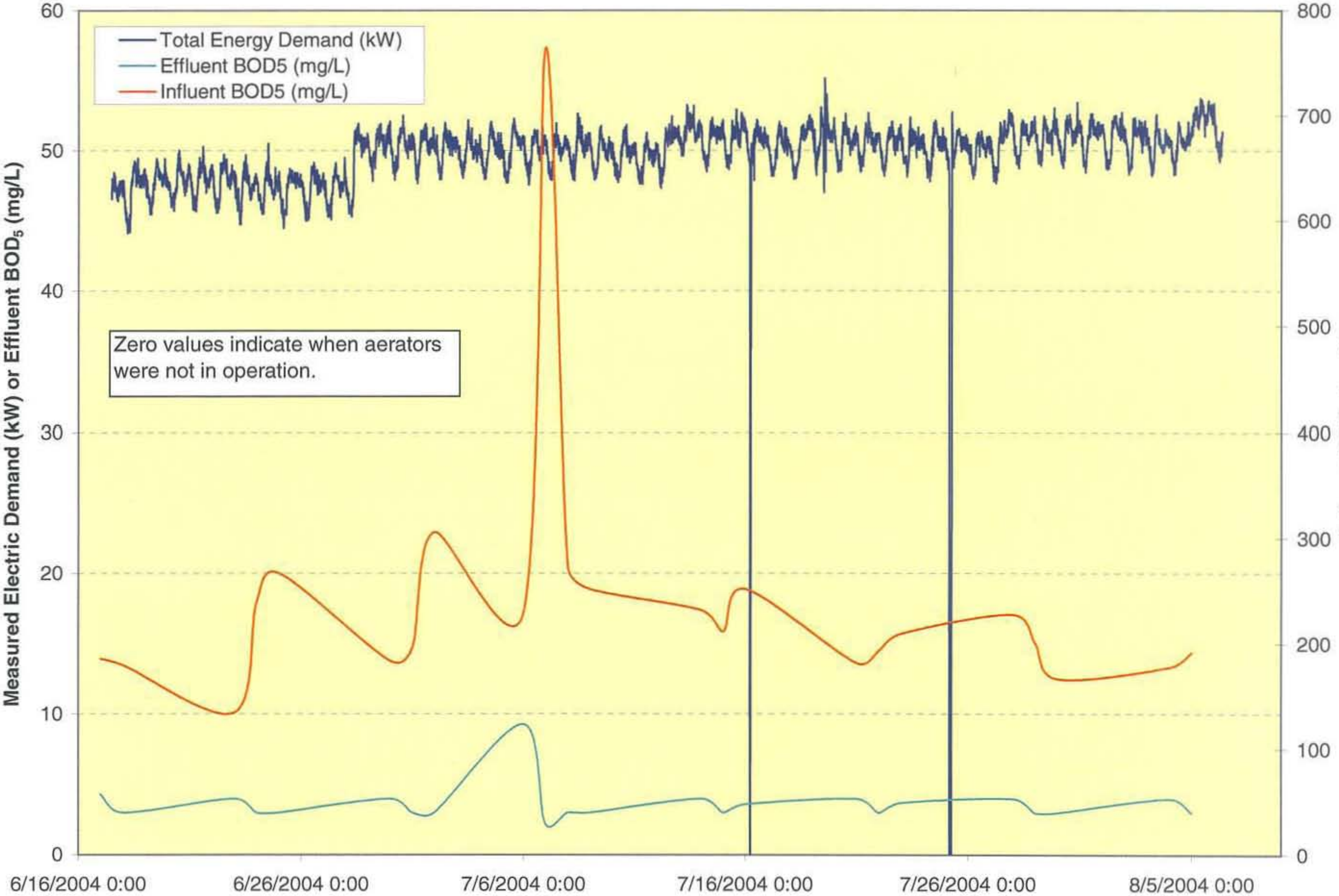

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FIGURE 4-6
BOD_5 CONCENTRATION VS. ELECTRIC DEMAND: MECHANICAL AERATOR

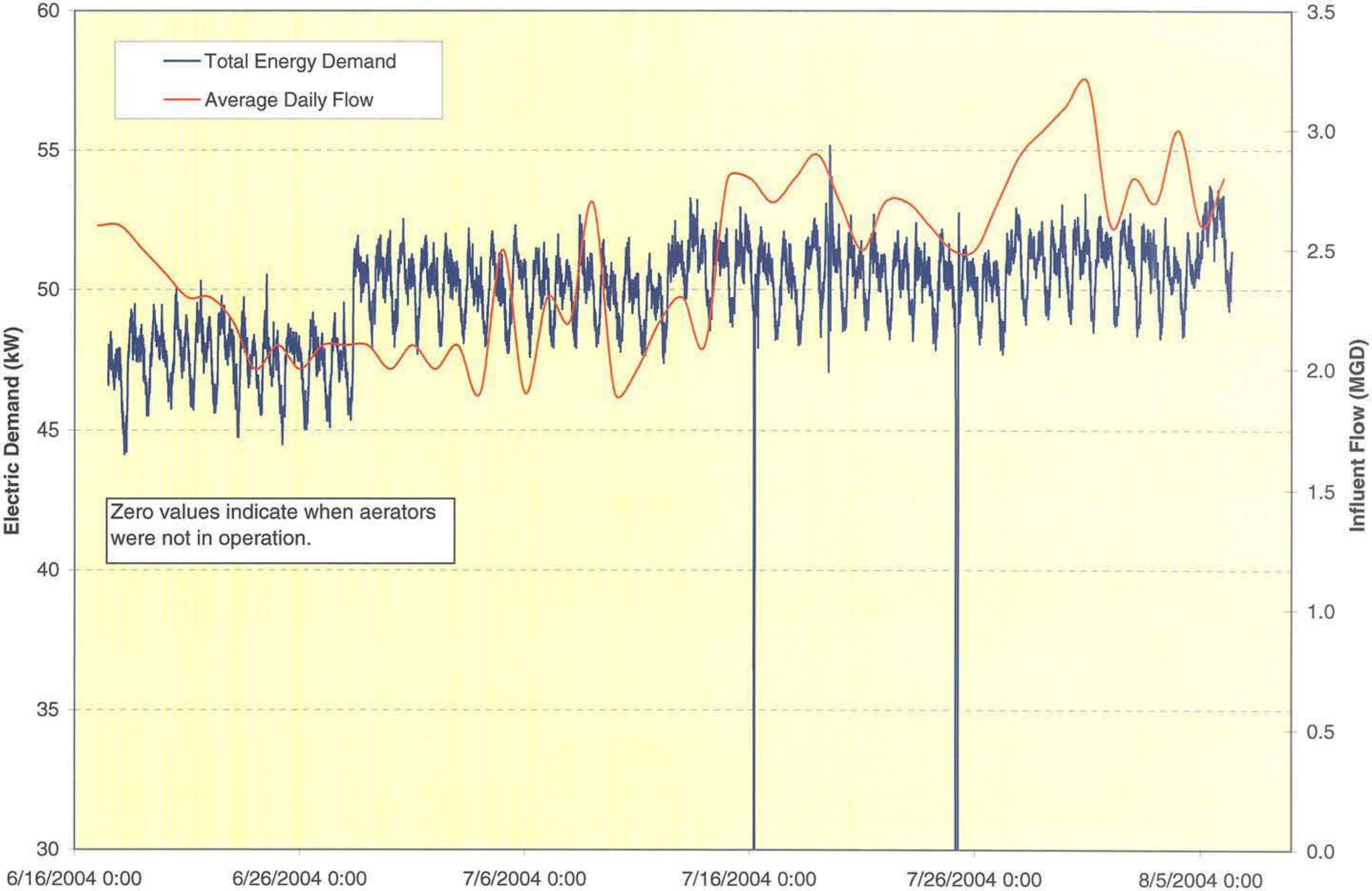

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FIGURE 4-7
INFLUENT FLOW VS. ELECTRIC DEMAND: MECHANICAL AERATOR

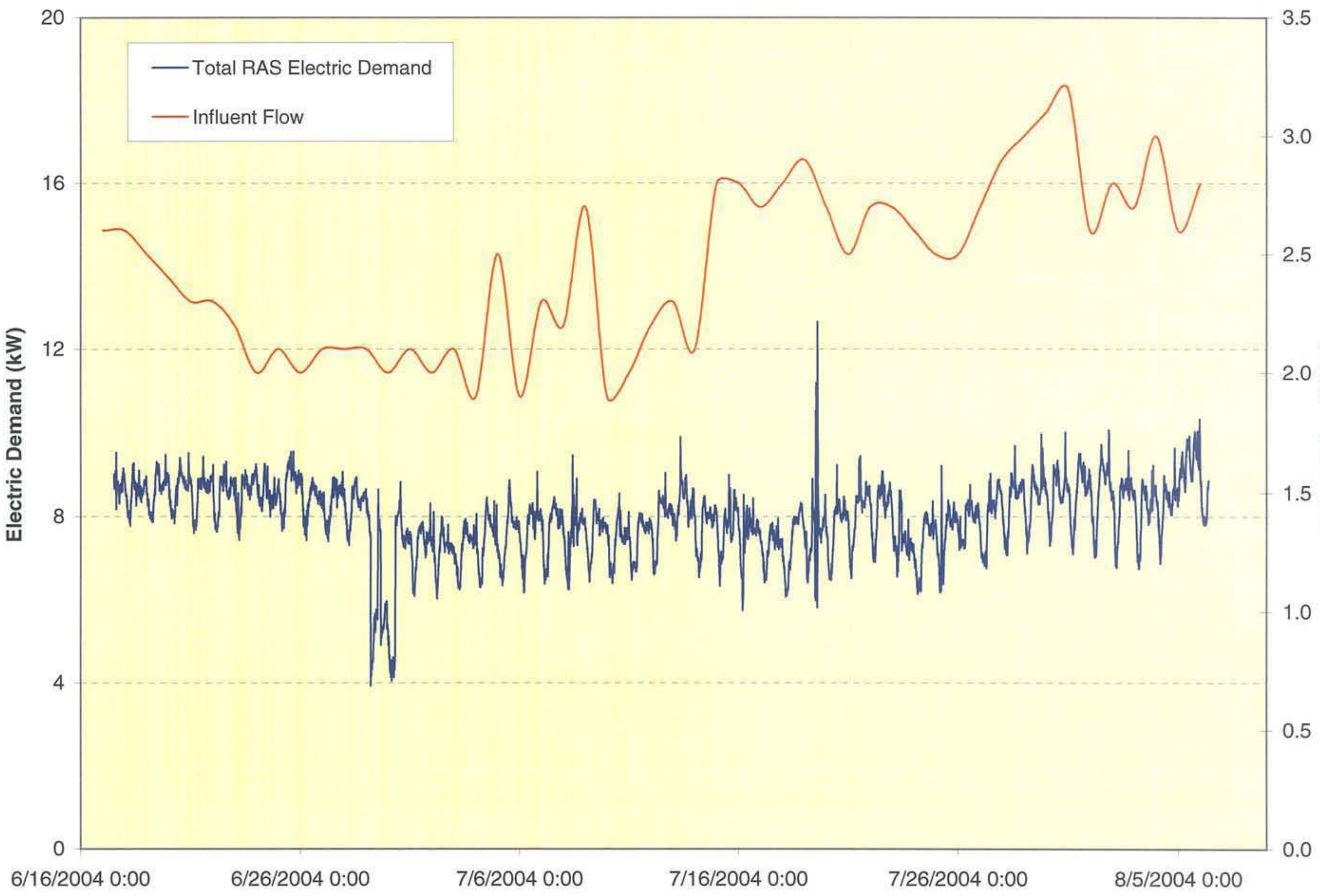

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FIGURE 4-8
INFLUENT FLOW VS. ELECTRIC DEMAND: RAS PUMPS

4.2.5 Disinfection System

The Wallkill Facility has a low pressure UV system for disinfection. Disinfection is necessary between May 15 and October 15. From FIGURE 4-9, there is no apparent correlation between the demand and the plant flow. It is noted that UV Panel No. 1 did not turn on during the entire submetering period.

4.2.6 Solids Handling

Solids are processed seven days per week, eight hours per day (day shift). No dewatering occurs on Christmas day. Approximately 20,000 to 25,000 gpd of waste sludge is produced. The following equipment and processes are associated with the solids handling at the Wallkill facility:

- Gravity Belt Thickener (GBT).
- Sludge Storage Tank.
- Belt Filter Presses (BFPs).

4.2.6.1 Gravity Belt Thickener

The GBT thickens the sludge to 3% to 4% solids. Polymer is typically added to the sludge to enhance dewatering. The GBT filtrate had an average of 53.75 mg/L of total suspended solids during the submetering period. The overflow from the GBT is reintroduced into the treatment system prior to secondary treatment.

4.2.6.2 Sludge Storage Tank

Two 18,000-gallon sludge-holding tanks (36,000 gallon total capacity) store sludge prior to the BFP process. The sludge storage tanks are aerated. The decant from the storage tanks is reintroduced into the system upstream of the oxidation basins.

4.2.6.3 Belt Filter Presses

Two BFPs (usually one in service at a time) further thicken sludge to a maximum of 17%. Polymer is typically added to the sludge to enhance thickening. During the submetering program, the influent into the BFP averaged about 2.1% solids, while the solids percentage in the cake coming out of the filter presses increased to an average of approximately 16.75%, which is typical of the BFP performance. The filtrate from the BFP is reintroduced into the main stream upstream of the oxidation basins. Thickened sludge is trucked to landfills.

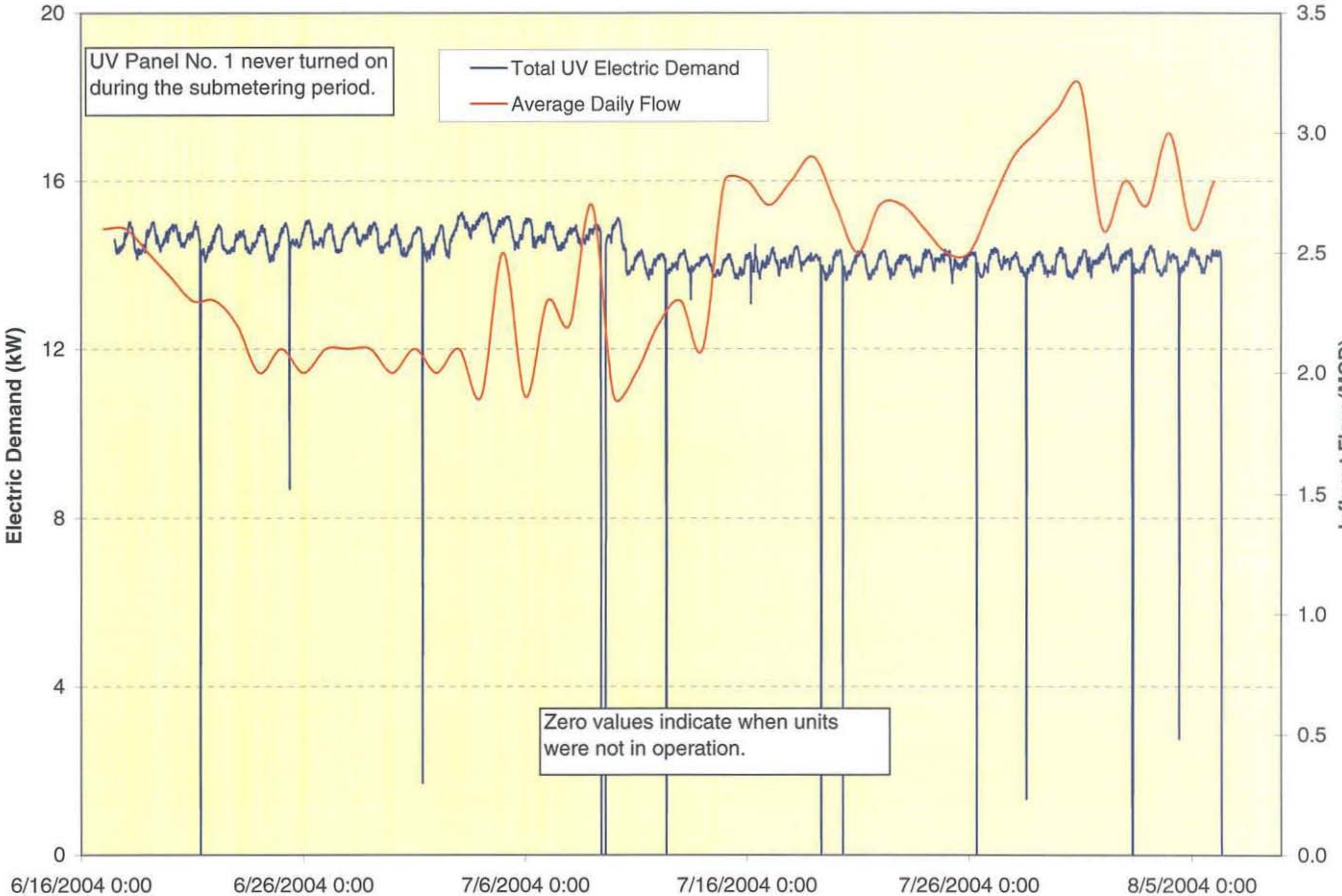

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FIGURE 4-9
INFLUENT FLOW VS. ELECTRIC DEMAND: UV PANELS

4.2.7 Other Equipment

As indicated in Section 3, other equipment at the plant includes:

- Lighting.
- Heating Units.
- Mechanical Screens.
- Grit collectors.
- Grit screw conveyors.
- Pista Grit – Cyclone – Grit Removal System.

For the other above mechanical equipment, the small size of the associated motors, the relatively low standard efficiencies of smaller motors, and/or the low frequency of use have indicated that any further evaluation of this equipment would most likely not yield significant cost savings.

4.3 SUMMARY OF PROCESS PERFORMANCE

The electric energy demand measured at the selected equipment was compared to the plant process performance during the monitoring period. Overall, the plant performance was good with BOD_5 and TSS removal efficiencies above 98%.

As previously discussed in Section 3, the mechanical aerators are the largest energy consumer at the WWTF and operate continuously. The raw sewage pumps are the second largest energy consumer at the WWTF. These pumps and the RAS pumps correlate to the influent flow to the plant. The remaining processes did not show apparent correlations to the WWTF data.

During the submetering period, the WWTP consumed an average of 5,894 kWh per day, with an average influent flow of 2.45 MGD. The standardized electric energy consumption of the major unit processes at the plant (metered during this period), or energy used per MG of wastewater treated, was 2,405 kWh/MG. The electric energy used by the raw sewage pumps was 69 kWh/MG.

The plant removed 4,742 lb/d BOD_5 during the submetering period. The energy used per pound of BOD_5 removed was 1.24 kWh/lb BOD_5.

Section 5

ENERGY SAVING MEASURES THROUGH CAPITAL IMPROVEMENTS

5.1 CAPITAL IMPROVEMENT ALTERNATIVES TO REDUCE ENERGY USAGE AND COSTS

Section 4 evaluated the energy usage by the major equipment in use at the plant and compared it to process performance. The detailed process and electric energy usage information collected during the monitoring period was used to identify and evaluate energy conservation opportunities at the wastewater treatment facility (WWTF).

Two pieces of equipment, the mechanical aerators and the ultraviolet (UV) system, were identified for further investigation. Additionally, replacement of standard efficiency motors with new premium efficiency motors was considered for some equipment.

5.1.1 Replacement of Constant-Speed Standard Efficiency Motors with Premium Efficiency Motors

For reduction of electric energy usage and associated cost for constant speed motors, the replacement of a standard efficiency motor with a premium efficiency motor can create significant savings, especially for those motors which may run continuously or a majority of the time. Motors at the WWTF which could potentially be eligible for replacement with premium efficiency motors include the following:

- Grit pumps.
- Mechanical aerators.
- Waste activated sludge (WAS) pumps.
- Gravity belt thickener (GBT) return pumps.
- Plant water pumps.
- Booster pumps.

5.1.2 Installation of Variable Frequency Drives on the Mechanical Aerators

FIGURE 5-1 shows the measured dissolved oxygen (DO) concentration during the submetering period. The DO was measured once a day in both oxidation basins. The DO concentration in Oxidation Basin I averaged 1.7 mg/L, with a maximum of 2.3 mg/L and a minimum of 0.9 mg/L; the DO concentration in

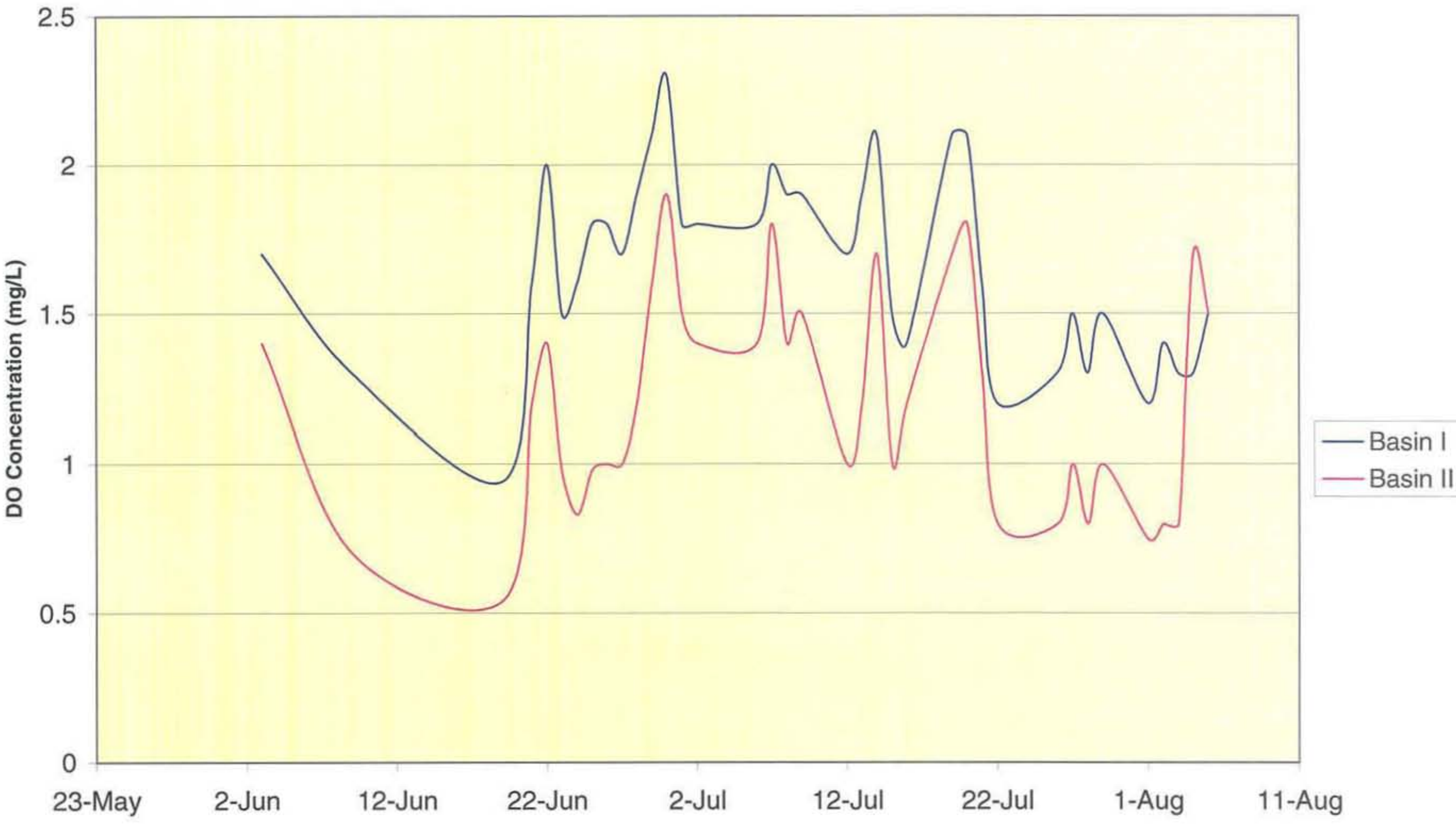

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FIGURE 5-1
DO CONCENTRATION IN OXIDATION BASINS

Oxidation Basin II averaged 1.2 mg/L, with a maximum of 1.9 mg/L and a minimum of 0.5 mg/L. The DO concentration in Oxidation Basin I appears to be approximately 0.5 mg/L higher than the DO concentration in Oxidation Basin II. DO concentrations were measured 6 to 10 feet from the basins effluent (horizontal distance). The effluent weirs, which control the mechanical aerators power draw, were set at the same elevation in the two basins during the monitoring period. For best operation, a DO concentration of 0.5 mg/L to 2.0 mg/L should be typically maintained.

Plant personnel indicated that the difference in DO concentration could be related to grit buildup on the bottom of Basin II. However, after Basin II was recently drained and cleaned, DO concentrations have not been measured to confirm this theory.

Currently, the aerator power output is controlled only on a seasonal basis by adjusting the effluent weirs, which does not allow for effective DO control. If VFDs are installed on the aerators, an automatic DO control system could be installed in the basins to monitor the DO concentration and control the operation of the mechanical aerators to maintain the set DO concentration at all times. This could potentially save energy.

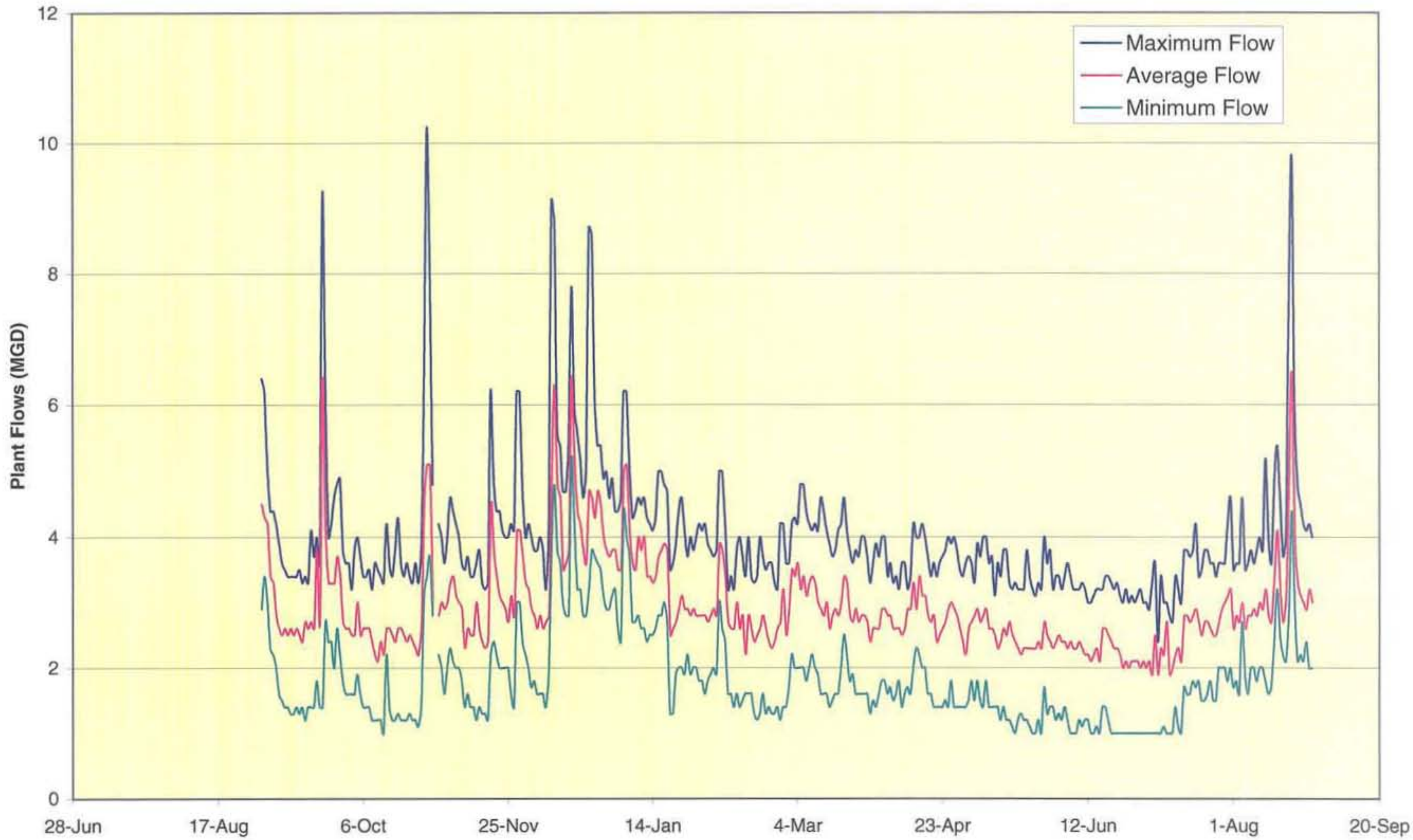
5.1.3 Replacement Mechanical Aerators with High-Efficiency Aerators

Another measure that could potentially save energy is the replacement of the mechanical aerators with new, innovative aerators which are more efficient and therefore draw less energy. For example, the Mixing & Mass Transfer Technologies (M^2T) HI-FLO Surface Aeration System provides a significant technical advancement in wastewater treatment surface aeration in both standard aeration efficiency and liquid mixing. Independent, large-scale, ASCE testing has shown a 20% to 40% higher efficiency as compared to conventional surface aerators, as well as higher liquid mixing rates.

5.1.4 UV Disinfection Improvement

The WWTF is required to disinfect the effluent between May and October. The facility is equipped with three modules of low pressure, low intensity UV lamps. One module is normally operated during the disinfection period; a second one is manually started when needed, during periods of higher flows or higher coliforms concentration. The UV system was installed in 1999.

A new system with low pressure, high intensity lamps would provide more operational flexibility. These lamps have a high efficiency and can be controlled by a flowmeter to dim the light intensity in response to flow changes. FIGURE 5-2 shows the maximum, average, and minimum influent flows to the facility during the past year. It is evident from the figure that the high flow variability could be combined with



MALCOLM PIRNIE	NYSERDA MUNICIPAL WASTEWATER TREATMENT PLANT ENERGY EVALUATION WALLKILL WASTEWATER TREATMENT FACILITY	FIGURE 5-2 INFLUENT FLOWS

variable energy lamps for energy savings. Although overall energy usage of the UV system is low (2.8%) compared to other systems at the plant, this improvement to the UV system was evaluated at the request of the Town.

5.2 ESTIMATE OF ENERGY USAGE, DEMAND, AND COST SAVINGS

The following section summarizes the estimated electric energy usage of the described alternatives, as well as estimates of electric energy and cost savings associated with the improvements.

5.2.1 Replacement of Constant-Speed Standard Efficiency Motors with Premium Efficiency Motors

TABLE 5-1 summarizes the current and future electric energy usage and cost savings associated with upgrading motors on select equipment. By replacing the constant-speed standard efficiency motors with premium efficiency motors, it is estimated that approximately 38,214 kWh and $2,878 in electric energy usage will be saved each year.

Alternatively, energy savings can be realized by replacing only the mechanical aerators motors. Annual savings of 33,196 kWh and $2,500 can potentially be realized.

5.2.2 Installation of VFDs on the Mechanical Aerators

The mechanical aerators motors can be replaced with new inverter duty motors equipped with VFDs which can vary the speed in response to the DO concentration. Based on the aerator power draw measurements and the current biochemical oxygen demand (BOD_5) loadings to the facility, the aerators seem to be operating at a higher power than actually needed.

TABLE 5-2 shows the estimated current and future electric energy usage and cost savings associated with the mechanical aerators. The annual electric energy usage of the proposed aerators running on VFDs was estimated based on the typical mechanical aerator field oxygen transfer efficiency and average and peak BOD_5 loadings. However, no DO measurements were available to determine the daily variation of DO and its correlation to the aerators power draw to confirm the estimated excessive electric energy usage. Installation of a DO monitor to collect data and confirm the DO variations in the basins is recommended before implementing this measure.

Wallkill Wastewater Treatment Facility

Table 5-1 Replacement of Select Motors with Premium Efficiency Motors

Process	Use	Quantity	Size (hp)[1]	Estimated Hours per Year	Current Motor Operation				Premium Efficiency Motor Operation				Energy Savings	
					Efficiency Rating[2]	Power Draw (kW) per Motor	Estimated Annual Usage (kWh)	Estimated Energy Cost[4]	Premium Efficiency Rating[2]	Power Draw (kW) per Motor	Estimated Annual Usage (kWh)	Estimated Energy Cost[4]	Estimated Annual Usage Savings (kWh)	Estimated Annual Cost Savings[4]
Preliminary Treatment	Grit Pumps	2	10	304	89.5%	11.2	3,405	$ 256	92%	10.9	3,312	$ 249	93	$ 7
Activated Sludge Aeration	Aerators[2]	4	75	35,040	93%	45	1,576,800	$ 118,733	95%	44.1	1,543,604	$ 116,233	33,196	$ 2,500
Solids Handling, Sludge Pumping	Waste Activated Sludge Pumps	2	7.5	5,840	86.5%	3.8	22,192	$ 1,671	91%	3.6	21,095	$ 1,588	1,097	$ 83
Solids Handling, Sludge Pumping	GBT Return Pump	1	7.5	677	86.5%	2.79	1,889	$ 142	91%	2.7	1,795	$ 135	94	$ 7
Wastewater Pumping	Plant Water Pumps	2	20	1,787	88.5%	12.7	22,695	$ 1,709	93%	12.1	21,597	$ 1,626	1,098	$ 83
Wastewater Pumping	Booster Pumps	2	10	2,548	84%	11.9	30,321	$ 2,283	92%	10.9	27,685	$ 2,085	2,637	$ 199
							1,657,302	**$ 124,795**			**1,619,088**	**$ 121,917**	**38,214**	**$ 2,878**

Notes:

[1] All equipment listed is 3-phase.

[2] Efficiency rating for motors based on motor size, using standard efficiencies.

[3] Premium efficiency rate obtained from motor manufacturer

[4] Costs based on 2003 cost of $0.0753 /kWh

Table 5-2: Summary of Electric Energy Usage and Savings for Upgrading the Mechanical Aerators

Operating Condition	Annual Electric Energy Usage (kWh)	Annual Electric Energy Usage Cost
Existing (from Submetering Data)	1,576,800	$118,733
Proposed – Variable Speed	1,182,600 to 980,800*	$89,050*
Estimated Savings	**394,200 to 596,000***	**$29,683 to $44,879***

Note:
*Savings based on theoretical estimates, to be confirmed by data measured by DO monitor.

5.2.3 Replacement of Mechanical Aerators with High-Efficiency Aerators

The mechanical aerators can be replaced with new high-efficiency aerators. TABLE 5-3 shows the estimated current and future electric energy usage and cost savings associated with replacing the mechanical aerators. The proposed aerators annual electric energy savings were calculated based on the low-end efficiency improvement, 20%.

Table 5-3: Summary of Electric Energy Usage and Savings for Replacing the Mechanical Aerators

Operating Condition	Annual Electric Energy Usage (kWh)	Annual Electric Energy Usage Cost
Existing (from Submetering Data)	1,576,800	$118,733
Proposed – New Aerators	1,261,440	$94,986
Estimated Savings	**315,360**	**$ 23,747**

5.2.4 UV Disinfection Improvement

The low pressure, low intensity, constant output UV disinfection system can be replaced with a low pressure, high intensity system. The output of the new system's high-intensity lamps can be varied as water quality or flow rates change. This variation optimizes energy usage and lowers annual operating costs. TABLE 5-4 shows the estimated current and future electric energy usage and cost savings associated with the UV system. The annual electric energy usage for the proposed new UV system was determined based on the reduced power draw of the low pressure, low intensity lamps.

Table 5-4: Summary of Electric Energy Usage and Savings for Upgrading the UV System

Operating Condition	Annual Electric Energy Usage (kWh)	Annual Electric Energy Usage Cost
Existing (from Submetering Data)	63,454	$4,778
Proposed – Flow Paced	31,536	$2,375
Estimated Savings	**31,918**	**$2,403**

5.3 ESTIMATE OF CAPITAL COSTS AND SIMPLE PAYBACK

5.3.1 Replacement of Constant-Speed Standard Efficiency Motors with Premium Efficiency Motors

The estimated capital cost for replacing the constant speed standard efficiency motors with premium efficiency motors is $48,550. With annual estimated savings of $2,878, this results in a payback period of approximately 17 years. The payback period is longer than typically desirable, therefore this improvement is not recommended.

If only the mechanical aerators motors are replaced, the capital cost is reduced to $20,000. With annual estimated savings of $2,500, this results in a payback period of 8 years.

5.3.2 Installation of VFDs on the Mechanical Aerators

The estimated capital cost for replacing the mechanical aerators motors, including new VFDs and an automatic DO control system, has been estimated in TABLE 5-5. With annual estimated savings of $29,683 to $44,879, this results in a payback period in the range of approximately 7.1 to 10.8 years, which may be marginally acceptable. However, because of additional benefits such as operational flexibility, additional process information, and increased process controls, this alternative may warrant further consideration. Estimated electric energy savings and payback should be confirmed by additional monitoring of DO concentrations in the aeration basins.

5.3.3 Replacement of Mechanical Aerators with High-Efficiency Aerators

The estimated capital cost for replacing the mechanical aerators with new high-efficiency aerators has been estimated in TABLE 5-6. With annual estimated savings of $23,747, this results in a payback period of approximately 16.8 years.

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Table 5-5 Capital Costs for Mechanical Aerators

Description	Quantity	Costs				
		Materials		Labor		Total
		Unit	Total	Unit	Total	
Mechanical Aerators Motors, VFDs, DO control system	1	135,000	135,000	67,500	67,500	$ 202,500
Subtotal						**$ 202,500**
Contractor Overhead and Profit (15%)						**$ 30,375**
Subtotal						**$ 232,875**
Contingency (10%)						**$ 23,288**
Total Construction						**$ 256,163**
Engineering, Construction, and Administration (25%)						**$ 64,041**
TOTAL						***$ 320,203***

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Table 5-6 Capital Costs for High-Efficiency Mechanical Aerators

Description	Quantity	Costs				
		Materials		Labor		Total
		Unit	Total	Unit	Total	
High-Efficiency Mechanical Aerators	1	194,300	194,300	58,290	58,290	$ 252,590
Subtotal						**$ 252,590**
Contractor Overhead and Profit (15%)						**$ 37,889**
Subtotal						**$ 290,479**
Contingency (10%)						**$ 29,048**
Total Construction						**$ 319,526**
Engineering, Construction, and Administration (25%)						**$ 79,882**
TOTAL						***$ 399,408***

5.3.4 UV Disinfection Improvement

The estimated capital cost for replacing the existing UV system with a new, energy efficient UV system, has been estimated in TABLE 5-7. With annual estimated savings of $2,403, the capital cost is too high to expect a reasonable payback time. Therefore this improvement is not recommended.

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Table 5-7 Capital Costs for UV System

Description	Quantity	Costs				
		Materials		Labor		Total
		Unit	Total	Unit	Total	
UV System	1	215,000	215,000	107,500	107,500	$ 322,500
Subtotal						**$ 322,500**
Contractor Overhead and Profit (15%)						**$ 48,375**
Subtotal						**$ 370,875**
Contingency (10%)						**$ 37,088**
Total Construction						**$ 407,963**
Engineering, Construction, and Administration (25%)						**$ 101,991**
TOTAL						***$ 510,000***

Section 6

ENERGY SAVING MEASURES THROUGH OPERATION MODIFICATIONS

6.1 OPERATIONAL MODIFICATIONS TO REDUCE ENERGY USAGE AND COSTS

Typically, the major operational changes that can be made to reduce electric energy usage are load shifting, peak shaving, and greater use of real-time data in energy-related decision making. Load shifting is the practice of changing the time of use of certain loads to reduce the total facility electric energy demand during peak periods. Peak shaving is the practice of dispatching on-site generating assets to reduce dependence on the grid during peak electric energy demand periods. The increased use of real-time data by the installation and monitoring of permanent submeters can assist the facility in making informed decisions regarding the usage of electric energy and offer alternatives for further reducing electric energy demand and usage.

6.1.1 Load Shifting

Electric energy demand data collected at the wastewater treatment facility (WWTF) were used to provide typical daily power draw information. These data were then used to provide an estimate of when peak electric energy demand occurs at the plant. FIGURE 6-1 shows the hourly electric energy demand for the submetered equipment for several representative days. As seen in the figure, a similar power draw is observed, with higher draw during the day, when equipment requiring staff supervision is operated. Significant peaks are typically not observed, and if they do occur, they are caused by increased pumping during high flows. As a result, there do not appear to be significant opportunities for further load shifting.

6.1.2 Peak Shaving

Peak shaving refers to the practice of reducing electric energy demand during peak demand periods by using on-site generation capabilities. Peak shaving opportunities through capital improvements is discussed in Section 5. The use of the existing generator for on-site generation is discussed in Section 8.

6.1.3 Operational Modifications

Based on current operations and communications with the staff, no modifications to the operation of the plant are feasible.

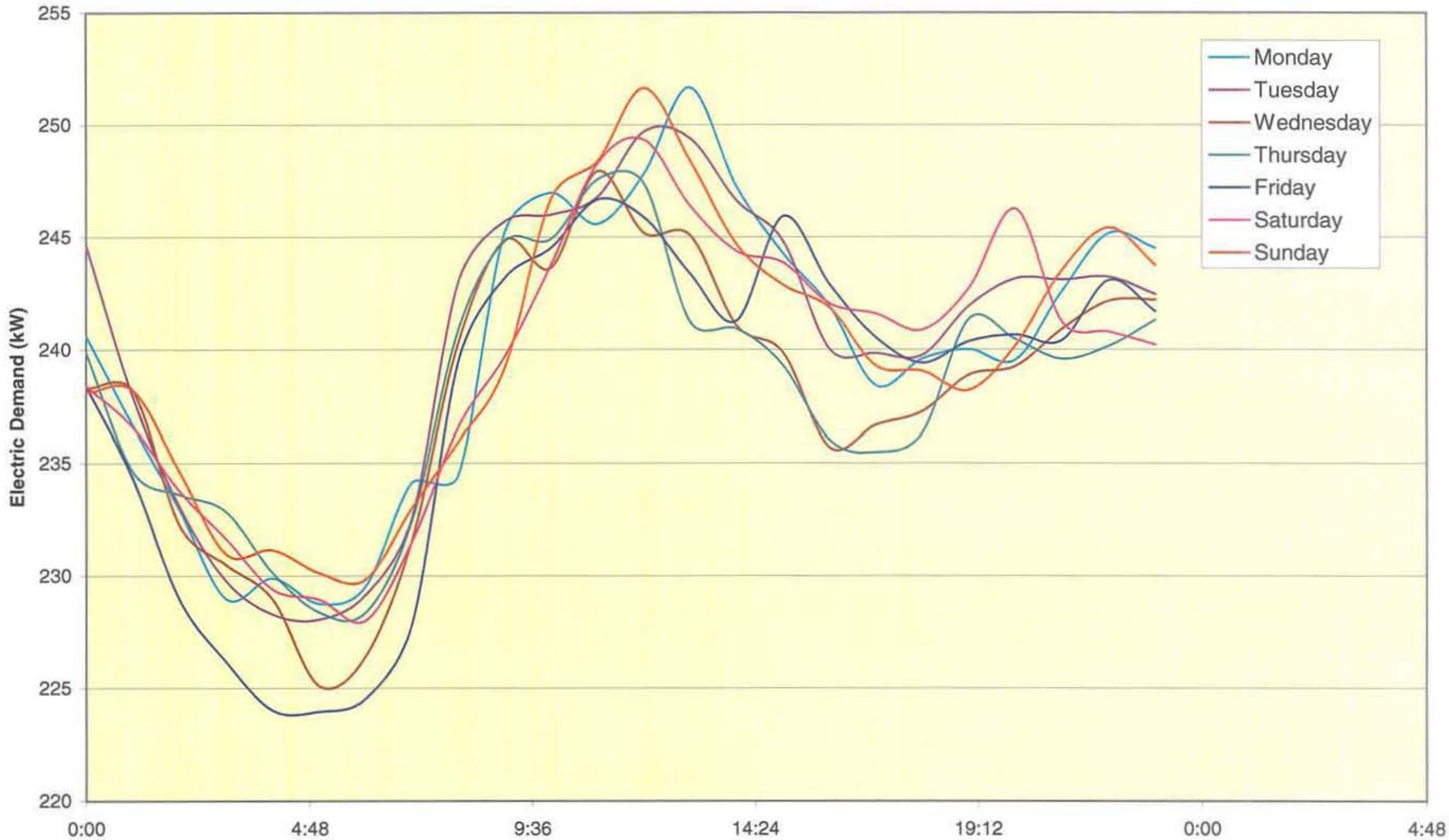

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FIGURE 6-1
PLANT HOURLY ELECTRIC DEMAND

Section 7

ENERGY SAVING MEASURES THROUGH LIGHTING/HVAC MODIFICATIONS

7.1 LIGHTING AND HEATING, VENTILATING, AND AIR CONDITIONING OVERVIEW

The Wallkill Wastewater Treatment Facility (WWTF) is comprised of five buildings. The plant was constructed in 1989 and has had no recent major improvements. The administration building is occupied from 7:00 a.m. through 4:00 p.m. by office staff. The facility is staffed for one shift every day.

A new Lennox gas furnace with split air-conditioning and a new 4.5-kilowatts (kW) electric domestic hot water heater were installed in the administration building in 2000. The new furnace provides heat for all of the building except for the laboratory. Air-conditioning is provided to the entire building. The remaining buildings use electric heat only and are controlled thermostatically. No control strategies are in place in the process areas.

Except for the administration building, the heating systems are not for comfort conditioning and individual thermostats providing control for each unit within the facility are set between 60 degrees Fahrenheit (°F) and 65°F for heating. The heating systems are mainly comprised of individual hanging electric unit heaters with some ventilation equipment. Only two ventilation fans were observed operating at the time of the site visit. There are also six radiant heating ceiling panels in the laboratory. There is no comfort air-conditioning at the facility other than for the administration building. A 20-gallon electric hot water heater provides domestic hot water for the solids handling/garage building.

The controls and control routines utilized for the heating, ventilating, and air conditioning (HVAC) equipment are of original design. It would be beneficial to analyze adding new controls and end of line actuators to air handlers, pumps, and boilers for potential savings. This would allow for proper control and occupancy scheduling.

The majority of the lighting in the five buildings consists of T-12 34-watt fluorescent fixtures installed in 1989. Lighting in the solids handling building was replaced in 2001. The solids handling building/garage contain 22 metal halide fixtures.

Lighting in the process areas is normally off and it is turned on when areas are occupied. Lighting in the administration building is constantly on during the occupied hours. No incandescent bulbs or occupancy sensors were observed during the site visit. The exterior lighting is controlled by daylight sensors.

7.2 HVAC AND LIGHTING ALTERNATIVES TO REDUCE ENERGY USAGE AND COSTS

Though there are several electric heating units throughout the facility, it is impractical to convert these units to a less expensive fuel source. These units are relatively small and spread over a large area. The cost of providing natural or propane gas and the labor to install such systems is prohibitive. A measure that could save some energy is to lower the thermostats setpoint for the process areas to 50 °F or 55 °F. However, this measure could compromise employees comfort, and raising the temperature when needed would have a long recuperating time due to the large spaces. Therefore, no HVAC alternatives are recommended to reduce energy usage.

Due to the short operating hours of the lighting systems, combined with the relatively reasonable cost of electricity, upgrading the lighting systems for this facility has a longer than normal payback period. Grants or rebates for eligible installed equipment may improve the feasibility of implementing these upgrades. Feasible alternatives are identified below.

7.2.1 Convert Exit Signs to Light Emitting Diode (LED)

All exit signs inspected were operated with compact fluorescent lamps. These can be replaced with LED exit signs that consume much less power and operate relatively maintenance free for 25 years.

7.2.2 T-12 to T-8 Lighting Upgrade

Fixtures throughout the facility contain T-12 lamps. These fixtures should be converted to use T-8 technology.

7.3 ESTIMATE OF COSTS AND SIMPLE PAYBACK

An estimate of the costs and savings for the identified lighting improvements is shown in TABLE 7-1.

Table 7-1: Summary of Costs and Savings for Lighting Measures

Costs:	$ 9,900
Savings:	$ 643
Payback:	15.4 years

Section 8
ON-SITE GENERATION

8.1 ESTIMATE OF ENERGY USAGE, DEMAND, AND COST SAVINGS

The best candidates for on-site generation are facilities with a simultaneous demand for both low-temperature heat and electric power. It is seldom economical for a plant to generate its own electricity unless the heat rejected from the electric generation process can also be used on-site. Moreover, because of the relatively high cost of co-generation equipment, the equipment must run for most of the year in order to be economical. Cogeneration is typically most cost-effective in applications where:

- Demand for both heat and electricity is substantial.
- Demand for heat and electricity is nearly continuous.
- Cost of electricity is relatively high.
- Cost of natural gas or other fuel source is relatively low.
- All heat and electricity generated by the system can be used on-site.

Using current natural gas market pricing it is estimated that power generated with a natural gas-fired internal combustion engine would cost about $ 0.085/kWh not including maintenance cost. This cost is higher than the current existing cost of purchased power for the Wallkill facility. There could be some fossil fuel savings from reclaiming waste heat for the existing heating systems; however, these savings would be marginal. The cost of installing a cogeneration system and the cost of replacing the existing electric heater to optimize the reclaimed waste heat would yield an excessively long payback (over 75) and is not recommended at this time.

8.1.1 Incentive Programs

Orange and Rockland Utilities, Inc. (O&R) offers two incentive programs for commercial customers, the Emergency Demand Response Program, and the Day-Ahead Demand Reduction Program. Additionally, Siemens offers the Special Case Recourses Program.

8.1.1.1 Emergency Demand Response Program

The Emergency Demand Response (EDR) Program is a short-notice program that provides payments to electric customers who reduce load during specific times when electric availability in New York could be jeopardized. During these events, participants are expected, though not obligated, to either reduce energy consumption or transfer load to a qualifying on-site generator for a minimum of four hours. To participate in this program, the facility must be capable of reducing load by at least 100 kW. The current incentive equals $0.50/kWh with no incentive for kW demand. Actual financial benefits are dependent on the number of events.

The Wallkill facility previously participated in this program, which was called "New York Curtailable Service". The facility declared 300 kW as the curtailable load. The curtailment period was limited to the period June through September. In 1995, the last year the Wallkill facility participated in the program, the incentive payment was $3.00/kW per month. A maximum of 15 occurrences were planned per calendar year. If during the curtailment period the facility's load exceeded the maximum level of 300 kW, the facility had to pay a penalty of $0.34 for each kWh used in excess of the maximum demand (in kW) specified, times the number of hours in the curtailable period. The Wallkill WWTF stopped participating in this program because O&R stopped offering the rate discount.

8.1.1.2 Day-Ahead Demand Reduction Program

The Day-Ahead Demand Reduction (DADR) Program allows large energy users to bid their load-reduction capability, on a day-to-day basis, into New York's wholesale electricity market, where load reduction bids compete with generators' offers to meet the State's electricity demands. If the load reduction bid is less expensive than a generator's offer to produce more electricity, it is accepted and the bidder is obligated to reduce load during the specified hours on the following day. The basis of payment is determined by the difference between the metered load and a predetermined baseline amount during the same period.

However, to participate in this program, the facility must be capable of reducing load by at least one megawatt (MW) through load curtailment. The average peak summer demand for the facility is only half of this amount.

8.1.1.3 Special Case Resources Program

The Special Case Resources (SCR) Program is an example of a New York Independent System Operator (NYISO) program, administered by Siemens. This program is similar to EDR, however the program typically offers $10/kW for demand curtailment as well as $0.30/kWh for the energy reduction. These prices are dependent on the NYISO strip auction prices held every 6 months. Siemens provides the customers 70% of the funds collected. Twice a year a NYISO operator calls and requests the participants to test their system for one hour. Tests occur in the Summer (May 1 to October 31) and Winter (November 1 to April 30) strip. As long as these tests are passed, the participant receives the kW incentive. Direct customers may also be subjected to a fine for non compliance. If the NYISO operator calls for an actual emergency curtailment event, the participant also receives the extra $0.30/kWh. There is no penalty for not participating in an event for Siemens customers, however the NYISO will de-rate them for the next 6-month strip. Siemens can implement this program for Wallkill by aggregating smaller customers in a pool for NYISO programs; these participants would not normally qualify for the program on their own unless they obtain NYISO approval and have at least 1 MW to curtail.

If the Wallkill facility signs up for this program, it is estimated that it will receive at least $3,000 per year, just to complete the testing, based on shedding a minimum of 300-kW peak electric energy demand. It should be noted, however, that air permitting for generating systems used for peak shaving or load reduction is required by current New York State Department of Environmental Conservation (NYSDEC) and United States Environmental Protection Agency (USEPA) regulations. A facility using a generator for non-emergencies would be required to submit a study as to the amount of emissions of not only the generators, but all systems, such as boilers, heater, etc. currently on site. Total emissions would not be allowed to exceed certain levels and the facility, as a whole, would need to conform. Diesel or natural gas powered generators with a maximum mechanical power rating of less than 400 brake horsepower are exempt from the air permitting requirement; however, the Wallkill generator has a rated capacity of 500 kW and therefore is not covered by this exemption. Some energy service providers refer to the regulations in saying that the emergency generators may be exempt from the air permit requirements if they operate less than 500 hours per year. However, it is unclear from the regulations whether such an exemption can be granted by NYSDEC for utilities participating in such load reduction programs. Therefore, it is recommended that prior to signing up for this program that Wallkill contact their local NYSDEC office to verify that no air permit requirements are required for participating in this program.

8.1.2 Peak Shaving

Peak shaving refers to the practice of reducing demand during peak demand periods by using on-site generation capabilities. Unfortunately, the current O&R electric tariff, approved by the Public Service Commission, does not economically allow emergency or backup generators to be used in this manner. With the exception of some small systems and/or some renewable fuel systems, the tariff requires the payment of several charges that can be very punitive. Peak shaving opportunities through capital improvements, however, are discussed in Section 5.

8.2 ESTIMATE OF CAPITAL COSTS AND SIMPLE PAYBACK

Participation in the NYISO program such as Siemens's or similar programs that may be administered by other independent providers would generate revenue for the facility. In order to monitor, measure, and verify electric output from the generator, a permanent submeter and data logger for the backup generator system would need to be installed. This would be the only cost associated with participating in the program, since the generator is usually exercised one hour per month and no additional fuel would be consumed. TABLE 8-1 shows the estimated cost and simple payback period for participating in this program.

Table 8-1: Summary of Costs and Savings for On-Site Generation

SCR annual incentive	$ 3,000
Capital cost: meter	$ 1,000
Simple payback	0.3 years

Section 9

FINAL RECOMMENDATIONS

9.1 SUMMARY OF EVALUATIONS

This report has identified alternatives to reduce electric energy usage at the Wallkill Wastewater Treatment Facility (WWTF). These alternatives include:

- Installation of premium efficiency motors on all the constant speed standard efficiency motors.
- Installation of variable frequency drives (VFDs) on the mechanical aerators.
- Replacement of mechanical aerators with high-efficiency mechanical aerators.
- Replacing the ultraviolet (UV) disinfection system.
- Lighting improvements.
- Participation in the New York State Independent System Operator (NYISO) Special Case Recourses (SCR) program.

TABLE 9-1 summarizes the estimated electric energy savings, implementation costs, and simple payback periods for all the alternatives.

9.2 SUMMARY OF RECOMMENDATIONS

TABLE 9-2 presents the recommended alternative, which consists of:

- Installation of premium efficiency motors on the mechanical aerators.
- Participation in the NYISO program (such as the Special Case Recourses program, or similar).

The recommended alternative offers a payback of approximately 6.7 to 10 years, with the resulting savings representing approximately 28% to 19% of total energy costs, respectively. Though the upper range of this payback may be marginally acceptable, the added benefits such as enhanced operational flexibility and increased process control with installation of VFDs on the mechanical aerators warrants further consideration of the alternative. Installation of a dissolved oxygen (DO) monitor in the aeration basins is recommended as part of this alternative. In addition to providing a useful tool to monitor the aeration process, the DO meters will provide data to confirm the feasibility of installing VFDs on the aerators. The remaining alternatives are not recommended due to long payback periods.

Wallkill Wastewater Treatment Facility

Table 9-1 Summary of Energy Savings Alternatives Presented in Sections 5, 6, and 7

ECM #	MEASURE DESCRIPTION	FUEL TYPE SAVED[1]	ENERGY (Elec kWh)	TOTAL ENERGY SAVED (mmBTU)[2]	TOTAL ANNUAL DOLLARS SAVED	IMPLEMENTATION COSTS	SIMPLE PAYBACK PERIOD (years)
1	Installation of premium efficiency motors	Elec	38,214	3.29	$2,878	$48,550	16.9
2	Installation of premium efficiency motors on mechanical aerators	Elec	33,196	2.86	$2,500	$20,000	8.0
3	Installation of VFDs on the mechanical aerators[3] min	Elec	394,200	33.98	$29,683	$320,203	10.8
	Installation of VFDs on the mechanical aerators[3] max		596,000	51.38	$44,879	$320,203	7.1
4	Replacement of mechanical aerators	Elec	315,360	27.19	$23,747	$399,408	16.8
5	Replacing the UV disinfection system	Elec	31,918	2.75	$2,403	$510,000	212
6	Lighting improvements	Elec	8,539	0.74	$643	$9,900	15.4
7	NYISO program	Elec	0	0	$3,000	$1,000	0.3

Notes:

[1] Fuel Saved: Elec, Ngas, Oil 1, Oil 2, Oil 4, Oil 6, Coal, LPG.

[2] mmBTU = 1,000,000 BTU
Electric = 11,600 BTU/kWh

[3] Savings to be confirmed by measured DO data. Installation of a DO monitor recommended.

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Municipal Wastewater Treatment Plant Energy Evaluation

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Table 9-2 Summary of Recommended Alternatives

ECM #	MEASURE DESCRIPTION	FUEL TYPE SAVED[1]	ENERGY (Elec kWh)	TOTAL ENERGY SAVED (mmBTU)[2]	TOTAL ANNUAL DOLLARS SAVED	IMPLEMENTATION COSTS	SIMPLE PAYBACK PERIOD (years)
3	Installation of VFDs on the mechanical aerators[3] min	Elec	394,200	33.98	$29,683	$320,203	10.8
	Installation of VFDs on the mechanical aerators[3] max		596,000	51.38	$44,879	$320,203	7.1
7	NYISO program	Elec	0	0	$3,000	$1,000	0.3

Notes:

[1] Fuel Saved: Elec, Ngas, Oil 1, Oil 2, Oil 4, Oil 6, Coal, LPG.

[2] mmBTU = 1,000,000 BTU
Electric = 11,600 BTU/kWh

[3]Savings to be confirmed by measured DO data. Installation of a DO monitor recommended.