MUNICIPAL WASTEWATER TREATMENT PLANT ENERGY EVALUATION FOR CHEMUNG COUNTY SEWER DISTRICT #1 LAKE STREET WASTEWATER TREATMENT PLANT

Agreement No. 7185

Prepared for

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

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Section 1
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 use information through submetering various unit processes and equipment, and to determine if that information is a cost-effective tool for identifying energy conservation measures. In addition to evaluating the usefulness of submetering, a secondary goal of the program is to identify and evaluate energy cost saving measures at WWTPs, and make the findings available to other facilities across New York State.

Over the years, Chemung County Sewer District No. 1 (CCSD#1) has implemented various energy savings measures at its Lake Street Plant, but energy savings and energy-related cost savings opportunities still exist at the Plant. As a result, Chemung County agreed to participate in the submetering study, as conducted by the Research Team consisting of Malcolm Pirnie and Siemens Building Technologies.

1.2 FACILITY BACKGROUND

The Lake Street WWTP is a 9.5 million gallon per day (MGD) secondary treatment plant located in Elmira, New York, treating primarily residential and domestic wastewater. The facility was originally constructed in 1976.

Monthly average flows through the plant vary from 3.5 MGD to over 10 MGD seasonally, with the higher flows primarily due to infiltration and inflow during the wetter (spring) season.

The facility staff consists of seven WWTP operators and one chief operator. The staff operates the plant seven days per week in two shifts; 16 hours per day Monday through Friday and 12 hours per day Saturday, Sunday, and holidays.

The New York State Electric and Gas Corporation (NYSEG) provides two primary 15-kilovolt-ampere (kVa) high voltage services to the facility. The two primary services are transformed to one 480-volt service, which is then used to run the facility. Both the primary services are metered on a monthly basis. There are no other power meters at the plant.

The treatment processes at the Lake Street Plant include the following:

- Preliminary treatment, including mechanically cleaned bar screens and grit removal.
- Primary clarification.
- Secondary biological treatment with trickling filters followed by secondary clarification and post-aeration.
- Solids handling consisting of anaerobic digestion followed by dewatering using a belt filter press.

A more detailed description of the Lake Street Plant treatment process is presented in Section 2 of this report.

1.3 SCOPE AND OBJECTIVES

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

1.3.1 Review of Historical Plant Performance and Energy Usage Data

Data were obtained from CCSD#1 to establish a baseline for plant performance and energy usage at the Lake Street Plant. 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 CCSD#1 included:

- Average, minimum, and maximum daily flow.
- Influent and final effluent total suspended solids (TSS) and biochemical oxygen demand (BOD_5).
- Influent and final effluent total kjeldahl nitrogen (TKN) and ammonia (NH_3).
- Effluent dissolved oxygen (DO) concentrations.
- Digested sludge volumes with TSS and volatile solids (VSS).
- Historical electric energy usage, including available time-of-use monitoring data, two years of utility bills and any process changes recently undertaken or contemplated.

- Recent energy consumption data for non-electric accounts, including natural gas, and fuel oil.

1.3.2 Electric Submetering

Continuous submetering and instantaneous power draw measurements were completed to assess the typical electric usage of some of the larger motors (greater than 5 horsepower (hp)) at the Lake Street Plant. Continuous submetering locations were selected on the basis of information gained during a site energy audit that was conducted on April 15, 2003 so 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 demand for major pieces of equipment, as well as to provide a representative sample of electric energy usage, including electric 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 on March 4, 2004 and the data were used to verify expected energy demand at the facility, as well as monitor changes in demand as equipment is cycled on and off.

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

- Influent flow rate.
- Influent and final effluent BOD_5.
- Influent and final effluent TSS.
- Dissolved oxygen (DO) in post aeration tanks.

Additionally, a follow-up set of data was collected after the submetering period to verify the following plant performance data:

- Primary effluent BOD_5, trickling filter 1 (TF 1) effluent BOD_5, and trickling filter 2 (TF 2) effluent BOD_5.
- Primary effluent TKN, TF 1 effluent TKN, and TF 2 effluent TKN.
- Primary effluent NH_3, TF 1 effluent NH_3, and TF 2 effluent NH_3.
- Secondary clarifier effluent DO and post-aeration tank DO.

These additional process data collected were used to correlate energy usage and process parameters to develop alternatives for energy savings as well as compare the Lake Street Plant's energy performance to other WWTPs 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 modifications were identified based on review of the submetering data. Some of these opportunities, while they may consume more energy than existing processes, may also serve to improve treatment at the plant, thereby saving operational dollars in the facility's overall budget.

1.3.4 Identification of Energy Savings Opportunities through Operational Changes

The submetering data were further reviewed to evaluate the impact of demand throughout the course of the day and identify potential energy saving opportunities through load shifting and greater use of real-time data in energy-related decision making. Load shifting involves changing the time of use of certain loads to reduce the total facility demand during peak periods, the goal of which is to reduce demand charges.

This report summarizes the data evaluation and offers recommendations for opportunities to reduce energy usage, and thereby energy-related costs, at the Lake Street Plant.

Section 2

CURRENT AND HISTORICAL OPERATIONS

2.1 EXISTING TREATMENT PROCESSES

FIGURE 2-1 presents a schematic of the wastewater treatment and solids handling processes. A brief description of the unit treatment processes that are currently implemented at the plant is presented below.

2.1.1 Preliminary Treatment

Preliminary treatment is accomplished through the use of comminutors and an aerated grit chamber. Once influent passes through the aerated grit chamber, it is pumped to primary treatment via three main wastewater pumps.

2.1.2 Primary Treatment

Primary treatment is carried out in three rectangular primary clarifiers. Approximately 40% to 60% of the total suspended solids (TSS) and 25% to 35% of the biochemical oxygen demand (BOD_5) are removed during primary treatment. Settled solids are pumped from the tanks to the anaerobic digesters.

2.1.3 Secondary Treatment

After passing through the primary clarifiers, secondary treatment is carried out through the use of two trickling filters operated in series, where 40% to 70% of the remaining BOD_5 is removed. The trickling filters are operated in series to increase the ammonia removal (nitrification) of the wastewater stream. After passing through the trickling filters, final clarification is carried out in three rectangular secondary clarifiers. The sludge produced in the secondary clarifiers is wasted to the anaerobic digesters.

2.1.4 Post-Aeration

The final step is aeration, carried out in a rectangular post-aeration tank to increase the effluent dissolved oxygen (DO) content.

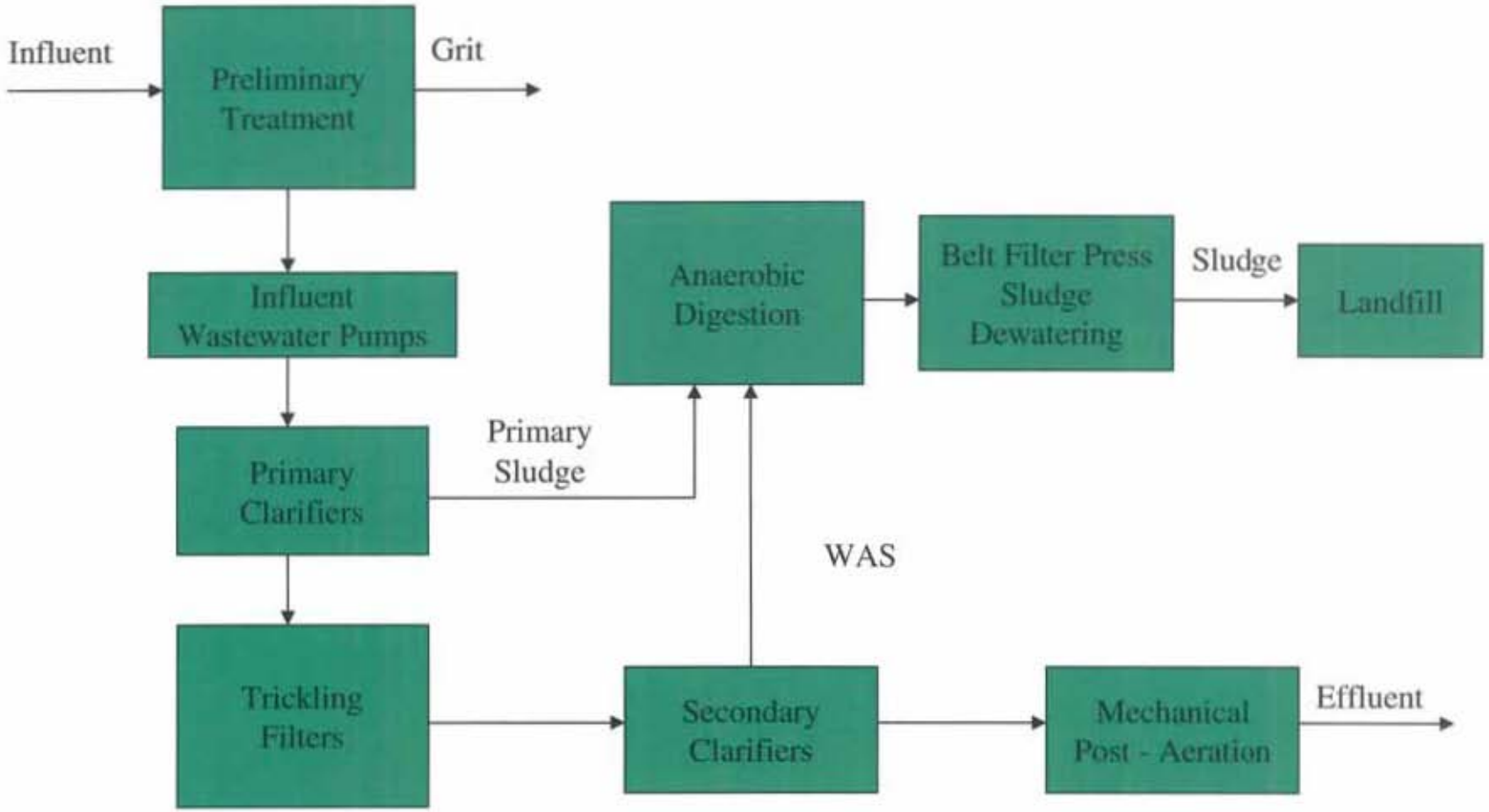

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FIGURE 2-1
WASTEWATER FLOW SCHEME

2.1.5 Solids Handling

The primary sludge is combined with the sludge from the secondary clarifiers and is processed in a two-stage anaerobic digestion system. The sludge is then dewatered using a belt filter press and is trucked to an off-site landfill for disposal.

2.2 HISTORICAL ENERGY USAGE AND UTILITY BILLING

To establish historical energy usage, monthly utility bills were obtained from CCSD. The billing information covered the following periods:

- Electric Energy Usage and Demand: December 2000 to November 2002
- Natural Gas Usage: January 2001 to December 2002

Utility data were summarized and graphical representations of average monthly usages and demands were developed to look for trends in energy usage. Monthly electric energy usage and demand is presented in FIGURE 2-2.

When comparing 2001 data with 2002 data, there is an overall increase in both electric energy demand and usage. Electric energy demand increases by 8% and usage increases by 10%. The comparisons are presented graphically in FIGURES 2-3 and 2-4. The greatest change in each parameter occurs in the months of June and July. There was an unusual peak in influent flows during these months in 2002, which most likely caused the increase in electric energy demand and usage. The variations in electric energy demand and usage correlated to an average increase in electricity charges of 8%.

2.3 NATURAL GAS USAGE

Natural gas usage peaks in the winter months due to elevated heating requirements, and is at a minimum in the summer. The relationship between natural gas usage and average monthly temperature for the years 2001 and 2002 is presented in FIGURE 2-5. The average temperature for 2001 was 47.7 degrees Fahrenheit (°F) with a total natural gas usage of 44,816 therms at a total cost of $33,332. The average temperature for 2002 was 48.2 °F with a total natural gas usage of 44,010 therms at a total cost of $29,223. Although the usage was nearly the same for each year, the average cost per therm in 2001 was $0.72, while it was only $0.66 per therm in 2002.

Total plant natural gas usage on a square foot basis can be estimated as a benchmark performance parameter for building heating by dividing the annual gas usage by the square footage of the buildings.

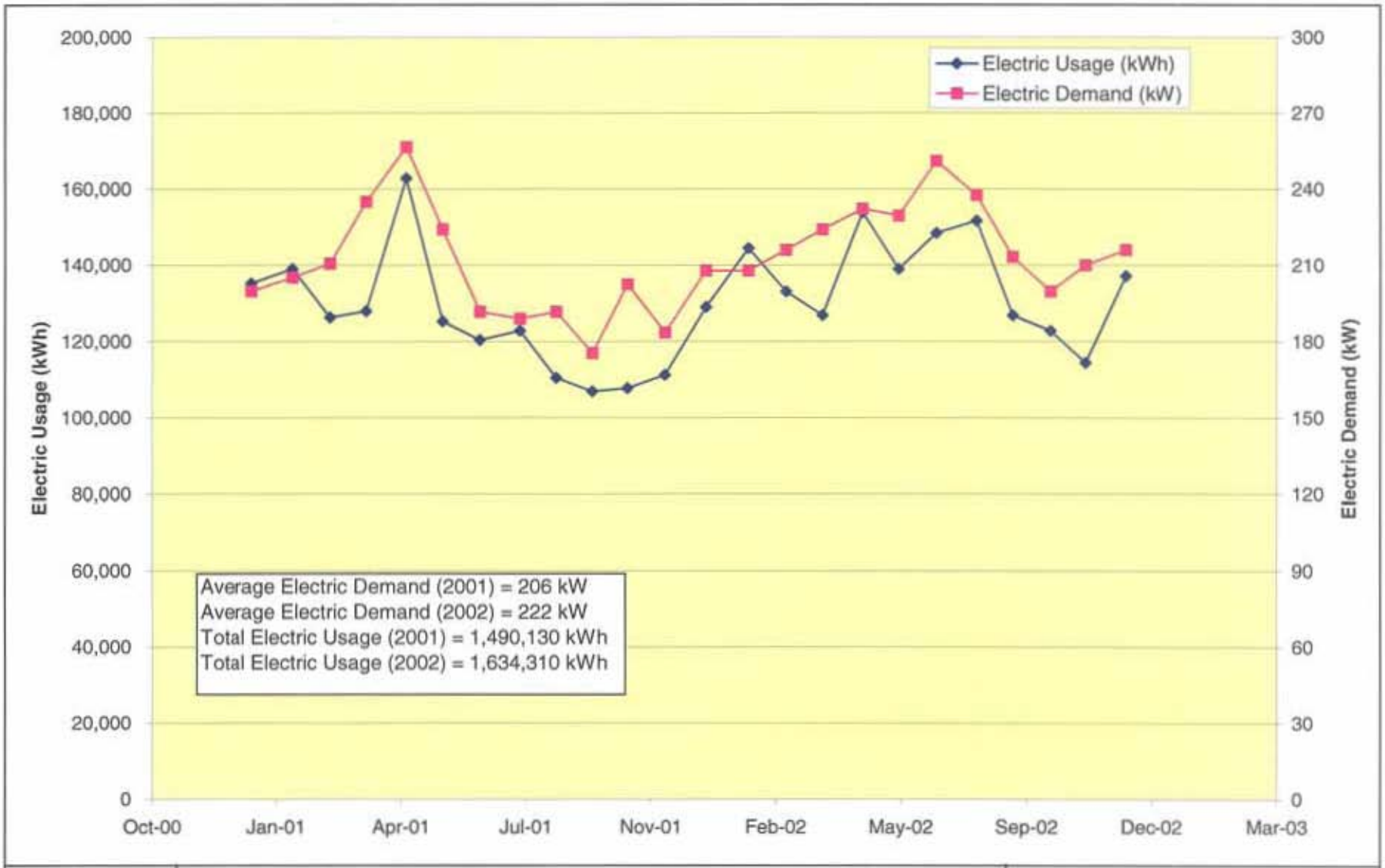

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FIGURE 2-2
ELECTRIC DEMAND AND USAGE

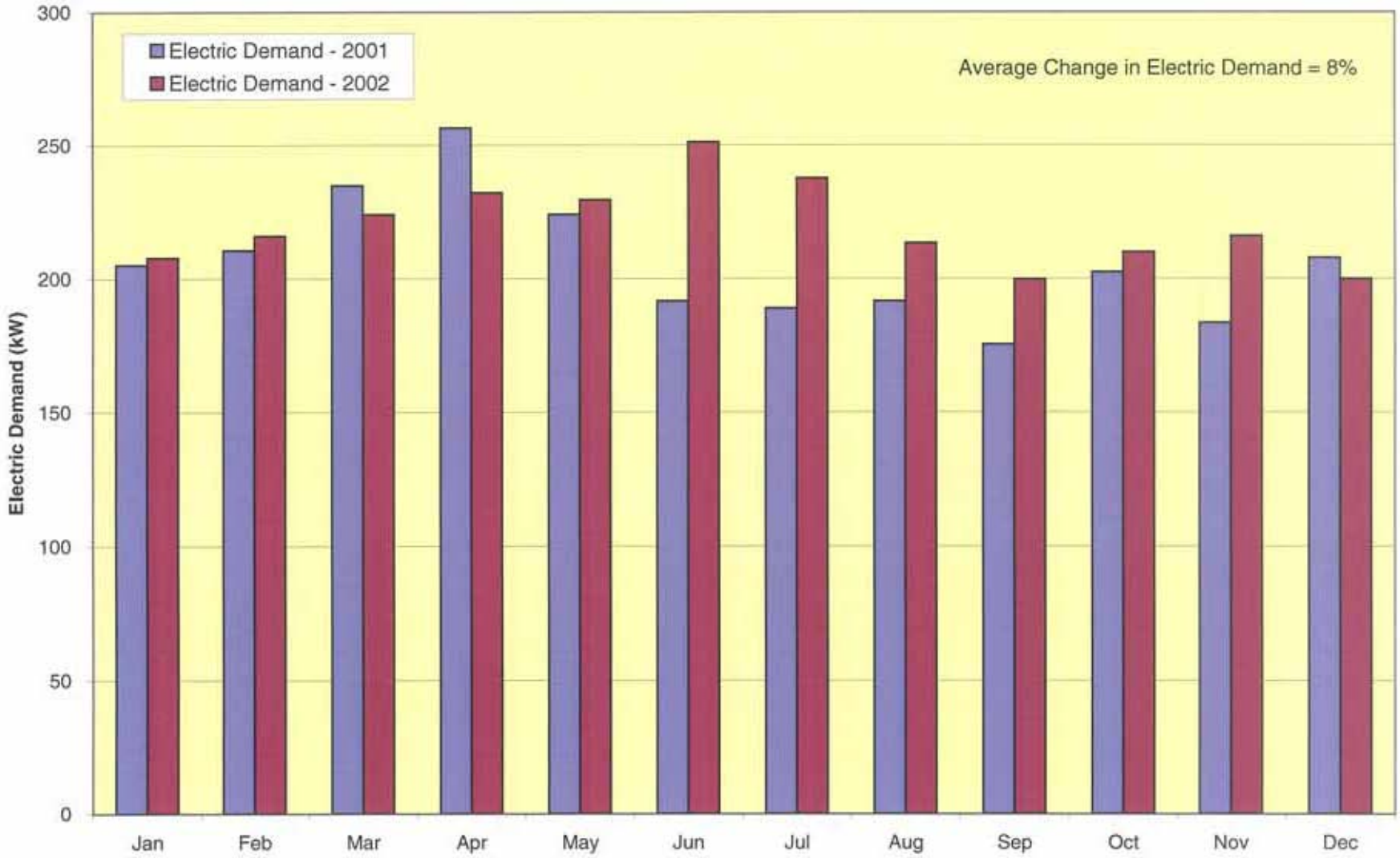

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FIGURE 2-3
CHANGE IN ELECTRIC DEMAND
(2001 - 2002)

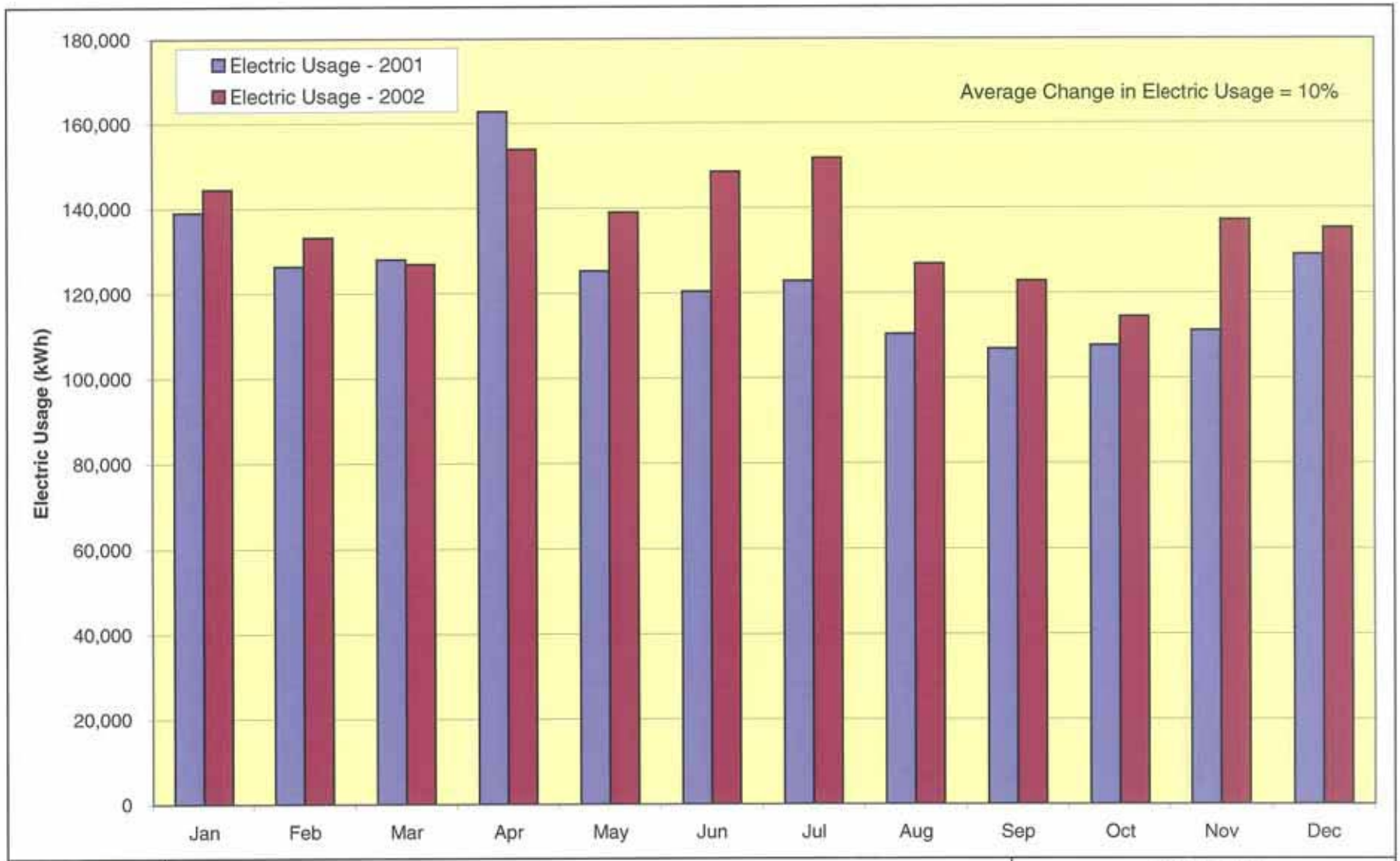

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FIGURE 2-4
CHANGE IN ELECTRIC USAGE
(2001 - 2002)

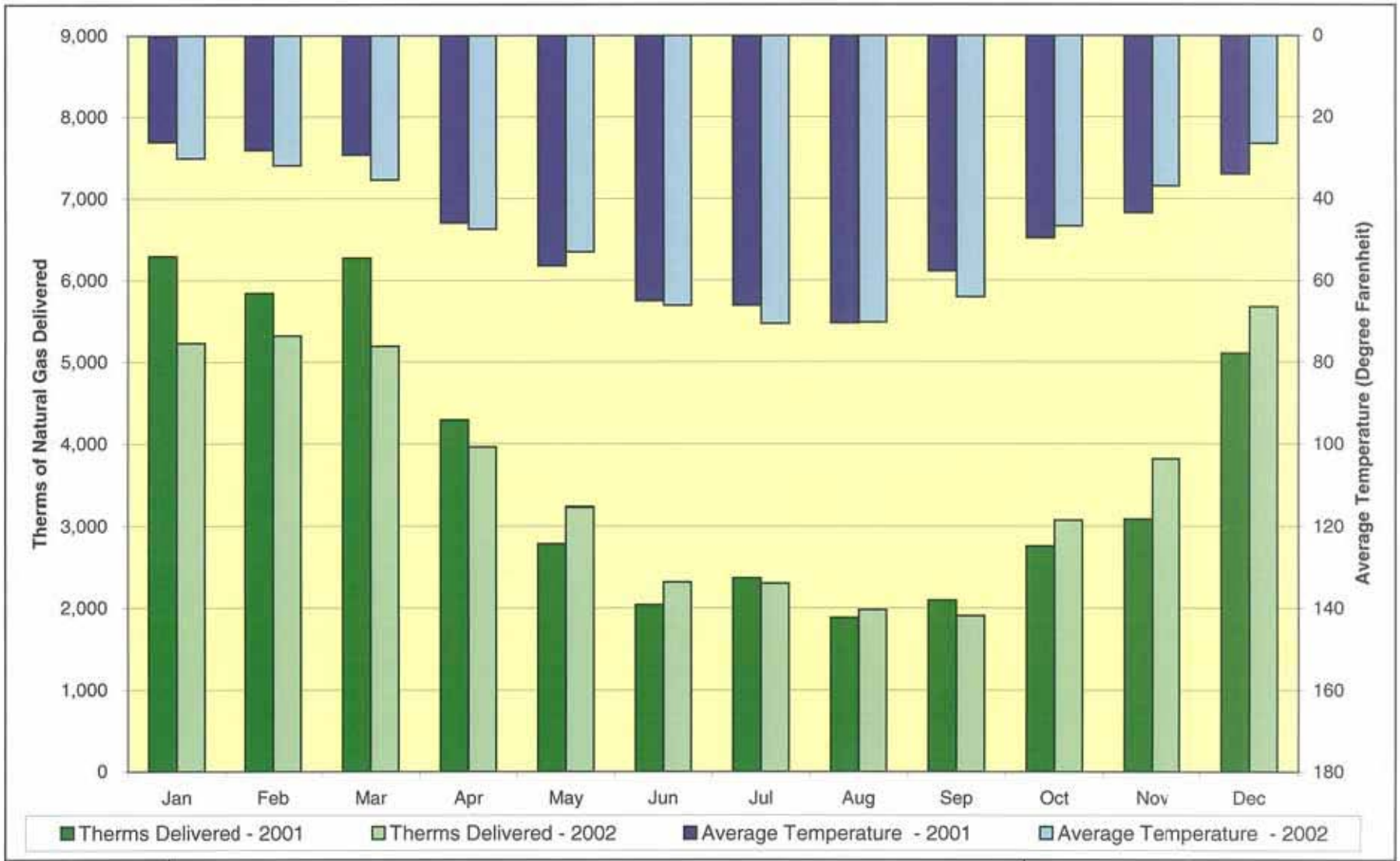

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FIGURE 2-5
NATURAL GAS USAGE
(2001 - 2002)

Based on a facility square footage of 50,000 sq. ft. the Lake Street Plant uses an average of approximately 0.9 therms / sq. ft. of natural gas on an annual basis.

2.4 SUMMARY OF ENERGY COSTS

A summary of annual utility costs for 2001 and 2002 is presented in TABLE 2-1.

Table 2-1: Utility Cost Summary for 2001 and 2002

Year		2001	2002
Average Flow (MGD)		5.0	6.4
Electricity	Annual Usage (kWh)	1,490,130	1,634,310
	Rate ($/kWh)	$0.074	$0.072
	Annual Costs	$109,489	$118,166
	Average Usage (kWh per MGD)	817	700
	Average Cost ($/MGD)	$59.99	$50.58
Natural Gas	Annual Usage (therms)	44,816	44,010
	Rate ($/therm)	$0.72	$0.66
	Annual Costs	$32,332	$29,223
	Average Usage (therms per MGD)	25	19
	Average Cost ($/MGD)	$17.72	$12.51
Total Energy Cost of Electricity and Natural Gas		$141,821	$147,389
Total Energy Cost per MGD		$77.71	$63.09

2.5 SUMMARY OF HISTORICAL LOADINGS AND EFFLUENT QUALITY

Malcolm Pirnie collected and analyzed the following operational data from CCSD#1 for the period 2001 to 2003:

- Flow.
- BOD_5.
- (TSS).
- Total Kjeldahl Nitrogen (TKN).
- Ammonia (NH_3).

Monthly plant flow and process data provided by CCSD#1 for 2001 to 2003 are tabulated in TABLE 2-2.

Table 2-2: Summary of Lake Street Plant Performance

Wastewater Parameter	Average (2001 To 2003 Data)
Influent Plant Flow	6.8 MGD
Influent BOD_5 Concentration	85.1 mg/L
Influent BOD_5 Loading	4,629 lb/day
Average BOD_5 Removal	88%
Influent TSS Concentration	100.5 mg/L
Influent TSS Loading	5,452 lb/day
Average TSS Removal	89%
Influent TKN Concentration	16.9 mg/L
Influent TKN Loading	928 lb/day
Average TKN Removal	49%
Influent NH_3 Concentration	8.3 mg/L
Influent NH_3 Loading	460 lb/day
Average NH_3 Removal	53%

It should be noted that the average removals of TKN and NH_3 increase during the summer months (June through October), to approximately 64% removal for TKN and nearly 70% removal for NH_3 during these months.

FIGURE 2-6 shows the relationship of influent BOD_5 and TSS loadings versus plant flow. Typically, loadings should increase with increased plant flows. However, this data set shows that there are periods of high flows that correspond with relatively low loadings. This trend could be attributed, in part, to dilution of the influent during the wet weather conditions due to the infiltration and inflow issues in the collection system tributary to the plant. FIGURE 2-7 presents the same relationship with TKN and NH_3. Overall, the loadings follow similar trends to those seen with BOD_5 and TSS.

The average BOD_5 and TSS removals are approximately 90% at the Lake Street Plant. WWTP effluent concentrations typically range between 8 mg/L and 13 mg/L for both parameters, which is well below the discharge permit limits of 25 mg/L for BOD_5 and 30 mg/L for TSS.

The plant has a seasonal limit on NH_3 discharge of 227 lb/day from June through October. The average effluent loading for this period is 136 lb/day, with an average NH_3 removal of nearly 70%.

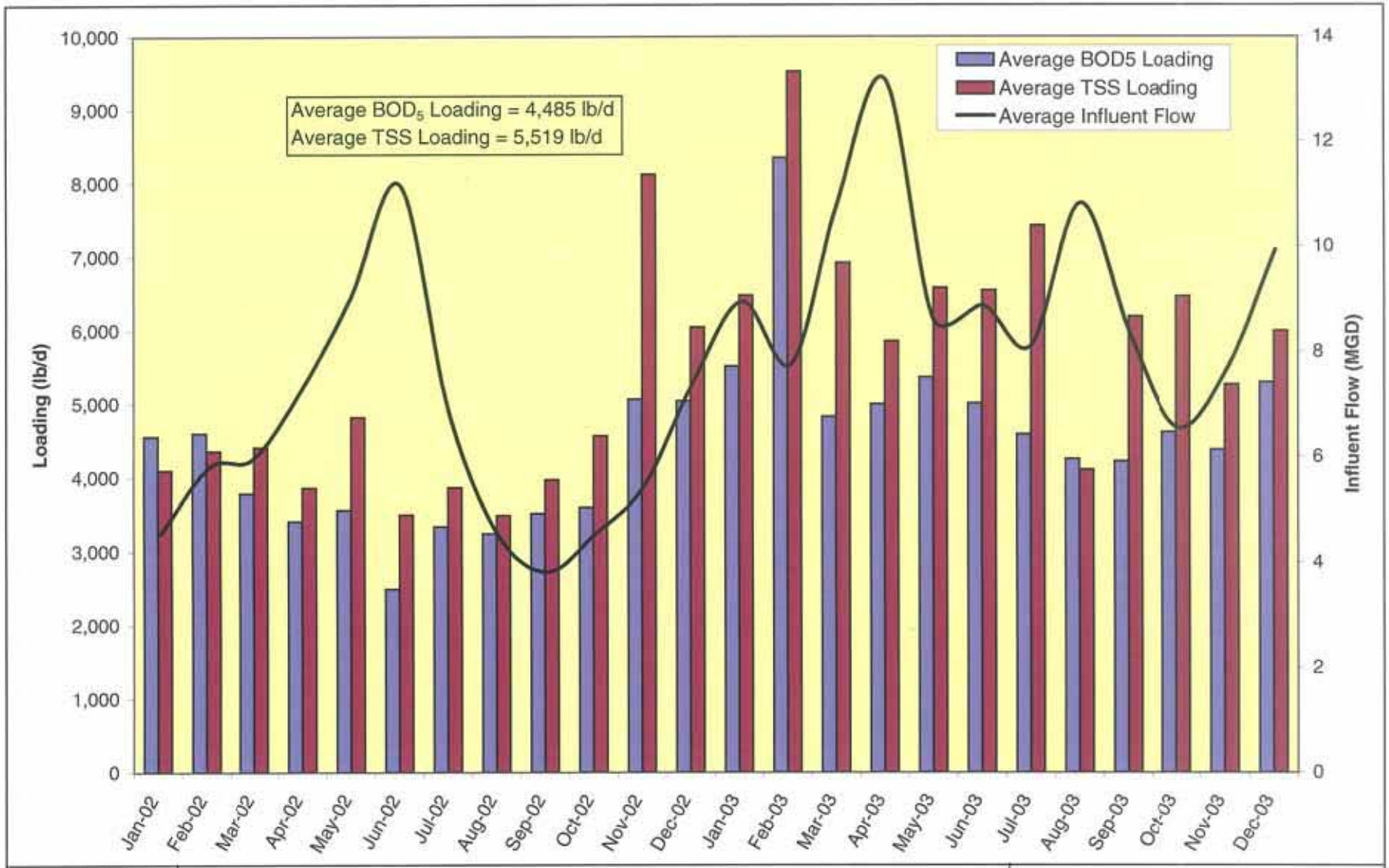

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FIGURE 2-6
INFLUENT BOD$_5$ AND TSS LOADING

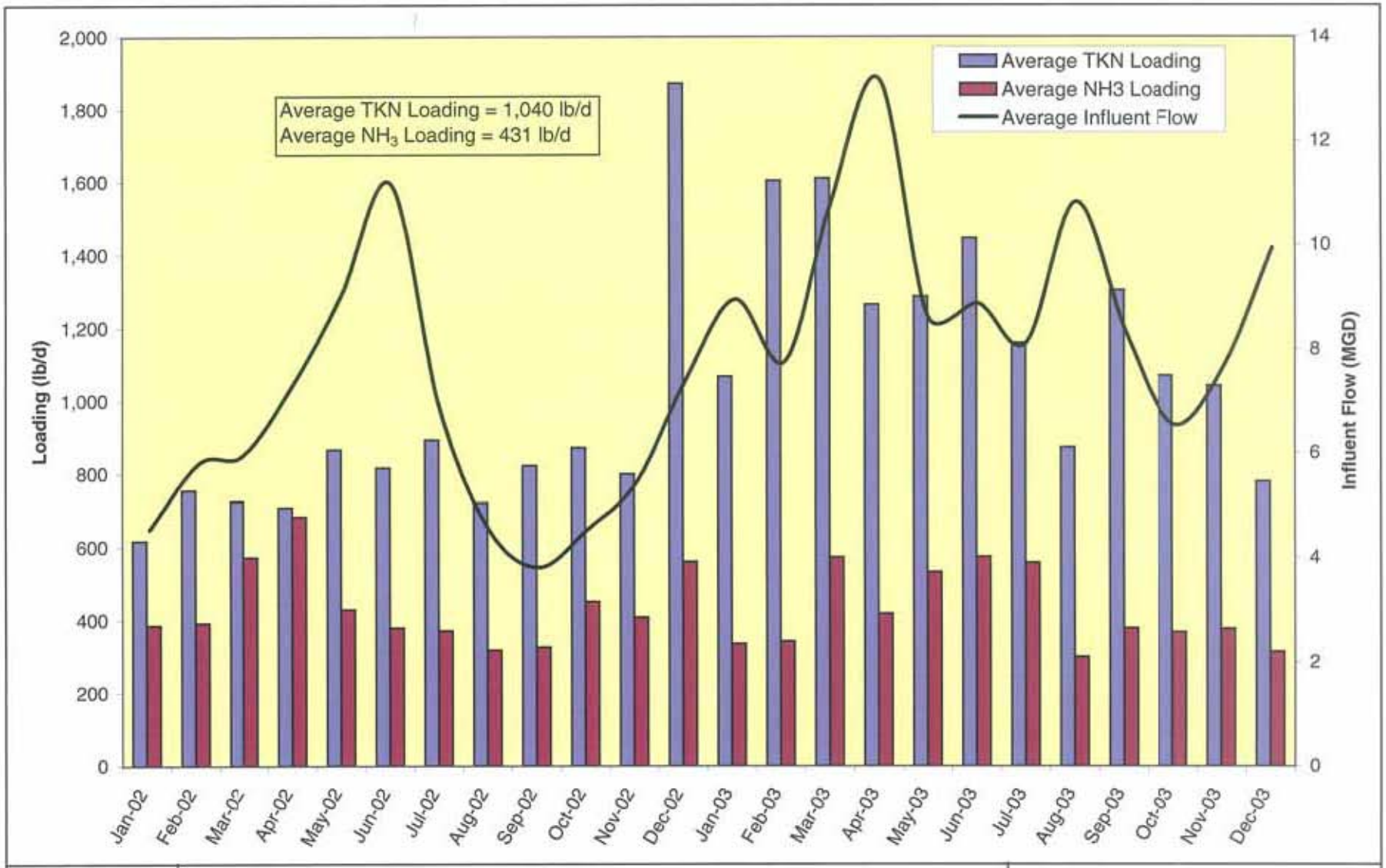

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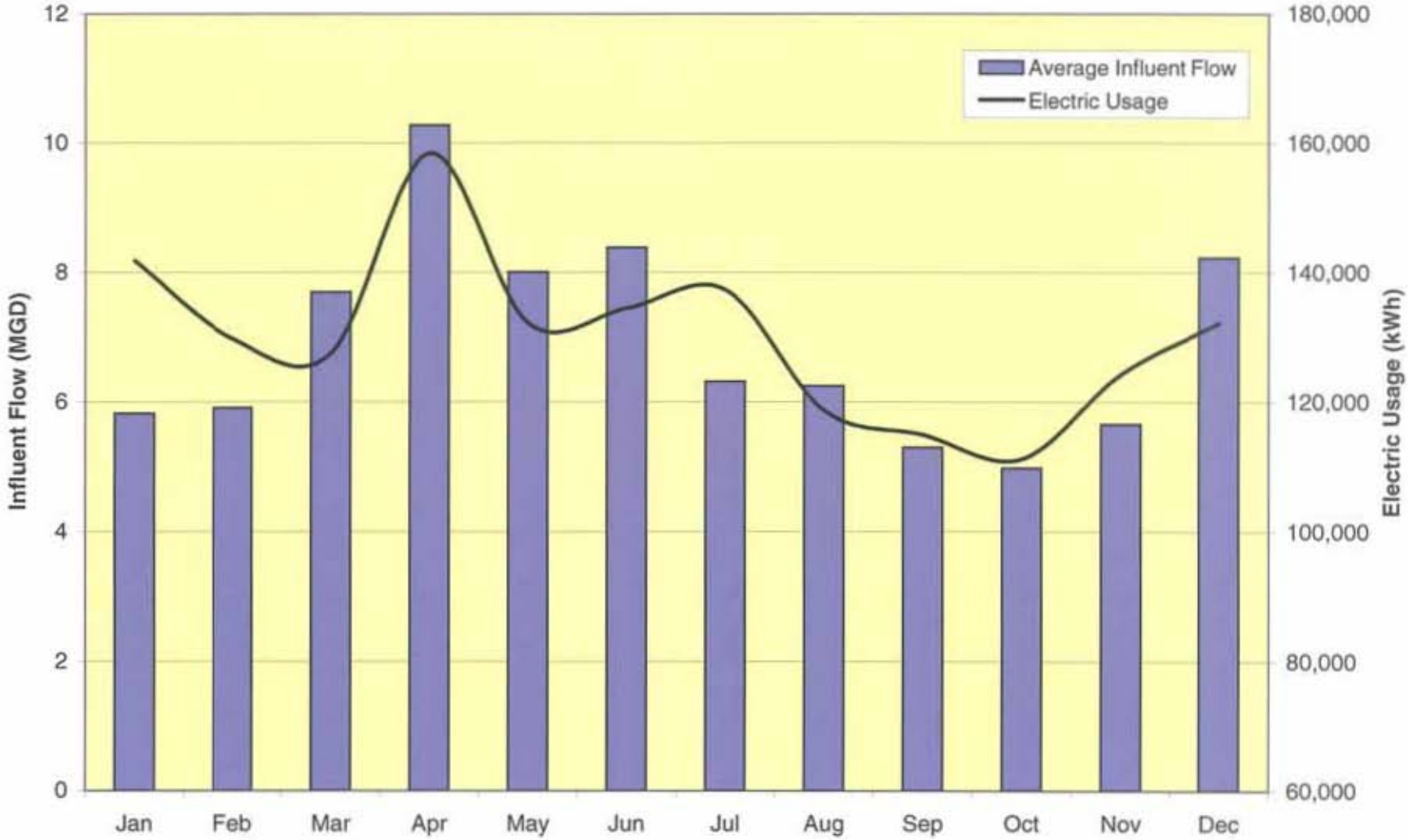
FIGURE 2-7
INFLUENT TKN AND NH_3 LOADING

In order to evaluate the energy usage at the Lake Street Plant, the electric energy usage and demand data were compared to influent flows to establish the effects of varying flows on energy usage. FIGURE 2-8 presents the average monthly influent flow and average monthly electric energy usage. The figure shows that the electric energy usage peaks in the spring and is at a minimum in the fall. The average influent flow appears to follow the same trend. January and February appear to not follow this general trend, which may be due to increased lighting and heating requirements during the winter months, but relatively lower flows.

The electric energy demand shows a similar trend. Average monthly electric energy demand is presented in FIGURE 2-9. The figure indicates that peak demand occurs in the spring when flows are typically at their highest.

FIGURE 2-10 shows the relationship between natural gas usage and influent wastewater flow. There does not appear to be a strong correlation between plant influent flow and natural gas usage. As seen in FIGURE 2-5, natural gas usage is mainly affected by outdoor temperature.

Based on the 2001 and 2002 data, approximately 4,068 lb/d BOD_5 are removed. Therefore, the estimated electric energy usage per pound of BOD_5 removed is 1 kWh per lb of BOD_5 removed. Based on the 2001 through 2002 data, approximately 4,852 lb/d TSS is removed, resulting in an estimated electric energy usage of 0.88 kWh per lb of TSS removed. The natural gas usage is approximately 0.03 therms per lb BOD_5 removed.



MALCOLM PIRNIE	NYSERDA MUNICIPAL WASTEWATER TREATMENT PLANT ENERGY EVALUATION CHEMUNG COUNTY SEWER DISTRICT #1 - LAKE STREET PLANT	FIGURE 2-8 ELECTRIC USAGE vs INFLUENT FLOW

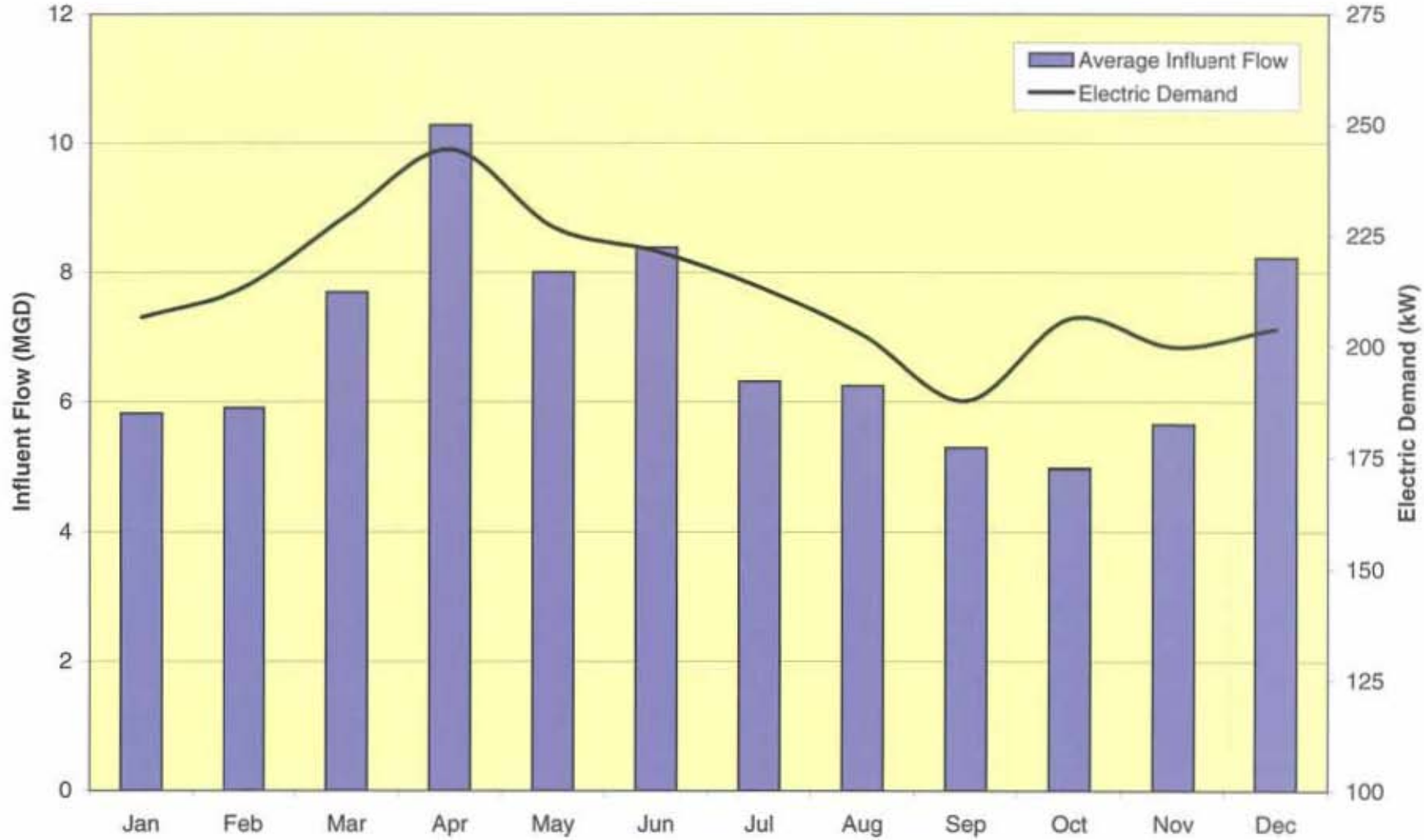


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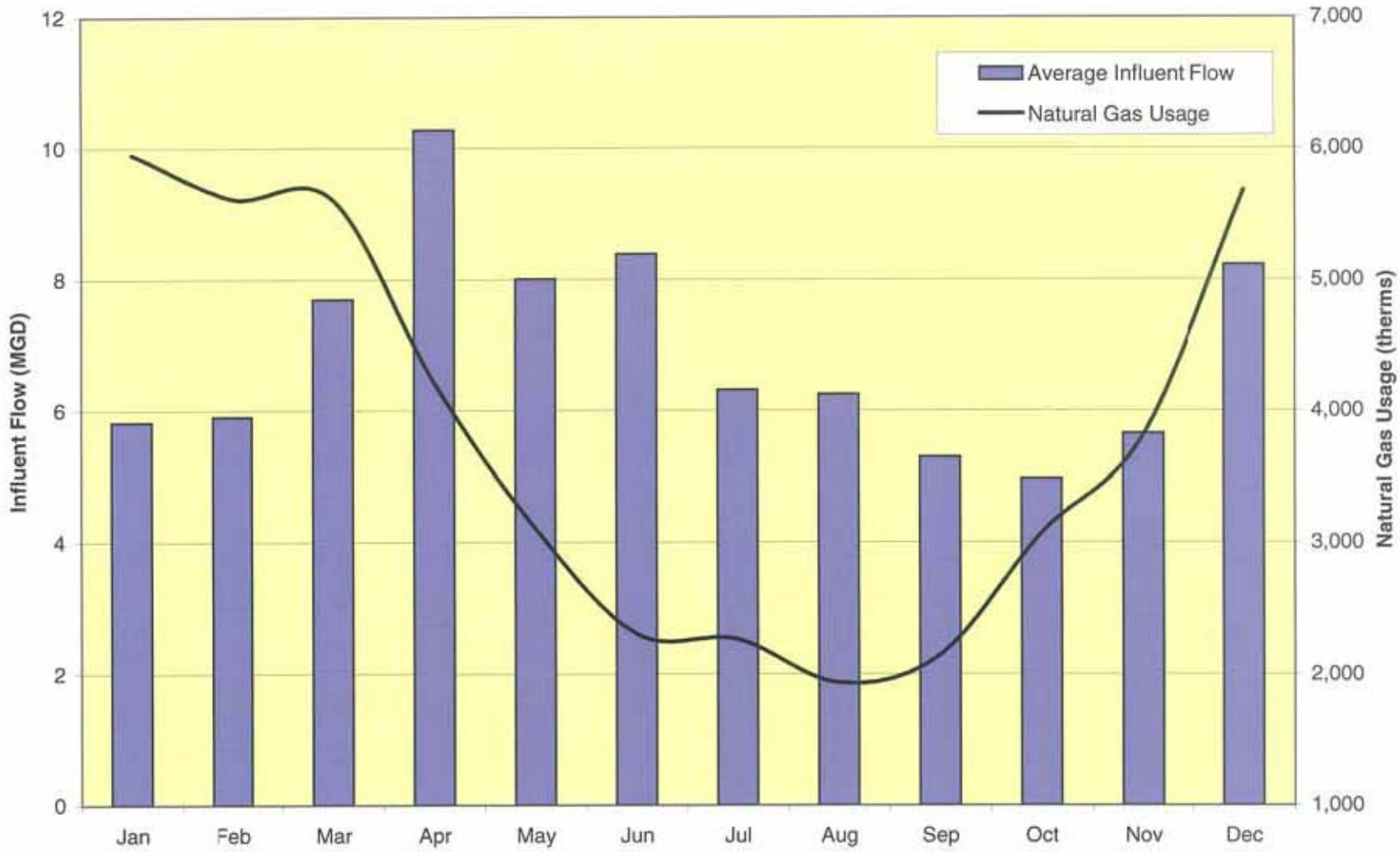
FIGURE 2-9
ELECTRIC DEMAND vs INFLUENT FLOW



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CHEMUNG COUNTY SEWER DISTRICT #1 - LAKE STREET PLANT

FIGURE 2-10
NATURAL GAS USAGE vs. INFLUENT FLOW

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 (CREDLs). 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 submetering program, daily process data were collected. 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 at the Lake Street Plant. The submetering and instantaneous readings in conjunction with estimated operating hours were then used to estimate total energy usage for the particular pieces of equipment.

3.1.2 Submeter Locations

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

- One meter at the pump building – equals total usage at the Lake Street Plant.
- Three meters on the influent pumps, one on each pump motor – 30 hp, 50 hp, and 60 hp.
- One meter at the administration building.
- One meter at the primary clarifiers.

The submeters were installed on March 4, 2004, and removed April 30, 2004; data were recorded in 15-minute intervals.

Chemung County Sewer District #1 - Lake Street Plant

Table 3-1: List of Motors Over 5-hp[1]

Process	Use	MCC Location	Quantity	Size (hp)	Constant/ Variable Speed	Voltage
Wastewater Pumping	Influent Pump	Master Control Room	1	60	C	480
Wastewater Pumping	Influent Pump	Master Control Room	1	50	C	480
Wastewater Pumping	Influent Pump	Master Control Room	1	30	C	480
Secondary Treatment	TF Pumping	Master Control Room	3	50	C	460
Final Effluent	Post Aeration	Master Control Room	1	20	C	460
Other Processes	Gas Compressor	Master Control Room	1	15	C	460
Plant Water Pumping	Plant Water Pump	Master Control Room	1	15	C	460
Solids Handling	Sludge Pump	Master Control Room	2	7.5	C	460
Preliminary Treatment	Aerated Grit Blower	Master Control Room	2	7.5	C	460

Notes:
[1] All equipment listed is 3-phase.

3.2 SUMMARY OF SITE AUDIT

A one-day on-site survey was conducted on April 15, 2003 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 as a result of the site audit. In addition, a list of existing equipment at the plant with motors 5 hp or greater was developed during the site survey. As shown in TABLE 3-1, the motors potentially using the most energy are those on the influent wastewater pumps, the trickling filter pumps, and the post aeration mechanical aerator.

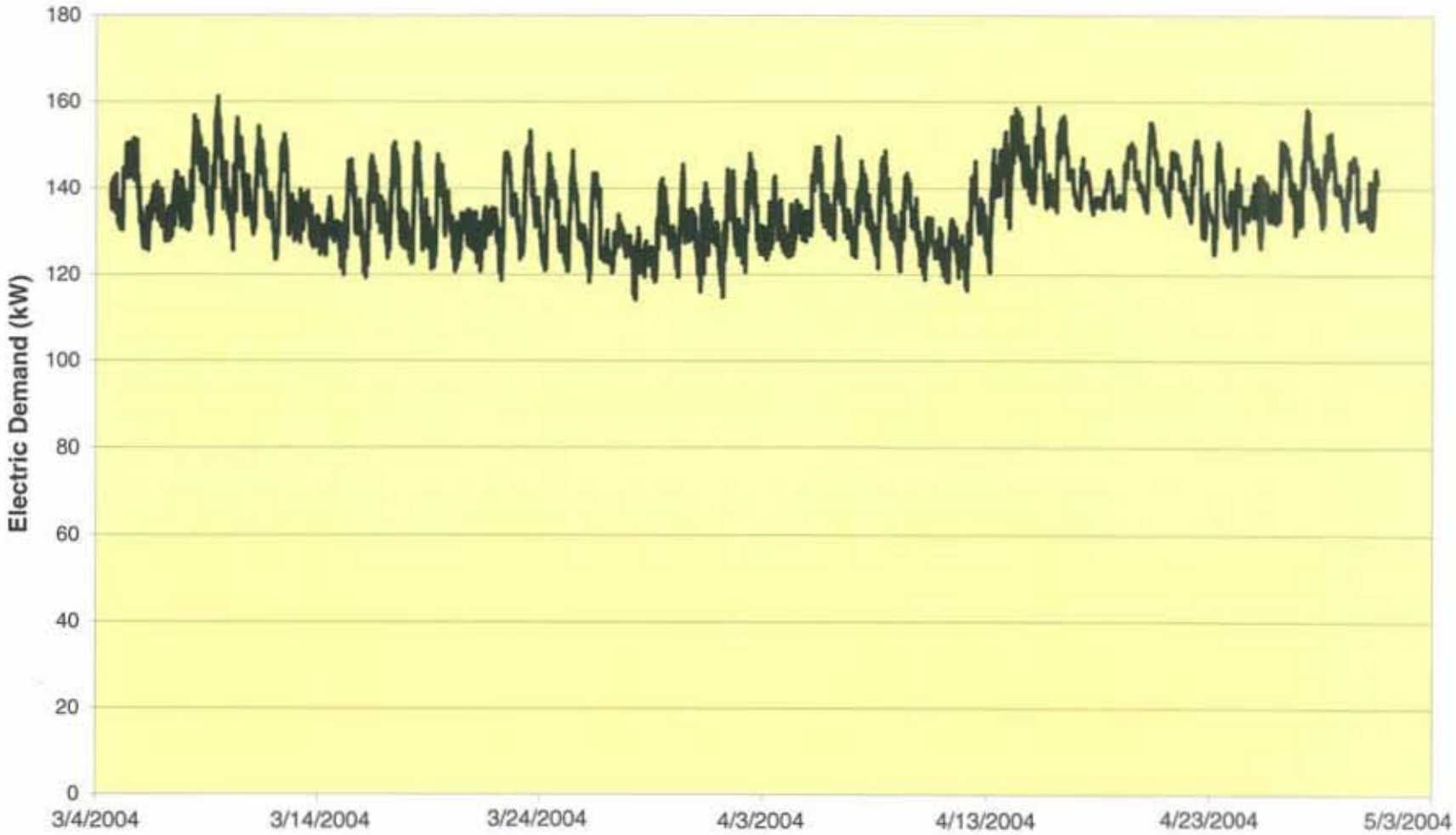
3.3 SUMMARY OF CONTINUOUS SUBMETERING

The following sections summarize the results from continuous submetering activities. The overall energy demand for the Lake Street Plant, as metered at the pump building, is shown in FIGURE 3-1. Significant demand peaks were not observed in the data.

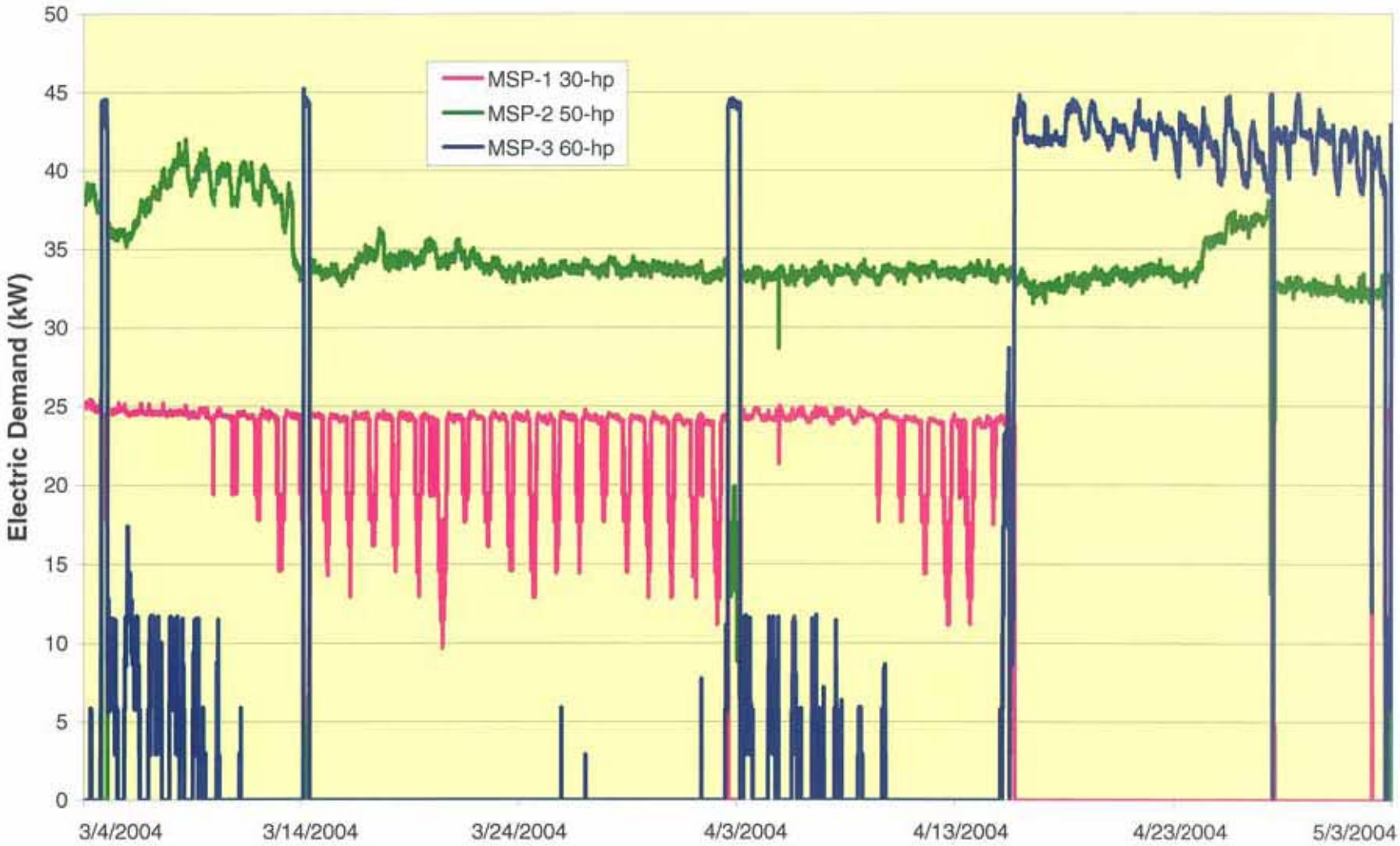
3.3.1 Influent Wastewater Pumps

Continuous submeters were installed on each of the three constant speed influent pumps, which have 30-hp, 50-hp, and 60-hp motors. FIGURE 3-2 shows electric energy demand during the submetering program. The data indicate that the 50-hp pump was operated on a nearly continuous basis. The 30-hp and 60-hp units were used as lag pumps. The use of the 30-hp pump was prevalent up until early April when the flow began to increase. As the flow increased, the use of the 60-hp pump began. The average electric energy demand for the 30-hp, 50-hp, and 60-hp pumps (when in operation) are 23 kW, 34 kW, and 34 kW, respectively. The large spikes observed in the data represent times that the 60-hp pump was in operation for a period longer than 5 minutes. The pump motor draws 40 kW to 45 kW when operating. The 5 kW to 15 kW spikes are times when the pump was operating for a period less than 5 minutes. The submeter takes the average kW value over a 5-minute interval.

TABLE 3-2 summarizes the electric energy usage and estimated cost for influent pump operations during the submetering period. Extrapolating the data to a full year, it is estimated that the total annual electric energy usage of the influent pumps is 555,750 kWh, with a corresponding cost of $42,793, which is approximately 36% of the total annual electric cost.



MALCOLM PIRNIE	NYSERDA MUNICIPAL WASTEWATER TREATMENT PLANT ENERGY EVALUATION CHEMUNG COUNTY SEWER DISTRICT #1 - LAKE STREET PLANT	FIGURE 3-1 PLANT ELECTRIC DEMAND AS METERED AT PUMP BUILDING



MALCOLM PIRNIE	NYSERDA MUNICIPAL WASTEWATER TREATMENT PLANT ENERGY EVALUATION CHEMUNG COUNTY SEWER DISTRICT #1 - LAKE STREET PLANT	FIGURE 3-2 SUBMETERING - INFLUENT WASTEWATER PUMPING

Table 3-2: Summary of Influent Pumps during the Submetering Period

Influent Pump	Electric Energy Usage (kWh)	Estimated Cost*
30-hp	22,675	$1,746
50-hp	47,184	$3,633
60-hp	18,805	$1,448
TOTAL	88,664	$6,827

Note:
*Cost based on average 2004 electric rate of $0.077/kWh

The equivalent electric energy usage of influent wastewater pumping per million gallons (MG) of wastewater is approximately 133 kWh/MG, based on an average flow of 11.5 MGD during the submetering period.

3.3.2 Administration Building

A continuous submeter was installed on the main electric feed to the administration building. The largest draws of electric energy in the administration building are the lighting and office equipment. A summary of the submetering data is presented in FIGURE 3-3. The peaks in demand appear to occur between the hours of 7:30 am and 4:00 pm, which are the typical working hours when the administration building would be occupied.

TABLE 3-3 summarizes the administration building electric energy usage during the submetering period. Extrapolating the data to the full year, it is estimated that the total annual electric energy usage of the administration building is 29,064 kWh, with a corresponding cost of $2,238, which is approximately 1.9% of the total annual electric cost.

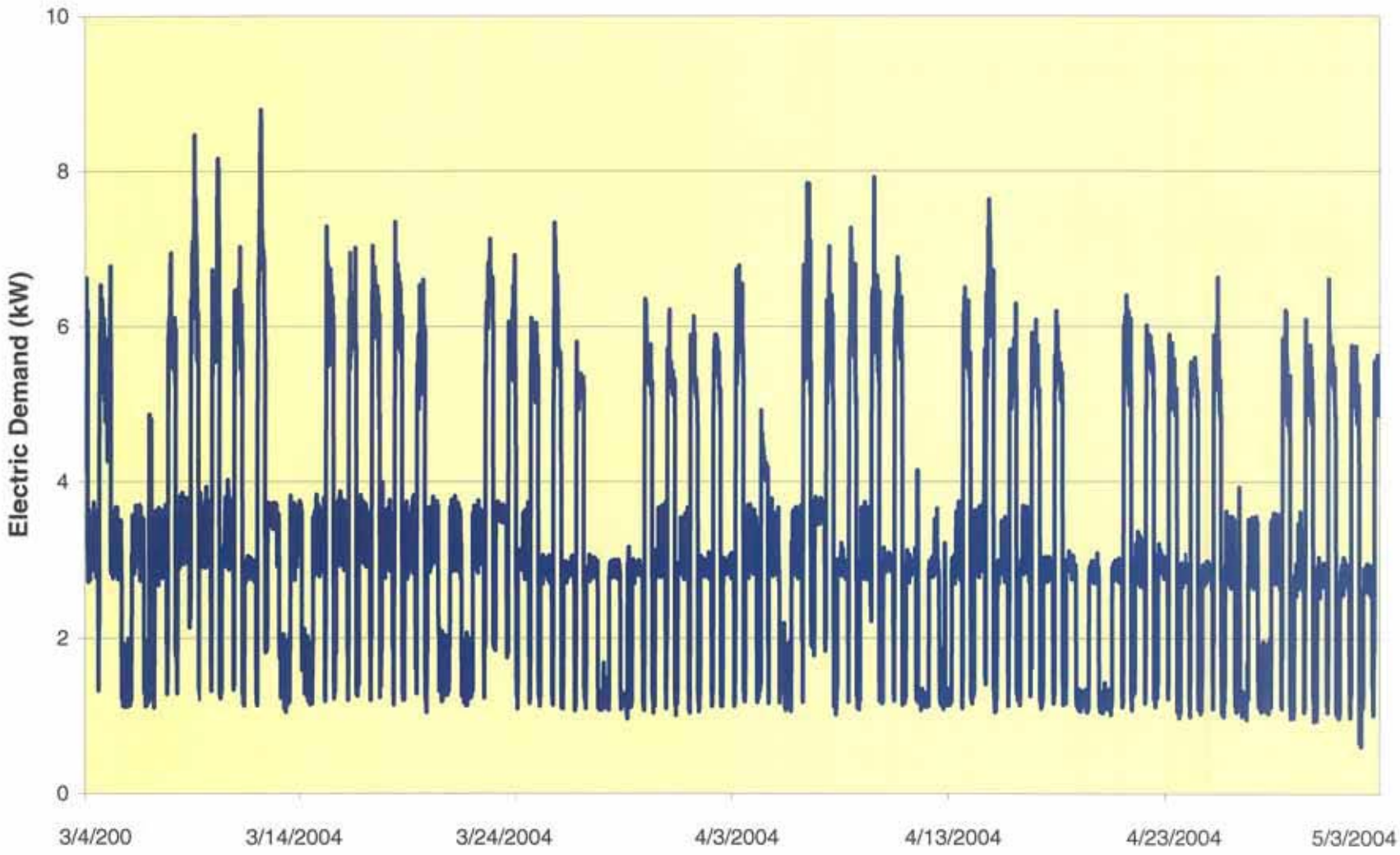
Table 3-3: Summary of the Administration Building during the Submetering Period

Location	Electric Energy Usage (kWh)	Estimated Cost*
Administration Building	4,618	$356

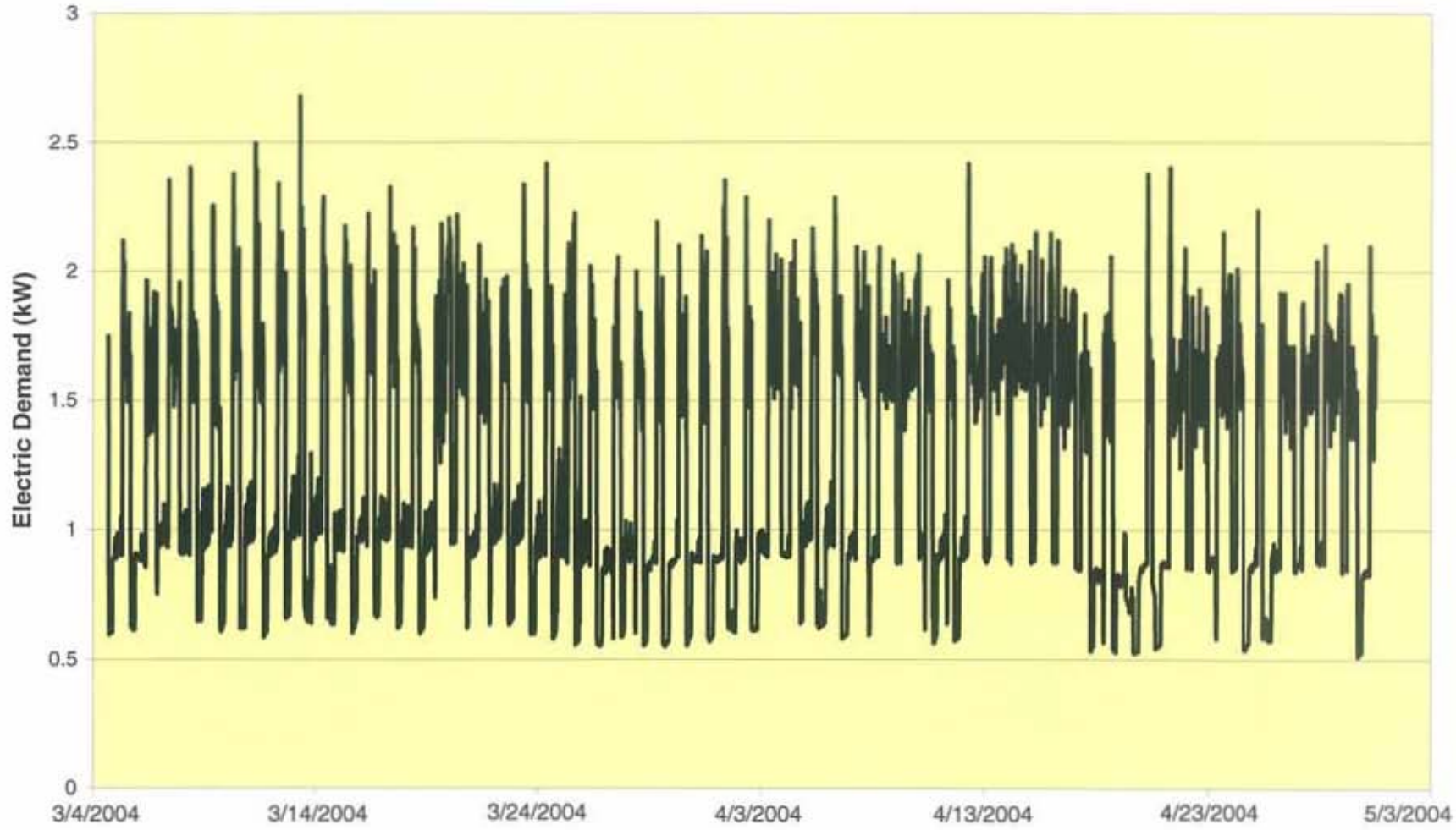
Note:
* Cost based on average 2004 electric rate of $0.077/kWh

3.3.3 Primary Clarifiers

A continuous submeter was installed on the electric feed to the primary clarifiers to record the electric energy usage of the sludge pumps and drive mechanisms. FIGURE 3-4 presents the data, which shows a relatively low electric energy usage; the average demand was 1.2 kW. Extrapolating the data to the full year, it is estimated that the annual electric energy usage of the primary clarifiers would be 10,808 kWh,



MALCOLM PIRNIE	NYSERDA MUNICIPAL WASTEWATER TREATMENT PLANT ENERGY EVALUATION CHEMUNG COUNTY SEWER DISTRICT #1 - LAKE STREET PLANT	FIGURE 3-3 SUBMETERING - ADMINISTRATION BUILDING



MALCOLM PIRNIE	NYSERDA MUNICIPAL WASTEWATER TREATMENT PLANT ENERGY EVALUATION CHEMUNG COUNTY SEWER DISTRICT #1 - LAKE STREET PLANT	FIGURE 3-4 SUBMETERING - PRIMARY CLARIFIERS

with a cost of $832, which is 0.7% of the total annual electric cost. A summary of the submetering data is presented in TABLE 3-4.

Table 3-4: Summary of the Primary Clarifiers during the Submetering Period

Location	Electric Energy Usage (kWh)	Estimated Cost*
Primary Clarifiers	1,718	$132

Note:
* Cost based on average 2004 electric rate of $0.077/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. This data set was collected to verify energy demand at the facility, as well as to monitor changes in demand as equipment is cycled on and off.

Instantaneous measurements were obtained using hand-held meters. A summary of the instantaneous readings is presented in TABLE 3-5.

Table 3-5: Instantaneous Electric Energy Usage Readings

Unit	Volts	Amps	Electric Energy Demand (kW)	Power Factor
Trickling Filter Pump P-3 - 50 HP	447	65.2	14	-0.48
Trickling Filter Pump P-2 - 50 HP	447	88.8	29.1	-0.74
Effluent Aerator - 20 HP	451	24.5	15.3	0.79
Primary Clarifier Sludge Pump	447	2.28	1.18	0.68
Aerated Grit Blower - 7.5 HP	457	7.12	2.75	0.49
Plant Water Pump - 15 HP	458	7.85	6.17	0.99

The instantaneous readings show that the trickling filter pumps as well as the effluent aerator account for a significant electric energy demand. These pieces of equipment are operated on a continuous basis. For comparison purposes, the instantaneous demand values were used to develop total annual electric energy usage. TABLE 3-6 presents an overall summary of annual electric energy usage and cost for the equipment monitored in both the continuous and instantaneous submetering.

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New York State Energy Research and Development Authority
Municipal Wastewater Treatment Plant Energy Evaluation

Chemung County Sewer District #1 - Lake Street Plant

Table 3-6: Estimates of Electric Energy Usage and Costs[1,2]

Process	Use	MCC Location	Size (hp)	Efficiency Rating[4]	Estimate of Electric Energy Usage[3]				Notes
					Estimated Hours Per Year	Power Draw (kW) per motor	Estimated Annual Usage (kWh)	Estimated Cost[5]	
Wastewater Pumping	Influent Pump	Master Control Room	60	90.3%	3,484	34.0	118,456	$ 9,121	Run as Influent Flow Dictates
Wastewater Pumping	Influent Pump	Master Control Room	50	89.9%	8,632	34.1	294,351	$ 22,665	Run as Influent Flow Dictates
Wastewater Pumping	Influent Pump	Master Control Room	30	88.1%	6,188	23.1	142,943	$ 11,007	Run as Influent Flow Dictates
Secondary Treatment	TF Pumping	Master Control Room	50	89.9%	8,760	29.1	254,916	$ 19,629	Run constantly
Secondary Treatment	TF Pumping	Master Control Room	50	89.9%	8,760	14	122,640	$ 9,443	Run constantly
Final Effluent	Post Aeration	Master Control Room	20	87.5%	8,760	15.3	134,028	$ 10,320	Run 1 motor constantly
Other Processes	Gas Compressor	Master Control Room	15	86.5%	8,760	6.17	54,049	$ 4,162	Run 1 constantly
Plant Water Pumping	Plant Water Pump	Master Control Room	15	86.5%	8,760	6.17	54,049	$ 4,162	Run 1 pump constantly
Solids Handling	Sludge Pump	Master Control Room	7.5	84.3%	1,460	2.75	4,015	$ 309	Run 1 - 4 hours per day
Preliminary Treatment	Aerated Grit Blower	Master Control Room	7.5	84.3%	8,760	2.75	24,090	$ 1,855	Run 1 constantly
						TOTALS	1,085,081	$ 83,551	

Notes:

[1] All equipment listed is 3-phase.

[2] Energy demand determined by submetering or instantaneous power draw measurements and plant reports of operating hours.

[3] For influent pumps, operating hours determined using continuous submetering. All other operating hours information provided by plant staff.

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

[5] Costs based on average 2004 cost of $0.077/kWh.

3.5 SUMMARY OF ENTIRE SUBMETERING PROGRAM

FIGURE 3-5 summarizes the apparent electric energy usage distribution among the larger motors at the Lake Street Plant. TABLE 3-7 also presents the corresponding percentages of total electric energy usage.

Table 3-7: Summary of Major Equipment Total Estimated Electric Energy Usage and Cost at the Lake Street Plant

Equipment	Electric Energy Usage (kWh)	Cost*	Percentage of Total Cost
Influent Pumps	555,750	$ 42,793	36%
TF Pumping	377,556	$ 29,072	24%
Effluent Aerator	134,028	$ 10,320	9%
Plant Water Pump	54,049	$ 4,162	3%
Admin Building	29,064	$ 2,238	2%
Grit Tank Blower	24,090	$ 1,855	1%
Primary Clarifiers	10,808	$ 832	1%
Other	376,875	$ 29,019	24%
Total Cost	1,562,220	$ 120,291	100%

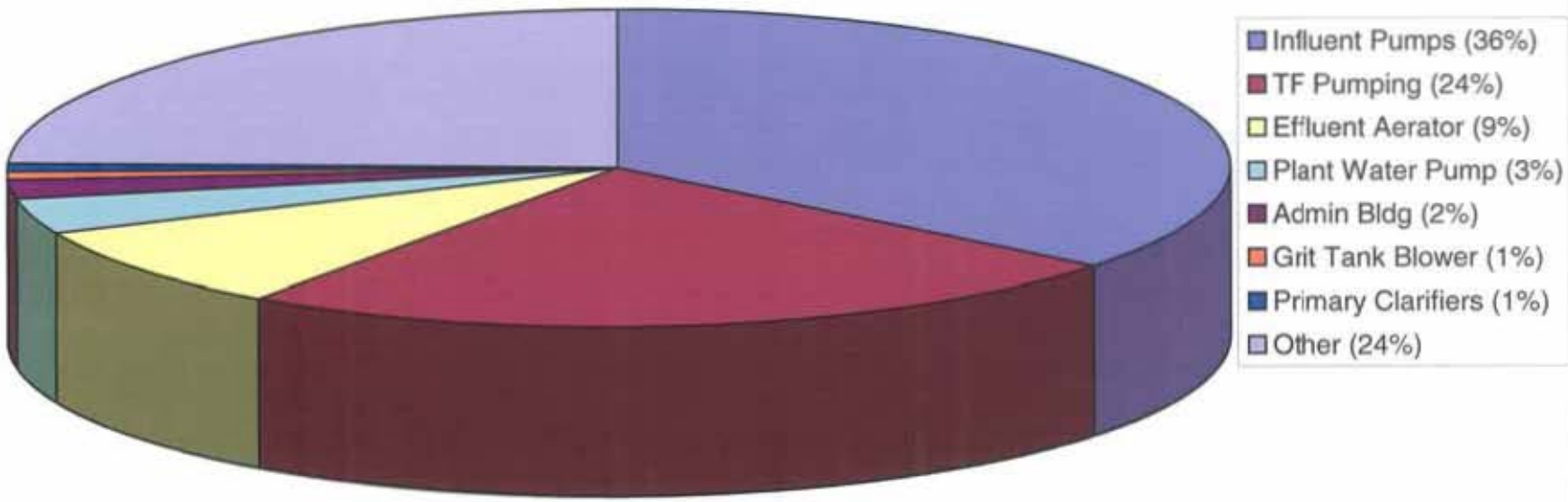
Note:
*Cost based on average 2004 electric rate of $0.077/kWh

The figure and table show that the largest "identified" uses of energy at the plant are the influent pumps and the trickling filter pumps. Approximately 24% of the total usage is accounted for as "other", which would involve equipment such as heating and ventilating fans, lights, solids dewatering, and other equipment with electric motors less than 5-hp that were not included as part of this submetering program. These ancillary processes and equipment represent a higher percentage of the total WWTP electric energy usage at smaller plants when compared to larger plants.

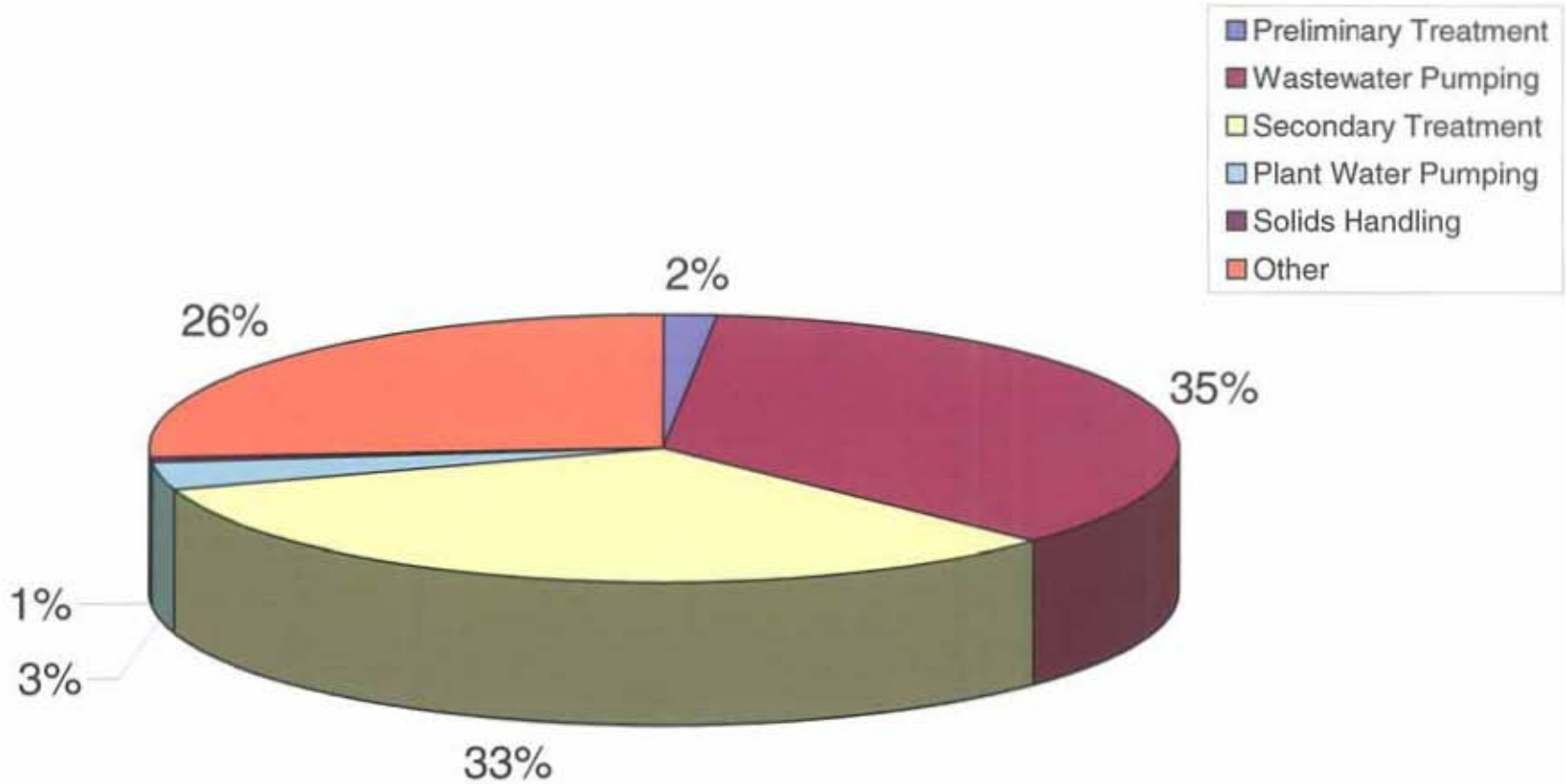
FIGURE 3-6 presents the distribution of estimated energy use among the major processes at the plant. Equipment was grouped into processes as follows:

- Wastewater Pumping – Influent wastewater pumps.
- Preliminary Treatment – Aerated grit blower.
- Primary Treatment – No major energy users noted.
- Secondary Treatment – Trickling filter pumps and effluent aerator.
- Plant Water Pumping – Plant water pump only.
- Solids Handling – Primary clarifier sludge pumps and sludge booster pump.
- Other – All other equipment not listed above, including dewatering equipment.

Wastewater pumping and secondary treatment account for the largest electrical use at the Lake Street Plant.



MALCOLM PIRNIE	NYSERDA MUNICIPAL WASTEWATER TREATMENT PLANT ENERGY EVALUATION CHEMUNG COUNTY SEWER DISTRICT #1 - LAKE STREET PLANT	FIGURE 3-5 ESTIMATED DISTRIBUTION OF ELECTRIC ENERGY USAGE AND COST



MALCOLM PIRNIE	NYSERDA MUNICIPAL WASTEWATER TREATMENT PLANT ENERGY EVALUATION CHEMUNG COUNTY SEWER DISTRICT #1 - LAKE STREET PLANT	FIGURE 3-6 DISTRIBUTION OF ELECTRIC ENERGY USAGE AMONG PROCESSES

Section 4

PROCESS PERFORMANCE DURING SUBMETERING

Process data were collected during the continuous submetering program. These data were compared to historical plant data to determine if plant operation and corresponding energy usage during submetering period could be considered typical for the Lake Street Plant.

4.1 SUMMARY OF PROCESS PERFORMANCE PARAMETER MONITORING

For the duration of the submetering program, the following process performance data were collected:

- Influent and effluent biochemical oxygen demand (BOD_5).
- Influent and effluent total suspended solids (TSS).
- Effluent dissolved oxygen (DO).

FIGURE 4-1 shows the influent and plant effluent BOD_5 concentrations during the course of the submetering program. The BOD_5 concentrations were measured twice per week during the submetering program. Influent BOD_5 concentrations do not seem to be highly affected by plant flow beyond the fact that the highest concentrations occurred during periods of relatively low flows. FIGURE 4-2 shows the relationship between BOD_5 loading (in pounds per day) and influent plant flow. The flow typically affects the loading to the plant, but due to a wide variation in influent BOD_5 concentration, the effects are not readily apparent in the graphical summary. In this case, the influent concentration has the largest affect on loading. The greatest loadings occur at relatively low flows and correspond to high influent concentrations.

FIGURES 4-3 and 4-4 show the TSS concentrations and loadings for the influent and plant effluent. TSS concentrations and loadings appear to follow trends similar to the BOD_5 concentrations and loadings regarding the high concentration, low flow, high loading relationship.

FIGURE 4-5 presents the DO concentrations for the plant effluent following the post-aeration tank. The data indicates relatively high DO concentrations in the effluent that appear to decrease over time. This decrease at the end of the period corresponds to the warm temperatures associated with the approach of summer. As the wastewater temperature increases, the solubility of oxygen decreases.

A follow-up sampling program was conducted from November 4, 2004 through November 17, 2004. The purpose of the sampling was to track daily BOD_5, TKN, and NH_3 concentrations through the trickling filters. Daily composite samples were collected from the following locations:

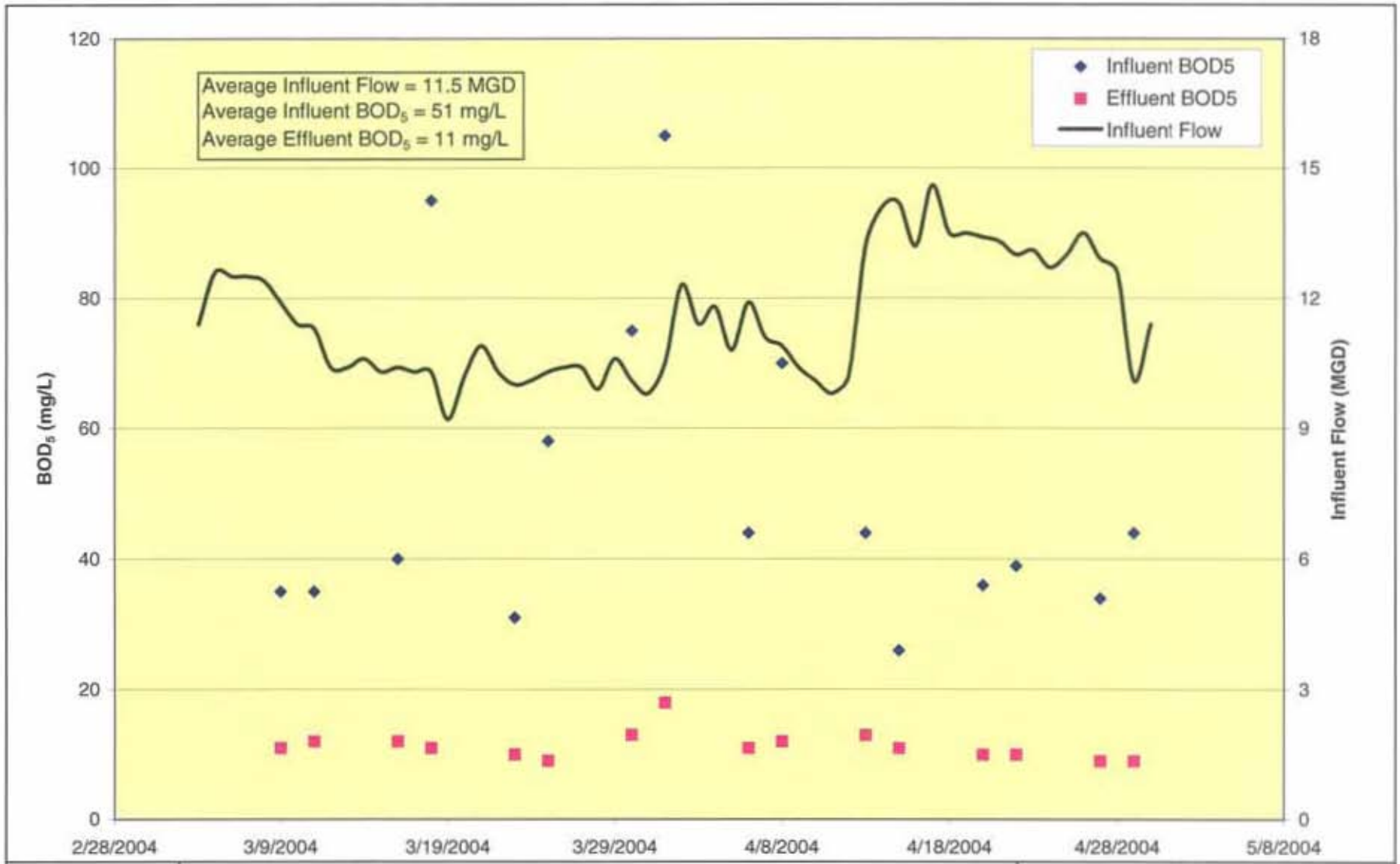


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FIGURE 4-1
SUBMETERING - BOD_5 vs INFLUENT FLOW

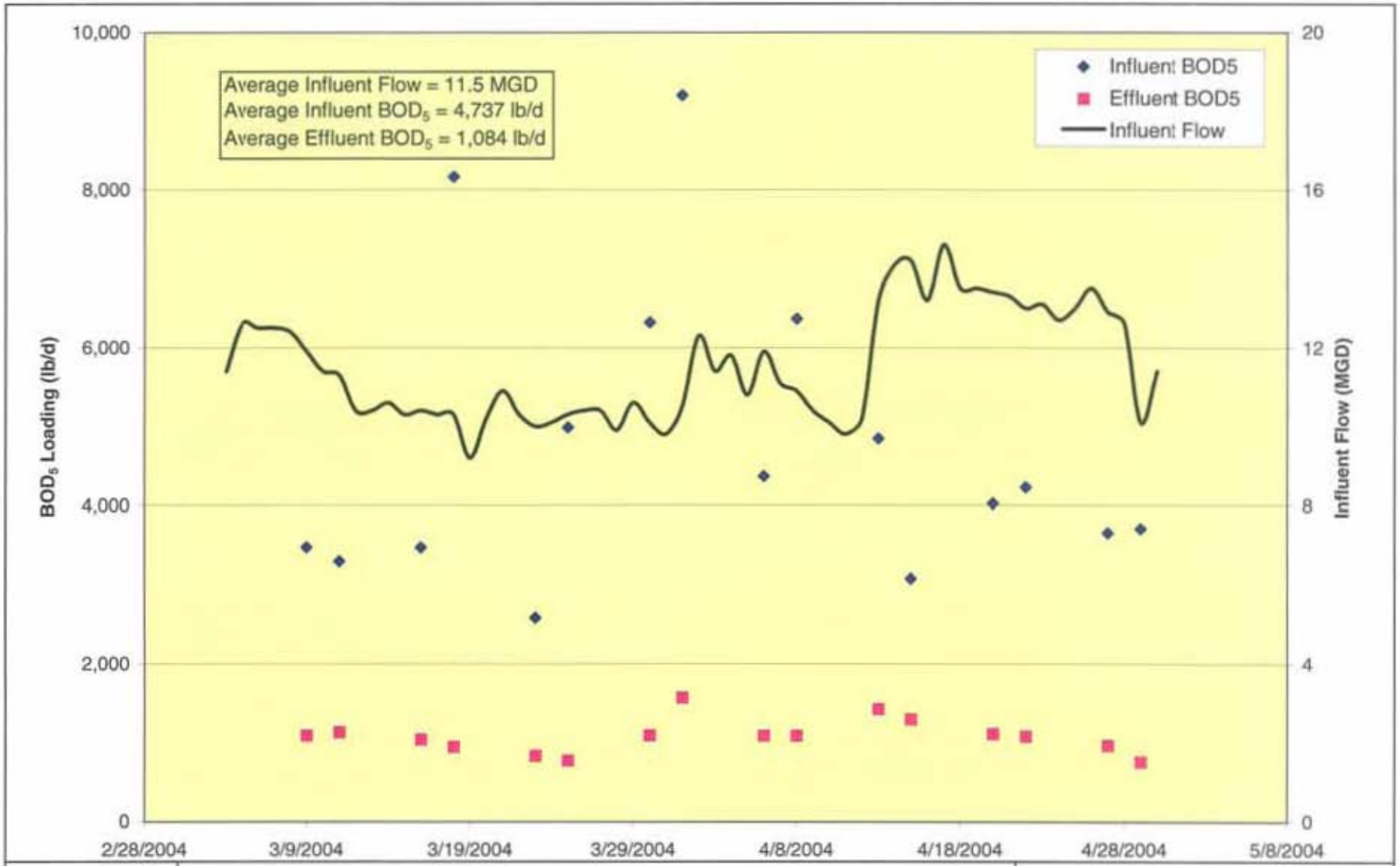

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FIGURE 4-2
SUBMETERING - BOD_5 LOADING vs INFLUENT FLOW

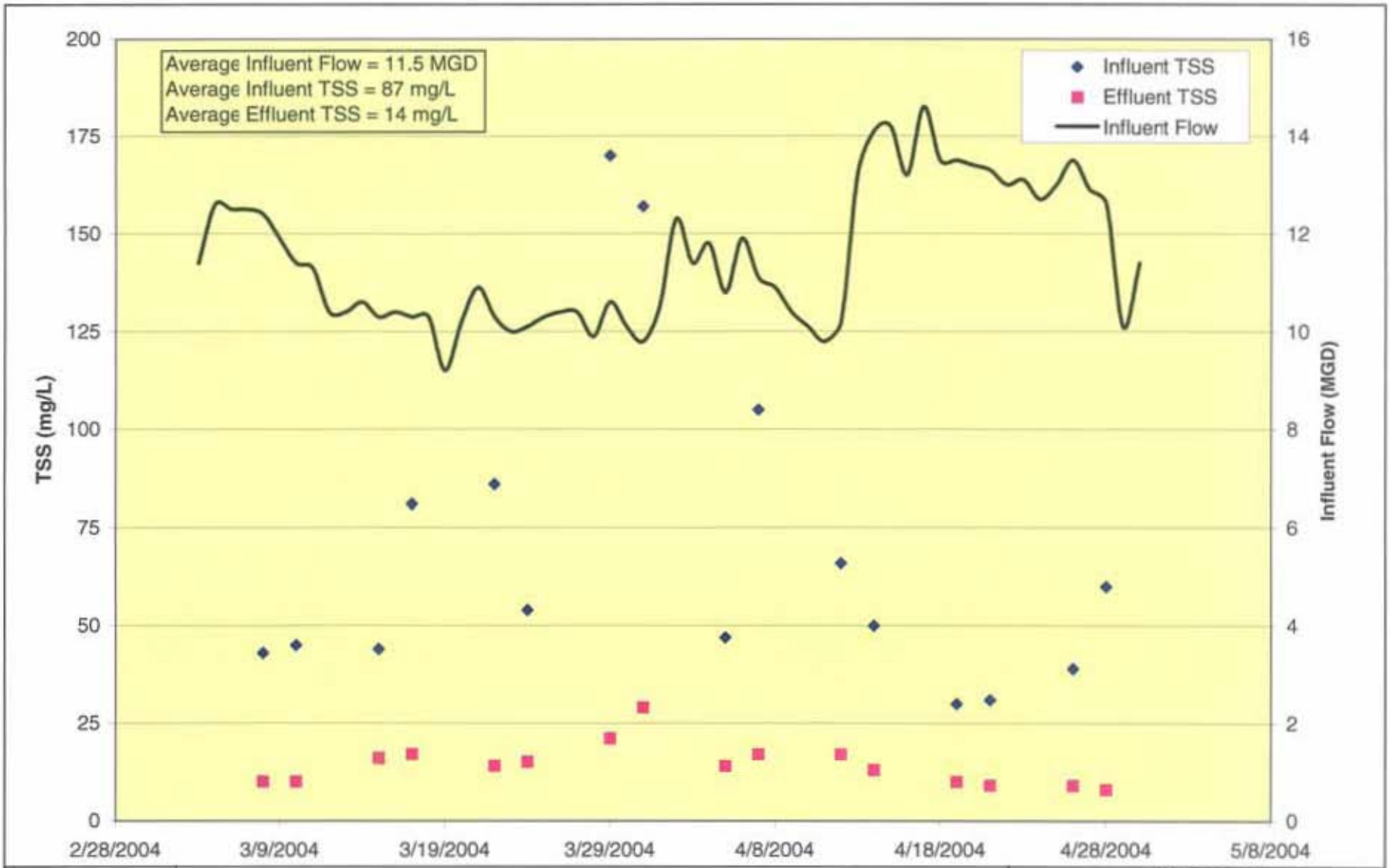

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FIGURE 4-3
SUBMETERING - TSS vs INFLUENT FLOW

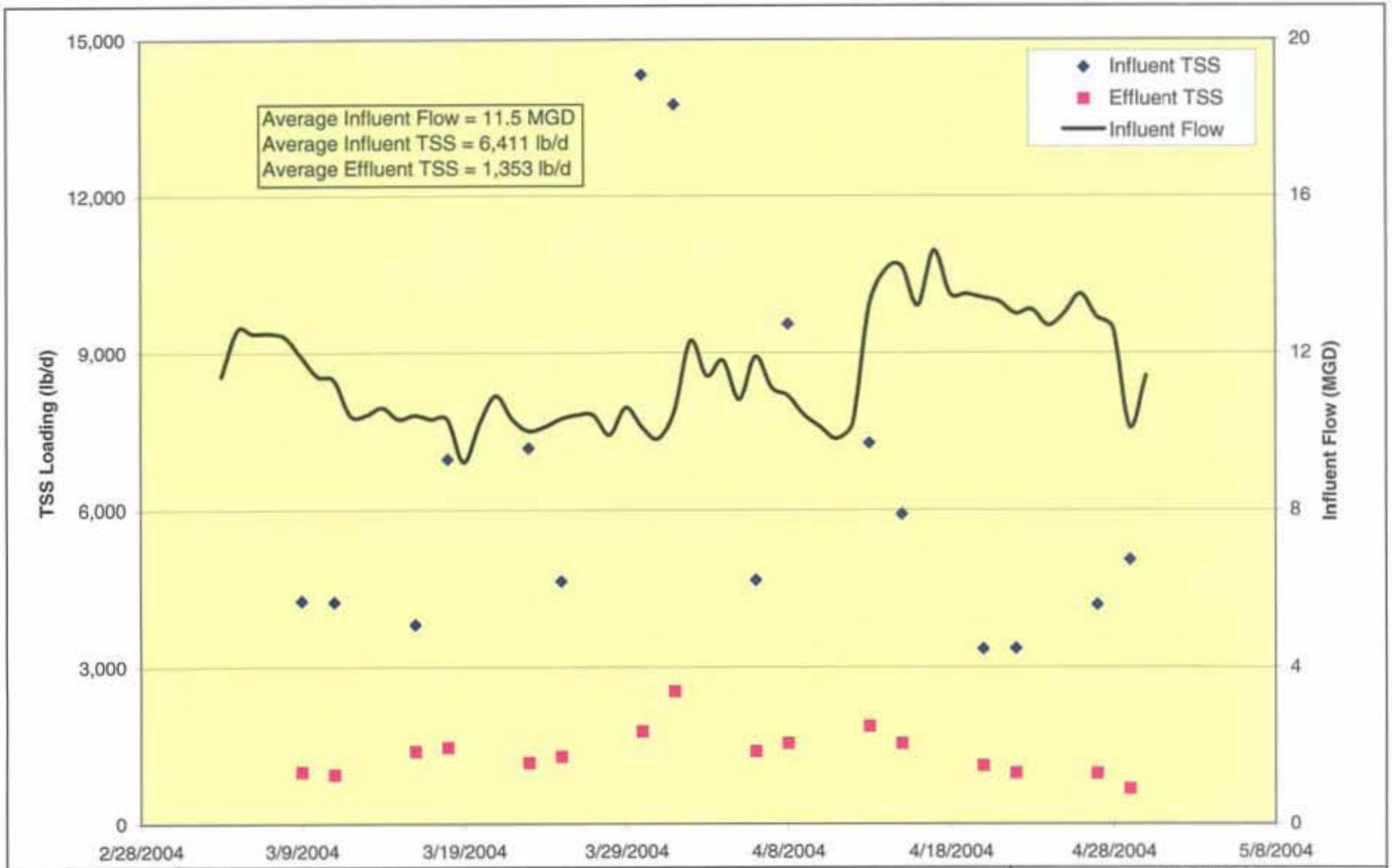

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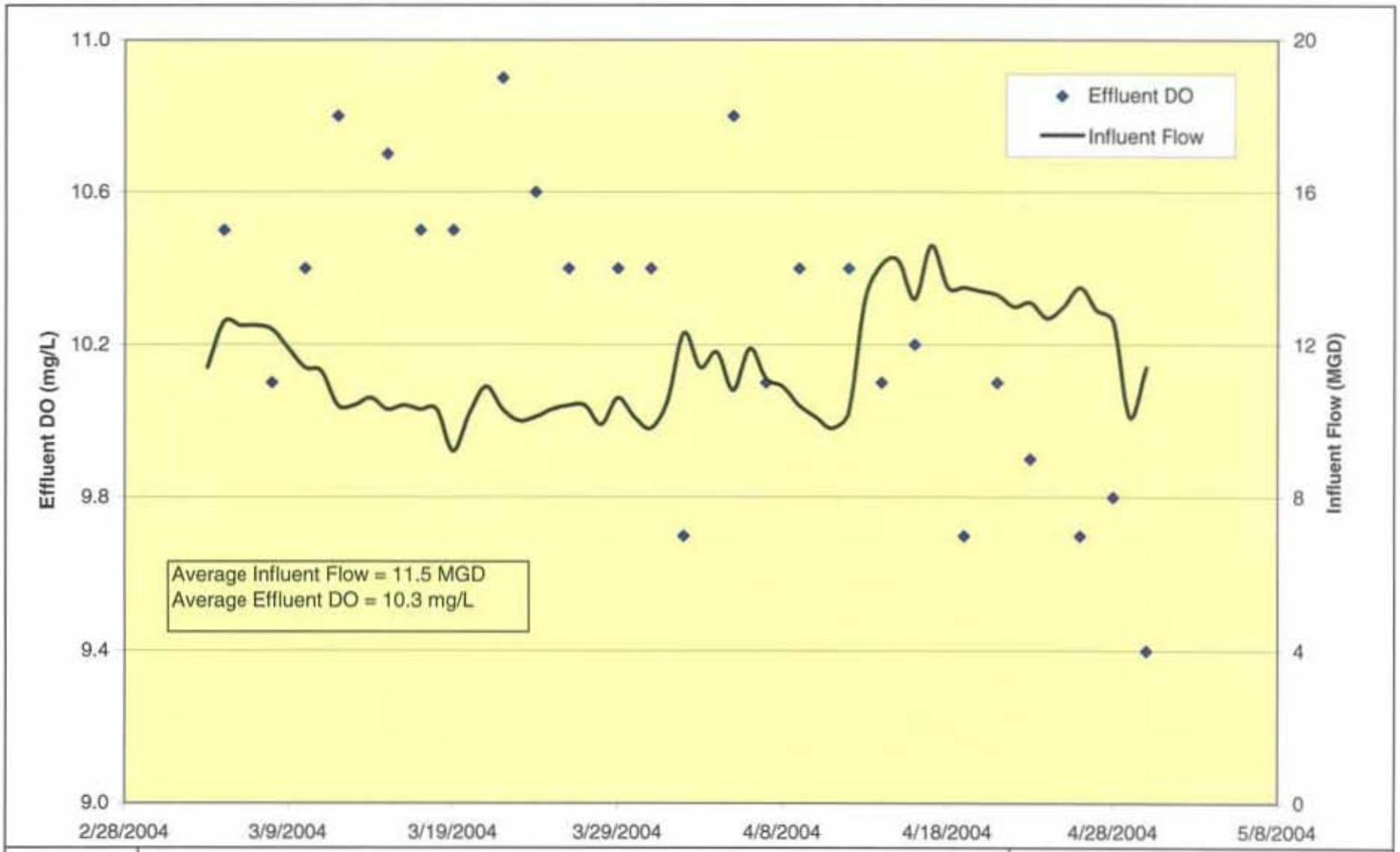
FIGURE 4-4
SUBMETERING - TSS LOADING vs INFLUENT FLOW



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CHEMUNG COUNTY SEWER DISTRICT #1 - LAKE STREET PLANT

FIGURE 4-5
SUBMETERING - EFFLUENT DO vs INFLUENT FLOW

- Primary effluent.
- Trickling filter 1 (TF 1) effluent.
- Trickling filter 2 (TF 2) effluent.

FIGURE 4-6 shows the BOD_5 concentrations at each location over the sampling period. There is no definitive relationship between influent flow and BOD_5 concentration, although a spike in the BOD_5 concentration did occur on November 11, 2004 as the flow began to decrease. FIGURE 4-7 presents the BOD_5 loadings, which do not seem to be affected by the flow rate. Loading is often dependent upon the flow rate, but in this case the flow was relatively steady, ranging from 6.05 to 7.77 MGD. The average BOD_5 removal of the trickling filters (influent of TF 1 to effluent of TF 2) during the sampling period was 54%.

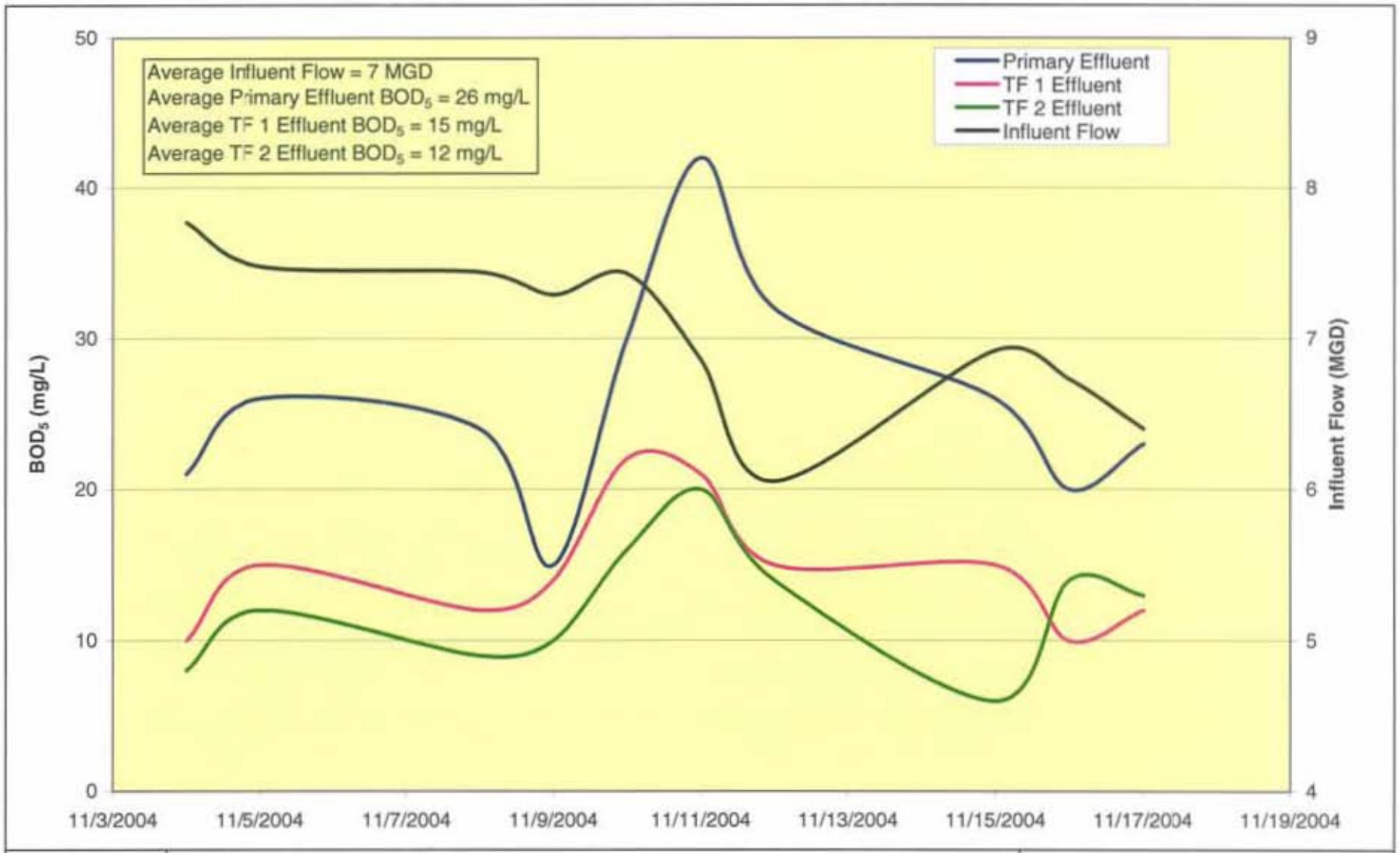
FIGURES 4-8 and 4-9 show the TKN concentrations and loadings for the three sampling locations. Similar to the BOD_5 results, there are no definitive trends observed. The average TKN removal of the trickling filters (influent of TF 1 to effluent of TF 2) during the sampling period was 42%.

FIGURES 4-10 and 4-11 present the NH_3 concentrations and loadings, which follow trends similar to the TKN concentrations and loadings. The average NH_3 removal of the trickling filters (influent of TF 1 to effluent of TF 2) during the sampling period was 60%.

In addition to the BOD_5, TKN, and NH_3 sampling, dissolved oxygen (DO) concentrations were recorded every two hours for a period of two days. The sampling dates were November 9 and 10, 2004. DO readings were taken at the following locations:

- Plant influent.
- Secondary tank effluent.
- Plant effluent.

A summary of DO concentrations is presented in FIGURE 4-12. The figure shows that much of the variability of the influent DO concentrations is dampened out through the final mechanical aeration step. The DO concentrations of the secondary clarifier effluent were above 6 mg/L, which is the "summer" season SPDES effluent limit. The sampling was conducted during the "winter" season when DO solubility is higher and biological activity is lower, so the results may not be indicative of the summer conditions.



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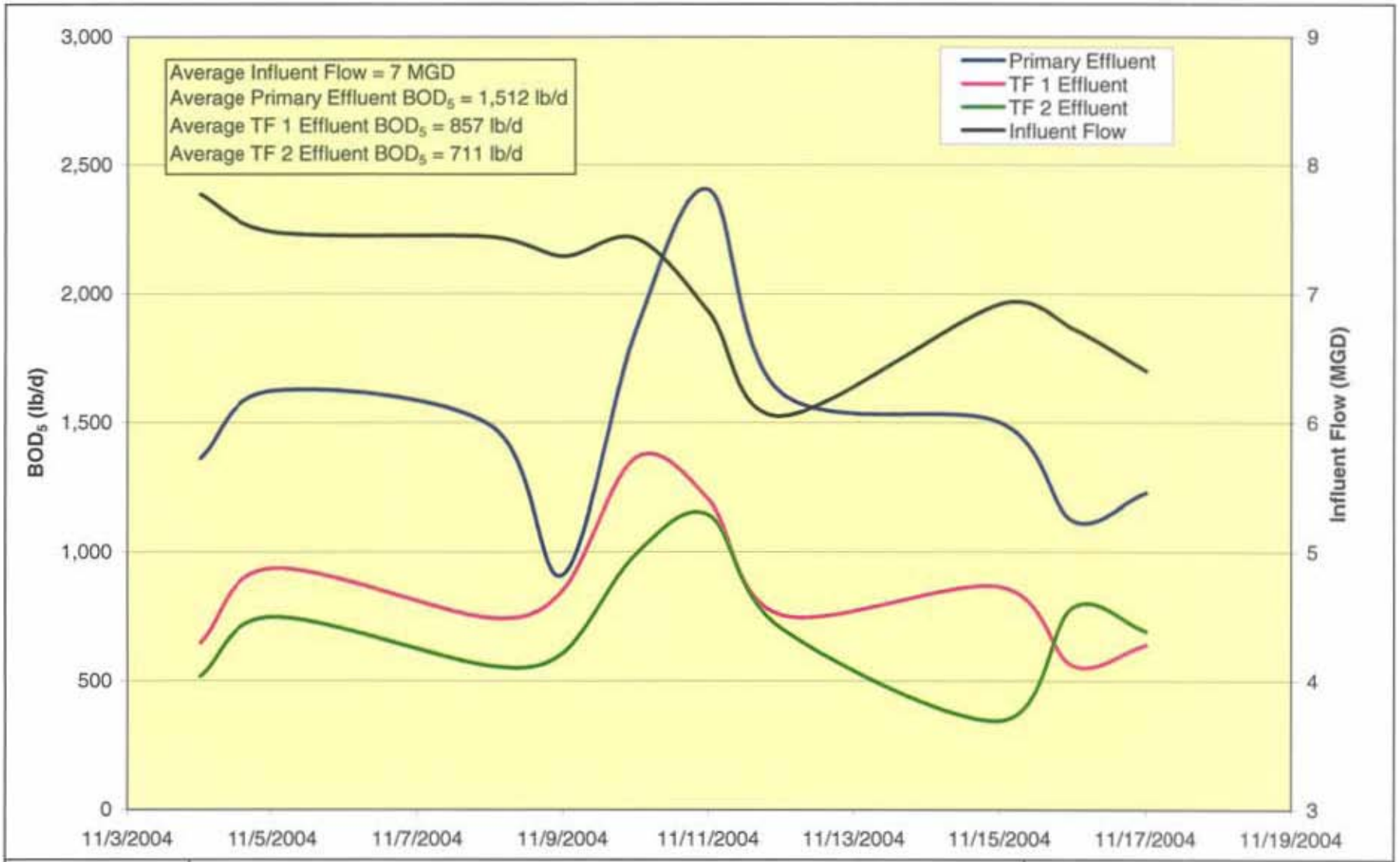
CHEMUNG COUNTY SEWER DISTRICT #1 - LAKE STREET PLANT

FIGURE 4-6
ADDITIONAL SAMPLING - BOD_5 vs INFLUENT FLOW



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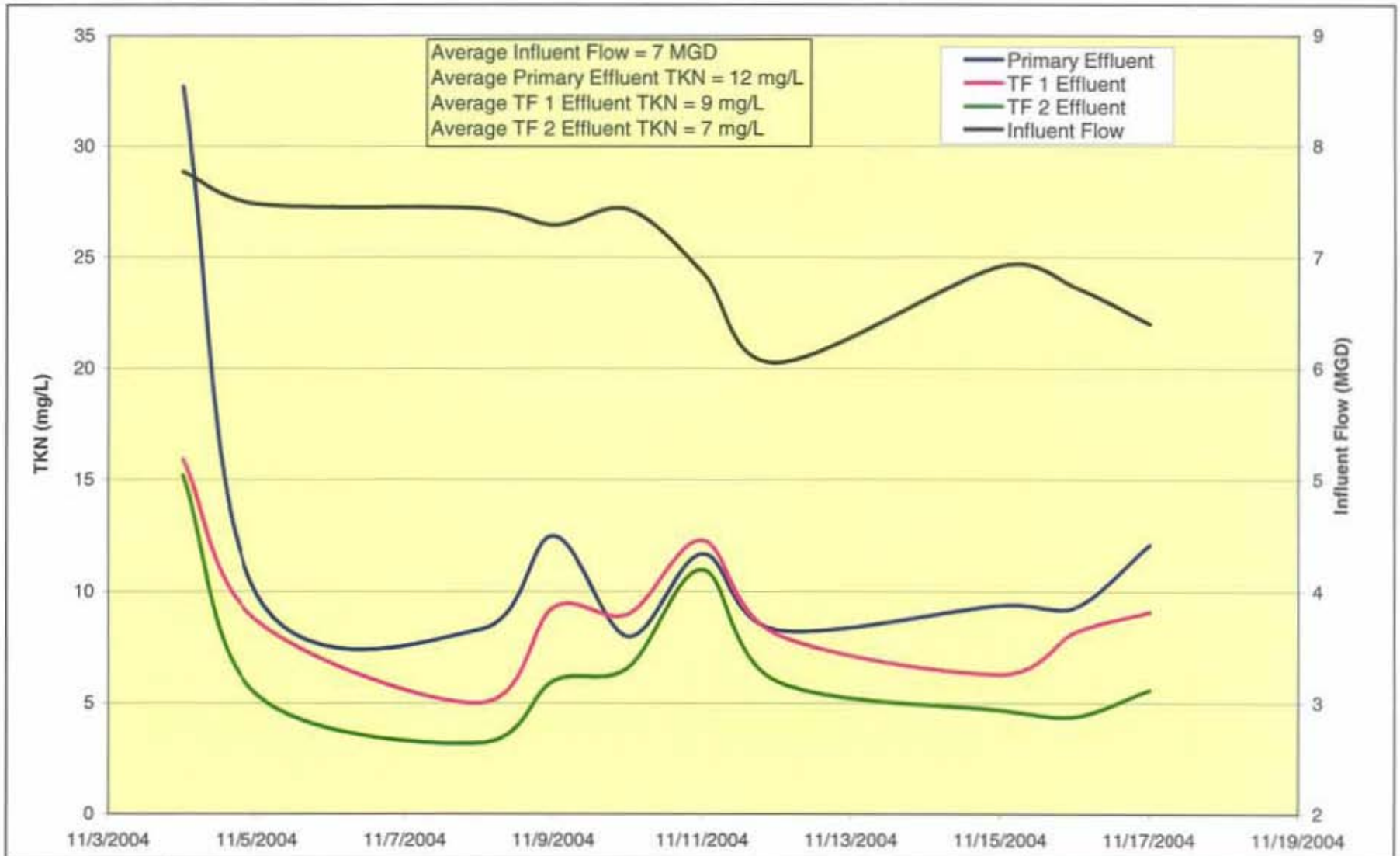
CHEMUNG COUNTY SEWER DISTRICT #1 - LAKE STREET PLANT

FIGURE 4-7
ADDITIONAL SAMPLING - BOD_5 LOADING vs INFLUENT FLOW



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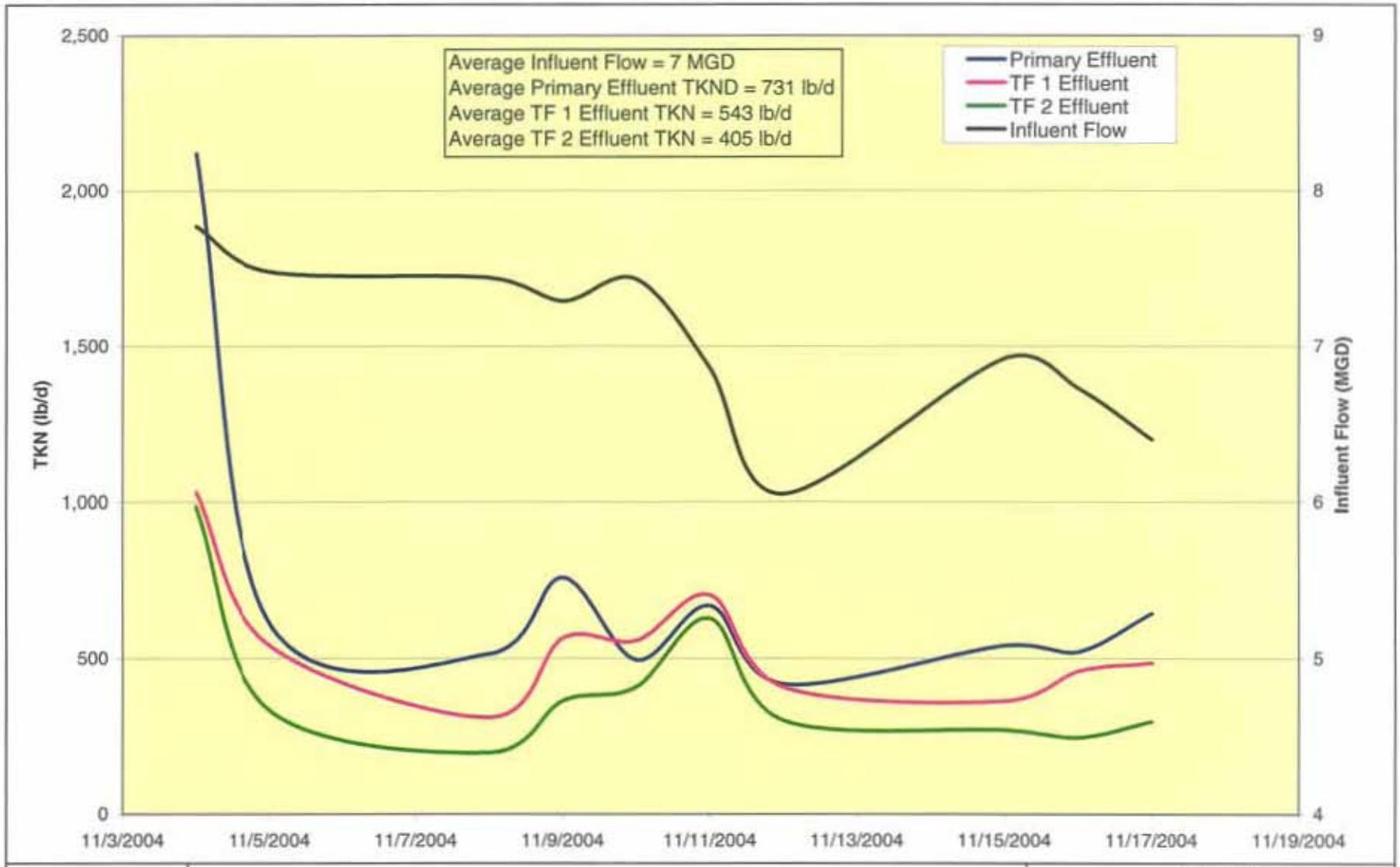
CHEMUNG COUNTY SEWER DISTRICT #1 - LAKE STREET PLANT

FIGURE 4-8
ADDITIONAL SAMPLING - TKN vs INFLUENT FLOW



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CHEMUNG COUNTY SEWER DISTRICT #1 - LAKE STREET PLANT

FIGURE 4-9
ADDITIONAL SAMPLING - TKN LOADING vs INFLUENT FLOW

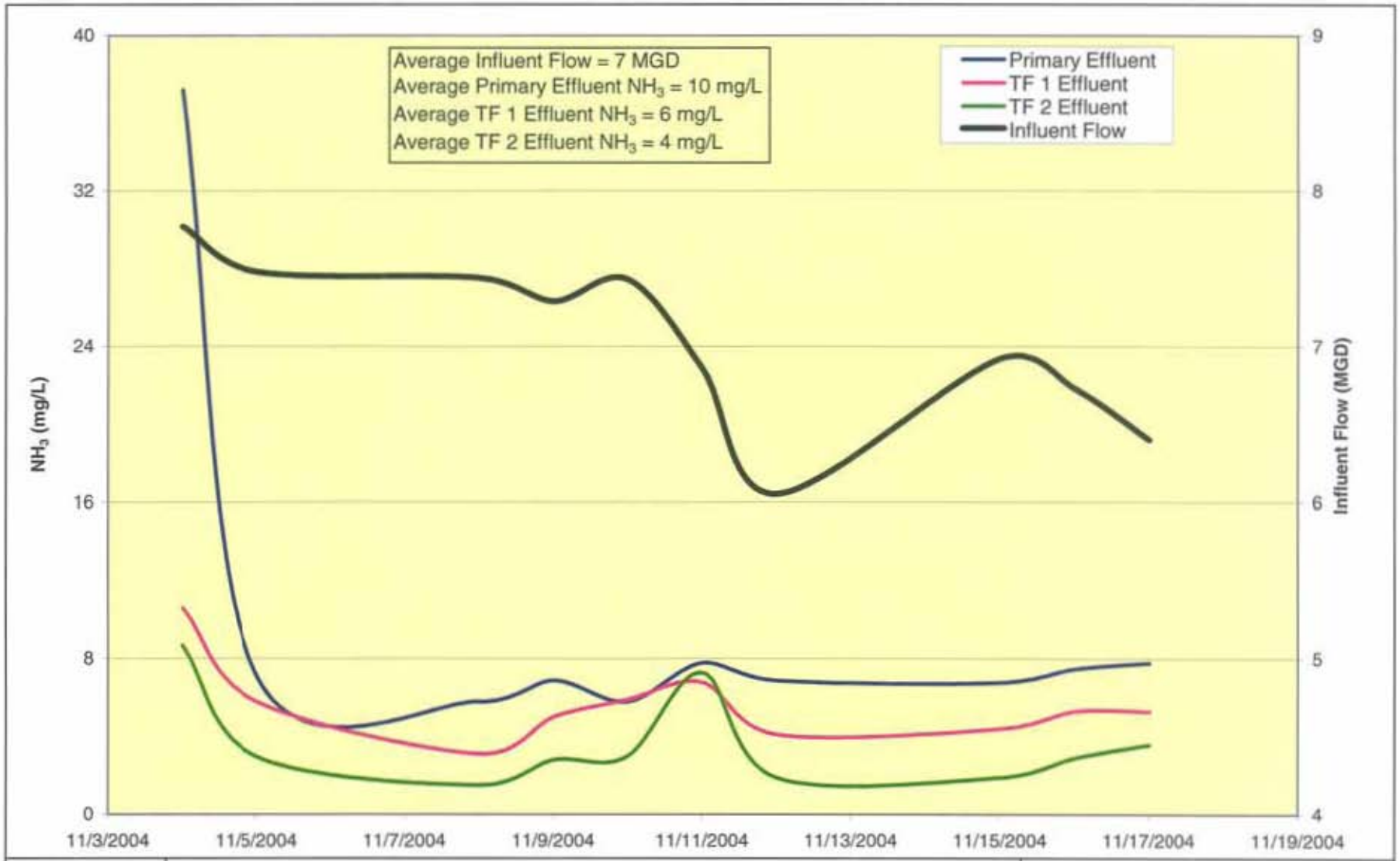

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FIGURE 4-10
ADDITIONAL SAMPLING - NH_3 vs INFLUENT FLOW

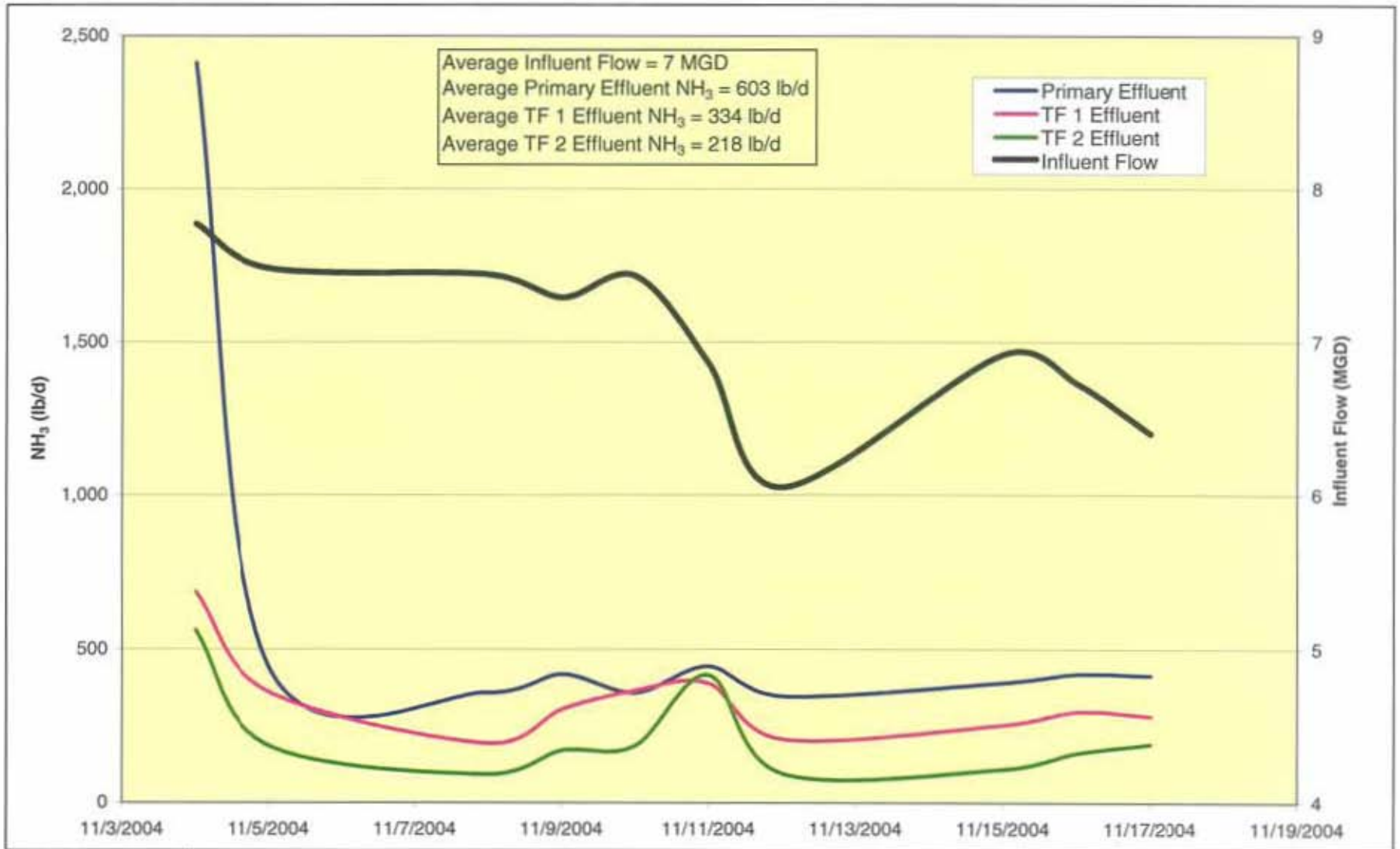

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FIGURE 4-11
ADDITIONAL SAMPLING - NH_3 LOADING vs INFLUENT FLOW

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FIGURE 4-12
ADDITIONAL SAMPLING - PLANT DO SUMMARY

4.2 RELATIONSHIP BETWEEN PLANT PROCESS DATA AND SUBMETERING DATA

4.2.1 Influent Wastewater Pumps

The Lake Street Plant has three separate wastewater influent pumps. The three pumps are as follows:

- Main Sewage Pump 1 – 30 hp.
- Main Sewage Pump 2 – 50 hp.
- Main Sewage Pump 3 – 60 hp.

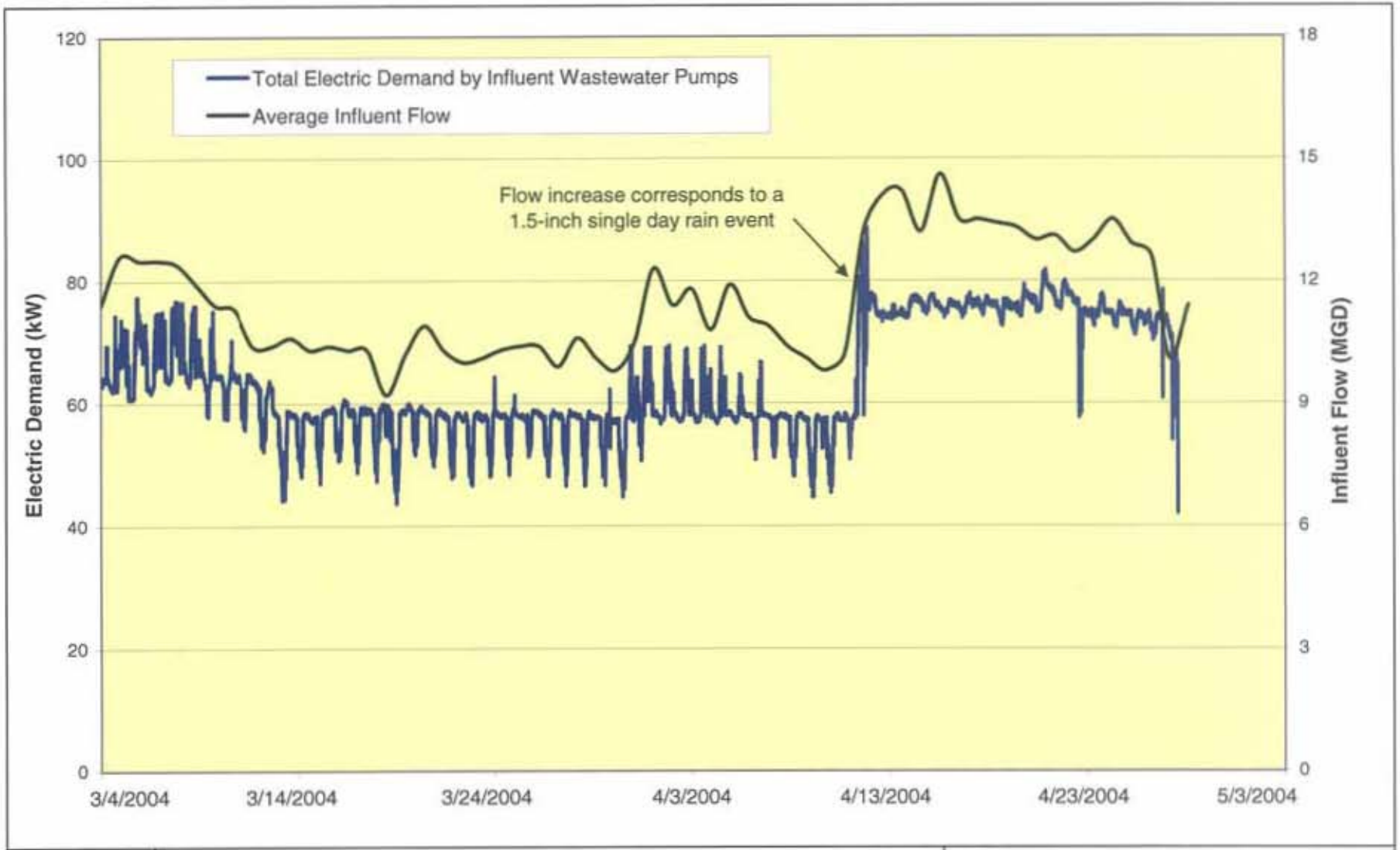
The pumps operate at 480 volts and constant speed. The pumps are cycled on as needed based on the level of wastewater in the influent wet well. Electric energy usage for each pump was recorded in 5-minute intervals during the submetering period (March 4, 2004 to April 30, 2004).

Total energy demand for the influent wastewater pumps is the algebraic sum of the energy demand for wastewater pumps 1, 2, and 3. FIGURE 4-13 shows a comparison of the average daily influent flow and the total electric energy demand from the three wastewater pumps during the submetering period. During this period the flow ranged from approximately 8 MGD on March 19, 2004 to a peak of 16 MGD on April 13, 2004. The figure shows a strong correlation between total influent flow and electric energy usage indicating that the electric energy usage by the main wastewater pumps is dependent upon flow rate, i.e., the greater the influent flow, the greater the pumps' electric energy usage.

A sharp increase in the total pump energy usage was observed on April 13, 2004. The increase corresponds to a rainfall event that recorded nearly 1.5 inches of rain in a single day, resulting in a substantial increase in influent wastewater flow. This suggests that wet weather events contribute to significant increases in influent flow and subsequently, electric energy usage by the influent wastewater pumps.

4.2.2 Trickling Filter Pumps

A total of two 50-hp trickling filter pumps operate on a continuous basis. Each pump operates at a continuous speed with a design capacity of 9.5 MGD. Since the pumps run continuously at a constant speed, the instantaneous power draw measurements for each pump are sufficient to determine the total electric energy usage over the entire year. The pump operation and electric energy usage are not affected by influent flows or loadings. Based on the instantaneous data and operation schedule, the estimated annual electric energy usage is 377,556 kWh.



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CHEMUNG COUNTY SEWER DISTRICT #1 - LAKE STREET PLANT

FIGURE 4-13
AVERAGE INFLUENT FLOW vs TOTAL INFLUENT
WASTEWATER PUMP ELECTRIC DEMAND

4.2.3 Post-Aeration Motor

The mechanical aerator used for post-aeration is driven by a 20-hp motor that is operated at a constant speed on a continuous basis. Therefore, the instantaneous power draw measurement is sufficient to determine the total electric energy usage over the entire year. Based on the instantaneous data and operation schedule, the estimated annual electric energy usage is 134,028 kWh. It should be noted that the DO in the secondary effluent, prior to the post-aeration tank, was over 6 mg/L during the additional sampling conducted in November 2004. Although the seasonal SPDES limit of 6 mg/L ends in October, the data suggest that it may be worthwhile to monitor the secondary effluent during the SPDES regulated period to determine whether post-aeration is always necessary. The sampling was conducted during the "winter" season when DO solubility is higher and biological activity is lower, so the results may not be indicative of the summer conditions.

4.2.4 Plant Water Pump

The plant water pump supplies treated effluent for use in other processes at the plant. The pump is driven by a 15-hp motor that operates at a constant speed on a continuous basis. Therefore, the instantaneous power draw measurement may be sufficient to determine the total electric energy usage over the entire year. Based on the instantaneous data and operation schedule, the estimated annual electric energy usage is 54,049 kWh.

4.2.5 Aerated Grit Tank Blower

The aerated grit tank blower supplies the air that aids in separating grit from the plant influent. The blower is driven by a 7.5-hp motor that operates at a constant speed on a continuous basis. Therefore, the instantaneous power draw measurement may be sufficient to determine the total electric energy usage over the entire year. Based on the instantaneous data and operation schedule, the estimated annual electric energy usage is 24,090 kWh.

4.2.6 Other Equipment

Other equipment at the plant includes:

- Lighting.
- HVAC equipment.

- Grit collectors.
- Solids handling equipment.

4.3 SUMMARY OF PROCESS PERFORMANCE

The energy demand measured at the selected equipment was compared to the plant process performance during the monitoring period. Overall, the plant performance was satisfactory; however, the BOD_5 and TSS removal efficiencies averaged only at 78% and 84%, respectively (as compared to the 85% removal requirement in the plant's SPDES permit). It should be noted that the BOD_5 and TSS concentrations entering the plant during the period were relatively low and influent flows were relatively high, making it more difficult to achieve high removal efficiencies. All of the BOD_5 and TSS effluent concentrations and loadings were below the SPDES 30-day mean concentration and loading limits.

As previously discussed in Section 3, the influent wastewater pumps are the largest electric energy consumer at the facility. The electric energy usage is directly related to the influent flow rate to the plant.

The second highest electric energy consumers are the trickling filter pumps. The pumps currently operate at a constant speed and operate independent of the influent flow rate.

During the submetering period, the Lake Street Plant consumed an average of 3,254 kWh per day, with an average influent flow of 11.5 MGD. The standardized electric consumption of the major unit processes at the plant, or energy used per MG of wastewater treated, was 283 kWh/MG.

The plant removed 3,653 lb/d BOD_5. The energy used per pound of BOD_5 removed was 0.89 kWh/lb BOD_5.

Section 5

ENERGY SAVINGS MEASURES THROUGH CAPITAL IMPROVEMENTS

5.1 CAPITAL IMPROVEMENT ALTERNATIVES TO REDUCE ENERGY USAGE AND COSTS

5.1.1 Replacement of Constant Speed Motors with Premium Efficiency Motors

The raw wastewater pumps and trickling filter pumps are mostly original equipment, with 1962 standard efficiency motors. There are one 60-horsepower (hp), four 50-hp, and one 30-hp motors. One of the 50-hp trickling filter motors rarely operates but the rest run on a nearly continuous basis throughout the year. One of the 50-hp trickling filter recycle pumps is a newer pump and should not require replacement. The National Electrical Manufacturers Association (NEMA) has set forth a specification providing minimum efficiencies that must be met to term a motor "energy efficient" or "premium efficiency". TABLE 5-1 presents standard efficiencies as well as typical premium efficiencies for the various horsepower motors.

Table 5-1: NEMA Efficiency Ratings for Standard and Premium Efficiency Motors

Motor Size	Standard Efficiency (Existing Motors)	NEMA Premium Efficiency (Proposed Motors)
60 hp	90.3%	94.5%
50 hp	89.9%	94.3%
30 hp	88.1%	93.6%

Based on this evaluation, it may be cost-effective to consider replacement as a beneficial, energy-savings opportunity.

5.1.2 Replacement of Current Pumps with Higher Efficiency Pumps

The "wet end" efficiencies of the raw wastewater pumps were also evaluated. In order to determine the pump efficiency, the "wire-to-water" efficiencies of the pumps and motors were estimated based on actual power usage, flow, and total dynamic head. The "wet end" pump efficiency was then estimated based on the measured "wire-to-water" efficiencies and assumed motor efficiencies. The overall "wire-to-water" efficiency was determined to be in the range of 65% to 70% for motors and pumps. Based on a motor efficiency 88%, the pump efficiency ranges from 74% to nearly 80%, which is good for non-clog impellers capable of handling the solids content associated with raw influent. Since the current pump efficiency is relatively high, it was determined that there would not be any energy savings associated with pump replacement.

5.1.3 Reduction of Trickling Filter Pumping Rates

The trickling filter pumps currently operate continuously at a constant speed. The pumps operate at a rate of 9.5 million gallons per day (MGD), which equals the rated capacity of the plant. The flow to the trickling filters enters a flow splitter structure where it is pumped to the top of the filters for distribution. Because all flow is taken from and returned to the flow splitter, the actual recycle rate is equal to the 9.5 MGD flow rate of the pumps minus the actual flow to the box from the primary clarifiers.

In order to reduce electric energy usage, two seasonal operating scenarios are suggested:

- In-series operation with a 30% recycle rate (up to a maximum flow of 9.5 MGD) during the period from June to October.
- In-parallel operation with a fixed 4.75 MGD flow rate to each trickling filter from November to May.

Series operation in the June to October period is maintained in order to facilitate ammonia (NH_3) removal (nitrification) in the second stage. The recycle rate can be maintained at 30% by installing a variable frequency drive (VFD) that would pace the recycle pumps based on the influent flow to the plant. Based on the average daily influent flow rates and the 30% recycle, the hydraulic loading to the trickling filters would remain in the range of 0.16 gallons per minute per square foot (gpm/ft^2) to 0.48 gpm/ft^2, which is consistent with loadings typically associated with high rate trickling filters.

Parallel operation is recommended for the period from November to May since the ammonia loadings in the effluent are not limited in the SPDES permit. The VFDs can be used to maintain a set flow rate of 4.75 MGD to each of the trickling filters. It should be noted that the average influent flow for the month of April is 10.3 MGD. In order for the trickling filters to treat all flow during this month, the average flow to each would have to be increased to 5.15 MGD.

In order to determine the effect of the recycle rate and parallel operation, the trickling filters were modeled using the National Research Council (NRC) equations, which were developed, based on extensive analysis of operational records from stone media trickling filter plants serving military installations. The equations estimate both the first and second stage removal efficiencies based on biochemical oxygen demand (BOD_5) loading, media volume, and recycle ratio. In order to use the NRC equations, several assumptions were made:

- BOD_5 removal through the primary clarifiers ranged from 15% to 30%. The values were based on the overflow rate to the primary clarifiers as well as the relatively low influent BOD_5 concentrations.
- For series operation, the calculated removal efficiency for the second stage trickling filter (TF 2) was reduced by a factor of 0.5 to 0.6 due to the lack of an intermediate clarification step as well as the relatively low influent BOD_5 concentrations. The reduction factor was based on actual removal efficiencies measured at the Lake Street Plant.

Average monthly influent flow and influent BOD_5 concentrations were used to determine the removal efficiencies for each month of the year. The model was set up to estimate removals under the current operating conditions as well as both series operation with 30% recycle flow and parallel operation. The estimated BOD_5 concentrations for the effluent of TF 2 under series operation were then compared to the measured BOD_5 concentrations in the plant effluent. A similar comparison was made based on the trickling filter effluent under parallel operation. A summary of the data and modeling results is presented in TABLE 5-2.

Table 5-2: Modeled Trickling Filter BOD_5 Effluent Concentrations

Month	Flow (MGD)	Concentrations (mg/L)			
		Measured Average		Modeled Trickling Filter Effluent	
		Influent BOD_5	Effluent BOD_5	Current Operation	Modified Operation*
Jan	5.8	109.9	12.0	12.2	*14.7*
Feb	5.9	116.0	11.0	13.4	*16.0*
Mar	7.7	74.0	12.0	9.7	*10.5*
Apr	10.3	48.3	9.6	8.6	*7.1*
May	8.0	65.8	9.4	8.4	*9.2*
Jun	8.4	58.8	8.5	7.4	7.4
Jul	6.3	77.0	9.1	7.8	8.2
Aug	6.2	87.5	8.2	9.3	9.8
Sep	5.3	102.5	8.3	10.3	11.4
Oct	5.0	95.2	8.7	8.8	10.0
Nov	5.7	98.8	10.5	9.2	*12.4*
Dec	7.3	87.3	10.8	9.8	*12.8*

Note:
*Modified operations in parallel indicated by italics (November through May). In series operations June through October.

As shown in the table, the modeled TF 2 effluent concentrations were very close to the measured BOD_5 concentrations in the plant effluent. The 30% recycle flow caused the TF 2 effluent concentrations to

increase by an average of 0.6 milligrams per liter (mg/L). The parallel operation caused the trickling filter effluent concentrations to increase by an average of 1.6 mg/L. All BOD_5 concentrations are well below the SPDES permit 30-day arithmetic mean concentration of 25 mg/L. The maximum effluent loading of 787 pounds per day (lb/day) occurring in February is well below the 30-day mean limit of 1,981 lb/day. Therefore, in terms of effluent loading and concentration limits, the elimination of recycle is a viable option. The permit also states that a removal efficiency of 85% must be maintained through the plant. Based on actual data, the removal efficiencies under current operation can drop below this value in wet weather months with high flows and diluted influent (such as March and April). Although based on the modeling results the alternative operations could maintain a removal efficiency of 85% for both months, this may not be the case in real life as the model predicts the same for current conditions. However, the difference in the model-predicted performance is negligible, and it is likely that the modified operations will result in the same level of performance as the current conditions. Additional seasonal testing of the trickling filter effluent will be necessary to verify performance. If the modified operations result in further reduction of removal efficiency during wet weather months, then there may be some advantage to maintaining existing operations during these months. Both the reduction in recycle flows from June to October and parallel operation from November to May should meet the treatment levels required and reduce electric energy usage.

5.1.4 Effluent Mechanical Aerator Control

Secondary effluent is aerated prior to discharge from the plant. Aeration is accomplished through the use of a mechanical aerator. Historical effluent dissolved oxygen (DO) concentrations average at approximately 9.4 mg/L. According to the SPDES permit, the effluent DO is seasonally regulated. The permit states that the effluent DO must be greater than 6 mg/L between the months of June and October. The average effluent DO of 9.4 mg/L is substantially higher than this limit. The average effluent DO concentrations are very close to saturation and it is expected that a good deal of electric energy is used on unnecessary mixing. A calculation of the required DO loading was performed based on the average wastewater flow rate and the difference between a conservative DO concentration for the secondary effluent coming into the post-aeration tank and the permitted level required for the effluent. Although the sampling data indicates that the DO of the wastewater entering the post-aeration tank was at or above 6 mg/L in November, an inlet value of 2 mg/L was assumed for this evaluation in order to provide sufficient oxygen supply during warm weather. The difference in concentration is 4.0 mg/L and based on an average flow rate of 6.8 MGD, this corresponds to an oxygen (O_2) loading requirement of 230 lb/d. Based on this evaluation, it would appear that the current mixer does not need to operate at full capacity at all times, and opportunity exists for turn-down during periods of lower oxygen requirements.

5.1.5 Effluent Mechanical Aerator Replacement

A fine bubble diffuser system was considered as a more efficient aeration method to replace the current effluent mechanical aerator. The following parameters were used to size the system:

- Peak Monthly Flow - 10.3 MGD
- Diffuser Depth - 7 feet
- Desired Final DO Concentration - 7 mg/L
- Blower Efficiency - 80%

Based on these parameters and the conservative assumption that the inlet DO to the final aeration step is 2 mg/L, a total of 482 cubic feet per minute (cfm) would be required to maintain the effluent DO concentration above the permit threshold for the entire year. In order to achieve and maintain the desired flowrate, the blower would be equipped with a 15-hp motor.

5.2 ESTIMATE OF ENERGY USAGE, DEMAND, AND COST SAVINGS

5.2.1 Replacement of Constant Speed Motors with Energy Efficient Motors

TABLE 5-3 summarizes the current and future energy use and cost savings associated with upgrading the motors on select pumping equipment. By replacing the largest motors with premium efficiency motors, it is estimated that approximately 51,324 kilowatts per hour (kWh) of electric energy use will be saved each year, corresponding to an annual cost savings of $3,952.

5.2.2 Reduction of Trickling Filter Pumping Rates

Energy savings related to reducing trickling filter pumping rates were evaluated based on the current average flow rates and associated electric energy usage. The current recycle pumps operate at a constant rate of 9.5 MGD at an electric energy demand of 29.1 kilowatts (kW), yielding a total annual electric energy usage of 254,916 kWh per pump for a total of 509,832 kWh. The "wire-to-water" efficiency of the current pumps is approximately 77%. In order to determine annual electric energy savings separate estimates were made based on the filter operation in series with a 30% recycle rate and in parallel. The average influent flow rate from June to October was 6.2 MGD. Adding a 30% recycle yields a trickling filter flow rate of 8.0 MGD. Based on a pump efficiency of 72% at 8.0 MGD, the average electric energy demand for each pump is approximately 24.4 kW, equating to an average electric energy demand reduction

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Table 5-3: Replacement of Selected Motors with Premium Efficiency Motors[1]

Process	Use	MCC Location	Quantity	Size (hp)	Estimated Operating Hours Per Year	Current Motor Operation				Premium Efficiency Motor Operation				Energy Savings	
						Efficiency Rating[2]	Power Draw per motor (kW)	Estimated Annual Electric Energy Usage (kWh)	Estimated Energy Cost[4]	Premium Efficiency Rating[3]	Power Draw (kW) per motor	Annual Energy Usage (kWh)	Estimated Energy Cost[4]	Estimated Annual Usage Savings (kWh)	Estimated Annual Cost Savings[4]
Wastewater Pumping	Main Wastewater Pump	Preliminary Treatment Building	1	30	6,220	88.1%	23.1	143,682	$ 11,064	93.6%	21.7	135,239	$ 10,413	8,443	$ 650
Wastewater Pumping	Main Wastewater Pump	Preliminary Treatment Building	1	50	8,672	89.9%	34.1	295,715	$ 22,770	94.3%	32.5	281,917	$ 21,708	13,798	$ 1,062
Wastewater Pumping	Main Wastewater Pump	Preliminary Treatment Building	1	60	3,504	90.3%	34	119,136	$ 9,173	94.5%	32.5	113,841	$ 8,766	5,295	$ 408
Secondary Treatment	Trickling Filter Pump	Trickling Filter Building	2	50	17,520	89.9%	29.1	509,832	$ 39,257	94.3%	27.7	486,043	$ 37,425	23,789	$ 1,832
							Totals	1,068,365	$ 82,264			1,017,041	$ 78,312	51,324	$ 3,952

Notes:
[1] All equipment listed is 3-phase.
[2] Efficiency rating for motors based on motor size, using standard efficiencies, for current operation.
[3] Premium efficiency rate obtained from motor manufacturer.
[4] Costs based on 2004 average of $0.077/kWh.

of 4.7 kW per pump, for a total electric energy demand reduction of 9.4 kW. This reduction corresponds to an electric energy usage savings of 34,517 kWh, which equates to a seasonal cost savings of $2,657. In order to pace the recycle pumps with flow, a VFD would have to be installed on each of the two operating pumps as well as the stand-by pump. Parallel operation would effectively cut the electric energy demand of each pump in half, equating to an electric energy demand savings of 29.1 kW from November to May. This reduction corresponds to an electric energy usage savings of 148,061 kWh, which equates to a seasonal cost savings of $11,401. A summary of the savings is presented in TABLE 5-4.

Table 5-4: Summary of Electric Energy Usage and Savings for Reduction of TF Pumping

TF Pump Operating Condition	Annual Electric Energy Usage (kWh)	Annual Electric Cost*
Existing – Constant Speed	509,832	$39,257
Proposed – Series Operation	179,194	$13,798
Proposed – Parallel Operation	148,061	$11,401
Estimated Savings	182,577	$14,059

Note:
*Cost based on average 2004 electric rate of $0.077/kWh

Based on the model-predicted removal efficiencies, full-scale testing during March and April is recommended to determine whether the plant can maintain 85% BOD_5 removal efficiencies with the proposed modifications.

5.2.3 Effluent Mechanical Aerator Control

In order to estimate the required energy expenditure of the mixer, a typical text book factor of 3 lb O_2 per horsepower hour (hp-hr) was used. This factor assumes that 3 lbs of O_2 can be supplied to a liquid stream per hp-hr of mixing. Based on an inlet DO concentration of 2 mg/L an average of 230 lb O_2/day is required. In order to supply the required DO, 77 hp-hr is required on a daily basis, which corresponds to 27,962 hp-hr per year. Converting that value to electric energy usage indicates that 20,851 kWh of electric energy should be required on an annual basis. Currently, a total of 134,028 kWh is used for post-aeration purposes, suggesting that an excess of 113,177 kWh is used on an annual basis. Based on an average electric energy price of $0.077/kWh, the excess energy usage of 113,177 kWh corresponds to an extra $8,715 per year to unnecessarily elevate DO to current levels. The installation of a continuous DO probe with a VFD to control the effluent mechanical aerator would allow better control of the effluent DO concentration. An added benefit of a continuous DO probe is the reduction of man-hours required to take manual DO readings. A summary of the savings is presented in TABLE 5-5.

Table 5-5: Summary of Electric Energy Usage and Savings for Effluent Mechanical Aerator Control Improvements

Aerator Operating Condition	Annual Electric Energy Usage (kWh)	Annual Electric Cost*
Existing – Constant Speed	134,028	$10,320
Proposed – Variable Speed	20,851	$1,605
Estimated Savings	113,177	$8,715

Note:
*Cost based on average 2004 electric rate of $0.077/kWh

5.2.4 Effluent Mechanical Aerator Replacement

Based on the actual horsepower requirements to achieve the design airflow rate, the blower motor would exert an average demand of 7 kW. Based on the current mechanical aeration system demand of 15.3 kW, a demand reduction of 8.3 kW could be accomplished by switching to a fine bubble aeration system. With year-round operation the demand reduction results in an annual electric energy usage savings of 72,708 kWh, which equates to $5,599 per year. A summary of the savings is presented in TABLE 5-6.

Table 5-6: Summary of Electric Energy Usage and Savings for Effluent Mechanical Aerator Replacement

Aerator Operating Condition	Annual Electric Energy Usage (kWh)	Annual Electric Cost*
Existing – Mechanical	134,028	$10,320
Proposed – Fine Bubble	61,320	$4,721
Estimated Savings	72,708	$5,599

Note:
*Cost based on average 2004 electric rate of $0.077/kWh

5.3 ESTIMATE OF CAPITAL COST AND SIMPLE PAYBACK

5.3.1 Replacement of Constant Speed Motors with Energy Efficient Motors

TABLE 5-7 presents the capital cost associated with replacing the selected existing motors listed in TABLE 5-2 with premium efficiency units. The probable cost to change out the existing motors is approximately $30,200, which results in an estimated payback of 7.6 years.

5.3.2 Reduction of Trickling Filter Pumping Rates

TABLE 5-8 presents the capital cost associated with installing VFDs on the trickling filter motors to reduce pumping rates, and thereby electric energy usage. The probable cost for installing VFDs is approximately $32,300, which results in an estimated payback period of 3.5 years.

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New York State Energy Research and Development Authority
Municipal Wastewater Treatment Plant Energy Evaluation

Chemung County Sewer District #1 - Lake Street Plant

Table 5-7: Capital Costs of Replacing Selected Motors with Premium Efficiency Motors

Process	Use	MCC Location	Quantity	Size (hp)	Costs				
					Materials		Labor		Total
					Unit	Total	Unit	Total	
1. Equipment									
Wastewater Pumping	Main Wastewater Pump	Preliminary Treatment Building	1	30	$ 2,100	$ 2,100	$ 630	$ 630	$ 2,730
Wastewater Pumping	Main Wastewater Pump	Preliminary Treatment Building	1	50	$ 3,000	$ 3,000	$ 900	$ 900	$ 3,900
Wastewater Pumping	Main Wastewater Pump	Preliminary Treatment Building	1	60	$ 3,600	$ 3,600	$ 1,080	$ 1,080	$ 4,680
Secondary Treatment	Trickling Filter Pump	Trickling Filter Building	2	50	$ 3,000	$ 6,000	$ 900	$ 1,800	$ 7,800
				Equipment Subtotal		**$ 14,700**		**$ 4,410**	**$ 19,110**
2. Electrical and Instrumentation (25% of Total Equipment Costs)									**$ 4,778**
				Subtotal of Equipment, Electrical, and Instrumentation					**$ 23,888**
3. Contractor Overhead and Profit (15%)									**$ 3,583**
				Subtotal					**$ 27,471**
4. Miscellaneous (10%)									**$ 2,747**
				Total					***$ 30,218***

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Table 5-8: Installation of VFDs for Reduction of TF Flow Rate

Process	Quan-tity	Costs				
		Materials		Labor		Total
		Unit	Total	Unit	Total	
VFD Equipment	3	$ 5,000	$ 15,000	$ 1,800	$ 5,400	$ 20,400
Miscellaneous Electrical Work (10%)	1					$ 2,040
Subtotal			$ 15,000		$ 5,400	$ 22,440
Contractor Overhead and Profit (15%)						$ 3,366
Subtotal						$ 25,806
Contingency (10%)						$ 2,581
Engineering, Legal, & Admin (25%)						$ 7,097
Total						*$ 35,483*

5.3.3 Effluent Mechanical Aerator Control

TABLE 5-9 presents the capital cost associated with installing a VFD on the effluent aerator motor. The probable cost for installing the VFD is approximately $13,300, with an estimated payback period of 1.5 years.

5.3.4 Effluent Mechanical Aerator Replacement

TABLE 5-10 presents the capital cost associated with complete replacement of the effluent mechanical aerator with a new fine bubble diffusion system. The probable cost for installing the system is approximately $50,500, with an estimated payback period of 14.1 years.

Chemung County Sewer District #1 - Lake Street Plant

Table 5-9: Installation of VFD for Effluent Aeration Control

Process	Quan-tity	Costs				
		Materials		Labor		Total
		Unit	Total	Unit	Total	
VFD Equipment	1	$ 3,500	$ 3,500	$ 1,350	$ 1,350	$ 4,850
Effluent DO Probe	1	$ 2,500	$ 2,500	$ 1,050	$ 1,050	$ 3,550
Miscellaneous Electrical Work (10%)	1					$ 840
Subtotal			$ 3,500		$ 1,350	$ 9,240
Contractor Overhead and Profit (15%)						$ 1,386
Subtotal						$ 10,626
Contingency (10%)						$ 1,063
Engineering, Legal, & Admin (25%)						$ 2,922
Total						*$ 14,611*

Chemung County Sewer District #1 - Lake Street Plant

Table 5-10: Installation of New Fine Bubble Aerator

Process	Quan-tity	Costs				
		Materials		Labor		Total
		Unit	Total	Unit	Total	
Air Blower	2	$ 9,500	$ 19,000	$ 980	$ 1,960	$ 20,960
Distribution Equipment	1	$ 11,507	$ 11,507	$ 3,000	$ 3,000	$ 14,507
Subtotal			$ 19,000		$ 1,960	$ 35,467
Contractor Overhead and Profit (15%)						$ 5,320
Subtotal						$ 40,787
Contingency (10%)						$ 4,079
Engineering, Legal, & Admin (25%)						$ 11,216
Total						*$ 56,082*

Section 6

ENERGY SAVING MEASURES THROUGH OPERATION MODIFICATIONS

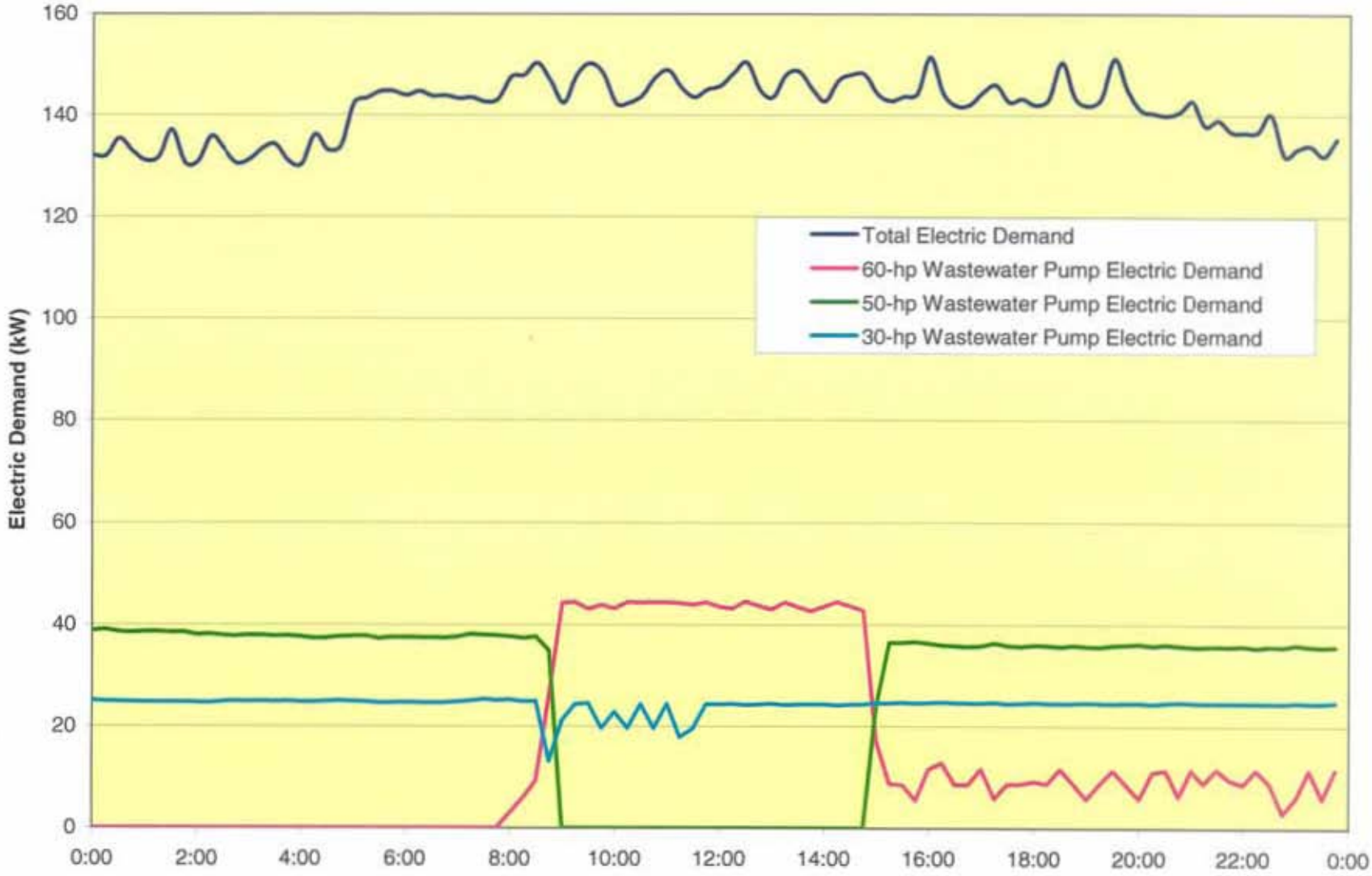
Typically, major operational changes that can be made to reduce energy usage are load shifting, peak shaving, and greater use of real-time data in energy-related decision making. Load shifting is the practice of changing the time of use of certain loads to reduce the total facility energy demand during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

6.1 Load Shifting

Total facility electric energy demand was recorded during the submetering period at the Lake Street Plant. FIGURE 6-1 presents typical daily electric energy demand curves for the total facility electric energy demand as well as the three main wastewater influent pumps. The figure shows that there is a limited amount of fluctuation in demand throughout the day. The overall demand is driven by the influent flow rate, which can not be controlled by the plant. Since the facility must be operated on a 24 hours per day, seven days per week schedule, it is very unlikely that any opportunities for load shifting would be available.

6.2 Peak Shaving

Peak shaving refers to the practice of reducing demand during peak demand periods by using on-site generation capabilities. Peak shaving opportunities through capital improvements is discussed in Section 5. A potential downside to on-site generation is the requirement for air permits. Agencies such as the New York State Department of Environmental Conservation (NYSDEC) and the United States Environmental Protection Agency (USEPA) require air permitting for generating systems. A facility using a generator for non-emergencies, such as peak shaving would be required to submit a study quantifying the emissions of not only the generator, but all systems, such as boilers, heaters, etc., currently on-site. In this case, the emissions inventory would be part of a NYSDEC Part 201 permitting process. Total emissions would not be allowed to exceed certain levels and the facility, as a whole, would need to conform to the air permit. Diesel or natural gas powered generators with a maximum mechanical power rating of less than 400 brake horsepower would be exempt.



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NYSERDA MUNICIPAL WASTEWATER TREATMENT PLANT ENERGY EVALUATION
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FIGURE 6-1
TYPICAL DAILY ELECTRIC DEMAND

Because the Lake Street Plant currently does not have a generator, and installation of a generator does not offer a reasonable payback (as detailed in Section 8), peak shaving opportunities were not considered for this facility.

6.3 Seasonal Use of the Effluent Mechanical Aerator

Electric energy savings could be realized by removing the effluent aerator from service between the months of November and May. However, the plant staff has indicated that shutting off the aerator may cause some solids deposition in the aeration tank. This concern may be addressed by the occasional removal of any settled solids, which could be accomplished with a vactor truck. It is anticipated that solids deposition should be minimal since the wastewater entering the post-aeration tank is coming from the much larger secondary clarifiers.

Removing the effluent aerator from service for the period from November to May could potentially save 77,800 kWh in electric energy usage, which equates to $5,991. The associated electric energy demand reduction would be 15.3 kW.

6.4 Hydraulic Modification of the Flow Splitter Structure

A preliminary hydraulic evaluation of the flow splitter structure was conducted as part of this study. The electric energy usage of a pump is directly related to the total dynamic head against which it must be pumped. The current total dynamic head at the trickling filters is 18 feet. Raising the water level within the flow splitter structure would reduce the total head and subsequently reduce electric energy usage by the pumps. Currently however, the liquid elevation within the flow splitter is backed up into the discharge piping of the trickling filters, and any further elevation would begin to flood the filters. Therefore, based on this evaluation, there are no potential cost savings associated with modifying the hydraulics of the flow splitter structure.

Section 7

ENERGY SAVING MEASURES THROUGH LIGHTING/HVAC MODIFICATIONS

The Lake Street Plant is comprised of approximately ten buildings and one connecting tunnel. Much of the process equipment is located below grade. The administration building is occupied from 6:00 am through 4:00 pm Monday thru Friday by office staff. The truck garage, building #1 (pump station) and building #3 (maintenance building) are occupied 24 hours per day seven days per week by maintenance or laboratory staff.

7.1 LIGHTING/HVAC MODIFICATIONS TO REDUCE ENERGY USAGE AND COSTS

In order to evaluate potential energy usage reductions through lighting/HVAC modifications, a survey of the existing lighting and HVAC units was conducted.

7.1.1 Lighting

The lighting in the administration building consists of 43 2x4 T-12 two-lamp magnetic ballast fixtures. The lighting in the truck and maintenance shops both consist of 31 250-watt high intensity discharge (HID) fixtures. The boiler room and chlorine building are equipped with 12 100-watt incandescent bulbs. These fixtures are all relatively inefficient and could benefit from a retrofit.

7.1.2 HVAC

Four separate areas were considered for the HVAC evaluation:

- Administration building.
- Maintenance shop.
- Chlorine building.
- Pump building.

Administration Building

The primary heating system for the administration building is a 225,000-BTUH Lochinvar hot water boiler, which uses natural gas and serves the perimeter baseboard fin-tube. Air conditioning is accomplished by means of a single Trane roof top air-handling unit with six tons of direct exchange (DX) cooling. There is

one $^1/_8$-hp exhaust fan serving the lavatories. The truck shop area to the rear of the administration building is heated only by overhead radiant heat and has one ¼-hp exhaust fan. The overhead radiant heat unit is fueled by natural gas. Both of these buildings were built in 1997 and all HVAC equipment is in good condition.

Maintenance Shop

There are two small Trane ceiling-hung gas-fired heating units. These units are 40,000 BTUH each, were manufactured in 1997, and have no mechanical defects.

Chlorine Building

There are currently two 5-kW electric cabinet heaters in the chlorine building. At the time of the site visit, the thermostat was not operating properly. During the site survey, the unit set point was 40 degrees but the room temperature was 60 degrees. These units should be considered for retrofitting with more efficient gas-fired equipment.

Pump Building

Hot water cabinet heaters, supplied by a Weil McLain 2,500-MBH dual-fuel boiler, heat the pump building and the remainder of the heated buildings on site. The boiler operates on both natural gas and digester gas. This unit is only several years old and is in good condition.

7.2 ESTIMATE OF ENERGY USAGE, DEMAND, AND COST SAVINGS

7.2.1 Lighting

It is recommended that the lighting fixtures be replaced with 2x4 T-8 electronic ballast fixtures. In the administration building the fixtures can be replaced one for one. In the maintenance areas the fixtures should also be replaced one for one but using six lamp fixtures as opposed to two lamp fixtures. For every two incandescent bulbs, one two-lamp 2x4 T-8 fixture should be installed. The overall electric energy usage reduction is estimated to be 30,928 kWh per year, corresponding to an annual savings of $2,165.

7.2.2 HVAC

The majority of the HVAC equipment is relatively new and in good condition, with the exception of the chlorine building. The two 5-kW electric cabinet heaters should be retrofitted with two 20,000-BTUH gas-fired cabinet heaters. The wall thermostat should also be replaced to ensure proper operation. The conversion from electric heaters to gas-fired heaters would eliminate 5 kW of electric energy demand. The overall electric energy usage reduction is estimated to be 11,013 kWh per year, corresponding to a cost savings of $804 per year.

7.3 ESTIMATE OF CAPITAL COSTS AND SIMPLE PAYBACK

A summary of the estimated capital costs and simple payback periods is presented in TABLE 7-1.

Table 7-1: Lighting/HVAC Improvement Estimated Capital Cost and Simple Payback

Improvement	Capital Cost ($)	Annual Savings ($)	Simple Payback (years)
Lighting	10,800	2,165	5.0
HVAC	5,500	804	6.8

Section 8

ENERGY SAVING MEASURES THROUGH ON-SITE GENERATION

8.1 DESCRIPTION OF ON-SITE GENERATOR

Currently, a portion of the digester gas that is produced by the plant is used in a boiler that generates heat for the digesters. The remainder of the produced digester gas is wasted through flaring. A potential energy savings exists through the use of the digester gas as a fuel source for on-site electricity generation.

The on-site generators would be powered by an engine that burns the digester gas. The engine would be equipped with a jacket and stack thermal heat recovery unit and the recovered heat could be used to warm the digesters.

8.2 ESTIMATE OF POTENTIAL GAS PRODUCTION

Chemung County does not currently monitor digester gas production at the facility. A digester gas meter was purchased by the County, but could not be installed on the gas piping due to excessive pressure loss. Therefore, digester gas production was estimated based on volatile solids reduction in the digesters. Based on the monthly sludge production values for the year 2003, the average amount of sludge removed from the plant was 70 tons per month at an average solids content of 25%. The solids exiting the plant had an average volatile content of 49%. The volatile solids content entering the digesters averaged at 73% and exited at 49% on average. Based on this information, an average volatile solids reduction of 26,900 lb per month was estimated. A typical gas production of 15 scf of digester gas per pound of volatile solids reduction, as reported in the literature, was used to estimate average and digester gas production of 540 scf per hour. Based on this production rate and an assumed value of 650-BTU per cf, it was determined that a 60-kW generator operating at 50% load would be optimal for the Lake Street Plant.

8.3 ESTIMATE OF CAPITAL COST

Based on similar projects, the overall cost for the installation of a 60-kW generator with a jacket and stack heat recovery system is approximately $249,150.

8.4 ESTIMATE OF SIMPLE PAYBACK

Annual savings were based on the generation of 30 kW of electricity on a year-round basis yielding a total electric energy generation of 262,800 kWh, which equates to a cost savings of $20,236. A summary of the estimated capital cost and simple payback period is presented in TABLE 8-1.

Table 8-1: On-Site Generation Estimated Capital Cost and Simple Payback

Improvement	Capital Cost ($)	Annual Savings ($)	Simple Payback (years)
On-Site Generation	249,150	20,236	12.3

Section 9
RECOMMENDATIONS

9.1 SUMMARY OF EVALUATIONS

This report identified and evaluated several alternatives that could potentially reduce energy usage at the Lake Street Plant. These alternatives include:

- Installation of premium efficiency motors on the three main wastewater pumps as well as the three trickling filter pumps.
- Reduction of the trickling filter pumping rates through the use of variable frequency drives (VFDs).
- Improvement of the effluent mechanical aeration process through the use of a dissolved oxygen (DO) monitor and the installation of a VFD on the mechanical aerator drive motor.
- Replacement of the effluent mechanical aerator with a more efficient fine bubble diffuser system.
- Modification of the current operating scenario through seasonal alternative operation of trickling filter 2 (TF 2), operating it in series at a reduced recycle flow June through October and operating it in parallel November through May.
- Modification of various lighting fixtures.
- Modification of various HVAC units.
- Potential on-site generation of electric energy.

TABLE 9-1 summarizes the estimated energy savings, implementation costs, and simple payback periods for all of the alternatives. The payback periods for the various measures range from 1.7 to 12.3 years.

9.2 SUMMARY OF RECOMMENDATIONS

Based on the evaluation results, the following alternatives are recommended for implementation:

- **Installation of premium efficiency motors on the three main wastewater pumps as well as the three trickling filter pumps.** There are definite cost savings that can be realized through the use of premium efficiency motors and all should be replaced at some point. If the total cost is a factor, it is recommended that the 50-hp main wastewater pump and one of the older trickling filter pumps be upgraded because they operate the most frequently.

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Table 9-1: Summary of Energy Savings Alternatives Presented in Sections 5, 6, 7, and 8

ECM#	Measure Description	Non-Energy Related Benefits	Fuel Type Saved	Energy Saved (kWh)	Total Annual Dollars Saved*	Implementation Costs	Simple Payback Period (years)
1	Installation of Premium Efficiency Motors on Influent and TF Pumps	N/A	Electric	51,324	$3,952	$30,200	7.6
2	Trickling Filter Pumping Reduction through VFDs	Flexibility to vary pumping rate as needed	Electric	182,577	$14,059	$35,500	2.5
3	Effluent Aeration DO Control through a VFD	Added process monitoring and control flexibility	Electric	113,177	$8,715	$14,600	1.7
4	Effluent Aeration Replacement with Fine Bubble Diffusers	Increased oxygen transfer efficiency	Electric	72,708	$5,599	$56,100	10.0
5	Seasonal Effluent Aeration	N/A	Electric	77,800	$5,991	$0	0.0
6	Lighting Modifications	N/A	Electric	30,928	$2,381	$10,800	4.5
7	HVAC Modifications	N/A	Electric	11,013	$848	$5,500	6.5
8	On-Site Generation	N/A	Electric	262,800	$20,236	$249,150	12.3

*Dollars saved calculated by multiplying the energy saved by the average 2004 rate of $0.077/kWh

- **Reduction of the trickling filter pumping rates through the use of VFDs.** This option includes the series operation with 30% recycle from June to October, and parallel operation at a constant rate from November to May. The modeling indicates that operating the trickling filters under these conditions should maintain the removals needed to meet effluent loading and concentration permit limitations. However, based on current issues with the plant not meeting the 85% removal requirement, additional seasonal testing of the trickling filter influent and effluent is recommended to verify that the proposed modifications will not reduce plant performance.

- **Improvement of the effluent mechanical aeration process through the use of a DO monitor and the installation of a VFD on the mechanical aerator drive motor combined with seasonal operation.** A significant amount of energy is wasted through excessive aeration of the final effluent. The installation of a DO probe in conjunction with a VFD would allow better control of the process. In addition, DO could be remotely recorded, which could reduce the man-hours required for routine monitoring. The effluent DO is not regulated from November to May; therefore, the effluent aeration process can be eliminated during this period.

- **Modification of various lighting fixtures**. This project involves a relatively simple change out of lighting fixtures.

- **Modification of various HVAC units**. HVAC modifications should be relatively easy to accomplish and this option has a relatively low implementation cost.

The remaining alternatives are not recommended due to long payback periods (effluent aeration replacement with fine bubble diffusers, on-site generation).

TABLE 9-2 summarizes the recommended energy-savings measures, associated costs to implement the recommended alternatives, potential savings, and simple payback. The set of recommended alternatives is estimated to cost a total of $95,300, resulting in a potential electric energy savings of 401,083 kWh and $30,883 annually. The overall payback for the set of recommended alternatives, if implemented together, is 3.1 years, with the resulting savings representing over 20% of total energy costs.

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Municipal Wastewater Treatment Plant Energy Evaluation

Chemung County Sewer District #1 - Lake Street Plant

Table 9-2: Summary of Recommended Alternatives

ECM#	Measure Description	Non-Energy Related Benefits	Fuel Type Saved	Energy Saved (kWh)	Total Annual Dollars Saved*	Implementation Costs	Simple Payback Period (years)
1	Installation of Premium Efficiency Motors on Influent and TF Pumps	N/A	Electric	51,324	$3,952	$30,200	7.6
2	Trickling Filter Pumping Reduction through VFDs	Flexibility to vary pumping rate as needed	Electric	182,577	$14,058	$35,500	2.5
3a	Effluent Aeration DO Control through a VFD	Added process monitoring and control flexibility	Electric	113,177	$8,715	$13,300	1.4
3b	Seasonal Use of Effluent Aerator	N/A	Electric	12,064	$929	$0	
4	Lighting Modifications	N/A	Electric	30,928	$2,381	$10,800	4.5
5	HVAC Modifications	N/A	Electric	11,013	$848	$5,500	6.5
TOTALS OF RECOMMENDED ALTERNATIVES				401,083	$30,883	$95,300	3.1

*Dollars saved calculated by multiplying the energy saved by the average 2004 rate of $0.077/kWh